Horticulture Innovation Australia

Final Report

Avocado rootstock assessment and improvement -Interim

Dr Elizabeth Dann
The University of Queensland

Project Number: AV13018

AV13018

This project has been funded by Horticulture Innovation Australia Limited using the avocado industry levy and funds from the Australian Government.

ISBN 0 7341 3800 8

Published and distributed by:
Horticulture Innovation Australia Limited
Level 8, 1 Chifley Square
Sydney NSW 2000
Tel: (02) 8295 2300
Fax: (02) 8295 2399

Contents

Summary

The Australian avocado industry, through Hort Innovation (previously HAL), funded a series of projects over the last decade evaluating the effect of rootstock on tree growth, fruit yield and postharvest quality. The collection of data was completed in 2012 and the final report submitted to HAL in March 2013. The aim of this small project was to urgently fund three activities during 2013-2015, until decisions on further rootstock evaluation investment were made and an appropriate new program established (or not). The target audience is primarily the Australian avocado Industry, including growers in all production regions and nursery operators.

Specifically, the activities included:

1) Maintenance of the avocado variety block at Maroochy Research Facility, Nambour, and testing each tree for avocado sunblotch viroid (ASbVd)

2) Collection of growth and yield data from a rootstock trial planted at Waikerie, SA, in October 2012.

3) Detailed statistical analyses of yield data generated in AV08000, the final phase of the rootstock evaluation program.

The key outputs were:

1) A healthy repository of avocado germplasm, tested to be free of avocado sunblotch viroid (ASBVd).

2) Data on survival, growth and yield for the first 3 years obtained from the rootstock trial in the tristate area.

3) Detailed analyses of rootstock performance across production zones, variability in propagation type and incidence of biennial bearing.

4) One publication and three conference presentations

The key outcomes are:

1) A well maintained and useful genetic resource for seed and budwood collection by nurserymen and researchers.

2) Estimation of the relative contribution of site factors or environment and genetics on yield of avocado.

3) Identification of rootstocks with superior performance (establishment, growth, yield, postharvest quality) in each major growing region, for recommendation to industry.

4) Capacity for rootstock evaluation in Australia (including trial design and complex data analyses) has been enhanced.

Recommendations to Industry:

1) Further funds should be provided immediately to maintain the avocado variety block at Maroochy Research Facility, and further material should be planted, under appropriate non-propagation agreements if necessary. All trees should have a permanent identification marker or tag.

2) Data must continue to be collected from the South Australian rootstock trial at Waikerie.

3) Decisions regarding future rootstock research investment must be finalised and a call for new projects made as soon as possible, so that the flow of research is maintained.

4) Further rootstock projects should have a molecular component to characterise the rootstock material we have in Australia more completely. This component would be aided by access to the annotated avocado genome, and/or by use of microsatellite markers. Development of a unique "barcode" for each variety, and particularly proprietary material (eg. SHSR04), would be extremely valuable for industry.

5) Further analyses should be undertaken to confirm effects of rootstock on fruit size, and packout rates. eg. Hass fruit from Reed rootstock were larger than from other rootstocks in several trials. While performance has traditionally been assessed on kg produced per tree, packout rates including size analyses, are also important, and would provide a true economic assessment of the effect of rootstock.

Keywords

Rootstock evaluation, avocado sunblotch viroid, yield efficiency, propagation

Introduction

This small budget, short term project follows on from AV08000 "Rootstock improvement for the Australian Avocado Industry-Phase 3" and previous rootstock improvement projects, and was initiated to complete some important maintenance and analyses until a fully-funded rootstock evaluation program could be approved and contracted. The project was largely based on a selection of recommendations from a report prepared by Dr Tony Whiley as an activity within AV08000 in February 2012, titled "Future Direction for Avocado Rootstock Improvement in Australia – Post 2012", and on the Final Report for AV08000, submitted to HAL in March 2013.

The activities in this interim project were the bare minimum to ensure a thorough analysis of data generated to date, maintenance of the genetic resource at Maroochy Research Station and the first three years growth data collected from trees in the trial at Waikerie, planted in 2012. This would allow a smooth transition to a new rootstock evaluation program.

Methodology

Further details are provided in Appendix 1, however, briefly:

1) Maintenance of rootstock/varieties block at Maroochy Research Station

The 'mother' tree block at Maroochy Research Station is an important genetic resource for the Australian avocado industry. There currently 48 trees in the block, with spaces for a further 6 or more. A maintenance program was initiated prior to commencement of this project, as trees were in decline. This included sprays for anthracnose and insect pests, phosphonate injections, fertilising, irrigating, weed control, pruning, mulching and treatment with uniconazole (Sunny) plant growth regulator. The block was indexed for avocado sunblotch viroid (ASBVd), using the PCR methodology developed in AV07001 (Geering and Horticulture Australia, 2011) to ensure these 'mother' trees are viroid-free.

2) Growth assessments of trees in the Waikerie rootstock block

The rootstock trial planted in October 2012 at Waikerie, SA, as an activity in AV08000. In designing this rootstock trial 'Edranol' pollinisers were incorporated into the planting design to demonstrate the effect of cross-pollination opportunities on the regularity and intensity of fruit set. Following advice from growers no pure Mexican race material was chosen for testing at this site due to past experience with high salinity in irrigation water (Mexican race varieties have the greatest susceptibility to salinity). Nine seedling rootstocks were chosen for this experiment. The trial was visited in August 2013, September 2014, May 2015 and August 2015. Measurements included tree deaths, tree height, canopy diameter, trunk circumference above and below the graft union (to determine level of potential physiological incompatibility), yield and fruit numbers per tree (in 2015). A severe frost occurred in August 2014 and an assessment of frost damage to flowering was recorded. The subsequent yield for the 2015 crop was affected, particularly in rows 1-5, which are slightly lower-lying than rows 6-10. Two Edranol polliniser trees were replaced in October 2014 where original trees had died. Several new commercial trees were replanted into sites where trial trees had died, but these trees were not included in measurements or statistical analyses.

3) Extensive data analysis and biometrical support

AV08000 generated large amounts of data on growth, yield and fruit quality of 'Hass' and 'Shepard' trees grafted to many rootstocks in trials at Pemberton, WA, and Hampton, Bundaberg and Walkamin in QLD. Considerable time was spent in re-formatting raw data, and several complex analyses were undertaken by Dr Joanne de Faveri (DAF, Mareeba). Initial analyses were completed in September 2015 (Appendix 2), with further modifications in November 2015 (Appendix 3). The specific questions that we wanted the analyses to address were a) Is there an effect of rootstock genotype (and/or horticultural race) on yield? b) Is there an effect of propagation type (seedling vs. clonal)? c) Are there any GxE effects? and d) Is there a genetic basis for biennial bearing?

Analyses (described in more detail in Appendices 2 and 3) included fixed effect analysis across all sites, trials & times, MET analysis for GxE (E refers to both times and locations) with GxE effects fitted as random effects, biennial bearing significance tests using biennial bearing indices, and mixed models + indices combined.

Outputs

Further details and data are provided in Appendix 1, however, briefly:

1) *A healthy repository of avocado germplasm, tested to be free of avocado sunblotch viroid (ASBVd).*

There are 48 trees remaining in the avocado variety block at Department of Agriculture and Fisheries' Maroochy Research Facility, Nambour, QLD. The trees are now in excellent health (see photos in Appendix 1), and each tree is free from ASbVd. Varieties present include Hass, Velvick, Pinkerton, Sharwil, Reed, Whitsell, Fuerte, Thomas, Edranol, Duke 7, Barr Duke, Gwen, Simmonds, Plowman and others. There is room to plant a few more trees.

2) *Data on survival, growth and yield for the first 3 years obtained from the rootstock trial in the tristate area.*

Trees grafted to Ashdot did not establish well and 70% died due to heatwave conditions 4 months after planting. Several Reed trees also died. First commercial harvest data shows that Velvick and Zutano yielded well (a single Ashdot tree also had a very high yield) and these rootstocks should be included in further rootstock evaluations for this area. Ashdot requires a lot of care during establishment to protect it from adverse weather conditions. There was no indication that Edranol polliniser trees significantly impacted yields of neighboring trees, however, the presence and activity of pollinators (eg. bees) was unknown.

3) *Detailed analyses of rootstock performance across production zones, variability in propagation type and incidence of biennial bearing.*

There were significant differences in yield parameters amongst rootstocks in each year at each site, and Environment (both site and year) had a large effect on rootstock yield performance. Differences in yield among rootstocks are more apparent at some sites than others. Velvick rootstocks had the highest cumulative yields (Hass variety, 2007-2012) in all seedling trials but not in the clonal trials. Zutano had the highest yields in the Pemberton and Walkamin clonal trials, while V1 and SHSR-03 had the highest cumulative yields in the Childers and Hampton clonal trials, respectively.

Variety (Hass v Shepard) and propagation (seedling v clonal) main effects were not significant for yield, however there was an overall effect of propagation type on fruit size with fruit from clonal trials being larger (heavier) than from the seedling trials. There was also an overall effect of propagation type on yield efficiency (YE) with the seedling trials having higher mean YE than the clonal trials. [This needs to be interpreted with caution remembering different varieties were grown in clonal & seedling trials].

There was no consistent evidence for clonal rootstocks having more uniform yield characteristics than seedlings eg. zero variability in clonal rootstocks at Pemberton, but definite variability (higher than seedling for some rootstocks) at other sites.

Horticultural race main effect was significant, where yields were higher when grafted to West Indian race rootstocks. Fruit size and yield efficiency (kg/m^3 of canopy) was greater from Mexican and West Indian rootstocks than from Guatemalan.

Based on predictions of fruit size, Reed rootstock has the largest Hass fruit in four out of six trials it was grown (Childers seedling, Hampton clonal and seedling and Pemberton clonal). V1 rootstock had the largest fruit in the Childers clonal and Pemberton seedling trial, Duke 7 in Walkamin clonal and Zutano in the Walkamin seedling trial.

There was evidence of biennial bearing at an overall site level. There was a strong biennial bearing pattern for all rootstock varieties at Hampton (especially the clonal trial but also the seedling trial). A similar pattern was observed in the Childers trials, however some rootstocks may not follow this overall trend so closely, and interestingly some individual trees seemed to be out of phase with their rootstock counterparts. To a lesser extent the biennial pattern can be also seen in the Pemberton trials. At Walkamin there is no clear overall biennial pattern in either the seedling or clonal trials.

4) *One publication and three conference presentations*

There has so far been one publication (*Acta Horticulturae*, in press) and three conference presentations during the project. Further manuscripts for publication in peer-reviewed journals are in preparation.

Outcomes

1) *A well maintained and useful genetic resource for seed and budwood collection by nurserymen and researchers.*

There are 48 healthy trees (free from avocado sunblotch viroid) in the variety block at Maroochy research facility. This site is well protected, and the staff have brought sick trees back to health with a well-structured management plan. This site is appropriate as a repository for avocado genetic material into the future.

2) *Estimation of the relative contribution of site factors or environment and genetics on yield of avocado.*

Data analyses clearly show GxE effects. Yields are lowest at Pemberton, WA, and highest at Childers and Walkamin, QLD. Hass on West Indian race rootstocks (eg. Velvick) consistently yield higher than on Guatemalan or Mexican rootstocks.

3) *Identification of rootstocks with superior performance (establishment, growth, yield, postharvest quality) in each major growing region, for recommendation to industry.*

Velvick seedling and clonal rootstocks consistently yields well at all sites, with seedling Velvick frequently outperforming clonal Velvick at the same site. Zutano was also among the highest yielding rootstocks at most sites it was included.

4) *Capacity for rootstock evaluation in Australia (including trial design and complex data analyses) has been enhanced.*

As seen from the above, the outcomes identified in the original proposal have been realized, and more detail is provided in Appendix 1. This was a small "interim" project, designed to continue activities already in operation, until further investment decisions were made. The variety block at Maroochy Research Facility contains some valuable mother-stock not available elsewhere in Australia. Establishment data from the trial in South Australia indicate that Velvick and Zutano have established well in that environment. Interesting results from the re-analyses of AV08000 data were that while there was no difference in yield per tree between the seedling and clonally propagated trees, the fruit from clonal trees were larger than from seedlings, but the yield efficiency was greater from seedling trees. Reed rootstock had the largest fruit in 2/3 of trials it was included.

Immediate benefits have been to secure the health and future of the avocado variety block, capture establishment data from the Waikerie trial, and undertake detailed analyses of yield data across sites and years generated in previous rootstock projects. Future rootstock evaluation projects will be strengthened by the outcomes delivered in this small project, thus benefits will continue to be realized for the medium to long term.

Evaluation and Discussion

The project has been extremely successful, and has already had major impact. The variety block at DAF's Maroochy Research Facility, Nambour, had declined in health considerably and several trees had died, prior to the project commencing, as funds had not been available to implement a rigorous maintenance schedule, including phosphonate injections, mulching, pruning etc. The block contains some significant genetic material, such as grafted progeny of the original Hass material (given as budwood to Dr Tony Whiley, and other delegates, at an avocado meeting in California), and Velvick once-removed from the original tree at Palmwoods (Whiley, pers. comm.) There are many advantages of having the industry's genetic repository at this site. It is government-owned, thus accessible and likely to be long-lived. Proprietary material may be added to the collection, under appropriate material transfer and non-propagation agreements, and there is little risk of incorrect use. The staff have developed an excellent maintenance schedule and have no competing commercial interests (as might occur if the block was on a commercial orchard), and the facility is located within easy drive from Brisbane so that it is easily accessible by researchers. A living repository of healthy material is important for future rootstock and variety research, and is currently the only method of storing viable genetic material, as recent cryopreservation techniques have not proved reliable for vegetative (clonal) preservation.

The collection of data from the rootstock trial at Waikerie, SA, has shown that Ashdot is particularly sensitive to extreme heat during the establishment phase. Ashdot rootstock is known to be tolerant of high pH and calcareous soils, and has established well in orchards at nearby Mildura when considerably more care was taken to establish the trees, eg. overhead irrigation during heatwaves, and activation of frost fans during extremely low temperatures. However, trees grafted to Velvick and Zutano rootstocks have established well with yields of 33 and 22kg/tree in the third year. High demand for avocado trees has resulted in a shortage of quality Velvick trees. Zutano is currently a popular seedling rootstock for the Australian industry, as there is a ready supply of fruit (seed) from NZ. However, recent work from AV10001 indicates that Zutano does not have the same level of tolerance to Phytophthora root rot as Velvick (or Dusa), so growers with Zutano will have to be vigilant with their integrated root rot management. A Qualicado field day was held at the site of the Waikerie field trial in May 2015. Liz presented the data obtained to date from the trial. Some discussion was held around continuing with growth and yield assessments. The South Australian avocado growers are very keen for this trial to be maintained and for continued measurements of growth and yields.

The analysis of the large volumes of data generated in AV08000 was an extremely worthwhile exercise. Previously, data was analysed separately for each site and year. Velvick seedling rootstock performed well (and better than its clonal counterparts) in most of the trials around Australia, and overall yields were greater from West Indian race rootstocks. Velvick is not cloned as easily as other rootstocks, so the reduced performance of Velvick clones may be due to weaker trees which may not have established as strongly and rapidly as the seedlings. The results also indicated that clonally produced trees were not necessarily more uniform than seedlings, particularly as they got older, so that seedling Velvick is undoubtedly still a very good option for Industry. While there was no significant difference in yields between seedling and clonally propagated trees, fruit from the clonal trials were larger than from seedling trials. There was also an overall effect of propagation type on yield efficiency (YE) with the seedling trials having higher mean YE than the clonal trials. This means that seedling trees produced more fruit per m^3 of canopy than clonals. New and improved cloning methods are in the commercial

pipeline, and it is likely that trees produced will be superior in quality, robustness and yield than those planted nearly a decade ago in the rootstock trials evaluated here.

The outputs are highly relevant to Industry at very practical levels, and also for rootstock evaluation into the future. The capacity to undertake rootstock evaluation in Australia has not been lost, but rather enhanced with the ability for more advanced statistical treatment of data, and new ideas for rootstock screening and field trial design. It is extremely important that rootstock evaluation and the capacity to undertake it, is maintained into the future, so that Australian horticultural R, D and E contributes to ongoing productivity and efficiency gains.

Recommendations

1) Further funds should be provided to maintain the avocado variety block at Maroochy Research Facility. Plant other varieties, eg. rootstocks Dusa, SHSR04, Bounty, under appropriate test and non-propagation agreements. All trees should have a permanent identification marker or tag.

2) The South Australian avocado growers are very keen for the Waikerie trial to be maintained and for continued measurements of growth and yields. A further fully replicated trial should be considered for this site, and should be included as part of a new evaluation of avocado rootstocks in major growing regions in Australia.

3) Rootstock research has been reviewed and discussed as part of the Orchard Productivity review, undertaken in 2013, and at various meetings since. There seems to be widespread support for such research to continue, particularly in the light of new and promising high yielding, Phytophthora-resistant material becoming available from the Australian (eg. SHSR04, and high yielding individual trees identified in AV08000), and from South African selection programs. Zutano has performed well in terms of yield in the sites it was planted, however preliminary trial indicates it has low tolerance to Phytophthora root rot (Dann and HIA 2015). Further rootstock evaluation must have a pathology component.

4) The impact on yield of polliniser trees eg. Edranol, interspersed throughout the orchard in Mediterranean climates, is well known. Most producers in those environments are planting pollinizers to increase cross-fertilisation and yield. Inclusion of pollinisers in future rootstock projects may be of limited value.

5) Further rootstock projects should have a molecular component to characterise the rootstock material we have in Australia more completely. This component would be aided by access to the annotated avocado genome, and/or by use of microsatellite markers. Development of a unique "barcode" for each variety, and particularly proprietary material (eg. SHSR04, would be extremely valuable for industry.

6) Further analyses should be undertaken to confirm effects of rootstock on fruit size, and packout rates. eg. Hass fruit from Reed rootstock were larger than from other rootstocks in several trials. While performance has traditionally been assessed on kg produced per tree, packout rates including size analyses, are also important, and would provide a true economic assessment of the effect of rootstock.

Scientific Refereed Publications

Coates, L., Dann, E., Whiley, A., Pegg, K., Dean, J., Cooke, T., Smith, L., Shuey, L., Hofman, P., Marques, R., Stubbings, B. (2015?) Rootstock selection, nitrogen and calcium influence postharvest disease in avocado *Acta Horticulturae* (in press).

Intellectual Property/Commercialisation

No commercial IP generated

References

Dann, Elizabeth and Hort Innovation (2015) AV10001: Improving yield and quality in avocado through disease management, Phase 2. Final report and Appendix 1, HIA Sydney.

Geering, Andrew D.W & HAL (2011). *Investigation of the distribution and incidence of Avocado Sunblotch Viroid in Australia*. Horticulture Australia, Sydney

Whiley, Anthony et al, and HAL (2013) Rootstock improvement for the Australian avocado industry Phase III, Final Report HAL AV08000, HAL, Sydney.

Acknowledgements

Tony Whiley is acknowledged for providing all of the raw yield data he collected in AV08000. He has also provided valuable information and advice throughout the project, and I thank him for his willing assistance and support.

Andrew Marshallsea, Rob Juster and farm staff at Maroochy Research Station are thanked for their excellent maintenance of the avocado variety block. Simon Newett and John Leonardi provided advice on fertiliser and canopy management regimes. Andrew Geering, Vish Steele and Emma Thoren are acknowledged for assisting with the ASbVd indexing.

Joanne de Faveri performed the data analyses, and provided practical interpretation of the detailed analyses. Craig Hardner is thanked for initial discussions on data analyses.

The rootstock trial at Waikerie was planted in collaboration with Kym and Craig Thiel, and they have been extremely supportive and helpful with site visits, data collection and local industry issues. Colin Fechner, Barry Avery and other Tristate growers have demonstrated their continued support for rootstock evaluation in their district. David Armour, Louisa Parkinson and Rachel Abel assisted with data collection from the trial.

Appendices

Appendix 1: Summary of results for AV13018, prepared by Liz Dann, December 2015

Appendix 2: Avocado Rootstock analyses (September 2015)

Appendix 3: Avocado Rootstock analyses (November 2015)

Appendix 1: Summary of results for AV13018, prepared by Liz Dann, December 2015

1) Maintenance of avocado varieties at the Maroochy Research Facility (MRF)

The avocado varieties block is a valuable resource for industry and it is important that it is maintained. Alternative methods of germplasm preservation, eg. cryopreservation, have not proven to be satisfactory for long term preservation of clonal material. There are 48 trees in the block and each tree was confirmed to be free from avocado sunblotch viroid when tested by PCR (Geering and Horticulture Australia, 2011) in May 2014. As seen from Figure 1a below, the trees were in a serious state of decline prior to this project commencing. A concerted effort by the MRF team, with input from Simon Newett, Liz Dann and John Leonardi, has resulted in the trees returning to health (Figure 1b-d). Schedules of operations are provided as requested, but include phosphonate injections, mulching, fertilising (including boron), irrigating, Sunny® applications and pruning to manage tree heights, mowing, pesticide applications etc.


b


c

Figure 1. Avocado trees in the Maroochy Research Station varieties block, a) August 2012, b) October 2013, c) February 2015 and d) December 2015

2) Data collection from trees in the Waikerie rootstock trial

The trial site at Waikerie, SA, was planted as a final activity in AV08000 in early October 2012. It was planted 6 years later than the other rootstock trials due to the extended drought in the area and the lack of water for irrigation from the Murray River. Table 1 lists the rootstocks planted in the trial, and provides some comment on each. All rootstocks were grafted with Hass. The trial was visited in late August 2013. The field plan was checked against trees as planted, and updated with plantings of spare/extra trees. Several trees died within 6 months of planting, due primarily to an extended period of extremely hot weather at Waikerie in February 2013. Only 30% of trees grafted to Ashdot survived, however 85% or more of the trees grafted to Zutano, AA1, A10, SHSR-02 and Velvick originally planted were still alive (Table 2). All of the Edranol polliniser plants (8 in total) also survived. Local experience has shown that trees make significant growth after the first year.

While differences in tree heights were not quite significant across the 9 rootstocks (P=0.054), the tallest trees were on A10, Reed and Zutano rootstocks, and the shortest on Ashdot, SHSR-02 and TT (Table 2). Edranol polliniser trees were approximately 90cm high (data not shown).

Canopy diameters could not be reliably measured for all trees, as they were protected with hessian, distorting their natural shape.

Table 1. Seedling rootstocks used in the Riverland avocado rootstock experiment planted at Waikerie on the 3rd October 2012. All rootstocks were propagated to 'Hass'. At least ten replicates of each rootstock were planted in a randomised block design. Edranol pollinisers were inter-planted in a pattern to give equal exposure to each rootstock line (reproduced from AV08000 Final Report)

Rootstock	Horticultural race	Comments
AA1	Guatemalan	AA1 An Anderson's nursery rootstock currently untested in the rootstock project.
A8	Guatemalan	An Anderson's nursery rootstock with good performance at some sites in the rootstock project.
A10	Guatemalan/Mexican	An Anderson's nursery rootstock with good performance at some sites in the rootstock project.
Ashdot	West Indian	A Birdwood nursery rootstock (from Israel) with dwarfing characteristics and high yield efficiency.
Reed	Guatemalan	Reed is used extensively as a rootstock in Western Australia. Good production at some sites in the rootstock project.
SHSR-02	Guatemalan	Consistently amongst the top yield rootstocks at sites across the rootstock project. Has good resistance to Phytophthora root rot.
TT	West Indian	An unknown rootstock with strong West Indian characteristics. Should have good salt tolerance.
Velvick	West Indian/ Guatemalan	Currently the most widely used rootstock in Australia. Consistently amongst the top yield rootstocks at sites across the rootstock project.
Zutano	Guatemalan/Mexican	Currently the main rootstock used in the Riverland and New Zealand. Good performance at most some sites used in the rootstock project.

Table 2. Survival and heights of 'Hass' trees grafted to different rootstocks 10 months after planting at Waikerie, SA.

Rootstock[a]	% survival	Height (cm)
AA1	90	115.5
A8	70	112.2
A10	100	130.5
Ashdot	30	105.7
Reed	75	127.0
SHSR-02	100	108.6
TT	80	109.0
Velvick	100	121.8
Zutano	85	125.5
P		**0.054**

The trial was visited for the second time in early September 2014 and assessed for growth parameters approximately 2 years after planting. Measurements of tree height, canopy diameter, rootstock and scion girths were obtained as well as first year yields (fruit numbers) and an assessment of frost damage to the 2014 flowering. The frost damage was subsequently shown to affect the fruit set and subsequent yield (2015 crop), which was the first commercially harvested and assessed for the block.

Tree heights were approximately 50% greater than after the first year, however there were no significant differences among the 9 rootstocks. The tallest trees were on Velvick, A8 and A10 (Table 3). In both the first and second year evaluations, trees on TT and Ashdot rootstocks were amongst the shortest in the trial. Edranol on Velvick rootstock polliniser trees were approximately 159 cm tall.

Highly significant ($P<0.001$) differences in canopy diameter were evident, with trees on Velvick having the greatest diameter, which was significantly larger than trees grafted to AA1, Zutano, Ashdot, A8 and TT rootstocks.

Tree survival stabilised after the extreme heat during the establishment phase resulted in many tree deaths. In 2014, there was only one additional death for each of the SHSR-02 and Reed rootstocks. Two Edranol polliniser trees had also died in the last year, and were replaced in October 2014.

Frost damage to the current season's developing flower buds showed a highly significant ($P<0.001$) position effect within the trial, with the greatest frost damage in rows 1-5, which have the lowest elevation within the trial block. Similarly, the flowering intensity of trees within

the same area was significantly reduced, highlighting the positional effects on tree performance. No significant rootstock effects were observed for either frost damage or flowering intensity (data not shown). Four of the rootstocks (AA1, A10, SHSR-02 and TT) encountered damage to greater than 50% of the flowers on at least half the trees in the trial.

Table 3. Survival, growth and 1st yield of 'Hass' trees grafted to different rootstocks 23 months after planting at Waikerie, SA

Rootstock	% survival	Height (cm)	Canopy diam. (cm)	Rootst:scion girth ratio	Average yield (Fruit no.)
Velvick	100	181	139 a	1.04 a	0.05
A10	100	167	133 ab	0.97 bc	0.55
Reed	60	159	132 ab	0.96 bc	0.33
SHSR-02	90	158	123 abc	0.92 c	0.46
AA1	90	155	122 bc	0.96 bc	0.30
Zutano	85	153	118 bc	1.01 ab	0.00
Ashdot	30	145	105 bcd	0.94 bc	2.67
A8	70	184	104 cd	0.96 bc	0.67
TT	80	133	92 d	0.99 ab	0.43
P		**0.179**	**<0.001**	**<0.001**	**0.062**

Nearly three years after planting, there were significant differences amongst rootstocks in tree heights, diameter and canopy volumes, but no significant differences in yields or fruit numbers per tree (Table 4). Trees on Velvick rootstock were significantly taller and had greater canopy volumes than all other rootstocks, except A10 and Reed. Five Velvick trees yielded over 10 kg each, and one tree yielded 26.5 kg. The smallest trees were on TT and Ashdot rootstocks.

Only 3 of the original 10 Ashdot trees remain in the trial, as several died in the first heatwave experienced in the establishment phase. This indicates that unless trees on Ashdot rootstock are carefully managed during establishment, they are perhaps more vulnerable to adverse weather conditions than other rootstocks. Ashdot is however, known to be tolerant of calcareous soils and high pH, which makes it a good candidate for the Tristate area. It must be noted that a single Ashdot tree yielded 16 kg in 2015, accounting for its high average yield and fruit number compared with most other rootstocks (Table 4). Velvick, Ashdot and Zutano yielded well and should be included in further rootstock evaluation for this area. There was no indication that Edranol polliniser trees significantly impacted yields of neighbouring trees.

Table 4. Growth and yield of 'Hass' trees grafted to different rootstocks recorded in August 2015, nearly 3 years after planting at Waikerie, SA

	Rows 1-10[1]							Rows 5-10[2]		
Rootstock	n	Height (cm)	Canopy diam (cm)	Canopy volume (m3)	Scion:rootst girth	Yield (kg)	Fruit no.	n	Yield (kg)	Fruit no.
AA1	10	228 bc	237 bcd	3.47 bc	0.99 c	2.47	9.50	6	4.06	15.7
A8	9	217 bc	222 cd	3.04 bc	0.98 c	1.05	3.69	7	1.31	4.60
A10	11	236 ab	247 abc	4.02 ab	1.00 bc	2.87	11.8	7	4.04	17.0
Ashdot	3	183 cd	201 de	2.01 cd	0.98 abc	6.94	29.3	3	6.94	29.3
Reed	6	249 ab	260 ab	4.60 ab	1.00 bc	2.90	12.0	4	4.17	17.5
SHSR02	13	217 bc	246 abcd	3.48 bc	0.97 c	1.40	5.46	8	2.24	8.75
TT	7	162 d	165 e	1.17 d	1.03 abc	1.56	7.71	4	2.56	13.0
Velvick	20	260 a	265 a	5.07 a	1.03 ab	4.35	18.1	11	7.85	32.6
Zutano	11	225 bc	246 abcd	3.67 bc	1.05 a	3.93	15.9	8	5.41	21.9
P		<0.001	<0.001	<0.001	0.017	0.482	0.436		0.317	0.273

[1] means of trees from all rows in the trial, [2] means of trees in rows 5-10, which were not severely frost-damaged during flowering in 2014

Figure 2. Waikerie rootstock trial, a) August 2013 and b) August 2015

Figure 3. Rachel Abel assisted with fruit harvest at the Waikerie rootstock trial, August 2015

3) Detailed statistical analyses of yield data collected in AV08000

Dr Joanne de Faveri, (DAF, Mareeba) utilised several different modelling and statistical methods to analyse the yield data (kg per tree, fruit size and yield efficiency), across sites (Walkamin, Childers, Hampton and Pemberton), and years (2007-2012). Initial analyses were completed in September 2015 (Appendix 2), with further analyses undertaken in November 2015. Analyses included fixed effect analysis across all sites, trials & times, MET analysis for GxE (E refers to both times and locations) with GxE effects fitted as random effects, biennial bearing significance tests using biennial bearing indices, and mixed models + indices combined.

The questions asked were

- Is there an effect of rootstock genotype (and/or horticultural race) on yield traits?
- Is there an effect of rootstock propagation type (seedling vs. clonal)?
- Are there any GxE effects? ie. an interaction between location and rootstock genotype
- Is there a genetic basis for biennial bearing?

The main conclusions were:

- There were significant differences in yield parameters amongst rootstocks in each year at each site
- Variety (Hass v Shepard) and propagation (seedling v clonal) main effects were not significant for yield, however there was an overall effect of propagation type on fruit size with the clonal trials having higher mean fruit size than the seedling trials. There was also an overall effect of propagation type on yield efficiency (YE) with the seedling trials having higher mean YE than the clonal trials. This needs to be interpreted with caution remembering different varieties were grown in clonal & seedling trials

Horticultural race main effect was significant, where yields were higher when grafted to West Indian race rootstocks (

- Figure 4). Fruit size and yield efficiency (kg/m^3 of canopy) was greater from Mexican and West Indian rootstocks than from Guatemalan
- There was no consistent evidence for clonal rootstocks having more uniform yield characteristics than seedlings eg. zero variability in clonal rootstocks at Pemberton, but definite variability (higher than seedling for some rootstocks) at other sites
- Environment (both site and year) have a large effect on rootstock yield performance. Differences in yield among rootstocks are more apparent at some sites than others, eg. at Pemberton the differences between rootstocks was smaller (yields were much lower) than at Childers where there were larger differences in yields among rootstocks (Table 5). Velvick is the highest ranked performer in all seedling trials but is not the highest in the clonal trials. Zutano is the top ranked rootstock in Pemberton and Walkamin clonal trials, while V1 has the highest cumulative yield in the Childers clonal trial and SHSR-03 is top ranked in the Hampton clonal trial.
- The biennial bearing pattern of large fruit size with low yield (small number of large fruit) and lower fruit size with high yield (large number of smaller fruit) was evident from the analyses. Based on predictions of fruit size, Reed rootstock has the largest Hass fruit in a number of trials, (Childers seedling, Hampton clonal and seedling and Pemberton clonal). V1 rootstock had the largest fruit in the Childers clonal and Pemberton seedling trial, Duke 7 in Walkamin clonal and Zutano in the Walkamin seedling trial.
- There is evidence of biennial bearing at an overall site level. There was a strong biennial bearing pattern for all rootstock varieties at Hampton (especially the clonal trial but also the seedling trial). Childers also shows a similar pattern but it can be seen that some rootstocks may not follow this overall trend so closely. To a lesser extent the pattern can be also seen at WA trials. At Walkamin there is no clear overall biennial pattern in either the seedling or clonal trials.

- There was evidence of biennial bearing pattern in some rootstocks (eg. A10, Nabal and Zutano at Hampton and Pemberton). There was no evidence for biennial bearing at Walkamin.

Figure 4 Yields per tree were significantly greater at each 2 year harvest period when grafted to West Indian race rootstocks

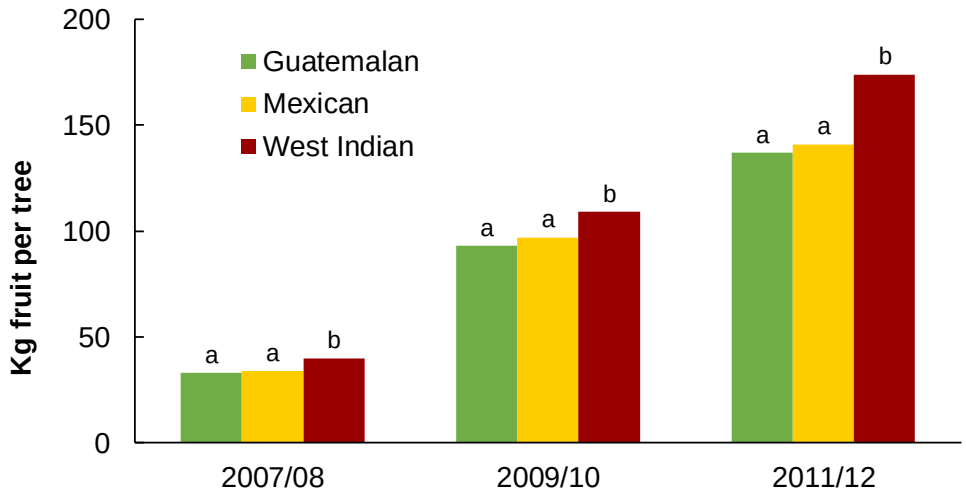


Table 5. Summary of best performing rootstocks for each site and propagation type, grafted with Hass scion, cumulative yields per tree 2007-2012

Location and propagation type		>150kg	>250kg	>300kg	>350kg	>400kg	>450kg
Pemberton	Seedling	Velvick, V1 Toro Canyon					
	Clonal	Zutano, A10					
Walkamin	Seedling				Barr Duke Rigato Velvick Zutano		
	Clonal		Zutano, A10				
Childers	Seedling				A8, V1 Nabal		Velvick Reed
	Clonal					Velvick SHSR-03	V1
Hampton	Seedling			Zutano Velvick			

Clonal	Zutano Velvick	SHSR-03	

References

Geering, A. D.W & Horticulture Australia (2011). Investigation of the distribution and incidence of Avocado Sunblotch Viroid in Australia. Horticulture Australia, Sydney (final report for project AV07001)

Appendix 2: Avocado Rootstock analyses (September 2015)

For Liz Dann QAAFI

1. Data

The data consists of multiple measurements (traits and times) on a number of avocado rootstocks under different Propagation types and Scions at a number of locations. There were 22 (RS) rootstocks from 3 Racial origins (Guatemalan , Mexican, West Indies). The rootstocks were propagated as seedling or clonal rootstocks. Two scions (Hass and Shepard) were grafted on to the rootstocks.

There were 4 locations (Childers, Hampton (Toowoomba), WA (Pemberton), and Walkamin).

Not all rootstocks were planted at each location. The concurrence of rootstocks across trials is given below in Table 1.

At each location the rootstock Propagation type (ie clonal and seedling) and the scion (Hass or Shepard) are planted in spatially separate "trials". Not all combinations of Propagation and Scion are at each location. There are 11 "trials" as listed in Table 1. Within each trial there were 10 complete blocks of 9-11 rootstocks.

The traits Yield, Fruit size and Yield efficiency were measured on each tree over a number of years (mostly 6 annual measurements).

The aims of the study are to investigate the following:

a. Is there an effect of Rootstock genotype on the traits
b. Is there an effect of RS propagation type (clonal or seedling) on the traits
c. Is there a difference in precocity (age of bearing among the rootstocks)
d. Is there an interaction between location and RS genotype (GxE)
e. Is there a genetic basis for biennial bearing

The data is unbalanced with 11 separate "trials"

```
[1] "Childers Hass_clonal"      "Childers Hass_seedling"
"Childers Shepard_seedling"
 [4] "Hampton Hass_clonal"       "Hampton Hass_seedling"
"WA Hass_clonal"
 [7] "WA Hass_seedling"          "Walkamin Hass_clonal"
"Walkamin Hass_seedling"
[10] "Walkamin Shepard_clonal"   "Walkamin Shepard_seedling
```

The congruence of varieties across the 11 "trials" is documented below with each variety having 10 reps (trees)

in the trials where they were grown.

Concurrence of Trt(Rootstocks) across "trials".

	A10	A8	Duke 7	Nabal	SHSR-03	Thomas	V1	Velvick	Zutano	Peasley	Reed	SHSR-02	Toro	Canyon	Velvick/Hazard	Edranol	Parida	Plowman	Shepard	Hass	Barr	Duke	SHSR-01	Rigato
Childers Hass_clonal	10	10	10	10	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Childers Hass_seedling	10	10	0	10	10	0	10	10	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0
Childers Shepard_seedling	10	0	0	10	0	0	0	10	0	0	10	10	10	10	0	10	10	10	10	0	0	0	0	0
Hampton Hass_clonal	10	10	10	10	10	0	0	10	10	0	10	0	0	0	0	0	0	10	0	10	0	0	0	0
Hampton Hass_seedling	10	10	10	10	10	0	0	10	10	0	10	10	0	10	0	0	0	10	0	0	0	0	0	0
WA Hass_clonal	10	0	10	10	0	0	0	10	10	0	10	0	0	0	0	0	0	0	0	10	10	10	0	0
WA Hass_seedling	10	0	10	10	0	0	10	10	0	0	0	10	10	0	0	0	0	10	0	0	0	0	0	0
Walkamin Hass_clonal	10	10	10	0	0	10	0	10	10	0	10	0	0	0	0	0	0	0	0	10	10	0	0	0
Walkamin Hass_seedling	10	10	10	10	0	0	0	10	10	0	10	10	0	0	0	0	0	0	0	0	10	0	10	0
Walkamin Shepard_clonal	10	0	10	10	10	10	0	10	10	0	0	0	0	0	0	0	0	0	10	0	10	0	0	0
Walkamin Shepard_seedling	10	10	10	10	10	0	10	10	10	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0

Table 1. Congruence of varieties across the 11 "trials".

The planting dates for the sites were as follows:

WA (Pemberton) planted Dec 2004 / Hampton Jan 2005 / Walkamin Hass April 2005 /

Walkamin Shepard April 2005 / Childers Hass May 2005 / Childers Shepard May 2005

The trial layouts (made to be regular col x row grids) were as follows:

Site Scion Rootstock type	**# Trees**	**Col**	**Row**	**Tree Spacing**
Childers Hass Clonal	90	2	45	11x5m
Childers Hass Seedling	110	2	55	
Childers Shepard Seedling	110	2	55	
Hampton Hass Clonal	120	4	30	9x6m
Hampton Hass Seedling	112	4	28	
WA Hass Clonal	90	3	30	6.5x3m
WA Hass Seedling	81	3	27	
Walkamin Hass Clonal	108	4	27	10x6m
Walkamin Hass Seedling	120	5	24	
Walkamin Shepard Clonal	114	3	38	
Walkamin Shepard Seedling	112	4	28	

Table 2. Trial layouts

The varieties were from 3 racial origins as follows (G= Guatemalan,M=Mexican, WI=West Indies)

RS	**Race**
A10	G
A8	G
Duke 7	M
Nabal	G
SHSR-03	M
Thomas	M
V1	WI
Velvick	WI
Zutano	M
Peasley	G
Reed	G
SHSR-02	G

Toro Canyon	M
Velvick/Hazard	WI
Edranol	G
Parida	M
Plowman	G
Shepard	M
Hass	G
Barr Duke	M
SHSR-01	M
Rigato	G

2. Statistical analyses

A number of statistical analyses have been performed to address the different questions. In most analyses (except where investigating biennial bearing) the data has been summed (or averaged) across 2 consecutive years (eg Yield 2007+Yield 2008, Yield 2009 + Yield 2010, Yield 2011 + Yield 2012) to remove the issue of biennial bearing. This is similar to the approach taken by Verbyla & Cullis (1992), Bevington & Cullis (1990) etc in citrus.

i. Initially a fixed effect analysis was conducted for each trial at each year (2007-2012) separately to get an understanding of Rootstock effects on the traits at each time.

I. A fixed effect analysis has been conducted across all sites, trials and times to investigate the effects of Scion Variety, Propagation, Race, RS on Yield, Fruit Size and Yield efficiency.

II. A further analysis has been conducted to compare the variation or consistency between clonal and seedling rootstocks. This analysis needs to take into account that there will be no genetic variance within RS genotypes propagated clonally (at one time) but there will be genetic variance within RS seedlings. The problem with this is that without a pedigree the seedling genetic variance is confounded with residual variance. This has been accommodated by including a simple pedigree relationship which links the seedlings in their family groups.

III. To investigate genotype by environment interaction (GXE where E refers to both times and locations) a MET analysis with genotype x environment effects fitted as random effects has been conducted. Because of the issues between clonal and seedling populations (discussed above) these populations have been kept separate and three sets of data have been analysed: namely Hass clonal (4 sites), Hass seedling (4 sites) and Shepard seedling (2 sites). Genetic correlations have been estimated between the sites and times and heatmaps of these correlations have been presented. Cluster analysis has also been used to group the sites & times (dendrograms) and plots of varieties across the sites and times have been used to investigate GxE.

IV. To investigate precocity of the RS genotypes the data has been coded as 1/0 where 1 refers to fuiting in the first year (Y2007) and 0 being first fruiting occurring later (years 2+). This analysis has been conducted using a generalised linear model assuming a binomial distribution and logit link. Predicted proportions of trees fruiting in the first year have been presented for each RS.

V. The issue of biennial bearing has been looked at in detail by using the approach of Hoblyn 1936, Huff 2001 & Smith 2004 of calculating biennial bearing indices (BBI) with significance tests and also an approach similar to Durand et al (2013) with mixed models and indices combined.

VI. An investigation into the spatial correlation between trees at each site has been done for yield. I was wondering if the different tree spacings (see Table 2) had any effect on the spatial correlation between neighbouring trees. It would appear that the trees at Childers may be subject to competition effects at a number of years. This is more for interest than much else.

In all analyses (I-III) linear mixed models have been fitted using ASReml and variance parameters have been estimated using REML. Spatial and temporal correlation has been accommodated in the models using separable spatio-temporal residual models using a heterogeneous autoregressive model (of order1) for the temporal component and a separable autoregressive ar1 process in both row and column directions for the spatial component (ie ar1h(Time):ar1(Col):ar1(Row)) in most cases (see Smith et al 2007 or De Faveri et al 2015 for more details).

The precocity data was analysed using GenStat.

3. Results

i. Fixed effect analysis for each "trial" separately at each time 2007-2012

Results from analysis of individual "trials"

Initially data from each year at each trial was analysed separately in order to see if there were significant RS effects. These initial analyses were based on a RCB analysis (no spatial analysis). These results are comparable to the results presented in the final report (however missing data when a tree has died has been included as a NA rather than 0 yield – which is slightly different than in the report).

The results for Yield are below:

Yield RCB analysis

Childers Hass Clonal

Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012

1	A10	4.210000	36.74600	49.86000	69.85000	144.99000	28.25865
2	A8	0.790000	29.62700	49.77000	51.98000	115.78000	27.28268
3	Duke 7	7.157556	46.27678	55.48615	93.57879	132.51111	46.56959
4	Nabal	3.970000	35.23900	48.97000	82.94000	121.81000	61.33022
5	SHSR-03	8.200000	48.88600	64.07000	91.49000	157.60000	53.24455
6	Thomas	2.441922	36.30084	41.66264	75.96509	60.04444	94.48612
7	V1	5.920000	63.31500	70.15000	131.71000	118.03000	110.38000
8	Velvick	5.700000	57.06800	39.20000	119.14000	92.22000	89.82000
9	Zutano	5.280000	36.71200	36.04000	96.50000	73.64000	110.79000
Pr		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Childers Hass_seedling

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	9.360	38.2680	63.08	62.73000	161.9500	32.71667
2	A8	7.790	48.5200	88.06	82.84000	175.3900	35.43750
3	Nabal	9.390	47.5910	65.54	91.30000	134.4300	52.67778
4	SHSR-03	12.930	28.5210	54.05	60.81000	126.1200	24.78333
5	V1	7.570	45.5650	65.73	76.69900	91.4200	110.64286
6	Velvick	12.910	50.1100	80.82	93.61000	158.0300	67.80000
7	Peasley	8.840	36.5400	76.20	62.33000	146.2400	35.25000
8	Reed	6.820	53.4800	82.57	101.09000	112.7900	118.44444
9	SHSR-02	11.460	31.3010	61.18	68.54000	126.6100	33.65000
10	Toro Canyon	13.925	47.9625	76.50	84.80648	133.3625	43.96250
11	Velvick/Hazard	1.720	18.7350	43.73	63.01000	96.3900	61.83333
Pr		<0.001	<0.001	<0.001	0.128	0.033	0.052

Childers Shepard_seedling

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	3.750000	0	46.67000	79.65000	49.74000	45.31000
2	Nabal	5.490000	0	36.69000	97.77000	78.66000	62.60000
3	Velvick	5.690000	0	58.23000	112.80000	88.56000	88.17000
4	Reed	1.621532	0	48.12512	95.72222	68.31950	57.25556
5	SHSR-02	3.965000	0	47.70000	94.62000	52.21000	47.48000
6	Toro Canyon	3.875321	0	35.33304	72.35556	48.07858	83.96667
7	Edranol	6.045000	0	55.46000	68.80000	51.59000	40.47000
8	Parida	4.465209	0	44.07793	90.75000	72.36035	70.72500
9	Plowman	4.635000	0	51.03000	103.53000	71.42000	56.27000
10	Shepard	3.940000	0	50.08859	100.43333	64.80080	52.84445
Pr		0.400	-	0.110	0.003	<0.001	<0.001

Hampton Hass_clonal

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	8.925	29.461	66.13	29.18	117.55	2.366665
2	A8	8.435	37.848	63.39	28.15	113.49	1.785714
3	Duke 7	10.560	45.510	97.27	8.37	100.14	1.462499
4	Nabal	4.363	19.165	64.56	18.29	125.70	2.583330
5	SHSR-03	9.260	54.110	91.66	38.30	135.86	3.362499
6	Velvick	7.065	37.645	81.93	29.25	134.75	2.212500
7	Zutano	9.725	35.610	83.63	31.59	130.04	5.020001
8	Reed	3.545	24.139	56.59	15.65	97.35	5.544444
9	Plowman	6.820	40.676	70.64	11.91	103.26	1.083334
10	Hass	4.870	26.465	77.80	23.49	99.72	14.114286
Pr		0.056	<0.001	0.081	0.072	<0.001	0.010

Hampton Hass_seedling

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	10.537531	40.35556	46.77333	55.43137	110.0175	16.451313
2	A8	2.075000	27.57000	47.77500	44.68500	118.1900	22.015531

3	Duke 7	1.165000	21.56000	49.22500	39.87500	89.1500	7.305535
4	Nabal	3.815000	40.20500	48.10000	60.70500	96.7700	33.601735
5	SHSR-03	7.605000	32.28500	40.23500	40.35400	98.8100	8.790000
6	Velvick	5.540000	57.81500	62.52900	61.57267	112.3295	22.075176
7	Zutano	8.700000	46.80500	72.18500	49.37267	135.4628	12.392666
8	Reed	3.809484	32.88749	74.73750	40.21233	111.9138	10.092799
9	SHSR-02	5.790000	51.70500	64.34500	40.13500	96.5800	26.964670
10	Velvick/Hazard	1.336886	15.23333	16.48333	59.41347	102.3602	23.330781
11	Plowman	1.662000	35.92500	55.93400	38.45140	114.0696	14.126053
Pr		<0.001	<0.001	0.028	0.762	0.494	0.662

WA Hass_clonal

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	0	28.34709	8.600626	27.79319	14.033928	110.75082
2	Duke 7	0	25.75995	2.064786	29.63546	7.960622	74.33568
3	Nabal	0	25.52326	11.676701	29.41992	30.016497	93.95516
4	Velvick	0	31.66892	8.093413	22.34671	17.820501	99.25364
5	Zutano	0	48.39000	6.650000	42.58000	38.040000	99.83000
6	Reed	0	21.00608	9.277774	18.87077	16.866902	101.80902
7	Hass	0	27.79247	6.404367	20.80389	27.778432	98.37728
8	Barr Duke	0	23.15946	2.753457	18.96891	11.673130	75.27513
9	SHSR-01	0	16.65352	4.464301	19.63121	23.355184	82.11100
Pr		-	0.005	0.156	0.091	0.031	0.329

WA Hass_seedling

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	0	31.78333	3.892949	35.60743	28.28572	57.92400
2	Duke 7	0	22.83125	1.123552	23.46763	16.23641	70.97094
3	Nabal	0	27.51500	3.140000	30.76000	27.56000	26.10000
4	V1	0	28.03749	3.313642	30.41008	39.30194	78.58150
5	Velvick	0	38.66667	5.015171	27.40743	46.89683	59.56845
6	SHSR-02	0	33.81000	3.445000	27.45000	30.90000	53.62000
7	Toro Canyon	0	31.66250	2.324171	27.44798	33.94324	73.09167
8	Plowman	0	22.66000	6.830000	35.81307	27.12133	58.62644
Pr		-	0.410	0.115	0.943	0.400	0.067

Walkamin Hass_clonal

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	0.720807304	10.227778	17.227299	67.20188	102.41120	141.14811
2	A8	0.799000000	7.915000	18.150000	60.95800	72.40100	109.59000
3	Duke 7	3.194710497	9.188889	8.987195	31.40585	57.01017	106.50220
4	Thomas	1.988303684	11.050000	10.336709	32.33046	76.40974	123.59506
5	Velvick	2.507000000	8.155000	11.090000	26.19506	76.06696	132.13605
6	Zutano	0.605000000	7.295000	13.545000	53.08400	66.97025	104.50209
7	Reed	-0.001928208	2.183334	3.839358	30.20340	45.09946	69.50292
8	Hass	0.298130076	5.550000	7.270110	18.48555	54.06526	106.24755
9	Barr Duke	0.433599386	3.977778	9.270529	35.85252	55.93089	104.72330
Pr		<0.001	0.164	0.027	<0.001	0.005	0.117

Walkamin Hass_seedling

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	2.395000	9.850000	24.015000	70.60000	108.36500	124.89000
2	A8	1.210000	7.315000	24.600000	68.45500	84.20000	109.24900
3	Duke 7	0.956600	3.746287	9.230373	33.56250	65.58376	99.75855
4	Nabal	2.447245	8.518905	11.845119	50.63124	78.13105	119.66352
5	Velvick	4.365000	20.505000	26.995000	83.22000	96.45000	158.23000
6	Zutano	2.421000	8.075000	23.155000	62.52000	95.66000	150.70381
7	Reed	1.279025	4.454462	15.440386	48.68998	77.87000	119.77138
8	SHSR-02	3.020000	15.770000	25.900000	69.85000	87.44500	121.53000
9	Barr Duke	3.380000	12.900000	21.565000	76.22100	101.98000	156.37000
10	Rigato	2.795000	14.291000	21.610000	67.46000	98.22100	164.57000
Pr		0.545	0.023	0.391	0.130	0.099	0.010

Walkamin Shepard_clonal

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	0.83000000	10.960000	32.94000	75.15000	74.69000	125.04000
2	Duke 7	0.47973074	1.873490	5.54331	40.36451	42.85255	58.45043
3	Nabal	0.06399615	1.355878	13.95027	27.74450	49.93685	48.50564
4	SHSR-03	1.41004204	18.737290	31.74417	80.34507	95.32202	125.94468
5	Thomas	2.10000000	14.030000	42.04000	106.38377	93.18587	159.79979
6	Velvick	0.65000000	12.980000	34.91000	70.48000	88.10669	100.55502
7	Zutano	0.42124862	7.453463	28.62692	72.75044	87.70809	130.53313
8	Shepard	1.02000000	17.430000	31.81000	79.60000	87.05000	106.60000
9	Barr Duke	0.72000000	8.070000	22.35000	69.13000	72.03000	113.46000
Pr		0.030	<0.001	<0.001	<0.001	<0.001	<0.001

Walkamin Shepard_seedling

	Trt	Y2007	Y2008	Y2009	Y2010	Y2011	Y2012
1	A10	1.6424988	13.37778	22.38937	69.22067	82.92002	100.03749
2	A8	2.4653748	18.52858	52.39817	74.93010	82.24746	100.27141
3	Duke 7	3.5400000	14.96000	28.12000	57.07170	62.42377	75.08749
4	Nabal	1.7500000	13.52000	35.81162	67.73932	81.69037	88.84999
5	SHSR-03	2.5020675	12.10000	37.23882	68.61281	82.85184	105.82499
6	V1	2.8281602	25.67778	51.47358	116.45592	111.20687	165.87501
7	Velvick	2.8200000	32.27000	34.62000	110.76000	116.58000	171.08000
8	Zutano	2.3500000	13.78000	30.64000	77.27699	77.98927	125.47146
9	Reed	0.9020675	16.15555	53.60548	91.03782	100.81023	138.32500
10	SHSR-02	3.5600000	23.18000	38.61000	95.08000	104.48486	175.58889
Pr		0.329	<0.001	0.013	<0.001	<0.001	<0.001

Fruit size RCB

Childers Hass Clonal

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	227.273	235.168	196.05	184.246	195.996	177.0714
2	A8	169.872	204.797	200.07	184.257	177.079	170.4291
3	Duke 7	179.2993	245.5229	190.7915	198.7037	202.2224	177.4006
4	Nabal	206.323	251.264	193.65	189.08	199.616	170.7042
5	SHSR-03	220.678	244.539	195.87	187.14	190.674	168.6234
6	Thomas	102.2494	226.2043	198.5106	189.359	188.764	159.2935
7	V1	240.658	264.537	213.33	197.504	224.252	175.586
8	Velvick	241.041	236.168	214.25	183.667	209.336	157.839
9	Zutano	197.031	221.474	214.44	186.183	228.605	164.687
Pr		0.005	0.381	<0.001	0.286	<0.001	0.243

Childers Hass Seedling

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	220.243	252.513	194.562	193.494	193.192	172.6198
2	A8	212.197	234.406	194.024	192.512	193.904	198.5086
3	Nabal	217.305	241.15	187.553	194.665	203.679	182.1682
4	SHSR-03	210.642	255.096	183.008	191.397	181.859	198.2017
5	V1	199.897	216.328	205.711	207.798	196.328	189.1832
6	Velvick	213.895	251.643	189.339	192.645	201.054	190.4247
7	Peasley	209.827	221.593	185.944	205.27	176.861	183.9937

8	Reed	229.337	236.99	217.215	209.151	226.594	185.606
9	SHSR-02	205.367	239.576	181.63	202.928	188.918	183.436
10	Toro Canyon	217.5672	245.2512	209.4937	199.3887	191.6011	193.2335
11	Velvick/Hazard	93.441	281.662	209.976	201.918	205.811	273.124
Pr		<0.001	0.948	0.003	0.759	0.044	0.6588

Childers Shepard Seedling

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	234.889	0	239.37	218.26	224.186	208.832
2	Nabal	231.917	0	210.51	219.974	246.147	211.265
3	Velvick	248.88	0	251.64	230.277	250.232	203.846
4	Reed	193.7567	0	234.6333	221.4256	225.2052	202.342
5	SHSR-02	141.5422	0	219.71	245.049	226.46	202.841
6	Toro Canyon	236.7389	0	243.6875	222.8822	231.4531	210.7832
7	Edranol	243.386	0	244.61	223.503	217.88	204.237
8	Parida	258.7625	0	255.5125	231.3362	233.7056	218.9556
9	Plowman	205.921	0	242.03	211.487	219.742	207.776
10	Shepard	234.955	0	242.05	217.1122	230.6653	205.1707
Pr		0.058	-	0.449	0.423	0.066	0.924

Hampton Hass Clonal

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	251.651	224.908	292.96	272.71	232.9	283.7333
2	A8	281.299	208.67	288.07	288.06	236.79	293.4143
3	Duke 7	261.202	242.001	295.7005	255.56	242.4	296.85
4	Nabal	201.984	228.281	293.49	291.33	244.87	296.3167
5	SHSR-03	290.61	245.486	286.71	273.26	220.88	292.4
6	Velvick	284.763	247.868	304.34	271.39	245.47	296.2875
7	Zutano	296.661	253.603	295.33	296.78	241.98	289.42
8	Reed	222.601	253.985	294.17	283.18	234.73	320.4444
9	Plowman	276.482	236.68	293.81	301.64	233.09	285.4167
10	Hass	228.772	240.916	295.67	297.57	250.61	305.2571
Pr		0.072	0.001	0.95	0.322	0.141	0.705

Hampton Hass Seedling

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	291.7856	220.8289	297.5355	265.2375	199.2444	294.7479
2	A8	212.866	226.572	299.3	288.44	231.43	275.156
3	Duke 7	114.679	169.518	240.4058	296.81	237.64	307.3622
4	Nabal	265.618	224.512	301.43	266.55	231.28	283.827
5	SHSR-03	253.42	227.342	295.69	272.56	223.01	241.06
6	Velvick	298.318	200.5311	276.34	290.5333	235.1246	275.3762
7	Zutano	289.013	235.048	294.55	288.2333	231.2024	268.3213
8	Reed	300.8738	237.685	290.5832	289.4125	240.9212	267.3461
9	SHSR-02	290.271	234.749	298.83	270.26	256.89	261.7041
10	Velvick/Hazard	106.9067	211.06	287.5502	294.3889	237.2066	304.7666
11	Plowman	204.966	181.548	229.3391	269.4444	236.4769	282.7399
Pr		<0.001	0.265	0.17	0.063	0.108	0.365

WA Hass Clonal

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	0	265.7022	190.0952	204.1064	256.4464	195.2333
2	Duke 7	0	253.6687	228.5159	195.6956	262.703	225.9571
3	Nabal	0	270.1688	218.1112	194.8884	283.5703	185.075
4	Velvick	0	240.4138	208.3711	194.2724	214.647	193.675
5	Zutano	0	241.658	232.05	200.65	279.53	200.85
6	Reed	0	260.18	236.2318	191.814	247.6667	183
7	Hass	0	179.38	150.7218	219.2839	305.0233	189.1049
8	Barr Duke	0	220.03	158.8837	201.0395	268.6596	202.8857
9	SHSR-01	0	298.94	209.071	168.9511	271.6587	188.64
Pr		-	0.067	0.079	0.929	0.377	0.014

WA Hass Seedling

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	0	243.38	175.5222	186.339	232.6103	202.8
2	Duke 7	0	240.7238	191.7625	202.4658	229.6394	197.3625
3	Nabal	0	230.961	171.75	187.6	211.17	181.49
4	V1	0	261.0212	162.7875	207.5794	269.2871	178.0833
5	Velvick	0	239.1033	169.6889	167.739	271.5214	176.8
6	SHSR-02	0	254.3733	193.4	197.02	246.37	171.39
7	Toro Canyon	0	224.7012	175.45	209.5187	234.5354	183.4875
8	Plowman	0	231.351	174.3	212.8104	216.6361	156.5444
Pr		-	0.956	0.981	0.237	0.532	0.047

Walkamin Hass Clonal

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	129.6222	230.9517	218.4556	229.8465	257.7125	186.15
2	A8	115.74	224.169	203.92	226.57	268.83	191.24
3	Duke 7	190.5444	245.2203	238.3222	284.041	295.9	205.3556
4	Thomas	96.83751	226.6833	260.225	250.4038	286.2857	210.6714
5	Velvick	172.82	264.892	244.91	268.3124	293.9857	207.1
6	Zutano	140.16	232.482	196.16	247.83	261.6222	165.3444
7	Reed	-8.42E-06	190.8065	166.1429	239.0092	256.7833	169.3833
8	Hass	49.47498	262.5352	232.2167	264.1432	302.0167	209.5167
9	Barr Duke	145.1444	260.5114	229.3	263.4521	280.35	198.4
Pr		<0.001	0.084	0.011	0.003	0.066	0.008

Walkamin Hass Shepard

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	158.21	224.498	210.74	227.98	251.3	180.47
2	A8	85.36	172.465	213.1	223.6427	260.23	171.73
3	Duke 7	52.39426	113.3882	201.2	242.5894	270.3996	205.1329
4	Nabal	156.8214	186.7054	197.2625	242.9836	276.0303	181.8569
5	Velvick	143.61	215.412	220.39	231.72	285	191.52
6	Zutano	108.13	173.628	191.82	239.65	267.13	194.3968

7	Reed	53.84557	201.3729	207.46	253.584	268.1155	164.8925
8	SHSR-02	170.51	223.285	205.5333	225.79	245.61	190.84
9	Barr Duke	167.42	199.499	204.75	217.62	261.16	184.59
10	Rigato	147.52	208.679	191.24	230.68	262.95	194.18
Pr		0.032	0.101	0.935	0.584	0.413	0.051

Walkamin Shepard Clonal

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	111.5556	246.872	233.38	235.22	242.34	211.37
2	Duke 7	90.28088	270.1048	286.7057	282.1192	258.7279	228.2076
3	Nabal	28.46082	164.1815	253.8881	287.3218	246.9554	225.356
4	SHSR-03	239.589	267.893	248.9322	254.236	250.3053	217.4979
5	Thomas	208.8799	271.211	259.89	234.88	238.4176	222.5165
6	Velvick	130.119	281.834	279.84	239.41	246.2187	213.6541
7	Zutano	78.39539	223.8118	278.4124	250.1134	236.8954	217.6831
8	Shepard	186.4286	241.237	262.06	235.26	234.79	208.21
9	Barr Duke	172.5379	264.532	278.18	261.64	257.94	226.27
Pr		0.002	0.128	0.002	<0.001	0.149	0.133

Walkamin Shepard Seedling

	Trt	FS2007	FS2008	FS2009	FS2010	FS2011	FS2012
1	A10	210.0069	279.6435	273.6716	236.831	243.9928	224.4375
2	A8	206.0638	261.6299	261.4152	234.1453	227.4721	232.3143
3	Duke 7	196.7659	277.276	252.78	237.0411	239.9422	211.5625
4	Nabal	117.5202	238.964	252.7958	243.6958	238.1472	208.575
5	SHSR-03	246.0588	281.1657	246.158	227.8108	238.841	217.8375
6	V1	228.1538	268.6179	267.9356	236.3892	243.1522	232.175
7	Velvick	254.6944	272.28	291.1	241.77	244.71	225.18
8	Zutano	172.3601	276.152	283.52	262.9297	263.4163	226.6429
9	Reed	171.1998	276.7234	236.8691	235.3254	223.361	226.2
10	SHSR-02	209.9495	261.403	262.08	249.9	246.9125	254.1778
Pr		0.156	0.363	0.035	0.498	0.17	0.221

Yield efficiency RCB

Childers Hass Clonal

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	1.441	2.266	0.803	0.503	1.019	0
2	A8	0.503	2.392	1.314	0.62	1.073	0
3	Duke 7	3.142457	3.184303	1.084444	0.810464	1.14	0
4	Nabal	0.944	1.944	0.763	0.561	0.883	0
5	SHSR-03	2.332	2.772	1.018	0.594	1.039	0
6	Thomas	0.648628	3.07899	0.972222	0.768145	0.561111	0
7	V1	1.475	2.881	1.038	0.914	0.765	0
8	Velvick	1.675	3.434	0.697	0.875	0.649	0
9	Zutano	1.811	2.459	1.368	0.802	0.604	0
Pr		<0.001	0.036	0.639	0.005	0.002	-

Childers Hass Seedling

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	2.57	1.931	1.041	0.522	0	0
2	A8	2.162	2.734	1.573	0.783	0	0
3	Nabal	2.24	2.6	1.103	0.708	0	0
4	SHSR-03	4.123	2.041	1.119	0.625	0	0
5	V1	1.919	2.425	93.903	0.74	0	0
6	Velvick	2.54	2.114	1.171	0.7	0	0
7	Peasley	2.425	2.103	1.511	0.604	0	0
8	Reed	1.93	2.859	1.348	0.849	0	0
9	SHSR-02	2.773	1.766	1.166	0.682	0	0
10	Toro Canyon	3.265	2.841527	1.503747	0.863783	0	0
11	Velvick/Hazard	0.801	1.274	0.981	0.67	0	0
Pr		<0.001	0.004	0.463	0.812	-	-

Childers Shepard Seedling

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	0.6643	0	0.891	0.679	0	0
2	Nabal	0.7924	0	0.532	0.802	0	0
3	Velvick	0.8563	0	0.785	0.907	0	0
4	Reed	0.271328	0	0.648711	0.988889	0	0
5	SHSR-02	0.6598	0	0.843	0.744	0	0
6	Toro Canyon	0.796474	0	0.685037	1.416667	0	0
7	Edranol	1.0193	0	1.783	0.968	0	0
8	Parida	0.860652	0	0.775467	0.90625	0	0
9	Plowman	0.7361	0	0.778	0.837	0	0
10	Shepard	0.6061	0	0.679482	0.832222	0	0
Pr		0.335	-	0.005	0.579	-	-

Hampton Hass Clonal

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	0.6643	0	1.099	0.482	0.991	0.011667
2	Nabal	0.7924	0	1.618	0.482	1.032	0.015714
3	Velvick	0.8563	0	2.143	0.159	0.945	0.01875
4	Reed	0.271328	0	1.205	0.34	1.153	0.025
5	SHSR-02	0.6598	0	1.587	0.441	1.054	0.02375
6	Toro Canyon	0.796474	0	1.45	0.38	1.118	0.02
7	Edranol	1.0193	0	1.411	0.41	0.981	0.048
8	Parida	0.860652	0	1.02	0.252	0.784	0.035556
9	Plowman	0.7361	0	1.323	0.293	1.005	0.008333
10	Shepard	0.6061	0	1.479	0.354	0.859	0.148571
Pr		0.335	-	0.072	0.555	0.032	0.013

Hampton Hass Seedling

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	2.576667	2.603333	3.224444	1.13625	1.07	0.181034
2	A8	0.697	2.456	3.621	0.944	1.23	0.140617
3	Duke 7	0.318	2.056	4.723	1.246	1.364	0.068602

4	Nabal	1.057	2.556	2.963	1.098	1.004	0.306045
5	SHSR-03	2.598	3.004	4.097	1.082	1.479	0.075
6	Velvick	1.294	2.811	3.276	1.146667	1.138889	0.214349
7	Zutano	1.633	2.849	4.497	0.8	1.167778	0.053055
8	Reed	0.70875	1.63	4.1225	0.52	0.935	0.068807
9	SHSR-02	1.197	2.628	3.32	0.926	0.927	0.225685
10	Velvick/Hazard	4.336667	2.48	2.407778	1.673333	1.133333	0.266676
11	Plowman	0.322	1.618	2.625555	0.753333	0.962222	0.111688
Pr		0.389	0.31	0.431	0.504	0.351	0.512

WA Hass Clonal

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	0	4.579759	0.557778	0.789172	0.266505	2.127614
2	Duke 7	0	2.908426	0.11625	0.840385	0.158548	1.434823
3	Nabal	0	3.486254	0.65375	0.899649	0.598084	2.098242
4	Velvick	0	3.718524	0.4725	0.915408	0.378175	2.361852
5	Zutano	0	3.773	0.36	1.184	0.61686	1.95
6	Reed	0	2.279596	0.421429	0.467881	0.327528	1.917296
7	Hass	0	3.378114	0.376667	0.544766	0.545005	2.320466
8	Barr Duke	0	6.406941	0.12	0.645485	0.269353	1.863802
9	SHSR-01	0	3.723357	0.262	0.546331	0.424294	1.536286
Pr		-	0.02	0.025	0.274	0.051	0.243

WA Hass Seedling

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	0	5.017778	0.196667	1.005556	0.696464	1.536575
2	Duke 7	0	3.83625	0.06	1.10625	0.361458	2.544749
3	Nabal	0	3.441	0.173	1.104	0.704	1.111
4	V1	0	4.11	0.21875	1.266667	1.070204	2.114022
5	Velvick	0	3.311111	0.244444	0.747778	1.309798	1.484353
6	SHSR-02	0	4.369	0.183	0.773	0.694	1.489
7	Toro Canyon	0	4.33625	0.1375	1.08375	0.756619	3.012729
8	Plowman	0	2.607	0.313	0.775556	0.56329	1.273428
Pr		-	0.101	0.311	0.809	0.039	0.027

Walkamin Hass Clonal

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	0.391111	2.628088	0.930112	2.481183	2.327786	2.105177
2	A8	0.54	3.121	1.82846	2.817	2.107048	2.002
3	Duke 7	1.901111	2.83223	1.093037	1.869929	2.114427	2.22843
4	Thomas	1.01625	2.651434	0.521348	0.682861	1.628728	1.885816
5	Velvick	1.321	1.724	0.536	1.318	1.759854	1.706931
6	Zutano	0.359	1.663	0.857	1.766	1.768977	1.698997
7	Reed	1.95E-08	1.232283	0.441446	2.456673	1.845236	1.880677
8	Hass	0.19875	0.902577	0.347815	0.786774	1.475291	1.825553
9	Barr Duke	0.337778	1.504452	0.751926	1.867707	2.32128	2.66212
Pr		<0.001	0.001	<0.001	<0.001	0.392	0.318

Walkamin Hass Seedling

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	1.305	2.636	1.216	1.768	2.029	1.717
2	A8	1.06977	2.444	1.96	2.995	2.545	2.288
3	Duke 7	1.133152	1.615333	1.3425	3.100112	2.007315	2.626343
4	Nabal	1.621804	2.140129	0.6425	1.836579	2.482861	2.058729
5	Velvick	1.222	2.659	1.378	2.29	1.898	2.412
6	Zutano	1.259	1.873	1.204	2.088	1.846	1.806971
7	Reed	0.827765	1.096585	1.416	2.693688	1.902819	1.993852
8	SHSR-02	0.977	1.679	1.21	1.556	1.419	1.609
9	Barr Duke	1.71	1.916	1.536	3.19	2.12	2.095
10	Rigato	0.911	1.575	0.647	1.363	1.504	2.346
Pr		0.966	0.67	0.039	0.003	0.047	0.041

Walkamin Shepard Clonal

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	0.35261	1.658	1.631	2.172	1.677	2.622339
2	Duke 7	0.227792	0.526667	0.946231	3.51	1.6825	2.469259
3	Nabal	0.035315	0.58875	1.319483	1.608572	1.792857	1.860325
4	SHSR-03	0.947555	2.317778	1.767037	2.327778	2.104444	2.83606
5	Thomas	0.770123	1.695	1.204	1.916667	1.223333	2.22088
6	Velvick	0.783295	2.476	1.8	2.253	1.966667	2.674753
7	Zutano	0.249316	1.025556	1.35524	2.074444	1.938889	2.677665
8	Shepard	0.569744	1.616	1.397	2.362	2.034	2.490559
9	Barr Duke	1.19471	1.72	1.428	2.522	1.951	2.474862
Pr		0.289	<0.001	0.035	<0.001	0.006	0.384

Walkamin Shepard Seedling

	Trt	YE2007	YE2008	YE2009	YE2010	YE2011	YE2012
1	A10	1.387739	3.9985	1.209028	2.17625	2.48875	3.645632
2	A8	0.591432	2.714668	1.737295	2.175714	2.01	3.153277
3	Duke 7	1.25	2.609	1.483	2.15	1.8	3.205439
4	Nabal	0.599674	2.781	1.996297	2.24	2.9125	3.227384
5	SHSR-03	1.293862	1.661102	1.621746	2.04625	2.0175	2.997906
6	V1	0.702722	3.538533	1.718677	2.461111	2.10875	3.099996
7	Velvick	1.492726	3.489	1.285	2.366	2.269	3.726
8	Zutano	1.033837	3.854	2.592	2.552857	2.294285	3.999608
9	Reed	0.348357	2.325546	2.193968	2.105	2.09375	2.476513
10	SHSR-02	0.9	2.889	1.722	2.11	2.118889	3.625784
Pr		0.23	0.159	0.005	0.947	0.685	0.78

I. Fixed effect analysis – across Sites at each Time

A fixed effect analysis (across Sites) was conducted for each Trait at each Time (sum or average of 2 consecutive years) separately. In this analysis Sites are considered replicates in order to test the effects of Scion Variety and Propagation type as Scions and Propagation type were tested in spatially separate blocks at each Site. This analysis allowed for conditional Wald tests to be calculated to test the fixed effects in the model correctly. A combined analysis across all times was also conducted but the complexity and sparseness of this analysis meant conditional wald tests were unable to be obtained so comparisons from this analysis need to be interpreted carefully.

The asreml model used for analysis at a single time was

*METY3atest.asr<-asreml(SumYld~ Variety*Prop*(Race/Trt),*

random =~ Site/Wplot/Rep,

rcov=~at(SiteScion):ar1(Col):ar1(Row),

data=Ysumsub2,na.method.X="include",workspace=2e8,maxiter=30)

Yield

Time 1 (Y2007+Y2008)

wald(METY3atest.asr,SSType="conditional", denDF="default")

```
$Wald
                     Df denDF   F.inc           Pr
(Intercept)           1   3.0 15.4800 2.950735e-02
Variety               1   1.7  2.9850 2.497025e-01
Prop                  1   2.3  3.4860 1.874056e-01
Race                  2 443.0 20.1200 4.334422e-09
Variety:Prop          1   1.9  2.6040 2.547615e-01
Race:Trt             17 432.9  6.2880 2.982274e-13
Variety:Race          2 281.6  1.5490 2.143407e-01
Prop:Race             2 487.0  9.4160 9.719928e-05
Variety:Race:Trt      9 263.2  0.8363 5.832520e-01
Prop:Race:Trt         8 450.6  7.2080 5.236328e-09
Variety:Prop:Race     2 297.3  3.6670 2.672826e-02
Variety:Prop:Race:Trt 3 356.8  1.6830 1.702664e-01
```

The (conditional) Wald tests for testing the fixed effects in the model are given above. Hence for time 1 there was a significant Variety:Prop:Race interaction with the following predicted means:

```
   Variety     Prop Race predicted.value standard.error est.status
1     Hass   Clonal    G        27.39053       8.579939  Estimable
2     Hass   Clonal    M        32.81022       8.642209  Estimable
3     Hass   Clonal   WI        46.05520       9.015841  Estimable
4     Hass Seedling    G        33.13767       8.574722  Estimable
5     Hass Seedling    M        33.73565       8.656378  Estimable
6     Hass Seedling   WI        28.49771       8.765539  Estimable
7  Shepard   Clonal    G        28.91980       9.252528  Estimable
```

```
8  Shepard   Clonal    M        34.22141       9.096391  Estimable
9  Shepard   Clonal   WI        35.18377       9.408106  Estimable
10 Shepard Seedling    G        41.35517       9.203088  Estimable
11 Shepard Seedling    M        38.16534       9.293034  Estimable
12 Shepard Seedling   WI        54.06756       9.396376  Estimable

$avsed
 overall
4.312032
```

If we take 2x the avsed (average standard error of difference) we get an approximate LSD (least significant difference) to use to compare between predictions.

Hence for Hass clonal and Shepard seedling, WI rootstocks have significantly higher yield than the other rootstocks but for Hass seedling & Shepard clonal this was not the case. For Shepard Scion the G and WI seedling rootstocks were significantly higher than their clonal counterparts.

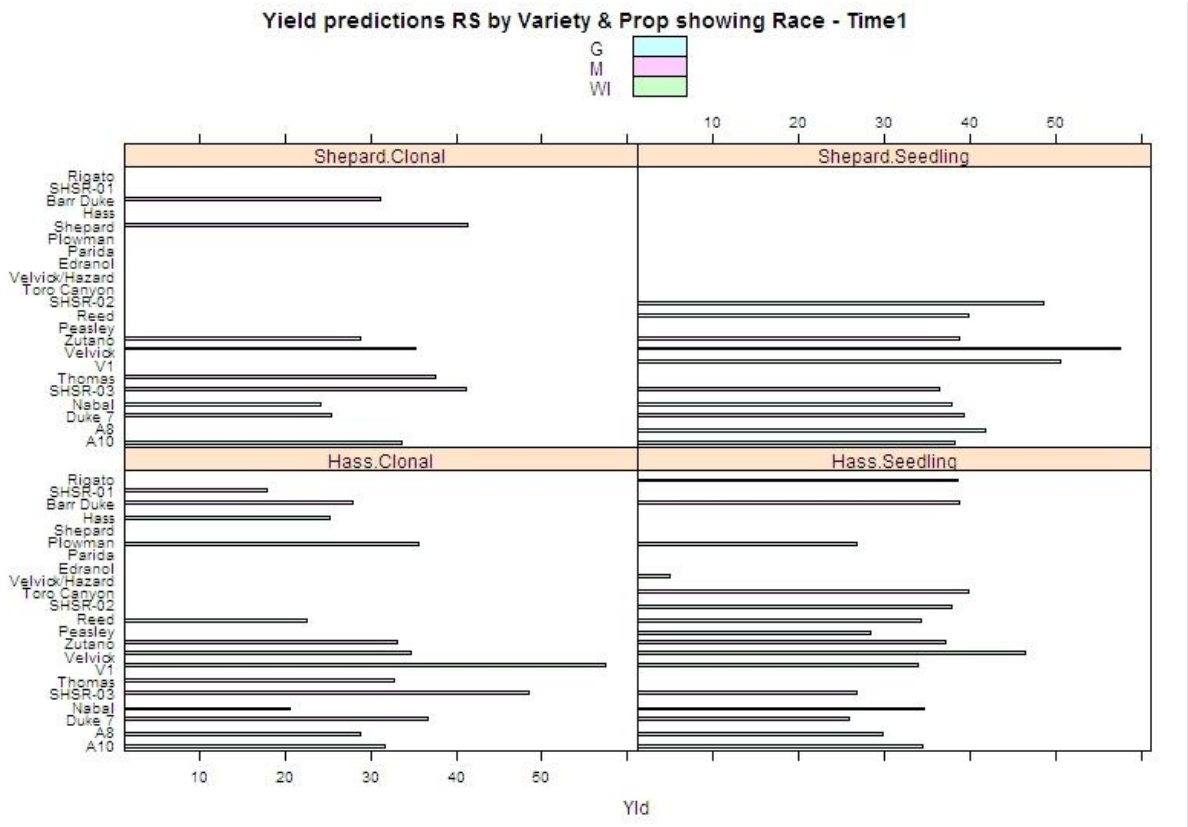
The main effects need to be considered with the above interaction in mind.

The Variety and Propagation main effects were not significant.

```
  Variety predicted.value standard.error est.status
1    Hass        32.41959       8.440682  Estimable
2 Shepard        38.30310       8.843850  Estimable

$avsed
 overall
3.091632
```

```
      Prop predicted.value standard.error est.status
1   Clonal        32.68117       8.549132  Estimable
2 Seedling        36.48768       8.533179  Estimable

$avsed
 overall
2.253645
```

```
The Race main effect was significant with WI RS having higher yield than
Mexican or Guatemalan RS.

  Race predicted.value standard.error est.status
1    G        33.05048       8.477836  Estimable
2    M        34.26820       8.517455  Estimable
3   WI        40.11530       8.550343  Estimable

$avsed
 overall
1.543368
```



Time 2 (2009+Y2010)

```
$Wald
                       Df denDF    F.inc            Pr
(Intercept)             1   2.9 20.19000 2.147731e-02
Variety                 1   4.1  3.31000 1.409740e-01
Prop                    1   3.9  0.63010 4.725012e-01
Race                    2 506.8  6.74000 1.291344e-03
Variety:Prop            1   4.2  0.02631 8.786533e-01
Race:Trt               19 416.0  3.06800 1.851012e-05
Variety:Race            2 243.6  3.06200 4.860744e-02
Prop:Race               2 513.2  7.76400 4.763734e-04
Variety:Race:Trt       11 244.7  6.11000 7.640097e-09
Prop:Race:Trt           9 470.4  6.76800 3.707227e-09
Variety:Prop:Race       2 205.1  0.56120 5.714084e-01
Variety:Prop:Race:Trt   3 206.0  3.27700 2.202880e-02
```

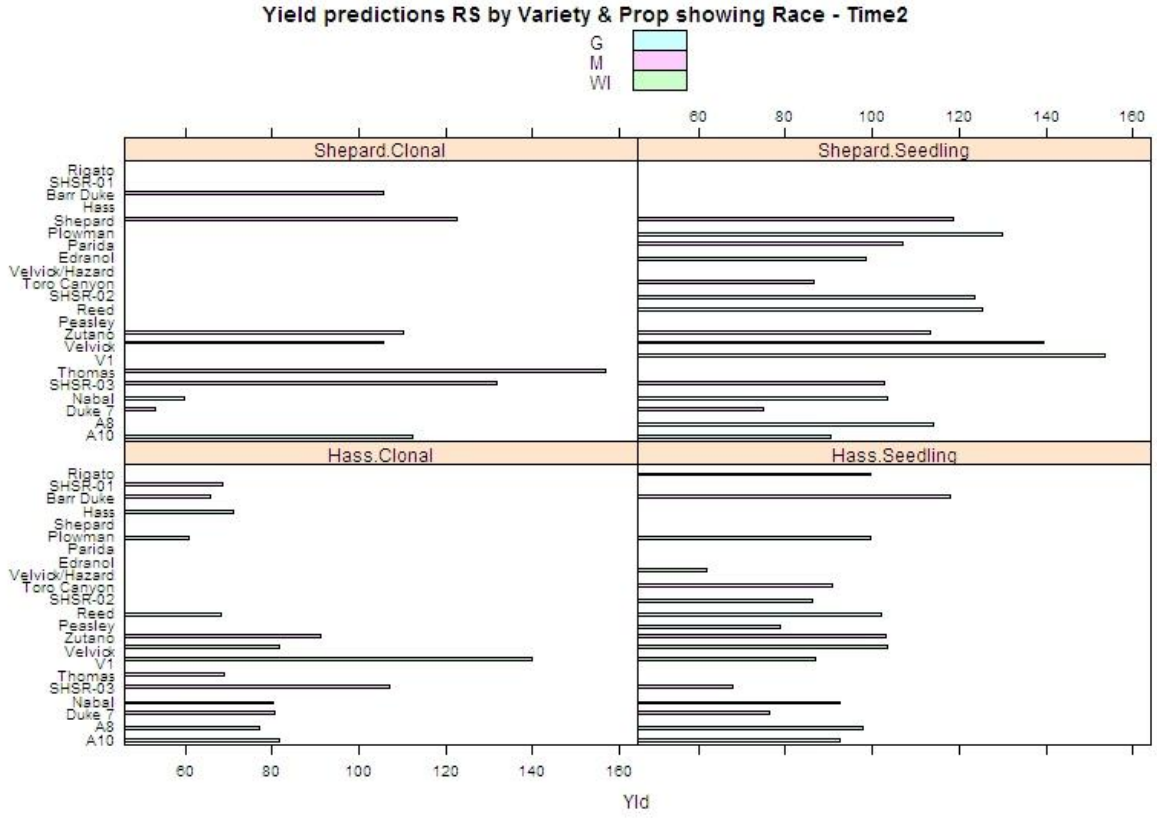
There is a significant Variety:Prop:Race:Trt interaction so we should focus on these predicted means.

	Variety	Prop	Race	Trt	predicted.value	standard.error	est.status
1	Hass	Clonal	G	A10	81.78961	21.76262	Estimable
2	Hass	Clonal	G	A8	76.94169	22.04640	Estimable
3	Hass	Clonal	G	Duke 7	NA	NA	Aliased
4	Hass	Clonal	G	Nabal	80.33280	21.89691	Estimable
5	Hass	Clonal	G	SHSR-03	NA	NA	Aliased
6	Hass	Clonal	G	Thomas	NA	NA	Aliased
7	Hass	Clonal	G	V1	NA	NA	Aliased
8	Hass	Clonal	G	Velvick	NA	NA	Aliased
9	Hass	Clonal	G	Zutano	NA	NA	Aliased
10	Hass	Clonal	G	Peasley	NA	NA	Aliased
11	Hass	Clonal	G	Reed	68.37085	21.97912	Estimable
12	Hass	Clonal	G	SHSR-02	NA	NA	Aliased
13	Hass	Clonal	G	Toro Canyon	NA	NA	Aliased
14	Hass	Clonal	G	Velvick/Hazard	NA	NA	Aliased
15	Hass	Clonal	G	Edranol	NA	NA	Aliased
16	Hass	Clonal	G	Parida	NA	NA	Aliased
17	Hass	Clonal	G	Plowman	60.90205	23.25208	Estimable

18	Hass	Clonal	G	Shepard	NA	NA	Aliased
19	Hass	Clonal	G	Hass	70.93057	22.24699	Estimable
20	Hass	Clonal	G	Barr Duke	NA	NA	Aliased
21	Hass	Clonal	G	SHSR-01	NA	NA	Aliased
22	Hass	Clonal	G	Rigato	NA	NA	Aliased
23	Hass	Clonal	M	A10	NA	NA	Aliased
24	Hass	Clonal	M	A8	NA	NA	Aliased
25	Hass	Clonal	M	Duke 7	80.49996	21.79261	Estimable
26	Hass	Clonal	M	Nabal	NA	NA	Aliased
27	Hass	Clonal	M	SHSR-03	106.88933	22.38509	Estimable
28	Hass	Clonal	M	Thomas	68.84194	22.78142	Estimable
29	Hass	Clonal	M	V1	NA	NA	Aliased
30	Hass	Clonal	M	Velvick	NA	NA	Aliased
31	Hass	Clonal	M	Zutano	91.22708	21.73323	Estimable
32	Hass	Clonal	M	Peasley	NA	NA	Aliased
33	Hass	Clonal	M	Reed	NA	NA	Aliased
34	Hass	Clonal	M	SHSR-02	NA	NA	Aliased
35	Hass	Clonal	M	Toro Canyon	NA	NA	Aliased
36	Hass	Clonal	M	Velvick/Hazard	NA	NA	Aliased
37	Hass	Clonal	M	Edranol	NA	NA	Aliased
38	Hass	Clonal	M	Parida	NA	NA	Aliased
39	Hass	Clonal	M	Plowman	NA	NA	Aliased
40	Hass	Clonal	M	Shepard	NA	NA	Aliased
41	Hass	Clonal	M	Hass	NA	NA	Aliased
42	Hass	Clonal	M	Barr Duke	65.79808	22.28793	Estimable
43	Hass	Clonal	M	SHSR-01	68.54188	23.17416	Estimable
44	Hass	Clonal	M	Rigato	NA	NA	Aliased
45	Hass	Clonal	WI	A10	NA	NA	Aliased
46	Hass	Clonal	WI	A8	NA	NA	Aliased
47	Hass	Clonal	WI	Duke 7	NA	NA	Aliased
48	Hass	Clonal	WI	Nabal	NA	NA	Aliased
49	Hass	Clonal	WI	SHSR-03	NA	NA	Aliased
50	Hass	Clonal	WI	Thomas	NA	NA	Aliased
51	Hass	Clonal	WI	V1	139.81458	23.80925	Estimable
52	Hass	Clonal	WI	Velvick	81.70253	21.80292	Estimable
53	Hass	Clonal	WI	Zutano	NA	NA	Aliased
54	Hass	Clonal	WI	Peasley	NA	NA	Aliased
55	Hass	Clonal	WI	Reed	NA	NA	Aliased
56	Hass	Clonal	WI	SHSR-02	NA	NA	Aliased
57	Hass	Clonal	WI	Toro Canyon	NA	NA	Aliased
58	Hass	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
59	Hass	Clonal	WI	Edranol	NA	NA	Aliased
60	Hass	Clonal	WI	Parida	NA	NA	Aliased
61	Hass	Clonal	WI	Plowman	NA	NA	Aliased
62	Hass	Clonal	WI	Shepard	NA	NA	Aliased
63	Hass	Clonal	WI	Hass	NA	NA	Aliased
64	Hass	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Hass	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Hass	Clonal	WI	Rigato	NA	NA	Aliased
67	Hass	Seedling	G	A10	92.50751	22.06343	Estimable
68	Hass	Seedling	G	A8	97.78863	22.68815	Estimable
69	Hass	Seedling	G	Duke 7	NA	NA	Aliased
70	Hass	Seedling	G	Nabal	92.45589	22.02915	Estimable
71	Hass	Seedling	G	SHSR-03	NA	NA	Aliased
72	Hass	Seedling	G	Thomas	NA	NA	Aliased
73	Hass	Seedling	G	V1	NA	NA	Aliased
74	Hass	Seedling	G	Velvick	NA	NA	Aliased
75	Hass	Seedling	G	Zutano	NA	NA	Aliased
76	Hass	Seedling	G	Peasley	78.79085	25.01018	Estimable
77	Hass	Seedling	G	Reed	102.17722	23.04251	Estimable
78	Hass	Seedling	G	SHSR-02	86.33091	22.01464	Estimable
79	Hass	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Hass	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Hass	Seedling	G	Edranol	NA	NA	Aliased
82	Hass	Seedling	G	Parida	NA	NA	Aliased
83	Hass	Seedling	G	Plowman	99.48618	22.49405	Estimable
84	Hass	Seedling	G	Shepard	NA	NA	Aliased
85	Hass	Seedling	G	Hass	NA	NA	Aliased
86	Hass	Seedling	G	Barr Duke	NA	NA	Aliased
87	Hass	Seedling	G	SHSR-01	NA	NA	Aliased
88	Hass	Seedling	G	Rigato	99.67880	26.13491	Estimable
89	Hass	Seedling	M	A10	NA	NA	Aliased
90	Hass	Seedling	M	A8	NA	NA	Aliased
91	Hass	Seedling	M	Duke 7	76.15194	22.32487	Estimable
92	Hass	Seedling	M	Nabal	NA	NA	Aliased
93	Hass	Seedling	M	SHSR-03	67.80066	23.23746	Estimable
94	Hass	Seedling	M	Thomas	NA	NA	Aliased
95	Hass	Seedling	M	V1	NA	NA	Aliased
96	Hass	Seedling	M	Velvick	NA	NA	Aliased
97	Hass	Seedling	M	Zutano	103.00329	23.65738	Estimable
98	Hass	Seedling	M	Peasley	NA	NA	Aliased
99	Hass	Seedling	M	Reed	NA	NA	Aliased
100	Hass	Seedling	M	SHSR-02	NA	NA	Aliased
101	Hass	Seedling	M	Toro Canyon	90.89439	22.61229	Estimable
102	Hass	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Hass	Seedling	M	Edranol	NA	NA	Aliased
104	Hass	Seedling	M	Parida	NA	NA	Aliased
105	Hass	Seedling	M	Plowman	NA	NA	Aliased
106	Hass	Seedling	M	Shepard	NA	NA	Aliased
107	Hass	Seedling	M	Hass	NA	NA	Aliased
108	Hass	Seedling	M	Barr Duke	117.74461	26.17345	Estimable
109	Hass	Seedling	M	SHSR-01	NA	NA	Aliased
110	Hass	Seedling	M	Rigato	NA	NA	Aliased
111	Hass	Seedling	WI	A10	NA	NA	Aliased
112	Hass	Seedling	WI	A8	NA	NA	Aliased
113	Hass	Seedling	WI	Duke 7	NA	NA	Aliased
114	Hass	Seedling	WI	Nabal	NA	NA	Aliased
115	Hass	Seedling	WI	SHSR-03	NA	NA	Aliased
116	Hass	Seedling	WI	Thomas	NA	NA	Aliased
117	Hass	Seedling	WI	V1	87.01929	22.75143	Estimable
118	Hass	Seedling	WI	Velvick	103.29731	22.05268	Estimable
119	Hass	Seedling	WI	Zutano	NA	NA	Aliased
120	Hass	Seedling	WI	Peasley	NA	NA	Aliased
121	Hass	Seedling	WI	Reed	NA	NA	Aliased
122	Hass	Seedling	WI	SHSR-02	NA	NA	Aliased
123	Hass	Seedling	WI	Toro Canyon	NA	NA	Aliased
124	Hass	Seedling	WI	Velvick/Hazard	61.80703	23.31379	Estimable
125	Hass	Seedling	WI	Edranol	NA	NA	Aliased
126	Hass	Seedling	WI	Parida	NA	NA	Aliased
127	Hass	Seedling	WI	Plowman	NA	NA	Aliased
128	Hass	Seedling	WI	Shepard	NA	NA	Aliased
129	Hass	Seedling	WI	Hass	NA	NA	Aliased
130	Hass	Seedling	WI	Barr Duke	NA	NA	Aliased
131	Hass	Seedling	WI	SHSR-01	NA	NA	Aliased
132	Hass	Seedling	WI	Rigato	NA	NA	Aliased
133	Shepard	Clonal	G	A10	112.50382	29.68683	Estimable

134	Shepard	Clonal	G	A8	NA	NA	Aliased
135	Shepard	Clonal	G	Duke 7	NA	NA	Aliased
136	Shepard	Clonal	G	Nabal	59.92921	30.45697	Estimable
137	Shepard	Clonal	G	SHSR-03	NA	NA	Aliased
138	Shepard	Clonal	G	Thomas	NA	NA	Aliased
139	Shepard	Clonal	G	V1	NA	NA	Aliased
140	Shepard	Clonal	G	Velvick	NA	NA	Aliased
141	Shepard	Clonal	G	Zutano	NA	NA	Aliased
142	Shepard	Clonal	G	Peasley	NA	NA	Aliased
143	Shepard	Clonal	G	Reed	NA	NA	Aliased
144	Shepard	Clonal	G	SHSR-02	NA	NA	Aliased
145	Shepard	Clonal	G	Toro Canyon	NA	NA	Aliased
146	Shepard	Clonal	G	Velvick/Hazard	NA	NA	Aliased
147	Shepard	Clonal	G	Edranol	NA	NA	Aliased
148	Shepard	Clonal	G	Parida	NA	NA	Aliased
149	Shepard	Clonal	G	Plowman	NA	NA	Aliased
150	Shepard	Clonal	G	Shepard	NA	NA	Aliased
151	Shepard	Clonal	G	Hass	NA	NA	Aliased
152	Shepard	Clonal	G	Barr Duke	NA	NA	Aliased
153	Shepard	Clonal	G	SHSR-01	NA	NA	Aliased
154	Shepard	Clonal	G	Rigato	NA	NA	Aliased
155	Shepard	Clonal	M	A10	NA	NA	Aliased
156	Shepard	Clonal	M	A8	NA	NA	Aliased
157	Shepard	Clonal	M	Duke 7	53.26261	30.16536	Estimable
158	Shepard	Clonal	M	Nabal	NA	NA	Aliased
159	Shepard	Clonal	M	SHSR-03	131.80815	29.91014	Estimable
160	Shepard	Clonal	M	Thomas	156.90192	29.87894	Estimable
161	Shepard	Clonal	M	V1	NA	NA	Aliased
162	Shepard	Clonal	M	Velvick	NA	NA	Aliased
163	Shepard	Clonal	M	Zutano	110.20896	29.88375	Estimable
164	Shepard	Clonal	M	Peasley	NA	NA	Aliased
165	Shepard	Clonal	M	Reed	NA	NA	Aliased
166	Shepard	Clonal	M	SHSR-02	NA	NA	Aliased
167	Shepard	Clonal	M	Toro Canyon	NA	NA	Aliased
168	Shepard	Clonal	M	Velvick/Hazard	NA	NA	Aliased
169	Shepard	Clonal	M	Edranol	NA	NA	Aliased
170	Shepard	Clonal	M	Parida	NA	NA	Aliased
171	Shepard	Clonal	M	Plowman	NA	NA	Aliased
172	Shepard	Clonal	M	Shepard	122.70695	29.68022	Estimable
173	Shepard	Clonal	M	Hass	NA	NA	Aliased
174	Shepard	Clonal	M	Barr Duke	105.64238	29.78296	Estimable
175	Shepard	Clonal	M	SHSR-01	NA	NA	Aliased
176	Shepard	Clonal	M	Rigato	NA	NA	Aliased
177	Shepard	Clonal	WI	A10	NA	NA	Aliased
178	Shepard	Clonal	WI	A8	NA	NA	Aliased
179	Shepard	Clonal	WI	Duke 7	NA	NA	Aliased
180	Shepard	Clonal	WI	Nabal	NA	NA	Aliased
181	Shepard	Clonal	WI	SHSR-03	NA	NA	Aliased
182	Shepard	Clonal	WI	Thomas	NA	NA	Aliased
183	Shepard	Clonal	WI	V1	NA	NA	Aliased
184	Shepard	Clonal	WI	Velvick	105.64923	29.66184	Estimable
185	Shepard	Clonal	WI	Zutano	NA	NA	Aliased
186	Shepard	Clonal	WI	Peasley	NA	NA	Aliased
187	Shepard	Clonal	WI	Reed	NA	NA	Aliased
188	Shepard	Clonal	WI	SHSR-02	NA	NA	Aliased
189	Shepard	Clonal	WI	Toro Canyon	NA	NA	Aliased
190	Shepard	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
191	Shepard	Clonal	WI	Edranol	NA	NA	Aliased
192	Shepard	Clonal	WI	Parida	NA	NA	Aliased
193	Shepard	Clonal	WI	Plowman	NA	NA	Aliased
194	Shepard	Clonal	WI	Shepard	NA	NA	Aliased
195	Shepard	Clonal	WI	Hass	NA	NA	Aliased
196	Shepard	Clonal	WI	Barr Duke	NA	NA	Aliased
197	Shepard	Clonal	WI	SHSR-01	NA	NA	Aliased
198	Shepard	Clonal	WI	Rigato	NA	NA	Aliased
199	Shepard	Seedling	G	A10	90.36381	25.23657	Estimable
200	Shepard	Seedling	G	A8	113.94444	28.79416	Estimable
201	Shepard	Seedling	G	Duke 7	NA	NA	Aliased
202	Shepard	Seedling	G	Nabal	103.41613	25.15864	Estimable
203	Shepard	Seedling	G	SHSR-03	NA	NA	Aliased
204	Shepard	Seedling	G	Thomas	NA	NA	Aliased
205	Shepard	Seedling	G	V1	NA	NA	Aliased
206	Shepard	Seedling	G	Velvick	NA	NA	Aliased
207	Shepard	Seedling	G	Zutano	NA	NA	Aliased
208	Shepard	Seedling	G	Peasley	NA	NA	Aliased
209	Shepard	Seedling	G	Reed	125.37196	25.39554	Estimable
210	Shepard	Seedling	G	SHSR-02	123.67522	25.13673	Estimable
211	Shepard	Seedling	G	Toro Canyon	NA	NA	Aliased
212	Shepard	Seedling	G	Velvick/Hazard	NA	NA	Aliased
213	Shepard	Seedling	G	Edranol	98.41997	26.09180	Estimable
214	Shepard	Seedling	G	Parida	NA	NA	Aliased
215	Shepard	Seedling	G	Plowman	129.77437	26.12859	Estimable
216	Shepard	Seedling	G	Shepard	NA	NA	Aliased
217	Shepard	Seedling	G	Hass	NA	NA	Aliased
218	Shepard	Seedling	G	Barr Duke	NA	NA	Aliased
219	Shepard	Seedling	G	SHSR-01	NA	NA	Aliased
220	Shepard	Seedling	G	Rigato	NA	NA	Aliased
221	Shepard	Seedling	M	A10	NA	NA	Aliased
222	Shepard	Seedling	M	A8	NA	NA	Aliased
223	Shepard	Seedling	M	Duke 7	74.79666	27.77600	Estimable
224	Shepard	Seedling	M	Nabal	NA	NA	Aliased
225	Shepard	Seedling	M	SHSR-03	102.72240	28.32481	Estimable
226	Shepard	Seedling	M	Thomas	NA	NA	Aliased
227	Shepard	Seedling	M	V1	NA	NA	Aliased
228	Shepard	Seedling	M	Velvick	NA	NA	Aliased
229	Shepard	Seedling	M	Zutano	113.38234	28.85868	Estimable
230	Shepard	Seedling	M	Peasley	NA	NA	Aliased
231	Shepard	Seedling	M	Reed	NA	NA	Aliased
232	Shepard	Seedling	M	SHSR-02	NA	NA	Aliased
233	Shepard	Seedling	M	Toro Canyon	86.41230	26.43975	Estimable
234	Shepard	Seedling	M	Velvick/Hazard	NA	NA	Aliased
235	Shepard	Seedling	M	Edranol	NA	NA	Aliased
236	Shepard	Seedling	M	Parida	106.94247	26.92587	Estimable
237	Shepard	Seedling	M	Plowman	NA	NA	Aliased
238	Shepard	Seedling	M	Shepard	118.56921	26.34862	Estimable
239	Shepard	Seedling	M	Hass	NA	NA	Aliased
240	Shepard	Seedling	M	Barr Duke	NA	NA	Aliased
241	Shepard	Seedling	M	SHSR-01	NA	NA	Aliased
242	Shepard	Seedling	M	Rigato	NA	NA	Aliased
243	Shepard	Seedling	WI	A10	NA	NA	Aliased
244	Shepard	Seedling	WI	A8	NA	NA	Aliased
245	Shepard	Seedling	WI	Duke 7	NA	NA	Aliased
246	Shepard	Seedling	WI	Nabal	NA	NA	Aliased
247	Shepard	Seedling	WI	SHSR-03	NA	NA	Aliased
248	Shepard	Seedling	WI	Thomas	NA	NA	Aliased
249	Shepard	Seedling	WI	V1	153.47547	27.93035	Estimable

```
250 Shepard Seedling   WI        Velvick       139.49421       25.13490  Estimable
251 Shepard Seedling   WI         Zutano              NA             NA    Aliased
252 Shepard Seedling   WI        Peasley              NA             NA    Aliased
253 Shepard Seedling   WI           Reed              NA             NA    Aliased
254 Shepard Seedling   WI        SHSR-02              NA             NA    Aliased
255 Shepard Seedling   WI    Toro Canyon              NA             NA    Aliased
256 Shepard Seedling   WI Velvick/Hazard              NA             NA    Aliased
257 Shepard Seedling   WI        Edranol              NA             NA    Aliased
258 Shepard Seedling   WI         Parida              NA             NA    Aliased
259 Shepard Seedling   WI        Plowman              NA             NA    Aliased
260 Shepard Seedling   WI        Shepard              NA             NA    Aliased
261 Shepard Seedling   WI           Hass              NA             NA    Aliased
262 Shepard Seedling   WI      Barr Duke              NA             NA    Aliased
263 Shepard Seedling   WI        SHSR-01              NA             NA    Aliased
264 Shepard Seedling   WI         Rigato              NA             NA    Aliased

$avsed
 overall
20.82417
```



The Variety and Propagation main effects were not significant.

```
  Variety predicted.value standard.error est.status
1    Hass         86.65058       20.52609  Estimable
2 Shepard        109.97392       23.04503  Estimable

$avsed
 overall
13.67629
```

```
      Prop predicted.value standard.error est.status
1   Clonal         91.35636       21.77711  Estimable
2 Seedling       101.21598       21.16529  Estimable

$avsed
overall
12.0057
```

```
The Race main effect was significant with WI RS having higher yield than
Mexican and Guatemalan RS.

  Race predicted.value standard.error est.status
1    G         93.29924       20.53358  Estimable
```

```
2    M        96.55433       20.97933  Estimable
3   WI       109.03246       20.68483  Estimable

$avsed
 overall
4.564138
  Variety Race predicted.value standard.error est.status
1    Hass    G        84.89168       20.59784  Estimable
2    Hass    M        85.21756       20.62908  Estimable
3    Hass   WI        94.72815       20.81720  Estimable
4 Shepard    G       106.37766       23.15994  Estimable
5 Shepard    M       106.94636       23.60308  Estimable
6 Shepard   WI       132.87297       23.76446  Estimable

$avsed
 overall
12.06524
```

It can be seen that the WI RS under Shepard Scion have significantly higher yield than all other Variety:Race combinations. G & M RS are not significantly higher under Shepard than Hass.

```
      Prop Race predicted.value standard.error est.status
1   Clonal    G        76.46258       21.36074  Estimable
2   Clonal    M        96.86077       22.52826  Estimable
3   Clonal   WI       109.05544       22.02550  Estimable
4 Seedling    G       102.27879       21.19545  Estimable
5 Seedling    M        96.22002       21.55476  Estimable
6 Seedling   WI       109.01866       21.35328  Estimable

$avsed
 overall
10.56313
```

It can be seen that the WI and M RS have similar yields with clonal and seedling however the G RS are significantly lower with clonal RS than seedling RS.

The Variety:Prop:Race:Trt interaction is however significant so it would appear that these trends (above) may not be consistent across all RS within each of these categories.

Time 3 (Y2011+Y2012)

```
$Wald
                     Df denDF     F.inc           Pr
(Intercept)           1   2.9 37.400000 1.001601e-02
Variety               1   4.1  0.722200 4.424513e-01
Prop                  1   3.8  0.127700 7.398450e-01
Race                  2 446.8 27.890000 3.842820e-12
Variety:Prop          1   4.0  0.002818 9.602225e-01
Race:Trt             19 363.5  4.401000 6.113490e-09
Variety:Race          2 257.9  3.783000 2.403511e-02
Prop:Race             2 454.8  3.384000 3.476685e-02
Variety:Race:Trt     11 265.6  4.310000 6.305657e-06
Prop:Race:Trt         9 395.5  4.455000 1.405168e-05
Variety:Prop:Race     2 202.4  3.548000 3.058858e-02
Variety:Prop:Race:Trt 3 181.1  8.121000 4.193628e-05
```

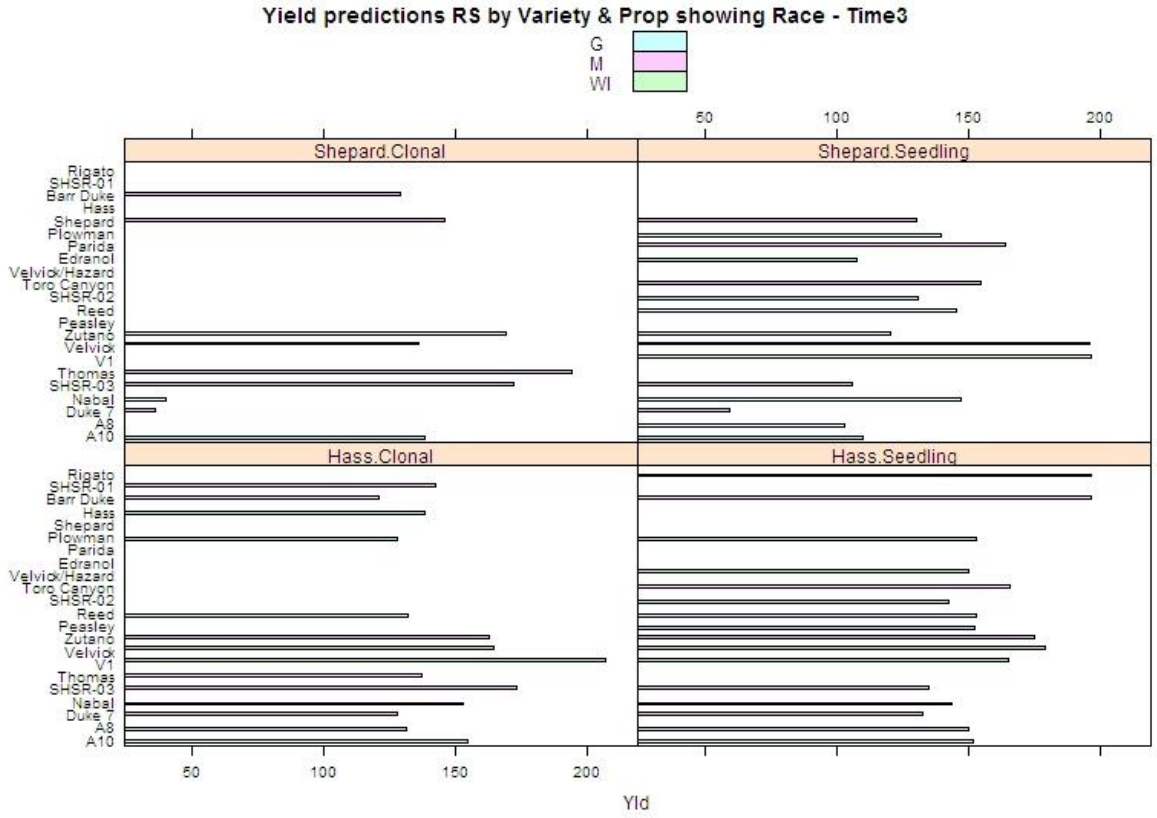
The Variety:Prop:Race:Trt interaction is significant for Time 3 so we should focus on these predicted means.

	Variety	Prop	Race	Trt	predicted.value	standard.error	est.status
1	Hass	Clonal	G	A10	154.85673	27.03544	Estimable
2	Hass	Clonal	G	A8	131.79926	27.23738	Estimable
3	Hass	Clonal	G	Duke 7	NA	NA	Aliased
4	Hass	Clonal	G	Nabal	153.29092	27.17795	Estimable
5	Hass	Clonal	G	SHSR-03	NA	NA	Aliased
6	Hass	Clonal	G	Thomas	NA	NA	Aliased
7	Hass	Clonal	G	V1	NA	NA	Aliased
8	Hass	Clonal	G	Velvick	NA	NA	Aliased
9	Hass	Clonal	G	Zutano	NA	NA	Aliased
10	Hass	Clonal	G	Peasley	NA	NA	Aliased
11	Hass	Clonal	G	Reed	132.19075	27.13719	Estimable
12	Hass	Clonal	G	SHSR-02	NA	NA	Aliased
13	Hass	Clonal	G	Toro Canyon	NA	NA	Aliased
14	Hass	Clonal	G	Velvick/Hazard	NA	NA	Aliased
15	Hass	Clonal	G	Edranol	NA	NA	Aliased
16	Hass	Clonal	G	Parida	NA	NA	Aliased
17	Hass	Clonal	G	Plowman	127.84669	28.24933	Estimable
18	Hass	Clonal	G	Shepard	NA	NA	Aliased
19	Hass	Clonal	G	Hass	138.35013	27.51323	Estimable
20	Hass	Clonal	G	Barr Duke	NA	NA	Aliased
21	Hass	Clonal	G	SHSR-01	NA	NA	Aliased
22	Hass	Clonal	G	Rigato	NA	NA	Aliased
23	Hass	Clonal	M	A10	NA	NA	Aliased
24	Hass	Clonal	M	A8	NA	NA	Aliased
25	Hass	Clonal	M	Duke 7	128.01022	26.93488	Estimable
26	Hass	Clonal	M	Nabal	NA	NA	Aliased
27	Hass	Clonal	M	SHSR-03	173.16176	27.31321	Estimable
28	Hass	Clonal	M	Thomas	137.35264	28.85075	Estimable
29	Hass	Clonal	M	V1	NA	NA	Aliased
30	Hass	Clonal	M	Velvick	NA	NA	Aliased
31	Hass	Clonal	M	Zutano	162.90038	27.01652	Estimable
32	Hass	Clonal	M	Peasley	NA	NA	Aliased
33	Hass	Clonal	M	Reed	NA	NA	Aliased
34	Hass	Clonal	M	SHSR-02	NA	NA	Aliased
35	Hass	Clonal	M	Toro Canyon	NA	NA	Aliased
36	Hass	Clonal	M	Velvick/Hazard	NA	NA	Aliased
37	Hass	Clonal	M	Edranol	NA	NA	Aliased
38	Hass	Clonal	M	Parida	NA	NA	Aliased
39	Hass	Clonal	M	Plowman	NA	NA	Aliased
40	Hass	Clonal	M	Shepard	NA	NA	Aliased
41	Hass	Clonal	M	Hass	NA	NA	Aliased
42	Hass	Clonal	M	Barr Duke	121.12861	29.48384	Estimable
43	Hass	Clonal	M	SHSR-01	142.47762	32.48473	Estimable
44	Hass	Clonal	M	Rigato	NA	NA	Aliased
45	Hass	Clonal	WI	A10	NA	NA	Aliased
46	Hass	Clonal	WI	A8	NA	NA	Aliased
47	Hass	Clonal	WI	Duke 7	NA	NA	Aliased
48	Hass	Clonal	WI	Nabal	NA	NA	Aliased
49	Hass	Clonal	WI	SHSR-03	NA	NA	Aliased
50	Hass	Clonal	WI	Thomas	NA	NA	Aliased
51	Hass	Clonal	WI	V1	207.43236	29.83137	Estimable
52	Hass	Clonal	WI	Velvick	164.41194	26.92279	Estimable
53	Hass	Clonal	WI	Zutano	NA	NA	Aliased
54	Hass	Clonal	WI	Peasley	NA	NA	Aliased
55	Hass	Clonal	WI	Reed	NA	NA	Aliased
56	Hass	Clonal	WI	SHSR-02	NA	NA	Aliased
57	Hass	Clonal	WI	Toro Canyon	NA	NA	Aliased
58	Hass	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
59	Hass	Clonal	WI	Edranol	NA	NA	Aliased
60	Hass	Clonal	WI	Parida	NA	NA	Aliased
61	Hass	Clonal	WI	Plowman	NA	NA	Aliased
62	Hass	Clonal	WI	Shepard	NA	NA	Aliased
63	Hass	Clonal	WI	Hass	NA	NA	Aliased
64	Hass	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Hass	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Hass	Clonal	WI	Rigato	NA	NA	Aliased
67	Hass	Seedling	G	A10	151.76458	27.45996	Estimable
68	Hass	Seedling	G	A8	149.95447	28.10223	Estimable
69	Hass	Seedling	G	Duke 7	NA	NA	Aliased
70	Hass	Seedling	G	Nabal	143.53002	27.31995	Estimable
71	Hass	Seedling	G	SHSR-03	NA	NA	Aliased
72	Hass	Seedling	G	Thomas	NA	NA	Aliased
73	Hass	Seedling	G	V1	NA	NA	Aliased
74	Hass	Seedling	G	Velvick	NA	NA	Aliased
75	Hass	Seedling	G	Zutano	NA	NA	Aliased
76	Hass	Seedling	G	Peasley	152.34655	34.75790	Estimable
77	Hass	Seedling	G	Reed	152.86949	28.20940	Estimable
78	Hass	Seedling	G	SHSR-02	142.71251	27.29678	Estimable
79	Hass	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Hass	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Hass	Seedling	G	Edranol	NA	NA	Aliased
82	Hass	Seedling	G	Parida	NA	NA	Aliased
83	Hass	Seedling	G	Plowman	152.72218	28.33333	Estimable
84	Hass	Seedling	G	Shepard	NA	NA	Aliased
85	Hass	Seedling	G	Hass	NA	NA	Aliased
86	Hass	Seedling	G	Barr Duke	NA	NA	Aliased
87	Hass	Seedling	G	SHSR-01	NA	NA	Aliased
88	Hass	Seedling	G	Rigato	196.40038	33.31812	Estimable
89	Hass	Seedling	M	A10	NA	NA	Aliased
90	Hass	Seedling	M	A8	NA	NA	Aliased
91	Hass	Seedling	M	Duke 7	132.78043	27.73317	Estimable
92	Hass	Seedling	M	Nabal	NA	NA	Aliased
93	Hass	Seedling	M	SHSR-03	134.64955	28.41352	Estimable
94	Hass	Seedling	M	Thomas	NA	NA	Aliased
95	Hass	Seedling	M	V1	NA	NA	Aliased
96	Hass	Seedling	M	Velvick	NA	NA	Aliased
97	Hass	Seedling	M	Zutano	175.17821	29.04166	Estimable
98	Hass	Seedling	M	Peasley	NA	NA	Aliased
99	Hass	Seedling	M	Reed	NA	NA	Aliased
100	Hass	Seedling	M	SHSR-02	NA	NA	Aliased
101	Hass	Seedling	M	Toro Canyon	166.00932	28.93531	Estimable
102	Hass	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Hass	Seedling	M	Edranol	NA	NA	Aliased

104	Hass	Seedling	M	Parida	NA	NA	Aliased
105	Hass	Seedling	M	Plowman	NA	NA	Aliased
106	Hass	Seedling	M	Shepard	NA	NA	Aliased
107	Hass	Seedling	M	Hass	NA	NA	Aliased
108	Hass	Seedling	M	Barr Duke	196.53176	33.37664	Estimable
109	Hass	Seedling	M	SHSR-01	NA	NA	Aliased
110	Hass	Seedling	M	Rigato	NA	NA	Aliased
111	Hass	Seedling	WI	A10	NA	NA	Aliased
112	Hass	Seedling	WI	A8	NA	NA	Aliased
113	Hass	Seedling	WI	Duke 7	NA	NA	Aliased
114	Hass	Seedling	WI	Nabal	NA	NA	Aliased
115	Hass	Seedling	WI	SHSR-03	NA	NA	Aliased
116	Hass	Seedling	WI	Thomas	NA	NA	Aliased
117	Hass	Seedling	WI	V1	165.46109	29.53060	Estimable
118	Hass	Seedling	WI	Velvick	178.96313	27.34237	Estimable
119	Hass	Seedling	WI	Zutano	NA	NA	Aliased
120	Hass	Seedling	WI	Peasley	NA	NA	Aliased
121	Hass	Seedling	WI	Reed	NA	NA	Aliased
122	Hass	Seedling	WI	SHSR-02	NA	NA	Aliased
123	Hass	Seedling	WI	Toro Canyon	NA	NA	Aliased
124	Hass	Seedling	WI	Velvick/Hazard	149.94160	28.57398	Estimable
125	Hass	Seedling	WI	Edranol	NA	NA	Aliased
126	Hass	Seedling	WI	Parida	NA	NA	Aliased
127	Hass	Seedling	WI	Plowman	NA	NA	Aliased
128	Hass	Seedling	WI	Shepard	NA	NA	Aliased
129	Hass	Seedling	WI	Hass	NA	NA	Aliased
130	Hass	Seedling	WI	Barr Duke	NA	NA	Aliased
131	Hass	Seedling	WI	SHSR-01	NA	NA	Aliased
132	Hass	Seedling	WI	Rigato	NA	NA	Aliased
133	Shepard	Clonal	G	A10	138.50630	39.62818	Estimable
134	Shepard	Clonal	G	A8	NA	NA	Aliased
135	Shepard	Clonal	G	Duke 7	NA	NA	Aliased
136	Shepard	Clonal	G	Nabal	39.88345	40.69550	Estimable
137	Shepard	Clonal	G	SHSR-03	NA	NA	Aliased
138	Shepard	Clonal	G	Thomas	NA	NA	Aliased
139	Shepard	Clonal	G	V1	NA	NA	Aliased
140	Shepard	Clonal	G	Velvick	NA	NA	Aliased
141	Shepard	Clonal	G	Zutano	NA	NA	Aliased
142	Shepard	Clonal	G	Peasley	NA	NA	Aliased
143	Shepard	Clonal	G	Reed	NA	NA	Aliased
144	Shepard	Clonal	G	SHSR-02	NA	NA	Aliased
145	Shepard	Clonal	G	Toro Canyon	NA	NA	Aliased
146	Shepard	Clonal	G	Velvick/Hazard	NA	NA	Aliased
147	Shepard	Clonal	G	Edranol	NA	NA	Aliased
148	Shepard	Clonal	G	Parida	NA	NA	Aliased
149	Shepard	Clonal	G	Plowman	NA	NA	Aliased
150	Shepard	Clonal	G	Shepard	NA	NA	Aliased
151	Shepard	Clonal	G	Hass	NA	NA	Aliased
152	Shepard	Clonal	G	Barr Duke	NA	NA	Aliased
153	Shepard	Clonal	G	SHSR-01	NA	NA	Aliased
154	Shepard	Clonal	G	Rigato	NA	NA	Aliased
155	Shepard	Clonal	M	A10	NA	NA	Aliased
156	Shepard	Clonal	M	A8	NA	NA	Aliased
157	Shepard	Clonal	M	Duke 7	36.31615	40.25359	Estimable
158	Shepard	Clonal	M	Nabal	NA	NA	Aliased
159	Shepard	Clonal	M	SHSR-03	172.49706	39.88992	Estimable
160	Shepard	Clonal	M	Thomas	194.20894	39.90777	Estimable
161	Shepard	Clonal	M	V1	NA	NA	Aliased
162	Shepard	Clonal	M	Velvick	NA	NA	Aliased
163	Shepard	Clonal	M	Zutano	169.42109	39.88592	Estimable
164	Shepard	Clonal	M	Peasley	NA	NA	Aliased
165	Shepard	Clonal	M	Reed	NA	NA	Aliased
166	Shepard	Clonal	M	SHSR-02	NA	NA	Aliased
167	Shepard	Clonal	M	Toro Canyon	NA	NA	Aliased
168	Shepard	Clonal	M	Velvick/Hazard	NA	NA	Aliased
169	Shepard	Clonal	M	Edranol	NA	NA	Aliased
170	Shepard	Clonal	M	Parida	NA	NA	Aliased
171	Shepard	Clonal	M	Plowman	NA	NA	Aliased
172	Shepard	Clonal	M	Shepard	146.02574	39.60436	Estimable
173	Shepard	Clonal	M	Hass	NA	NA	Aliased
174	Shepard	Clonal	M	Barr Duke	129.27791	39.68776	Estimable
175	Shepard	Clonal	M	SHSR-01	NA	NA	Aliased
176	Shepard	Clonal	M	Rigato	NA	NA	Aliased
177	Shepard	Clonal	WI	A10	NA	NA	Aliased
178	Shepard	Clonal	WI	A8	NA	NA	Aliased
179	Shepard	Clonal	WI	Duke 7	NA	NA	Aliased
180	Shepard	Clonal	WI	Nabal	NA	NA	Aliased
181	Shepard	Clonal	WI	SHSR-03	NA	NA	Aliased
182	Shepard	Clonal	WI	Thomas	NA	NA	Aliased
183	Shepard	Clonal	WI	V1	NA	NA	Aliased
184	Shepard	Clonal	WI	Velvick	136.47092	39.89370	Estimable
185	Shepard	Clonal	WI	Zutano	NA	NA	Aliased
186	Shepard	Clonal	WI	Peasley	NA	NA	Aliased
187	Shepard	Clonal	WI	Reed	NA	NA	Aliased
188	Shepard	Clonal	WI	SHSR-02	NA	NA	Aliased
189	Shepard	Clonal	WI	Toro Canyon	NA	NA	Aliased
190	Shepard	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
191	Shepard	Clonal	WI	Edranol	NA	NA	Aliased
192	Shepard	Clonal	WI	Parida	NA	NA	Aliased
193	Shepard	Clonal	WI	Plowman	NA	NA	Aliased
194	Shepard	Clonal	WI	Shepard	NA	NA	Aliased
195	Shepard	Clonal	WI	Hass	NA	NA	Aliased
196	Shepard	Clonal	WI	Barr Duke	NA	NA	Aliased
197	Shepard	Clonal	WI	SHSR-01	NA	NA	Aliased
198	Shepard	Clonal	WI	Rigato	NA	NA	Aliased
199	Shepard	Seedling	G	A10	109.85209	32.23129	Estimable
200	Shepard	Seedling	G	A8	103.02477	42.11224	Estimable
201	Shepard	Seedling	G	Duke 7	NA	NA	Aliased
202	Shepard	Seedling	G	Nabal	146.98189	32.22797	Estimable
203	Shepard	Seedling	G	SHSR-03	NA	NA	Aliased
204	Shepard	Seedling	G	Thomas	NA	NA	Aliased
205	Shepard	Seedling	G	V1	NA	NA	Aliased
206	Shepard	Seedling	G	Velvick	NA	NA	Aliased
207	Shepard	Seedling	G	Zutano	NA	NA	Aliased
208	Shepard	Seedling	G	Peasley	NA	NA	Aliased
209	Shepard	Seedling	G	Reed	145.53778	32.31545	Estimable
210	Shepard	Seedling	G	SHSR-02	130.66217	32.16380	Estimable
211	Shepard	Seedling	G	Toro Canyon	NA	NA	Aliased
212	Shepard	Seedling	G	Velvick/Hazard	NA	NA	Aliased
213	Shepard	Seedling	G	Edranol	107.48861	32.84015	Estimable
214	Shepard	Seedling	G	Parida	NA	NA	Aliased
215	Shepard	Seedling	G	Plowman	139.61598	32.82478	Estimable
216	Shepard	Seedling	G	Shepard	NA	NA	Aliased
217	Shepard	Seedling	G	Hass	NA	NA	Aliased
218	Shepard	Seedling	G	Barr Duke	NA	NA	Aliased
219	Shepard	Seedling	G	SHSR-01	NA	NA	Aliased

220	Shepard	Seedling	G	Rigato	NA	NA	Aliased
221	Shepard	Seedling	M	A10	NA	NA	Aliased
222	Shepard	Seedling	M	A8	NA	NA	Aliased
223	Shepard	Seedling	M	Duke 7	59.04904	40.80343	Estimable
224	Shepard	Seedling	M	Nabal	NA	NA	Aliased
225	Shepard	Seedling	M	SHSR-03	105.85590	40.75875	Estimable
226	Shepard	Seedling	M	Thomas	NA	NA	Aliased
227	Shepard	Seedling	M	V1	NA	NA	Aliased
228	Shepard	Seedling	M	Velvick	NA	NA	Aliased
229	Shepard	Seedling	M	Zutano	120.15828	42.13286	Estimable
230	Shepard	Seedling	M	Peasley	NA	NA	Aliased
231	Shepard	Seedling	M	Reed	NA	NA	Aliased
232	Shepard	Seedling	M	SHSR-02	NA	NA	Aliased
233	Shepard	Seedling	M	Toro Canyon	154.43268	32.93833	Estimable
234	Shepard	Seedling	M	Velvick/Hazard	NA	NA	Aliased
235	Shepard	Seedling	M	Edranol	NA	NA	Aliased
236	Shepard	Seedling	M	Parida	164.08718	33.07648	Estimable
237	Shepard	Seedling	M	Plowman	NA	NA	Aliased
238	Shepard	Seedling	M	Shepard	130.25404	33.08535	Estimable
239	Shepard	Seedling	M	Hass	NA	NA	Aliased
240	Shepard	Seedling	M	Barr Duke	NA	NA	Aliased
241	Shepard	Seedling	M	SHSR-01	NA	NA	Aliased
242	Shepard	Seedling	M	Rigato	NA	NA	Aliased
243	Shepard	Seedling	WI	A10	NA	NA	Aliased
244	Shepard	Seedling	WI	A8	NA	NA	Aliased
245	Shepard	Seedling	WI	Duke 7	NA	NA	Aliased
246	Shepard	Seedling	WI	Nabal	NA	NA	Aliased
247	Shepard	Seedling	WI	SHSR-03	NA	NA	Aliased
248	Shepard	Seedling	WI	Thomas	NA	NA	Aliased
249	Shepard	Seedling	WI	V1	196.88506	40.74003	Estimable
250	Shepard	Seedling	WI	Velvick	195.85209	32.12918	Estimable
251	Shepard	Seedling	WI	Zutano	NA	NA	Aliased
252	Shepard	Seedling	WI	Peasley	NA	NA	Aliased
253	Shepard	Seedling	WI	Reed	NA	NA	Aliased
254	Shepard	Seedling	WI	SHSR-02	NA	NA	Aliased
255	Shepard	Seedling	WI	Toro Canyon	NA	NA	Aliased
256	Shepard	Seedling	WI	Velvick/Hazard	NA	NA	Aliased
257	Shepard	Seedling	WI	Edranol	NA	NA	Aliased
258	Shepard	Seedling	WI	Parida	NA	NA	Aliased
259	Shepard	Seedling	WI	Plowman	NA	NA	Aliased
260	Shepard	Seedling	WI	Shepard	NA	NA	Aliased
261	Shepard	Seedling	WI	Hass	NA	NA	Aliased
262	Shepard	Seedling	WI	Barr Duke	NA	NA	Aliased
263	Shepard	Seedling	WI	SHSR-01	NA	NA	Aliased
264	Shepard	Seedling	WI	Rigato	NA	NA	Aliased

```
$avsed
 overall
31.01003
```



The Variety and Propagation main effects were not significant.

	Variety	predicted.value	standard.error	est.status
1	Hass	153.9008	24.60887	Estimable
2	Shepard	132.1810	28.97710	Estimable

```
$avsed
```

```
 overall
20.23307
```

```
      Prop predicted.value standard.error est.status
1   Clonal        140.7747       26.75638  Estimable
2 Seedling        146.8243       25.73456  Estimable

$avsed
 overall
17.69535
```

The Race main effect was significant with WI RS having higher yield than Mexican or Guatemalan RS.

```
  Race predicted.value standard.error est.status
1    G        136.6169       24.58111  Estimable
2    M        141.3811       25.36485  Estimable
3   WI        174.4273       24.91137  Estimable

$avsed
 overall
6.919957
```

```
  Variety Race predicted.value standard.error est.status
1    Hass    G        148.6168       24.73651  Estimable
2    Hass    M        151.8346       24.81362  Estimable
3    Hass   WI        173.2420       25.09665  Estimable
4 Shepard    G        117.9503       29.20434  Estimable
5 Shepard    M        131.7987       29.94243  Estimable
6 Shepard   WI        176.4027       30.63481  Estimable

$avsed
 overall
18.09332
```

It can be seen that within Shepard Scion the WI RS have significantly higher yield than M or G RS. Within Hass Scion the WI, M & G RS are more similar.

```
      Prop Race predicted.value standard.error est.status
1   Clonal    G        127.0905       26.05171  Estimable
2   Clonal    M        142.7315       28.05691  Estimable
3   Clonal   WI        169.4384       27.14728  Estimable
4 Seedling    G        141.6976       25.80396  Estimable
5 Seedling    M        139.9078       26.42764  Estimable
6 Seedling   WI        177.4206       26.24154  Estimable

$avsed
 overall
15.65387
```

It can be seen that within the seedling RS the WI RS have higher yield than M or G. The different races are similar between seedling and clonal.

The Variety:Prop:Race:Trt interaction is significant so some Trt are likely to be doing different things than what we can see in these one and 2 way tables.

Fruit Size

Time 1

	Df	denDF	F.inc	Pr
(Intercept)	1	2.8	222.90000	0.0009959950
Variety	1	4.3	1.99700	0.2264984500
Prop	1	3.6	0.08288	0.7891230087
Race	2	435.0	6.40200	0.0018184315
Variety:Prop	1	4.0	1.17700	0.3390106066
Race:Trt	19	445.0	2.98800	0.0000283159
Variety:Race	2	216.5	5.22100	0.0061004661
Prop:Race	2	586.7	8.30400	0.0002778955
Variety:Race:Trt	11	243.7	1.75000	0.0636119108
Prop:Race:Trt	9	493.3	2.75000	0.0038183310
Variety:Prop:Race	2	152.2	0.08411	0.9193726069
Variety:Prop:Race:Trt	3	168.5	1.74700	0.1593013549

There is a significant Prop:Race:Trt interaction and Variety:Race interaction. These interactions should be focussed on.

	Prop	Race	Trt	predicted.value	standard.error	est.status
1	Clonal	G	A10	217.4517	22.53369	Estimable
2	Clonal	G	A8	207.3998	18.52834	Estimable
3	Clonal	G	Duke 7	NA	NA	Aliased
4	Clonal	G	Nabal	171.6990	23.44667	Estimable
5	Clonal	G	SHSR-03	NA	NA	Aliased
6	Clonal	G	Thomas	NA	NA	Aliased
7	Clonal	G	V1	NA	NA	Aliased
8	Clonal	G	Velvick	NA	NA	Aliased
9	Clonal	G	Zutano	NA	NA	Aliased
10	Clonal	G	Peasley	NA	NA	Aliased
11	Clonal	G	Reed	200.3761	18.65578	Estimable
12	Clonal	G	SHSR-02	NA	NA	Aliased
13	Clonal	G	Toro Canyon	NA	NA	Aliased
14	Clonal	G	Velvick/Hazard	NA	NA	Aliased
15	Clonal	G	Edranol	NA	NA	Aliased
16	Clonal	G	Parida	NA	NA	Aliased
17	Clonal	G	Plowman	228.0736	19.68229	Estimable
18	Clonal	G	Shepard	NA	NA	Aliased
19	Clonal	G	Hass	199.8201	18.92881	Estimable
20	Clonal	G	Barr Duke	NA	NA	Aliased
21	Clonal	G	SHSR-01	NA	NA	Aliased
22	Clonal	G	Rigato	NA	NA	Aliased
23	Clonal	M	A10	NA	NA	Aliased
24	Clonal	M	A8	NA	NA	Aliased
25	Clonal	M	Duke 7	221.8976	22.93765	Estimable
26	Clonal	M	Nabal	NA	NA	Aliased
27	Clonal	M	SHSR-03	260.6493	23.04726	Estimable
28	Clonal	M	Thomas	231.0821	23.32673	Estimable
29	Clonal	M	V1	NA	NA	Aliased
30	Clonal	M	Velvick	NA	NA	Aliased
31	Clonal	M	Zutano	207.8395	22.92211	Estimable
32	Clonal	M	Peasley	NA	NA	Aliased
33	Clonal	M	Reed	NA	NA	Aliased
34	Clonal	M	SHSR-02	NA	NA	Aliased
35	Clonal	M	Toro Canyon	NA	NA	Aliased
36	Clonal	M	Velvick/Hazard	NA	NA	Aliased
37	Clonal	M	Edranol	NA	NA	Aliased
38	Clonal	M	Parida	NA	NA	Aliased

39	Clonal	M	Plowman	NA	NA	Aliased
40	Clonal	M	Shepard	242.9883	36.56132	Estimable
41	Clonal	M	Hass	NA	NA	Aliased
42	Clonal	M	Barr Duke	236.4187	23.33199	Estimable
43	Clonal	M	SHSR-01	281.9417	30.66215	Estimable
44	Clonal	M	Rigato	NA	NA	Aliased
45	Clonal	WI	A10	NA	NA	Aliased
46	Clonal	WI	A8	NA	NA	Aliased
47	Clonal	WI	Duke 7	NA	NA	Aliased
48	Clonal	WI	Nabal	NA	NA	Aliased
49	Clonal	WI	SHSR-03	NA	NA	Aliased
50	Clonal	WI	Thomas	NA	NA	Aliased
51	Clonal	WI	V1	257.9696	25.62890	Estimable
52	Clonal	WI	Velvick	238.9841	22.53458	Estimable
53	Clonal	WI	Zutano	NA	NA	Aliased
54	Clonal	WI	Peasley	NA	NA	Aliased
55	Clonal	WI	Reed	NA	NA	Aliased
56	Clonal	WI	SHSR-02	NA	NA	Aliased
57	Clonal	WI	Toro Canyon	NA	NA	Aliased
58	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
59	Clonal	WI	Edranol	NA	NA	Aliased
60	Clonal	WI	Parida	NA	NA	Aliased
61	Clonal	WI	Plowman	NA	NA	Aliased
62	Clonal	WI	Shepard	NA	NA	Aliased
63	Clonal	WI	Hass	NA	NA	Aliased
64	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Clonal	WI	Rigato	NA	NA	Aliased
67	Seedling	G	A10	242.0484	18.58897	Estimable
68	Seedling	G	A8	222.8383	20.35872	Estimable
69	Seedling	G	Duke 7	NA	NA	Aliased
70	Seedling	G	Nabal	217.8733	18.45941	Estimable
71	Seedling	G	SHSR-03	NA	NA	Aliased
72	Seedling	G	Thomas	NA	NA	Aliased
73	Seedling	G	V1	NA	NA	Aliased
74	Seedling	G	Velvick	NA	NA	Aliased
75	Seedling	G	Zutano	NA	NA	Aliased
76	Seedling	G	Peasley	206.9151	23.12690	Estimable
77	Seedling	G	Reed	224.9040	18.87836	Estimable
78	Seedling	G	SHSR-02	228.2459	18.51023	Estimable
79	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Seedling	G	Edranol	263.7998	32.27753	Estimable
82	Seedling	G	Parida	NA	NA	Aliased
83	Seedling	G	Plowman	215.8759	21.65783	Estimable
84	Seedling	G	Shepard	NA	NA	Aliased
85	Seedling	G	Hass	NA	NA	Aliased
86	Seedling	G	Barr Duke	NA	NA	Aliased
87	Seedling	G	SHSR-01	NA	NA	Aliased
88	Seedling	G	Rigato	232.6206	28.12654	Estimable
89	Seedling	M	A10	NA	NA	Aliased
90	Seedling	M	A8	NA	NA	Aliased
91	Seedling	M	Duke 7	200.4083	19.93144	Estimable
92	Seedling	M	Nabal	NA	NA	Aliased
93	Seedling	M	SHSR-03	250.2589	20.19301	Estimable
94	Seedling	M	Thomas	NA	NA	Aliased
95	Seedling	M	V1	NA	NA	Aliased
96	Seedling	M	Velvick	NA	NA	Aliased
97	Seedling	M	Zutano	234.6399	20.19569	Estimable
98	Seedling	M	Peasley	NA	NA	Aliased
99	Seedling	M	Reed	NA	NA	Aliased
100	Seedling	M	SHSR-02	NA	NA	Aliased
101	Seedling	M	Toro Canyon	235.6949	22.18357	Estimable
102	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Seedling	M	Edranol	NA	NA	Aliased
104	Seedling	M	Parida	292.4952	36.05840	Estimable
105	Seedling	M	Plowman	NA	NA	Aliased
106	Seedling	M	Shepard	247.6817	32.13885	Estimable
107	Seedling	M	Hass	NA	NA	Aliased

```
108 Seedling    M      Barr Duke        241.9212       28.16986  Estimable
109 Seedling    M        SHSR-01              NA             NA    Aliased
110 Seedling    M         Rigato              NA             NA    Aliased
111 Seedling   WI            A10              NA             NA    Aliased
112 Seedling   WI             A8              NA             NA    Aliased
113 Seedling   WI         Duke 7              NA             NA    Aliased
114 Seedling   WI          Nabal              NA             NA    Aliased
115 Seedling   WI        SHSR-03              NA             NA    Aliased
116 Seedling   WI         Thomas              NA             NA    Aliased
117 Seedling   WI             V1        231.7180       20.05980  Estimable
118 Seedling   WI        Velvick        252.9902       18.45838  Estimable
119 Seedling   WI         Zutano              NA             NA    Aliased
120 Seedling   WI        Peasley              NA             NA    Aliased
121 Seedling   WI           Reed              NA             NA    Aliased
122 Seedling   WI        SHSR-02              NA             NA    Aliased
123 Seedling   WI    Toro Canyon              NA             NA    Aliased
124 Seedling   WI Velvick/Hazard        172.3061       20.75879  Estimable
125 Seedling   WI        Edranol              NA             NA    Aliased
126 Seedling   WI         Parida              NA             NA    Aliased
127 Seedling   WI        Plowman              NA             NA    Aliased
128 Seedling   WI        Shepard              NA             NA    Aliased
129 Seedling   WI           Hass              NA             NA    Aliased
130 Seedling   WI      Barr Duke              NA             NA    Aliased
131 Seedling   WI        SHSR-01              NA             NA    Aliased
132 Seedling   WI         Rigato              NA             NA    Aliased

$avsed
overall
26.0358
```

The Variety:Race predictions are as follows:

```
  Variety Race predicted.value standard.error est.status
1    Hass    G        215.4733       15.54877  Estimable
2    Hass    M        222.8707       15.82343  Estimable
3    Hass   WI        219.9921       16.34623  Estimable
4 Shepard    G        222.6947       20.45648  Estimable
5 Shepard    M        251.1024       20.99982  Estimable
6 Shepard   WI        259.2332       22.51198  Estimable

$avsed
 overall
15.90989
```

Hence WI RS under Shepard Scion have significantly larger Fruit size than all Races under Hass Scion.

The Variety and Propagation main effects were not significant.

```
  Variety predicted.value standard.error est.status
1    Hass        218.9388       15.38213  Estimable
2 Shepard        241.4659       19.77716  Estimable

$avsed
 overall
16.29248
```

```
      Prop predicted.value standard.error est.status
1   Clonal        225.6788       17.64712  Estimable
2 Seedling        231.3784       16.59273  Estimable
```

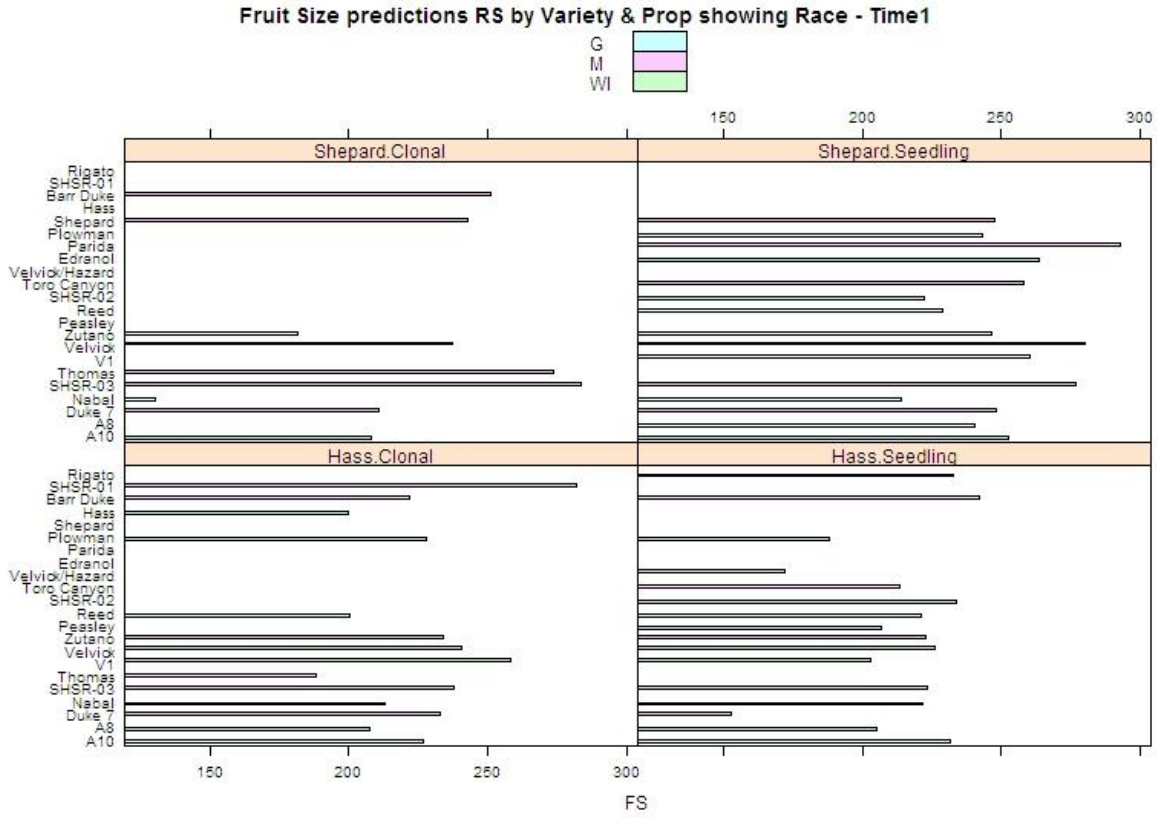
```
$avsed
 overall
14.43504
```

The Race main effect was significant with Mexican and West Indian RS having higher fruit size than Guatemalan RS.

```
  Race predicted.value standard.error est.status
1    G        218.2990       15.49236  Estimable
2    M        237.6003       16.36611  Estimable
3   WI        234.7075       16.13369  Estimable

$avsed
 overall
7.151077
```

The Prop:Race interaction was significant showing within the clonal RS WI and M RS had significantly higher fruit size than G RS. For G RS the clonal RS were significantly lower in fruit size than the seedling G RS.

```
      Prop Race predicted.value standard.error est.status
1   Clonal    G        201.7464       17.33222  Estimable
2   Clonal    M        236.7254       19.22495  Estimable
3   Clonal   WI        245.3126       20.00897  Estimable
4 Seedling    G        227.1271       16.75313  Estimable
5 Seedling    M        238.5547       17.62000  Estimable
6 Seedling   WI        228.3445       17.23801  Estimable

$avsed
overall
14.4048
```



Time 2

```
$Wald
                          Df denDF    F.inc            Pr
(Intercept)                1   3.0 116.9000 0.0017175562
Variety                    1   3.5  53.2800 0.0031426420
Prop                       1   3.4   3.3460 0.1544052419
Race                       2 358.3   8.0260 0.0003890251
Variety:Prop               1   3.9   0.3254 0.5993267852
Race:Trt                  19 407.4   2.4690 0.0006184435
Variety:Race               2 215.8   0.9849 0.3751546961
Prop:Race                  2 498.2   2.7690 0.0636606561
Variety:Race:Trt          11 260.2   1.8780 0.0424485469
Prop:Race:Trt              9 520.4   3.0980 0.0012274366
Variety:Prop:Race          2 253.3   3.5230 0.0309551598
Variety:Prop:Race:Trt      3 234.3   4.3310 0.0053985556
```

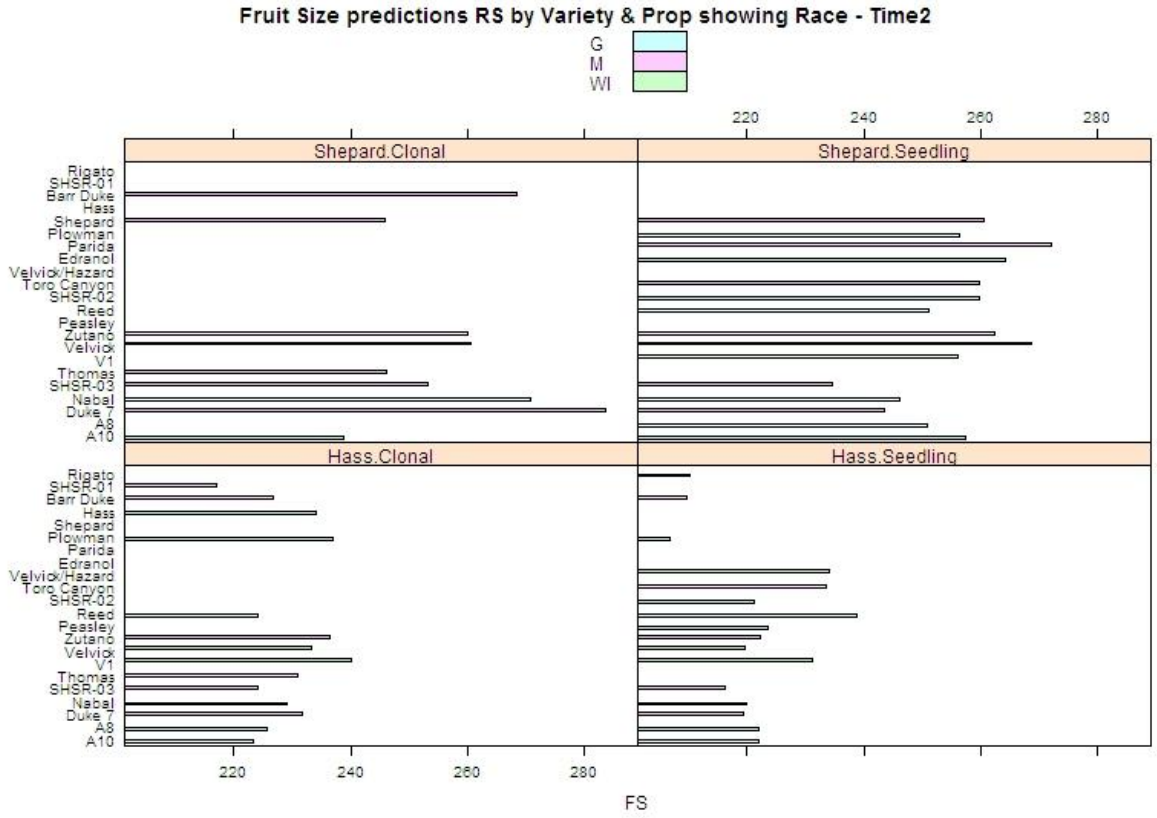
At time 2 there was a significant Variety:Prop:Race:Trt so focus should be on these predicted means.

```
      Variety     Prop Race           Trt predicted.value standard.error est.status
1      Hass   Clonal    G           A10        223.4625       21.75491  Estimable
2      Hass   Clonal    G            A8        225.6244       21.77294  Estimable
3      Hass   Clonal    G        Duke 7              NA             NA    Aliased
4      Hass   Clonal    G         Nabal        229.1417       21.77680  Estimable
5      Hass   Clonal    G       SHSR-03              NA             NA    Aliased
6      Hass   Clonal    G        Thomas              NA             NA    Aliased
7      Hass   Clonal    G            V1              NA             NA    Aliased
8      Hass   Clonal    G       Velvick              NA             NA    Aliased
9      Hass   Clonal    G        Zutano              NA             NA    Aliased
10     Hass   Clonal    G       Peasley              NA             NA    Aliased
11     Hass   Clonal    G          Reed        224.1863       22.16866  Estimable
12     Hass   Clonal    G       SHSR-02              NA             NA    Aliased
13     Hass   Clonal    G   Toro Canyon              NA             NA    Aliased
14     Hass   Clonal    G Velvick/Hazard              NA             NA    Aliased
15     Hass   Clonal    G       Edranol              NA             NA    Aliased
16     Hass   Clonal    G        Parida              NA             NA    Aliased
17     Hass   Clonal    G       Plowman        237.0630       22.47530  Estimable
18     Hass   Clonal    G       Shepard              NA             NA    Aliased
19     Hass   Clonal    G          Hass        234.1535       22.26236  Estimable
20     Hass   Clonal    G     Barr Duke              NA             NA    Aliased
21     Hass   Clonal    G       SHSR-01              NA             NA    Aliased
```

22	Hass	Clonal	G	Rigato	NA	NA	Aliased
23	Hass	Clonal	M	A10	NA	NA	Aliased
24	Hass	Clonal	M	A8	NA	NA	Aliased
25	Hass	Clonal	M	Duke 7	231.8146	21.77532	Estimable
26	Hass	Clonal	M	Nabal	NA	NA	Aliased
27	Hass	Clonal	M	SHSR-03	224.1466	21.79989	Estimable
28	Hass	Clonal	M	Thomas	230.8497	21.86944	Estimable
29	Hass	Clonal	M	V1	NA	NA	Aliased
30	Hass	Clonal	M	Velvick	NA	NA	Aliased
31	Hass	Clonal	M	Zutano	236.4960	21.74971	Estimable
32	Hass	Clonal	M	Peasley	NA	NA	Aliased
33	Hass	Clonal	M	Reed	NA	NA	Aliased
34	Hass	Clonal	M	SHSR-02	NA	NA	Aliased
35	Hass	Clonal	M	Toro Canyon	NA	NA	Aliased
36	Hass	Clonal	M	Velvick/Hazard	NA	NA	Aliased
37	Hass	Clonal	M	Edranol	NA	NA	Aliased
38	Hass	Clonal	M	Parida	NA	NA	Aliased
39	Hass	Clonal	M	Plowman	NA	NA	Aliased
40	Hass	Clonal	M	Shepard	NA	NA	Aliased
41	Hass	Clonal	M	Hass	NA	NA	Aliased
42	Hass	Clonal	M	Barr Duke	226.8780	23.42679	Estimable
43	Hass	Clonal	M	SHSR-01	217.1360	27.22216	Estimable
44	Hass	Clonal	M	Rigato	NA	NA	Aliased
45	Hass	Clonal	WI	A10	NA	NA	Aliased
46	Hass	Clonal	WI	A8	NA	NA	Aliased
47	Hass	Clonal	WI	Duke 7	NA	NA	Aliased
48	Hass	Clonal	WI	Nabal	NA	NA	Aliased
49	Hass	Clonal	WI	SHSR-03	NA	NA	Aliased
50	Hass	Clonal	WI	Thomas	NA	NA	Aliased
51	Hass	Clonal	WI	V1	240.2136	21.88639	Estimable
52	Hass	Clonal	WI	Velvick	233.3201	21.75970	Estimable
53	Hass	Clonal	WI	Zutano	NA	NA	Aliased
54	Hass	Clonal	WI	Peasley	NA	NA	Aliased
55	Hass	Clonal	WI	Reed	NA	NA	Aliased
56	Hass	Clonal	WI	SHSR-02	NA	NA	Aliased
57	Hass	Clonal	WI	Toro Canyon	NA	NA	Aliased
58	Hass	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
59	Hass	Clonal	WI	Edranol	NA	NA	Aliased
60	Hass	Clonal	WI	Parida	NA	NA	Aliased
61	Hass	Clonal	WI	Plowman	NA	NA	Aliased
62	Hass	Clonal	WI	Shepard	NA	NA	Aliased
63	Hass	Clonal	WI	Hass	NA	NA	Aliased
64	Hass	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Hass	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Hass	Clonal	WI	Rigato	NA	NA	Aliased
67	Hass	Seedling	G	A10	221.9428	21.92813	Estimable
68	Hass	Seedling	G	A8	222.0896	21.96991	Estimable
69	Hass	Seedling	G	Duke 7	NA	NA	Aliased
70	Hass	Seedling	G	Nabal	219.9051	21.92751	Estimable
71	Hass	Seedling	G	SHSR-03	NA	NA	Aliased
72	Hass	Seedling	G	Thomas	NA	NA	Aliased
73	Hass	Seedling	G	V1	NA	NA	Aliased
74	Hass	Seedling	G	Velvick	NA	NA	Aliased
75	Hass	Seedling	G	Zutano	NA	NA	Aliased
76	Hass	Seedling	G	Peasley	223.5662	22.24354	Estimable
77	Hass	Seedling	G	Reed	238.7284	22.04226	Estimable
78	Hass	Seedling	G	SHSR-02	221.2787	21.91113	Estimable
79	Hass	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Hass	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Hass	Seedling	G	Edranol	NA	NA	Aliased
82	Hass	Seedling	G	Parida	NA	NA	Aliased
83	Hass	Seedling	G	Plowman	206.6785	23.42534	Estimable
84	Hass	Seedling	G	Shepard	NA	NA	Aliased
85	Hass	Seedling	G	Hass	NA	NA	Aliased
86	Hass	Seedling	G	Barr Duke	NA	NA	Aliased
87	Hass	Seedling	G	SHSR-01	NA	NA	Aliased
88	Hass	Seedling	G	Rigato	210.2458	23.29396	Estimable
89	Hass	Seedling	M	A10	NA	NA	Aliased
90	Hass	Seedling	M	A8	NA	NA	Aliased
91	Hass	Seedling	M	Duke 7	219.4430	22.52365	Estimable
92	Hass	Seedling	M	Nabal	NA	NA	Aliased
93	Hass	Seedling	M	SHSR-03	216.1536	22.10702	Estimable
94	Hass	Seedling	M	Thomas	NA	NA	Aliased
95	Hass	Seedling	M	V1	NA	NA	Aliased
96	Hass	Seedling	M	Velvick	NA	NA	Aliased
97	Hass	Seedling	M	Zutano	222.3800	22.68158	Estimable
98	Hass	Seedling	M	Peasley	NA	NA	Aliased
99	Hass	Seedling	M	Reed	NA	NA	Aliased
100	Hass	Seedling	M	SHSR-02	NA	NA	Aliased
101	Hass	Seedling	M	Toro Canyon	233.4522	22.24764	Estimable
102	Hass	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Hass	Seedling	M	Edranol	NA	NA	Aliased
104	Hass	Seedling	M	Parida	NA	NA	Aliased
105	Hass	Seedling	M	Plowman	NA	NA	Aliased
106	Hass	Seedling	M	Shepard	NA	NA	Aliased
107	Hass	Seedling	M	Hass	NA	NA	Aliased
108	Hass	Seedling	M	Barr Duke	209.5789	23.32322	Estimable
109	Hass	Seedling	M	SHSR-01	NA	NA	Aliased
110	Hass	Seedling	M	Rigato	NA	NA	Aliased
111	Hass	Seedling	WI	A10	NA	NA	Aliased
112	Hass	Seedling	WI	A8	NA	NA	Aliased
113	Hass	Seedling	WI	Duke 7	NA	NA	Aliased
114	Hass	Seedling	WI	Nabal	NA	NA	Aliased
115	Hass	Seedling	WI	SHSR-03	NA	NA	Aliased
116	Hass	Seedling	WI	Thomas	NA	NA	Aliased
117	Hass	Seedling	WI	V1	231.1263	22.16731	Estimable
118	Hass	Seedling	WI	Velvick	219.5402	21.91632	Estimable
119	Hass	Seedling	WI	Zutano	NA	NA	Aliased
120	Hass	Seedling	WI	Peasley	NA	NA	Aliased
121	Hass	Seedling	WI	Reed	NA	NA	Aliased
122	Hass	Seedling	WI	SHSR-02	NA	NA	Aliased
123	Hass	Seedling	WI	Toro Canyon	NA	NA	Aliased
124	Hass	Seedling	WI	Velvick/Hazard	234.1154	22.12096	Estimable
125	Hass	Seedling	WI	Edranol	NA	NA	Aliased
126	Hass	Seedling	WI	Parida	NA	NA	Aliased
127	Hass	Seedling	WI	Plowman	NA	NA	Aliased
128	Hass	Seedling	WI	Shepard	NA	NA	Aliased
129	Hass	Seedling	WI	Hass	NA	NA	Aliased
130	Hass	Seedling	WI	Barr Duke	NA	NA	Aliased
131	Hass	Seedling	WI	SHSR-01	NA	NA	Aliased
132	Hass	Seedling	WI	Rigato	NA	NA	Aliased
133	Shepard	Clonal	G	A10	238.9250	22.97458	Estimable
134	Shepard	Clonal	G	A8	NA	NA	Aliased
135	Shepard	Clonal	G	Duke 7	NA	NA	Aliased
136	Shepard	Clonal	G	Nabal	270.8814	23.25654	Estimable
137	Shepard	Clonal	G	SHSR-03	NA	NA	Aliased

138	Shepard	Clonal	G	Thomas	NA	NA	Aliased
139	Shepard	Clonal	G	V1	NA	NA	Aliased
140	Shepard	Clonal	G	Velvick	NA	NA	Aliased
141	Shepard	Clonal	G	Zutano	NA	NA	Aliased
142	Shepard	Clonal	G	Peasley	NA	NA	Aliased
143	Shepard	Clonal	G	Reed	NA	NA	Aliased
144	Shepard	Clonal	G	SHSR-02	NA	NA	Aliased
145	Shepard	Clonal	G	Toro Canyon	NA	NA	Aliased
146	Shepard	Clonal	G	Velvick/Hazard	NA	NA	Aliased
147	Shepard	Clonal	G	Edranol	NA	NA	Aliased
148	Shepard	Clonal	G	Parida	NA	NA	Aliased
149	Shepard	Clonal	G	Plowman	NA	NA	Aliased
150	Shepard	Clonal	G	Shepard	NA	NA	Aliased
151	Shepard	Clonal	G	Hass	NA	NA	Aliased
152	Shepard	Clonal	G	Barr Duke	NA	NA	Aliased
153	Shepard	Clonal	G	SHSR-01	NA	NA	Aliased
154	Shepard	Clonal	G	Rigato	NA	NA	Aliased
155	Shepard	Clonal	M	A10	NA	NA	Aliased
156	Shepard	Clonal	M	A8	NA	NA	Aliased
157	Shepard	Clonal	M	Duke 7	283.7311	23.14406	Estimable
158	Shepard	Clonal	M	Nabal	NA	NA	Aliased
159	Shepard	Clonal	M	SHSR-03	253.1220	23.04824	Estimable
160	Shepard	Clonal	M	Thomas	246.2241	23.04388	Estimable
161	Shepard	Clonal	M	V1	NA	NA	Aliased
162	Shepard	Clonal	M	Velvick	NA	NA	Aliased
163	Shepard	Clonal	M	Zutano	260.0717	23.04248	Estimable
164	Shepard	Clonal	M	Peasley	NA	NA	Aliased
165	Shepard	Clonal	M	Reed	NA	NA	Aliased
166	Shepard	Clonal	M	SHSR-02	NA	NA	Aliased
167	Shepard	Clonal	M	Toro Canyon	NA	NA	Aliased
168	Shepard	Clonal	M	Velvick/Hazard	NA	NA	Aliased
169	Shepard	Clonal	M	Edranol	NA	NA	Aliased
170	Shepard	Clonal	M	Parida	NA	NA	Aliased
171	Shepard	Clonal	M	Plowman	NA	NA	Aliased
172	Shepard	Clonal	M	Shepard	245.7532	22.96893	Estimable
173	Shepard	Clonal	M	Hass	NA	NA	Aliased
174	Shepard	Clonal	M	Barr Duke	268.4736	23.01377	Estimable
175	Shepard	Clonal	M	SHSR-01	NA	NA	Aliased
176	Shepard	Clonal	M	Rigato	NA	NA	Aliased
177	Shepard	Clonal	WI	A10	NA	NA	Aliased
178	Shepard	Clonal	WI	A8	NA	NA	Aliased
179	Shepard	Clonal	WI	Duke 7	NA	NA	Aliased
180	Shepard	Clonal	WI	Nabal	NA	NA	Aliased
181	Shepard	Clonal	WI	SHSR-03	NA	NA	Aliased
182	Shepard	Clonal	WI	Thomas	NA	NA	Aliased
183	Shepard	Clonal	WI	V1	NA	NA	Aliased
184	Shepard	Clonal	WI	Velvick	260.5284	22.96550	Estimable
185	Shepard	Clonal	WI	Zutano	NA	NA	Aliased
186	Shepard	Clonal	WI	Peasley	NA	NA	Aliased
187	Shepard	Clonal	WI	Reed	NA	NA	Aliased
188	Shepard	Clonal	WI	SHSR-02	NA	NA	Aliased
189	Shepard	Clonal	WI	Toro Canyon	NA	NA	Aliased
190	Shepard	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
191	Shepard	Clonal	WI	Edranol	NA	NA	Aliased
192	Shepard	Clonal	WI	Parida	NA	NA	Aliased
193	Shepard	Clonal	WI	Plowman	NA	NA	Aliased
194	Shepard	Clonal	WI	Shepard	NA	NA	Aliased
195	Shepard	Clonal	WI	Hass	NA	NA	Aliased
196	Shepard	Clonal	WI	Barr Duke	NA	NA	Aliased
197	Shepard	Clonal	WI	SHSR-01	NA	NA	Aliased
198	Shepard	Clonal	WI	Rigato	NA	NA	Aliased
199	Shepard	Seedling	G	A10	257.4672	22.53435	Estimable
200	Shepard	Seedling	G	A8	250.7248	23.79884	Estimable
201	Shepard	Seedling	G	Duke 7	NA	NA	Aliased
202	Shepard	Seedling	G	Nabal	246.1874	22.48925	Estimable
203	Shepard	Seedling	G	SHSR-03	NA	NA	Aliased
204	Shepard	Seedling	G	Thomas	NA	NA	Aliased
205	Shepard	Seedling	G	V1	NA	NA	Aliased
206	Shepard	Seedling	G	Velvick	NA	NA	Aliased
207	Shepard	Seedling	G	Zutano	NA	NA	Aliased
208	Shepard	Seedling	G	Peasley	NA	NA	Aliased
209	Shepard	Seedling	G	Reed	251.0361	22.57175	Estimable
210	Shepard	Seedling	G	SHSR-02	259.8255	22.46830	Estimable
211	Shepard	Seedling	G	Toro Canyon	NA	NA	Aliased
212	Shepard	Seedling	G	Velvick/Hazard	NA	NA	Aliased
213	Shepard	Seedling	G	Edranol	264.0963	23.17940	Estimable
214	Shepard	Seedling	G	Parida	NA	NA	Aliased
215	Shepard	Seedling	G	Plowman	256.4327	23.16968	Estimable
216	Shepard	Seedling	G	Shepard	NA	NA	Aliased
217	Shepard	Seedling	G	Hass	NA	NA	Aliased
218	Shepard	Seedling	G	Barr Duke	NA	NA	Aliased
219	Shepard	Seedling	G	SHSR-01	NA	NA	Aliased
220	Shepard	Seedling	G	Rigato	NA	NA	Aliased
221	Shepard	Seedling	M	A10	NA	NA	Aliased
222	Shepard	Seedling	M	A8	NA	NA	Aliased
223	Shepard	Seedling	M	Duke 7	243.3934	23.39846	Estimable
224	Shepard	Seedling	M	Nabal	NA	NA	Aliased
225	Shepard	Seedling	M	SHSR-03	234.5460	23.63115	Estimable
226	Shepard	Seedling	M	Thomas	NA	NA	Aliased
227	Shepard	Seedling	M	V1	NA	NA	Aliased
228	Shepard	Seedling	M	Velvick	NA	NA	Aliased
229	Shepard	Seedling	M	Zutano	262.3171	23.82139	Estimable
230	Shepard	Seedling	M	Peasley	NA	NA	Aliased
231	Shepard	Seedling	M	Reed	NA	NA	Aliased
232	Shepard	Seedling	M	SHSR-02	NA	NA	Aliased
233	Shepard	Seedling	M	Toro Canyon	259.7931	23.52228	Estimable
234	Shepard	Seedling	M	Velvick/Hazard	NA	NA	Aliased
235	Shepard	Seedling	M	Edranol	NA	NA	Aliased
236	Shepard	Seedling	M	Parida	272.1329	23.55023	Estimable
237	Shepard	Seedling	M	Plowman	NA	NA	Aliased
238	Shepard	Seedling	M	Shepard	260.5173	23.49125	Estimable
239	Shepard	Seedling	M	Hass	NA	NA	Aliased
240	Shepard	Seedling	M	Barr Duke	NA	NA	Aliased
241	Shepard	Seedling	M	SHSR-01	NA	NA	Aliased
242	Shepard	Seedling	M	Rigato	NA	NA	Aliased
243	Shepard	Seedling	WI	A10	NA	NA	Aliased
244	Shepard	Seedling	WI	A8	NA	NA	Aliased
245	Shepard	Seedling	WI	Duke 7	NA	NA	Aliased
246	Shepard	Seedling	WI	Nabal	NA	NA	Aliased
247	Shepard	Seedling	WI	SHSR-03	NA	NA	Aliased
248	Shepard	Seedling	WI	Thomas	NA	NA	Aliased
249	Shepard	Seedling	WI	V1	255.9913	23.45056	Estimable
250	Shepard	Seedling	WI	Velvick	268.7538	22.45074	Estimable
251	Shepard	Seedling	WI	Zutano	NA	NA	Aliased
252	Shepard	Seedling	WI	Peasley	NA	NA	Aliased
253	Shepard	Seedling	WI	Reed	NA	NA	Aliased

```
254 Shepard Seedling   WI        SHSR-02             NA             NA    Aliased
255 Shepard Seedling   WI    Toro Canyon             NA             NA    Aliased
256 Shepard Seedling   WI Velvick/Hazard             NA             NA    Aliased
257 Shepard Seedling   WI        Edranol             NA             NA    Aliased
258 Shepard Seedling   WI         Parida             NA             NA    Aliased
259 Shepard Seedling   WI        Plowman             NA             NA    Aliased
260 Shepard Seedling   WI        Shepard             NA             NA    Aliased
261 Shepard Seedling   WI           Hass             NA             NA    Aliased
262 Shepard Seedling   WI      Barr Duke             NA             NA    Aliased
263 Shepard Seedling   WI        SHSR-01             NA             NA    Aliased
264 Shepard Seedling   WI         Rigato             NA             NA    Aliased

$avsed
 overall
10.46592
```



The Variety main effect was significant with Shepard Scion having higher Fruit size than Hass Scion.

```
  Variety predicted.value standard.error est.status
1    Hass        225.4904       21.50909  Estimable
2 Shepard        257.1219       21.78454  Estimable

$avsed
 overall
4.501074
```

The main effect of Propagation was not significant.

```
      Prop predicted.value standard.error est.status
1   Clonal        240.9651       21.63646  Estimable
2 Seedling        238.4981       21.57823  Estimable

$avsed
 overall
3.917851
```

The main effect of Race was significant with West Indian and Mexican RS having higher fruit size than Guatemalan RS.

```
  Race predicted.value standard.error est.status
```

```
1    G        236.2453       21.52178  Estimable
2    M        241.6697       21.58660  Estimable
3   WI        242.9486       21.57227  Estimable

$avsed
 overall
2.425129

   Variety     Prop Race predicted.value standard.error est.status
1     Hass   Clonal    G        228.9386       21.64426  Estimable
2     Hass   Clonal    M        227.8868       21.78838  Estimable
3     Hass   Clonal   WI        236.7669       21.70290  Estimable
4     Hass Seedling    G        220.5544       21.65290  Estimable
5     Hass Seedling    M        220.2015       21.76299  Estimable
6     Hass Seedling   WI        228.2606       21.75060  Estimable
7  Shepard   Clonal    G        254.9032       22.75139  Estimable
8  Shepard   Clonal    M        259.5626       22.47544  Estimable
9  Shepard   Clonal   WI        260.5284       22.96550  Estimable
10 Shepard Seedling    G        255.1100       21.93424  Estimable
11 Shepard Seedling    M        255.4500       22.07898  Estimable
12 Shepard Seedling   WI        262.3726       22.37337  Estimable

$avsed
 overall
7.106058
```

We can see that the Shepard Scion RS had higher fruit size than the Hass Scion RS. Within the Hass Clonal RS the WI RS had higher fruit size than the Hass seedling G & M RS.

Time 3

```
$Wald
                       Df denDF    F.inc            Pr
(Intercept)             1   2.9 278.2000 5.385388e-04
Variety                 1   3.7   1.9370 2.424683e-01
Prop                    1   3.8   0.2477 6.463330e-01
Race                    2 345.3   4.7230 9.466301e-03
Variety:Prop            1   3.7   1.2740 3.264302e-01
Race:Trt               19 342.9   2.9540 4.309849e-05
Variety:Race            2 312.7   0.4063 6.664497e-01
Prop:Race               2 440.8   0.9969 3.698620e-01
Variety:Race:Trt       11 367.0   0.8383 6.017277e-01
Prop:Race:Trt           9 445.1   1.0070 4.336819e-01
Variety:Prop:Race       2 393.2   0.3010 7.402744e-01
Variety:Prop:Race:Trt   3 329.1   2.9940 3.101039e-02
```

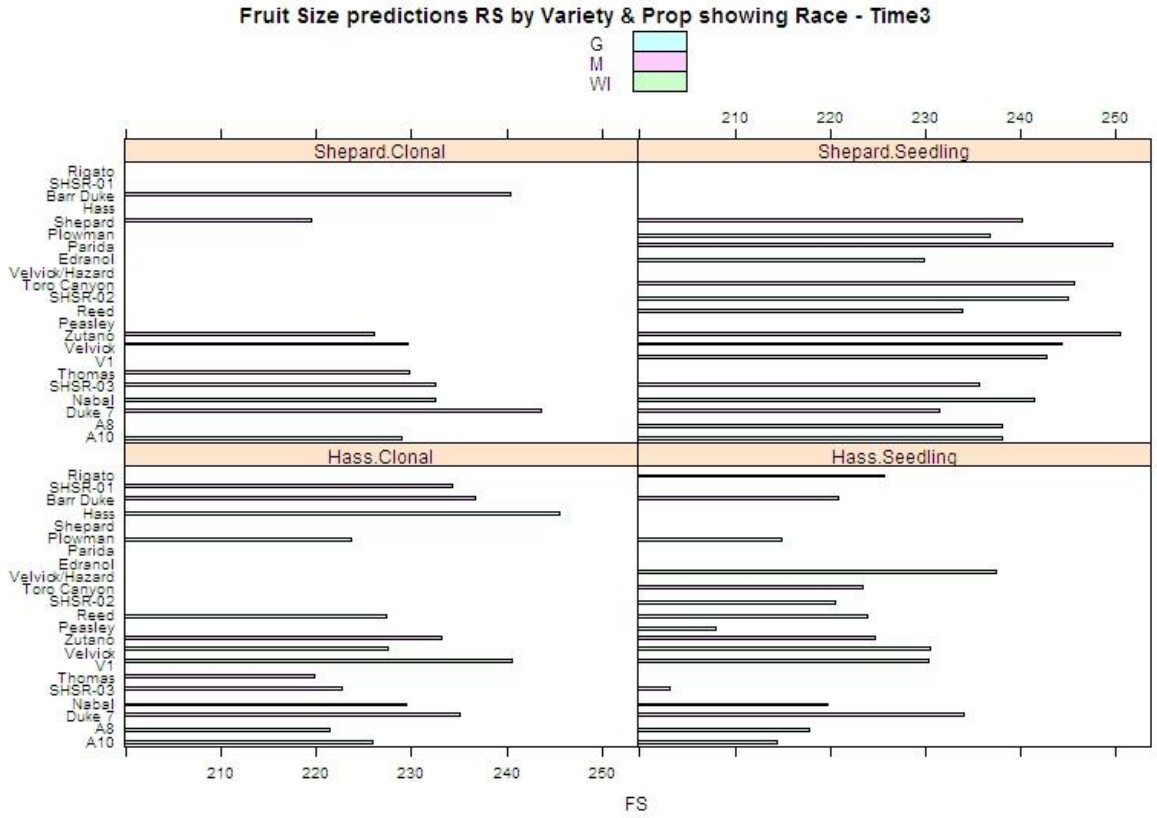
At time 3 there was a significant Variety:Prop:Race:Trt interaction so focus should be on these predicted means.

```
   Variety     Prop Race           Trt predicted.value standard.error est.status
1     Hass   Clonal    G           A10        225.8766       14.70988  Estimable
2     Hass   Clonal    G            A8        221.4592       14.79006  Estimable
3     Hass   Clonal    G        Duke 7              NA             NA    Aliased
4     Hass   Clonal    G         Nabal        229.3962       14.81745  Estimable
5     Hass   Clonal    G       SHSR-03              NA             NA    Aliased
6     Hass   Clonal    G        Thomas              NA             NA    Aliased
7     Hass   Clonal    G            V1              NA             NA    Aliased
8     Hass   Clonal    G       Velvick              NA             NA    Aliased
9     Hass   Clonal    G        Zutano              NA             NA    Aliased
10    Hass   Clonal    G       Peasley              NA             NA    Aliased
11    Hass   Clonal    G          Reed        227.2948       15.28006  Estimable
12    Hass   Clonal    G       SHSR-02              NA             NA    Aliased
13    Hass   Clonal    G   Toro Canyon              NA             NA    Aliased
14    Hass   Clonal    G Velvick/Hazard             NA             NA    Aliased
15    Hass   Clonal    G       Edranol              NA             NA    Aliased
16    Hass   Clonal    G        Parida              NA             NA    Aliased
17    Hass   Clonal    G       Plowman        223.6385       17.07757  Estimable
```

18	Hass	Clonal	G	Shepard	NA	NA	Aliased
19	Hass	Clonal	G	Hass	245.6222	15.58587	Estimable
20	Hass	Clonal	G	Barr Duke	NA	NA	Aliased
21	Hass	Clonal	G	SHSR-01	NA	NA	Aliased
22	Hass	Clonal	G	Rigato	NA	NA	Aliased
23	Hass	Clonal	M	A10	NA	NA	Aliased
24	Hass	Clonal	M	A8	NA	NA	Aliased
25	Hass	Clonal	M	Duke 7	235.1178	14.68899	Estimable
26	Hass	Clonal	M	Nabal	NA	NA	Aliased
27	Hass	Clonal	M	SHSR-03	222.7289	14.87191	Estimable
28	Hass	Clonal	M	Thomas	219.7672	14.89483	Estimable
29	Hass	Clonal	M	V1	NA	NA	Aliased
30	Hass	Clonal	M	Velvick	NA	NA	Aliased
31	Hass	Clonal	M	Zutano	233.2125	14.65783	Estimable
32	Hass	Clonal	M	Peasley	NA	NA	Aliased
33	Hass	Clonal	M	Reed	NA	NA	Aliased
34	Hass	Clonal	M	SHSR-02	NA	NA	Aliased
35	Hass	Clonal	M	Toro Canyon	NA	NA	Aliased
36	Hass	Clonal	M	Velvick/Hazard	NA	NA	Aliased
37	Hass	Clonal	M	Edranol	NA	NA	Aliased
38	Hass	Clonal	M	Parida	NA	NA	Aliased
39	Hass	Clonal	M	Plowman	NA	NA	Aliased
40	Hass	Clonal	M	Shepard	NA	NA	Aliased
41	Hass	Clonal	M	Hass	NA	NA	Aliased
42	Hass	Clonal	M	Barr Duke	236.7045	16.14950	Estimable
43	Hass	Clonal	M	SHSR-01	234.3348	21.15141	Estimable
44	Hass	Clonal	M	Rigato	NA	NA	Aliased
45	Hass	Clonal	WI	A10	NA	NA	Aliased
46	Hass	Clonal	WI	A8	NA	NA	Aliased
47	Hass	Clonal	WI	Duke 7	NA	NA	Aliased
48	Hass	Clonal	WI	Nabal	NA	NA	Aliased
49	Hass	Clonal	WI	SHSR-03	NA	NA	Aliased
50	Hass	Clonal	WI	Thomas	NA	NA	Aliased
51	Hass	Clonal	WI	V1	240.4954	14.95024	Estimable
52	Hass	Clonal	WI	Velvick	227.4965	14.65603	Estimable
53	Hass	Clonal	WI	Zutano	NA	NA	Aliased
54	Hass	Clonal	WI	Peasley	NA	NA	Aliased
55	Hass	Clonal	WI	Reed	NA	NA	Aliased
56	Hass	Clonal	WI	SHSR-02	NA	NA	Aliased
57	Hass	Clonal	WI	Toro Canyon	NA	NA	Aliased
58	Hass	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
59	Hass	Clonal	WI	Edranol	NA	NA	Aliased
60	Hass	Clonal	WI	Parida	NA	NA	Aliased
61	Hass	Clonal	WI	Plowman	NA	NA	Aliased
62	Hass	Clonal	WI	Shepard	NA	NA	Aliased
63	Hass	Clonal	WI	Hass	NA	NA	Aliased
64	Hass	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Hass	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Hass	Clonal	WI	Rigato	NA	NA	Aliased
67	Hass	Seedling	G	A10	214.4595	15.32027	Estimable
68	Hass	Seedling	G	A8	217.7617	15.55330	Estimable
69	Hass	Seedling	G	Duke 7	NA	NA	Aliased
70	Hass	Seedling	G	Nabal	219.7518	15.32808	Estimable
71	Hass	Seedling	G	SHSR-03	NA	NA	Aliased
72	Hass	Seedling	G	Thomas	NA	NA	Aliased
73	Hass	Seedling	G	V1	NA	NA	Aliased
74	Hass	Seedling	G	Velvick	NA	NA	Aliased
75	Hass	Seedling	G	Zutano	NA	NA	Aliased
76	Hass	Seedling	G	Peasley	208.0029	20.49726	Estimable
77	Hass	Seedling	G	Reed	223.8952	15.87964	Estimable
78	Hass	Seedling	G	SHSR-02	220.4698	15.16605	Estimable
79	Hass	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Hass	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Hass	Seedling	G	Edranol	NA	NA	Aliased
82	Hass	Seedling	G	Parida	NA	NA	Aliased
83	Hass	Seedling	G	Plowman	214.9688	16.75858	Estimable
84	Hass	Seedling	G	Shepard	NA	NA	Aliased
85	Hass	Seedling	G	Hass	NA	NA	Aliased
86	Hass	Seedling	G	Barr Duke	NA	NA	Aliased
87	Hass	Seedling	G	SHSR-01	NA	NA	Aliased
88	Hass	Seedling	G	Rigato	225.7312	16.59090	Estimable
89	Hass	Seedling	M	A10	NA	NA	Aliased
90	Hass	Seedling	M	A8	NA	NA	Aliased
91	Hass	Seedling	M	Duke 7	234.0643	15.55525	Estimable
92	Hass	Seedling	M	Nabal	NA	NA	Aliased
93	Hass	Seedling	M	SHSR-03	203.0753	16.66006	Estimable
94	Hass	Seedling	M	Thomas	NA	NA	Aliased
95	Hass	Seedling	M	V1	NA	NA	Aliased
96	Hass	Seedling	M	Velvick	NA	NA	Aliased
97	Hass	Seedling	M	Zutano	224.6736	15.98693	Estimable
98	Hass	Seedling	M	Peasley	NA	NA	Aliased
99	Hass	Seedling	M	Reed	NA	NA	Aliased
100	Hass	Seedling	M	SHSR-02	NA	NA	Aliased
101	Hass	Seedling	M	Toro Canyon	223.4964	17.20604	Estimable
102	Hass	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Hass	Seedling	M	Edranol	NA	NA	Aliased
104	Hass	Seedling	M	Parida	NA	NA	Aliased
105	Hass	Seedling	M	Plowman	NA	NA	Aliased
106	Hass	Seedling	M	Shepard	NA	NA	Aliased
107	Hass	Seedling	M	Hass	NA	NA	Aliased
108	Hass	Seedling	M	Barr Duke	220.9243	16.58876	Estimable
109	Hass	Seedling	M	SHSR-01	NA	NA	Aliased
110	Hass	Seedling	M	Rigato	NA	NA	Aliased
111	Hass	Seedling	WI	A10	NA	NA	Aliased
112	Hass	Seedling	WI	A8	NA	NA	Aliased
113	Hass	Seedling	WI	Duke 7	NA	NA	Aliased
114	Hass	Seedling	WI	Nabal	NA	NA	Aliased
115	Hass	Seedling	WI	SHSR-03	NA	NA	Aliased
116	Hass	Seedling	WI	Thomas	NA	NA	Aliased
117	Hass	Seedling	WI	V1	230.3075	17.71160	Estimable
118	Hass	Seedling	WI	Velvick	230.5050	15.21770	Estimable
119	Hass	Seedling	WI	Zutano	NA	NA	Aliased
120	Hass	Seedling	WI	Peasley	NA	NA	Aliased
121	Hass	Seedling	WI	Reed	NA	NA	Aliased
122	Hass	Seedling	WI	SHSR-02	NA	NA	Aliased
123	Hass	Seedling	WI	Toro Canyon	NA	NA	Aliased
124	Hass	Seedling	WI	Velvick/Hazard	237.4784	16.86601	Estimable
125	Hass	Seedling	WI	Edranol	NA	NA	Aliased
126	Hass	Seedling	WI	Parida	NA	NA	Aliased
127	Hass	Seedling	WI	Plowman	NA	NA	Aliased
128	Hass	Seedling	WI	Shepard	NA	NA	Aliased
129	Hass	Seedling	WI	Hass	NA	NA	Aliased
130	Hass	Seedling	WI	Barr Duke	NA	NA	Aliased
131	Hass	Seedling	WI	SHSR-01	NA	NA	Aliased
132	Hass	Seedling	WI	Rigato	NA	NA	Aliased
133	Shepard	Clonal	G	A10	229.0131	18.18503	Estimable

134	Shepard	Clonal	G	A8	NA	NA	Aliased
135	Shepard	Clonal	G	Duke 7	NA	NA	Aliased
136	Shepard	Clonal	G	Nabal	232.4218	18.36269	Estimable
137	Shepard	Clonal	G	SHSR-03	NA	NA	Aliased
138	Shepard	Clonal	G	Thomas	NA	NA	Aliased
139	Shepard	Clonal	G	V1	NA	NA	Aliased
140	Shepard	Clonal	G	Velvick	NA	NA	Aliased
141	Shepard	Clonal	G	Zutano	NA	NA	Aliased
142	Shepard	Clonal	G	Peasley	NA	NA	Aliased
143	Shepard	Clonal	G	Reed	NA	NA	Aliased
144	Shepard	Clonal	G	SHSR-02	NA	NA	Aliased
145	Shepard	Clonal	G	Toro Canyon	NA	NA	Aliased
146	Shepard	Clonal	G	Velvick/Hazard	NA	NA	Aliased
147	Shepard	Clonal	G	Edranol	NA	NA	Aliased
148	Shepard	Clonal	G	Parida	NA	NA	Aliased
149	Shepard	Clonal	G	Plowman	NA	NA	Aliased
150	Shepard	Clonal	G	Shepard	NA	NA	Aliased
151	Shepard	Clonal	G	Hass	NA	NA	Aliased
152	Shepard	Clonal	G	Barr Duke	NA	NA	Aliased
153	Shepard	Clonal	G	SHSR-01	NA	NA	Aliased
154	Shepard	Clonal	G	Rigato	NA	NA	Aliased
155	Shepard	Clonal	M	A10	NA	NA	Aliased
156	Shepard	Clonal	M	A8	NA	NA	Aliased
157	Shepard	Clonal	M	Duke 7	243.6976	18.29126	Estimable
158	Shepard	Clonal	M	Nabal	NA	NA	Aliased
159	Shepard	Clonal	M	SHSR-03	232.4707	18.22247	Estimable
160	Shepard	Clonal	M	Thomas	229.6831	18.23481	Estimable
161	Shepard	Clonal	M	V1	NA	NA	Aliased
162	Shepard	Clonal	M	Velvick	NA	NA	Aliased
163	Shepard	Clonal	M	Zutano	226.0662	18.22894	Estimable
164	Shepard	Clonal	M	Peasley	NA	NA	Aliased
165	Shepard	Clonal	M	Reed	NA	NA	Aliased
166	Shepard	Clonal	M	SHSR-02	NA	NA	Aliased
167	Shepard	Clonal	M	Toro Canyon	NA	NA	Aliased
168	Shepard	Clonal	M	Velvick/Hazard	NA	NA	Aliased
169	Shepard	Clonal	M	Edranol	NA	NA	Aliased
170	Shepard	Clonal	M	Parida	NA	NA	Aliased
171	Shepard	Clonal	M	Plowman	NA	NA	Aliased
172	Shepard	Clonal	M	Shepard	219.4057	18.17928	Estimable
173	Shepard	Clonal	M	Hass	NA	NA	Aliased
174	Shepard	Clonal	M	Barr Duke	240.4686	18.19417	Estimable
175	Shepard	Clonal	M	SHSR-01	NA	NA	Aliased
176	Shepard	Clonal	M	Rigato	NA	NA	Aliased
177	Shepard	Clonal	WI	A10	NA	NA	Aliased
178	Shepard	Clonal	WI	A8	NA	NA	Aliased
179	Shepard	Clonal	WI	Duke 7	NA	NA	Aliased
180	Shepard	Clonal	WI	Nabal	NA	NA	Aliased
181	Shepard	Clonal	WI	SHSR-03	NA	NA	Aliased
182	Shepard	Clonal	WI	Thomas	NA	NA	Aliased
183	Shepard	Clonal	WI	V1	NA	NA	Aliased
184	Shepard	Clonal	WI	Velvick	229.6210	18.23136	Estimable
185	Shepard	Clonal	WI	Zutano	NA	NA	Aliased
186	Shepard	Clonal	WI	Peasley	NA	NA	Aliased
187	Shepard	Clonal	WI	Reed	NA	NA	Aliased
188	Shepard	Clonal	WI	SHSR-02	NA	NA	Aliased
189	Shepard	Clonal	WI	Toro Canyon	NA	NA	Aliased
190	Shepard	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
191	Shepard	Clonal	WI	Edranol	NA	NA	Aliased
192	Shepard	Clonal	WI	Parida	NA	NA	Aliased
193	Shepard	Clonal	WI	Plowman	NA	NA	Aliased
194	Shepard	Clonal	WI	Shepard	NA	NA	Aliased
195	Shepard	Clonal	WI	Hass	NA	NA	Aliased
196	Shepard	Clonal	WI	Barr Duke	NA	NA	Aliased
197	Shepard	Clonal	WI	SHSR-01	NA	NA	Aliased
198	Shepard	Clonal	WI	Rigato	NA	NA	Aliased
199	Shepard	Seedling	G	A10	238.1905	16.22235	Estimable
200	Shepard	Seedling	G	A8	238.0428	17.29324	Estimable
201	Shepard	Seedling	G	Duke 7	NA	NA	Aliased
202	Shepard	Seedling	G	Nabal	241.4888	16.21810	Estimable
203	Shepard	Seedling	G	SHSR-03	NA	NA	Aliased
204	Shepard	Seedling	G	Thomas	NA	NA	Aliased
205	Shepard	Seedling	G	V1	NA	NA	Aliased
206	Shepard	Seedling	G	Velvick	NA	NA	Aliased
207	Shepard	Seedling	G	Zutano	NA	NA	Aliased
208	Shepard	Seedling	G	Peasley	NA	NA	Aliased
209	Shepard	Seedling	G	Reed	233.8824	16.22544	Estimable
210	Shepard	Seedling	G	SHSR-02	245.0816	16.19212	Estimable
211	Shepard	Seedling	G	Toro Canyon	NA	NA	Aliased
212	Shepard	Seedling	G	Velvick/Hazard	NA	NA	Aliased
213	Shepard	Seedling	G	Edranol	229.9433	16.79227	Estimable
214	Shepard	Seedling	G	Parida	NA	NA	Aliased
215	Shepard	Seedling	G	Plowman	236.8453	16.78498	Estimable
216	Shepard	Seedling	G	Shepard	NA	NA	Aliased
217	Shepard	Seedling	G	Hass	NA	NA	Aliased
218	Shepard	Seedling	G	Barr Duke	NA	NA	Aliased
219	Shepard	Seedling	G	SHSR-01	NA	NA	Aliased
220	Shepard	Seedling	G	Rigato	NA	NA	Aliased
221	Shepard	Seedling	M	A10	NA	NA	Aliased
222	Shepard	Seedling	M	A8	NA	NA	Aliased
223	Shepard	Seedling	M	Duke 7	231.5527	17.11616	Estimable
224	Shepard	Seedling	M	Nabal	NA	NA	Aliased
225	Shepard	Seedling	M	SHSR-03	235.6772	17.13705	Estimable
226	Shepard	Seedling	M	Thomas	NA	NA	Aliased
227	Shepard	Seedling	M	V1	NA	NA	Aliased
228	Shepard	Seedling	M	Velvick	NA	NA	Aliased
229	Shepard	Seedling	M	Zutano	250.4585	17.30429	Estimable
230	Shepard	Seedling	M	Peasley	NA	NA	Aliased
231	Shepard	Seedling	M	Reed	NA	NA	Aliased
232	Shepard	Seedling	M	SHSR-02	NA	NA	Aliased
233	Shepard	Seedling	M	Toro Canyon	245.7419	17.03230	Estimable
234	Shepard	Seedling	M	Velvick/Hazard	NA	NA	Aliased
235	Shepard	Seedling	M	Edranol	NA	NA	Aliased
236	Shepard	Seedling	M	Parida	249.7706	16.84192	Estimable
237	Shepard	Seedling	M	Plowman	NA	NA	Aliased
238	Shepard	Seedling	M	Shepard	240.1789	16.89908	Estimable
239	Shepard	Seedling	M	Hass	NA	NA	Aliased
240	Shepard	Seedling	M	Barr Duke	NA	NA	Aliased
241	Shepard	Seedling	M	SHSR-01	NA	NA	Aliased
242	Shepard	Seedling	M	Rigato	NA	NA	Aliased
243	Shepard	Seedling	WI	A10	NA	NA	Aliased
244	Shepard	Seedling	WI	A8	NA	NA	Aliased
245	Shepard	Seedling	WI	Duke 7	NA	NA	Aliased
246	Shepard	Seedling	WI	Nabal	NA	NA	Aliased
247	Shepard	Seedling	WI	SHSR-03	NA	NA	Aliased
248	Shepard	Seedling	WI	Thomas	NA	NA	Aliased
249	Shepard	Seedling	WI	V1	242.7808	17.14765	Estimable

```
250 Shepard Seedling   WI        Velvick        244.3296       16.15492  Estimable
251 Shepard Seedling   WI         Zutano              NA             NA    Aliased
252 Shepard Seedling   WI        Peasley              NA             NA    Aliased
253 Shepard Seedling   WI           Reed              NA             NA    Aliased
254 Shepard Seedling   WI        SHSR-02              NA             NA    Aliased
255 Shepard Seedling   WI    Toro Canyon              NA             NA    Aliased
256 Shepard Seedling   WI Velvick/Hazard              NA             NA    Aliased
257 Shepard Seedling   WI        Edranol              NA             NA    Aliased
258 Shepard Seedling   WI         Parida              NA             NA    Aliased
259 Shepard Seedling   WI        Plowman              NA             NA    Aliased
260 Shepard Seedling   WI        Shepard              NA             NA    Aliased
261 Shepard Seedling   WI           Hass              NA             NA    Aliased
262 Shepard Seedling   WI      Barr Duke              NA             NA    Aliased
263 Shepard Seedling   WI        SHSR-01              NA             NA    Aliased
264 Shepard Seedling   WI         Rigato              NA             NA    Aliased

$avsed
 overall
13.22034
```



The Variety and Propagation main effects were not significant.

```
  Variety predicted.value standard.error est.status
1    Hass        225.7570       13.86327  Estimable
2 Shepard        236.9505       15.15150  Estimable

$avsed
 overall
8.261084
```

```
      Prop predicted.value standard.error est.status
1   Clonal        230.6953       14.45938  Estimable
2 Seedling        230.7591       14.18438  Estimable

$avsed
 overall
7.178503
```

The Race main effect was significant with WI RS having greater fruit size than Guatemalan RS.

```
  Race predicted.value standard.error est.status
1    G        227.9669       13.84505  Estimable
```

```
2    M         231.8814        14.05665  Estimable
3   WI         235.3768        13.94745  Estimable
```

```
$avsed
 overall
2.965063
```

Yield efficiency

Time 1

```
$Wald
                       Df denDF    F.inc           Pr
(Intercept)             1   2.8 20.06000 2.479478e-02
Variety                 1   4.0  2.28100 2.060101e-01
Prop                    1   4.0  0.26330 6.348995e-01
Race                    2 496.4 13.90000 1.335046e-06
Variety:Prop            1   3.8  0.02123 8.915577e-01
Race:Trt               19 386.9  3.98400 7.240746e-08
Variety:Race            2 434.8  3.50100 3.100780e-02
Prop:Race               2 494.7  3.63700 2.703498e-02
Variety:Race:Trt       11 382.2  1.96100 3.104886e-02
Prop:Race:Trt           9 494.6  2.80600 3.196235e-03
Variety:Prop:Race       2 316.2  0.39590 6.733759e-01
Variety:Prop:Race:Trt   3 339.0  6.35600 3.342046e-04
```

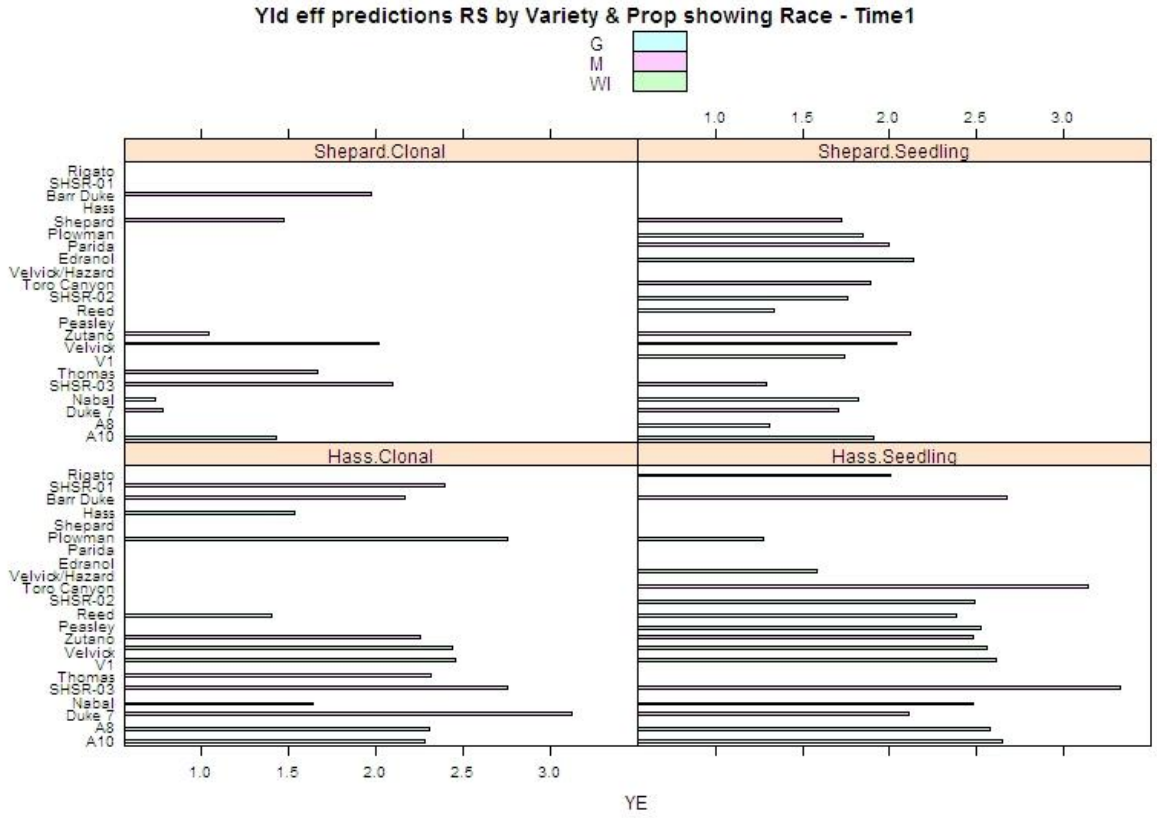
There was a significant Variety:Prop:Race:Trt interaction so focus on these predictions.

```
    Variety     Prop Race           Trt predicted.value standard.error est.status
1      Hass   Clonal    G           A10        2.275458      0.5670505  Estimable
2      Hass   Clonal    G            A8        2.308520      0.5679175  Estimable
3      Hass   Clonal    G        Duke 7              NA             NA    Aliased
4      Hass   Clonal    G         Nabal        1.638870      0.5771336  Estimable
5      Hass   Clonal    G       SHSR-03              NA             NA    Aliased
6      Hass   Clonal    G        Thomas              NA             NA    Aliased
7      Hass   Clonal    G            V1              NA             NA    Aliased
8      Hass   Clonal    G       Velvick              NA             NA    Aliased
9      Hass   Clonal    G        Zutano              NA             NA    Aliased
10     Hass   Clonal    G       Peasley              NA             NA    Aliased
11     Hass   Clonal    G          Reed        1.400485      0.5824932  Estimable
12     Hass   Clonal    G       SHSR-02              NA             NA    Aliased
13     Hass   Clonal    G   Toro Canyon              NA             NA    Aliased
14     Hass   Clonal    G Velvick/Hazard             NA             NA    Aliased
15     Hass   Clonal    G       Edranol              NA             NA    Aliased
16     Hass   Clonal    G        Parida              NA             NA    Aliased
17     Hass   Clonal    G       Plowman        2.752937      0.6311967  Estimable
18     Hass   Clonal    G       Shepard              NA             NA    Aliased
19     Hass   Clonal    G          Hass        1.529461      0.5850957  Estimable
20     Hass   Clonal    G     Barr Duke              NA             NA    Aliased
21     Hass   Clonal    G       SHSR-01              NA             NA    Aliased
22     Hass   Clonal    G        Rigato              NA             NA    Aliased
23     Hass   Clonal    M           A10              NA             NA    Aliased
24     Hass   Clonal    M            A8              NA             NA    Aliased
25     Hass   Clonal    M        Duke 7        3.126167      0.5672318  Estimable
26     Hass   Clonal    M         Nabal              NA             NA    Aliased
27     Hass   Clonal    M       SHSR-03        2.751920      0.5808426  Estimable
28     Hass   Clonal    M        Thomas        2.309647      0.5828560  Estimable
29     Hass   Clonal    M            V1              NA             NA    Aliased
30     Hass   Clonal    M       Velvick              NA             NA    Aliased
31     Hass   Clonal    M        Zutano        2.252888      0.5653008  Estimable
32     Hass   Clonal    M       Peasley              NA             NA    Aliased
33     Hass   Clonal    M          Reed              NA             NA    Aliased
34     Hass   Clonal    M       SHSR-02              NA             NA    Aliased
35     Hass   Clonal    M   Toro Canyon              NA             NA    Aliased
36     Hass   Clonal    M Velvick/Hazard             NA             NA    Aliased
37     Hass   Clonal    M       Edranol              NA             NA    Aliased
38     Hass   Clonal    M        Parida              NA             NA    Aliased
39     Hass   Clonal    M       Plowman              NA             NA    Aliased
40     Hass   Clonal    M       Shepard              NA             NA    Aliased
41     Hass   Clonal    M          Hass              NA             NA    Aliased
42     Hass   Clonal    M     Barr Duke        2.162996      0.6083789  Estimable
43     Hass   Clonal    M       SHSR-01        2.389560      1.1076068  Estimable
44     Hass   Clonal    M        Rigato              NA             NA    Aliased
45     Hass   Clonal   WI           A10              NA             NA    Aliased
46     Hass   Clonal   WI            A8              NA             NA    Aliased
47     Hass   Clonal   WI        Duke 7              NA             NA    Aliased
48     Hass   Clonal   WI         Nabal              NA             NA    Aliased
49     Hass   Clonal   WI       SHSR-03              NA             NA    Aliased
50     Hass   Clonal   WI        Thomas              NA             NA    Aliased
51     Hass   Clonal   WI            V1        2.453383      0.6055571  Estimable
52     Hass   Clonal   WI       Velvick        2.439824      0.5658892  Estimable
53     Hass   Clonal   WI        Zutano              NA             NA    Aliased
54     Hass   Clonal   WI       Peasley              NA             NA    Aliased
55     Hass   Clonal   WI          Reed              NA             NA    Aliased
56     Hass   Clonal   WI       SHSR-02              NA             NA    Aliased
57     Hass   Clonal   WI   Toro Canyon              NA             NA    Aliased
58     Hass   Clonal   WI Velvick/Hazard             NA             NA    Aliased
59     Hass   Clonal   WI       Edranol              NA             NA    Aliased
```

60	Hass	Clonal	WI	Parida	NA	NA	Aliased
61	Hass	Clonal	WI	Plowman	NA	NA	Aliased
62	Hass	Clonal	WI	Shepard	NA	NA	Aliased
63	Hass	Clonal	WI	Hass	NA	NA	Aliased
64	Hass	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Hass	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Hass	Clonal	WI	Rigato	NA	NA	Aliased
67	Hass	Seedling	G	A10	2.646266	0.5724455	Estimable
68	Hass	Seedling	G	A8	2.576299	0.5766492	Estimable
69	Hass	Seedling	G	Duke 7	NA	NA	Aliased
70	Hass	Seedling	G	Nabal	2.477736	0.5725321	Estimable
71	Hass	Seedling	G	SHSR-03	NA	NA	Aliased
72	Hass	Seedling	G	Thomas	NA	NA	Aliased
73	Hass	Seedling	G	V1	NA	NA	Aliased
74	Hass	Seedling	G	Velvick	NA	NA	Aliased
75	Hass	Seedling	G	Zutano	NA	NA	Aliased
76	Hass	Seedling	G	Peasley	2.519450	0.5965931	Estimable
77	Hass	Seedling	G	Reed	2.378375	0.5830018	Estimable
78	Hass	Seedling	G	SHSR-02	2.491719	0.5714392	Estimable
79	Hass	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Hass	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Hass	Seedling	G	Edranol	NA	NA	Aliased
82	Hass	Seedling	G	Parida	NA	NA	Aliased
83	Hass	Seedling	G	Plowman	1.274016	0.6823847	Estimable
84	Hass	Seedling	G	Shepard	NA	NA	Aliased
85	Hass	Seedling	G	Hass	NA	NA	Aliased
86	Hass	Seedling	G	Barr Duke	NA	NA	Aliased
87	Hass	Seedling	G	SHSR-01	NA	NA	Aliased
88	Hass	Seedling	G	Rigato	2.004742	0.6944220	Estimable
89	Hass	Seedling	M	A10	NA	NA	Aliased
90	Hass	Seedling	M	A8	NA	NA	Aliased
91	Hass	Seedling	M	Duke 7	2.109754	0.6264384	Estimable
92	Hass	Seedling	M	Nabal	NA	NA	Aliased
93	Hass	Seedling	M	SHSR-03	3.318944	0.5883195	Estimable
94	Hass	Seedling	M	Thomas	NA	NA	Aliased
95	Hass	Seedling	M	V1	NA	NA	Aliased
96	Hass	Seedling	M	Velvick	NA	NA	Aliased
97	Hass	Seedling	M	Zutano	2.479036	0.6446861	Estimable
98	Hass	Seedling	M	Peasley	NA	NA	Aliased
99	Hass	Seedling	M	Reed	NA	NA	Aliased
100	Hass	Seedling	M	SHSR-02	NA	NA	Aliased
101	Hass	Seedling	M	Toro Canyon	3.134319	0.5963580	Estimable
102	Hass	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Hass	Seedling	M	Edranol	NA	NA	Aliased
104	Hass	Seedling	M	Parida	NA	NA	Aliased
105	Hass	Seedling	M	Plowman	NA	NA	Aliased
106	Hass	Seedling	M	Shepard	NA	NA	Aliased
107	Hass	Seedling	M	Hass	NA	NA	Aliased
108	Hass	Seedling	M	Barr Duke	2.673913	0.6947746	Estimable
109	Hass	Seedling	M	SHSR-01	NA	NA	Aliased
110	Hass	Seedling	M	Rigato	NA	NA	Aliased
111	Hass	Seedling	WI	A10	NA	NA	Aliased
112	Hass	Seedling	WI	A8	NA	NA	Aliased
113	Hass	Seedling	WI	Duke 7	NA	NA	Aliased
114	Hass	Seedling	WI	Nabal	NA	NA	Aliased
115	Hass	Seedling	WI	SHSR-03	NA	NA	Aliased
116	Hass	Seedling	WI	Thomas	NA	NA	Aliased
117	Hass	Seedling	WI	V1	2.606908	0.5921472	Estimable
118	Hass	Seedling	WI	Velvick	2.556071	0.5720765	Estimable
119	Hass	Seedling	WI	Zutano	NA	NA	Aliased
120	Hass	Seedling	WI	Peasley	NA	NA	Aliased
121	Hass	Seedling	WI	Reed	NA	NA	Aliased
122	Hass	Seedling	WI	SHSR-02	NA	NA	Aliased
123	Hass	Seedling	WI	Toro Canyon	NA	NA	Aliased
124	Hass	Seedling	WI	Velvick/Hazard	1.581253	0.5890569	Estimable
125	Hass	Seedling	WI	Edranol	NA	NA	Aliased
126	Hass	Seedling	WI	Parida	NA	NA	Aliased
127	Hass	Seedling	WI	Plowman	NA	NA	Aliased
128	Hass	Seedling	WI	Shepard	NA	NA	Aliased
129	Hass	Seedling	WI	Hass	NA	NA	Aliased
130	Hass	Seedling	WI	Barr Duke	NA	NA	Aliased
131	Hass	Seedling	WI	SHSR-01	NA	NA	Aliased
132	Hass	Seedling	WI	Rigato	NA	NA	Aliased
133	Shepard	Clonal	G	A10	1.426007	0.8386685	Estimable
134	Shepard	Clonal	G	A8	NA	NA	Aliased
135	Shepard	Clonal	G	Duke 7	NA	NA	Aliased
136	Shepard	Clonal	G	Nabal	0.736124	0.8482906	Estimable
137	Shepard	Clonal	G	SHSR-03	NA	NA	Aliased
138	Shepard	Clonal	G	Thomas	NA	NA	Aliased
139	Shepard	Clonal	G	V1	NA	NA	Aliased
140	Shepard	Clonal	G	Velvick	NA	NA	Aliased
141	Shepard	Clonal	G	Zutano	NA	NA	Aliased
142	Shepard	Clonal	G	Peasley	NA	NA	Aliased
143	Shepard	Clonal	G	Reed	NA	NA	Aliased
144	Shepard	Clonal	G	SHSR-02	NA	NA	Aliased
145	Shepard	Clonal	G	Toro Canyon	NA	NA	Aliased
146	Shepard	Clonal	G	Velvick/Hazard	NA	NA	Aliased
147	Shepard	Clonal	G	Edranol	NA	NA	Aliased
148	Shepard	Clonal	G	Parida	NA	NA	Aliased
149	Shepard	Clonal	G	Plowman	NA	NA	Aliased
150	Shepard	Clonal	G	Shepard	NA	NA	Aliased
151	Shepard	Clonal	G	Hass	NA	NA	Aliased
152	Shepard	Clonal	G	Barr Duke	NA	NA	Aliased
153	Shepard	Clonal	G	SHSR-01	NA	NA	Aliased
154	Shepard	Clonal	G	Rigato	NA	NA	Aliased
155	Shepard	Clonal	M	A10	NA	NA	Aliased
156	Shepard	Clonal	M	A8	NA	NA	Aliased
157	Shepard	Clonal	M	Duke 7	0.776324	0.8428040	Estimable
158	Shepard	Clonal	M	Nabal	NA	NA	Aliased
159	Shepard	Clonal	M	SHSR-03	2.094471	0.8427842	Estimable
160	Shepard	Clonal	M	Thomas	1.667722	0.8385873	Estimable
161	Shepard	Clonal	M	V1	NA	NA	Aliased
162	Shepard	Clonal	M	Velvick	NA	NA	Aliased
163	Shepard	Clonal	M	Zutano	1.044013	0.8428444	Estimable
164	Shepard	Clonal	M	Peasley	NA	NA	Aliased
165	Shepard	Clonal	M	Reed	NA	NA	Aliased
166	Shepard	Clonal	M	SHSR-02	NA	NA	Aliased
167	Shepard	Clonal	M	Toro Canyon	NA	NA	Aliased
168	Shepard	Clonal	M	Velvick/Hazard	NA	NA	Aliased
169	Shepard	Clonal	M	Edranol	NA	NA	Aliased
170	Shepard	Clonal	M	Parida	NA	NA	Aliased
171	Shepard	Clonal	M	Plowman	NA	NA	Aliased
172	Shepard	Clonal	M	Shepard	1.470952	0.8385548	Estimable
173	Shepard	Clonal	M	Hass	NA	NA	Aliased
174	Shepard	Clonal	M	Barr Duke	1.972886	0.8386822	Estimable
175	Shepard	Clonal	M	SHSR-01	NA	NA	Aliased

176	Shepard	Clonal	M	Rigato	NA	NA	Aliased
177	Shepard	Clonal	WI	A10	NA	NA	Aliased
178	Shepard	Clonal	WI	A8	NA	NA	Aliased
179	Shepard	Clonal	WI	Duke 7	NA	NA	Aliased
180	Shepard	Clonal	WI	Nabal	NA	NA	Aliased
181	Shepard	Clonal	WI	SHSR-03	NA	NA	Aliased
182	Shepard	Clonal	WI	Thomas	NA	NA	Aliased
183	Shepard	Clonal	WI	V1	NA	NA	Aliased
184	Shepard	Clonal	WI	Velvick	2.015249	0.8384120	Estimable
185	Shepard	Clonal	WI	Zutano	NA	NA	Aliased
186	Shepard	Clonal	WI	Peasley	NA	NA	Aliased
187	Shepard	Clonal	WI	Reed	NA	NA	Aliased
188	Shepard	Clonal	WI	SHSR-02	NA	NA	Aliased
189	Shepard	Clonal	WI	Toro Canyon	NA	NA	Aliased
190	Shepard	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
191	Shepard	Clonal	WI	Edranol	NA	NA	Aliased
192	Shepard	Clonal	WI	Parida	NA	NA	Aliased
193	Shepard	Clonal	WI	Plowman	NA	NA	Aliased
194	Shepard	Clonal	WI	Shepard	NA	NA	Aliased
195	Shepard	Clonal	WI	Hass	NA	NA	Aliased
196	Shepard	Clonal	WI	Barr Duke	NA	NA	Aliased
197	Shepard	Clonal	WI	SHSR-01	NA	NA	Aliased
198	Shepard	Clonal	WI	Rigato	NA	NA	Aliased
199	Shepard	Seedling	G	A10	1.905705	0.6653067	Estimable
200	Shepard	Seedling	G	A8	1.315176	0.7559825	Estimable
201	Shepard	Seedling	G	Duke 7	NA	NA	Aliased
202	Shepard	Seedling	G	Nabal	1.824208	0.6646199	Estimable
203	Shepard	Seedling	G	SHSR-03	NA	NA	Aliased
204	Shepard	Seedling	G	Thomas	NA	NA	Aliased
205	Shepard	Seedling	G	V1	NA	NA	Aliased
206	Shepard	Seedling	G	Velvick	NA	NA	Aliased
207	Shepard	Seedling	G	Zutano	NA	NA	Aliased
208	Shepard	Seedling	G	Peasley	NA	NA	Aliased
209	Shepard	Seedling	G	Reed	1.334706	0.6665783	Estimable
210	Shepard	Seedling	G	SHSR-02	1.758063	0.6644935	Estimable
211	Shepard	Seedling	G	Toro Canyon	NA	NA	Aliased
212	Shepard	Seedling	G	Velvick/Hazard	NA	NA	Aliased
213	Shepard	Seedling	G	Edranol	2.135884	0.6738535	Estimable
214	Shepard	Seedling	G	Parida	NA	NA	Aliased
215	Shepard	Seedling	G	Plowman	1.850114	0.6739231	Estimable
216	Shepard	Seedling	G	Shepard	NA	NA	Aliased
217	Shepard	Seedling	G	Hass	NA	NA	Aliased
218	Shepard	Seedling	G	Barr Duke	NA	NA	Aliased
219	Shepard	Seedling	G	SHSR-01	NA	NA	Aliased
220	Shepard	Seedling	G	Rigato	NA	NA	Aliased
221	Shepard	Seedling	M	A10	NA	NA	Aliased
222	Shepard	Seedling	M	A8	NA	NA	Aliased
223	Shepard	Seedling	M	Duke 7	1.703102	0.7263579	Estimable
224	Shepard	Seedling	M	Nabal	NA	NA	Aliased
225	Shepard	Seedling	M	SHSR-03	1.295446	0.7369376	Estimable
226	Shepard	Seedling	M	Thomas	NA	NA	Aliased
227	Shepard	Seedling	M	V1	NA	NA	Aliased
228	Shepard	Seedling	M	Velvick	NA	NA	Aliased
229	Shepard	Seedling	M	Zutano	2.116645	0.7324549	Estimable
230	Shepard	Seedling	M	Peasley	NA	NA	Aliased
231	Shepard	Seedling	M	Reed	NA	NA	Aliased
232	Shepard	Seedling	M	SHSR-02	NA	NA	Aliased
233	Shepard	Seedling	M	Toro Canyon	1.889226	0.6761574	Estimable
234	Shepard	Seedling	M	Velvick/Hazard	NA	NA	Aliased
235	Shepard	Seedling	M	Edranol	NA	NA	Aliased
236	Shepard	Seedling	M	Parida	1.997271	0.6787530	Estimable
237	Shepard	Seedling	M	Plowman	NA	NA	Aliased
238	Shepard	Seedling	M	Shepard	1.722060	0.6740540	Estimable
239	Shepard	Seedling	M	Hass	NA	NA	Aliased
240	Shepard	Seedling	M	Barr Duke	NA	NA	Aliased
241	Shepard	Seedling	M	SHSR-01	NA	NA	Aliased
242	Shepard	Seedling	M	Rigato	NA	NA	Aliased
243	Shepard	Seedling	WI	A10	NA	NA	Aliased
244	Shepard	Seedling	WI	A8	NA	NA	Aliased
245	Shepard	Seedling	WI	Duke 7	NA	NA	Aliased
246	Shepard	Seedling	WI	Nabal	NA	NA	Aliased
247	Shepard	Seedling	WI	SHSR-03	NA	NA	Aliased
248	Shepard	Seedling	WI	Thomas	NA	NA	Aliased
249	Shepard	Seedling	WI	V1	1.743274	0.7308922	Estimable
250	Shepard	Seedling	WI	Velvick	2.037268	0.6646758	Estimable
251	Shepard	Seedling	WI	Zutano	NA	NA	Aliased
252	Shepard	Seedling	WI	Peasley	NA	NA	Aliased
253	Shepard	Seedling	WI	Reed	NA	NA	Aliased
254	Shepard	Seedling	WI	SHSR-02	NA	NA	Aliased
255	Shepard	Seedling	WI	Toro Canyon	NA	NA	Aliased
256	Shepard	Seedling	WI	Velvick/Hazard	NA	NA	Aliased
257	Shepard	Seedling	WI	Edranol	NA	NA	Aliased
258	Shepard	Seedling	WI	Parida	NA	NA	Aliased
259	Shepard	Seedling	WI	Plowman	NA	NA	Aliased
260	Shepard	Seedling	WI	Shepard	NA	NA	Aliased
261	Shepard	Seedling	WI	Hass	NA	NA	Aliased
262	Shepard	Seedling	WI	Barr Duke	NA	NA	Aliased
263	Shepard	Seedling	WI	SHSR-01	NA	NA	Aliased
264	Shepard	Seedling	WI	Rigato	NA	NA	Aliased

```
$avsed
  overall
0.6603783
```



The Variety and Propagation main effects were not significant.

```
  Variety predicted.value standard.error est.status
1    Hass        2.354031      0.5026416  Estimable
2 Shepard        1.659662      0.6071231  Estimable

$avsed
  overall
0.4562285


      Prop predicted.value standard.error est.status
1   Clonal        1.956342      0.5566774  Estimable
2 Seedling        2.111515      0.5296503  Estimable

$avsed
  overall
0.4057081


  Race predicted.value standard.error est.status
1    G        1.937405      0.4999374  Estimable
2    M        2.106924      0.5193960  Estimable
3   WI        2.179154      0.5034337  Estimable

$avsed
  overall
0.1360291

The Variety Race interaction was significant with the Mexican RS under
Hass having significantly higher yield efficicncy than the Mexican &
Guatemalan RS under Shepard.

  Variety Race predicted.value standard.error est.status
1    Hass    G        2.162453      0.5048746  Estimable
```

```
2    Hass     M         2.609922      0.5127431  Estimable
3    Hass    WI         2.327488      0.5118080  Estimable
4 Shepard     G         1.587332      0.6107733  Estimable
5 Shepard     M         1.645843      0.6253781  Estimable
6 Shepard    WI         1.931930      0.6215702  Estimable

$avsed
  overall
0.3893278
```

Time 2

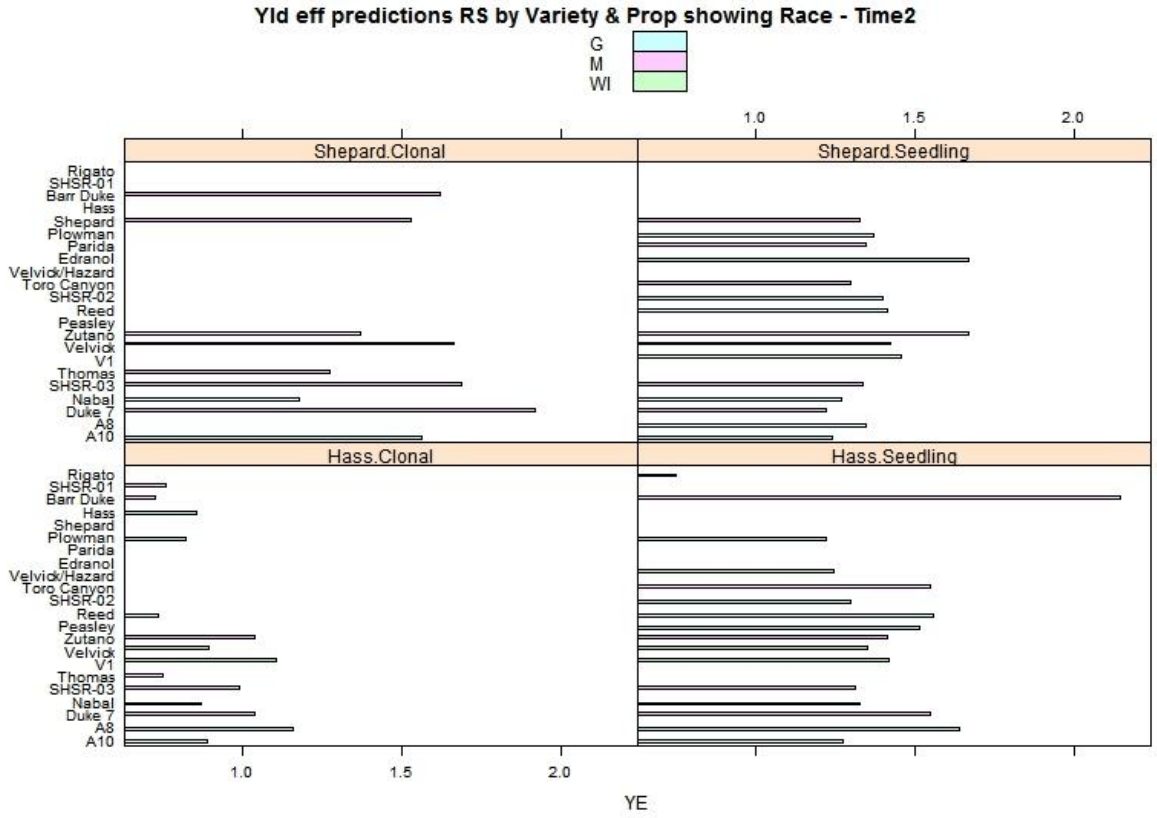
```
                        Df denDF   F.inc            Pr
(Intercept)              1   2.8 22.5800 2.058921e-02
Variety                  1   4.6  0.6983 4.448288e-01
Prop                     1   4.0  1.5450 2.814148e-01
Race                     2 461.9  1.6060 2.017086e-01
Variety:Prop             1   4.0  1.1040 3.521769e-01
Race:Trt                19 328.4  3.0330 2.831491e-05
Variety:Race             2 264.5  1.0130 3.644435e-01
Prop:Race                2 523.2  0.5116 5.998492e-01
Variety:Race:Trt        11 241.8  0.7989 6.411083e-01
Prop:Race:Trt            9 446.8  2.4740 9.210044e-03
Variety:Prop:Race        2 221.3  0.4440 6.420579e-01
Variety:Prop:Race:Trt    3 241.5  2.7270 4.473988e-02
```

At time 2 there was a significant Variety:Prop:Race:Trt interaction so we need to focus on these predictions.

```
    Variety     Prop Race            Trt predicted.value standard.error est.status
1      Hass   Clonal    G           A10       0.8887676      0.3082712  Estimable
2      Hass   Clonal    G            A8       1.1572444      0.3116304  Estimable
3      Hass   Clonal    G        Duke 7              NA             NA    Aliased
4      Hass   Clonal    G         Nabal       0.8691014      0.3093740  Estimable
5      Hass   Clonal    G       SHSR-03              NA             NA    Aliased
6      Hass   Clonal    G        Thomas              NA             NA    Aliased
7      Hass   Clonal    G            V1              NA             NA    Aliased
8      Hass   Clonal    G       Velvick              NA             NA    Aliased
9      Hass   Clonal    G        Zutano              NA             NA    Aliased
10     Hass   Clonal    G       Peasley              NA             NA    Aliased
11     Hass   Clonal    G          Reed       0.7341571      0.3124781  Estimable
12     Hass   Clonal    G       SHSR-02              NA             NA    Aliased
13     Hass   Clonal    G   Toro Canyon              NA             NA    Aliased
14     Hass   Clonal    G Velvick/Hazard             NA             NA    Aliased
15     Hass   Clonal    G       Edranol              NA             NA    Aliased
16     Hass   Clonal    G        Parida              NA             NA    Aliased
17     Hass   Clonal    G       Plowman       0.8205262      0.3211443  Estimable
18     Hass   Clonal    G       Shepard              NA             NA    Aliased
19     Hass   Clonal    G          Hass       0.8556234      0.3153588  Estimable
20     Hass   Clonal    G     Barr Duke              NA             NA    Aliased
21     Hass   Clonal    G       SHSR-01              NA             NA    Aliased
22     Hass   Clonal    G        Rigato              NA             NA    Aliased
23     Hass   Clonal    M           A10              NA             NA    Aliased
24     Hass   Clonal    M            A8              NA             NA    Aliased
25     Hass   Clonal    M        Duke 7       1.0395611      0.3087113  Estimable
26     Hass   Clonal    M         Nabal              NA             NA    Aliased
27     Hass   Clonal    M       SHSR-03       0.9913196      0.3130983  Estimable
28     Hass   Clonal    M        Thomas       0.7506496      0.3302428  Estimable
29     Hass   Clonal    M            V1              NA             NA    Aliased
30     Hass   Clonal    M       Velvick              NA             NA    Aliased
31     Hass   Clonal    M        Zutano       1.0360373      0.3078712  Estimable
32     Hass   Clonal    M       Peasley              NA             NA    Aliased
33     Hass   Clonal    M          Reed              NA             NA    Aliased
34     Hass   Clonal    M       SHSR-02              NA             NA    Aliased
35     Hass   Clonal    M   Toro Canyon              NA             NA    Aliased
36     Hass   Clonal    M Velvick/Hazard             NA             NA    Aliased
37     Hass   Clonal    M       Edranol              NA             NA    Aliased
38     Hass   Clonal    M        Parida              NA             NA    Aliased
39     Hass   Clonal    M       Plowman              NA             NA    Aliased
40     Hass   Clonal    M       Shepard              NA             NA    Aliased
41     Hass   Clonal    M          Hass              NA             NA    Aliased
42     Hass   Clonal    M     Barr Duke       0.7270746      0.3291242  Estimable
43     Hass   Clonal    M       SHSR-01       0.7603002      0.3454754  Estimable
44     Hass   Clonal    M        Rigato              NA             NA    Aliased
45     Hass   Clonal   WI           A10              NA             NA    Aliased
46     Hass   Clonal   WI            A8              NA             NA    Aliased
47     Hass   Clonal   WI        Duke 7              NA             NA    Aliased
48     Hass   Clonal   WI         Nabal              NA             NA    Aliased
49     Hass   Clonal   WI       SHSR-03              NA             NA    Aliased
50     Hass   Clonal   WI        Thomas              NA             NA    Aliased
51     Hass   Clonal   WI            V1       1.1063248      0.3318988  Estimable
52     Hass   Clonal   WI       Velvick       0.8925701      0.3084430  Estimable
53     Hass   Clonal   WI        Zutano              NA             NA    Aliased
```

54	Hass	Clonal	WI	Peasley	NA	NA	Aliased
55	Hass	Clonal	WI	Reed	NA	NA	Aliased
56	Hass	Clonal	WI	SHSR-02	NA	NA	Aliased
57	Hass	Clonal	WI	Toro Canyon	NA	NA	Aliased
58	Hass	Clonal	WI	Velvick/Hazard	NA	NA	Aliased
59	Hass	Clonal	WI	Edranol	NA	NA	Aliased
60	Hass	Clonal	WI	Parida	NA	NA	Aliased
61	Hass	Clonal	WI	Plowman	NA	NA	Aliased
62	Hass	Clonal	WI	Shepard	NA	NA	Aliased
63	Hass	Clonal	WI	Hass	NA	NA	Aliased
64	Hass	Clonal	WI	Barr Duke	NA	NA	Aliased
65	Hass	Clonal	WI	SHSR-01	NA	NA	Aliased
66	Hass	Clonal	WI	Rigato	NA	NA	Aliased
67	Hass	Seedling	G	A10	1.2738353	0.3105489	Estimable
68	Hass	Seedling	G	A8	1.6385046	0.3136491	Estimable
69	Hass	Seedling	G	Duke 7	NA	NA	Aliased
70	Hass	Seedling	G	Nabal	1.3253820	0.3104152	Estimable
71	Hass	Seedling	G	SHSR-03	NA	NA	Aliased
72	Hass	Seedling	G	Thomas	NA	NA	Aliased
73	Hass	Seedling	G	V1	NA	NA	Aliased
74	Hass	Seedling	G	Velvick	NA	NA	Aliased
75	Hass	Seedling	G	Zutano	NA	NA	Aliased
76	Hass	Seedling	G	Peasley	1.5135174	0.3168753	Estimable
77	Hass	Seedling	G	Reed	1.5556803	0.3152746	Estimable
78	Hass	Seedling	G	SHSR-02	1.2961550	0.3100931	Estimable
79	Hass	Seedling	G	Toro Canyon	NA	NA	Aliased
80	Hass	Seedling	G	Velvick/Hazard	NA	NA	Aliased
81	Hass	Seedling	G	Edranol	NA	NA	Aliased
82	Hass	Seedling	G	Parida	NA	NA	Aliased
83	Hass	Seedling	G	Plowman	1.2198468	0.3282318	Estimable
84	Hass	Seedling	G	Shepard	NA	NA	Aliased
85	Hass	Seedling	G	Hass	NA	NA	Aliased
86	Hass	Seedling	G	Barr Duke	NA	NA	Aliased
87	Hass	Seedling	G	SHSR-01	NA	NA	Aliased
88	Hass	Seedling	G	Rigato	0.7469128	0.4185716	Estimable
89	Hass	Seedling	M	A10	NA	NA	Aliased
90	Hass	Seedling	M	A8	NA	NA	Aliased
91	Hass	Seedling	M	Duke 7	1.5467592	0.3255884	Estimable
92	Hass	Seedling	M	Nabal	NA	NA	Aliased
93	Hass	Seedling	M	SHSR-03	1.3130419	0.3157146	Estimable
94	Hass	Seedling	M	Thomas	NA	NA	Aliased
95	Hass	Seedling	M	V1	NA	NA	Aliased
96	Hass	Seedling	M	Velvick	NA	NA	Aliased
97	Hass	Seedling	M	Zutano	1.4135956	0.3743306	Estimable
98	Hass	Seedling	M	Peasley	NA	NA	Aliased
99	Hass	Seedling	M	Reed	NA	NA	Aliased
100	Hass	Seedling	M	SHSR-02	NA	NA	Aliased
101	Hass	Seedling	M	Toro Canyon	1.5484236	0.3142014	Estimable
102	Hass	Seedling	M	Velvick/Hazard	NA	NA	Aliased
103	Hass	Seedling	M	Edranol	NA	NA	Aliased
104	Hass	Seedling	M	Parida	NA	NA	Aliased
105	Hass	Seedling	M	Plowman	NA	NA	Aliased
106	Hass	Seedling	M	Shepard	NA	NA	Aliased
107	Hass	Seedling	M	Hass	NA	NA	Aliased
108	Hass	Seedling	M	Barr Duke	2.1420658	0.4195323	Estimable
109	Hass	Seedling	M	SHSR-01	NA	NA	Aliased
110	Hass	Seedling	M	Rigato	NA	NA	Aliased
111	Hass	Seedling	WI	A10	NA	NA	Aliased
112	Hass	Seedling	WI	A8	NA	NA	Aliased
113	Hass	Seedling	WI	Duke 7	NA	NA	Aliased
114	Hass	Seedling	WI	Nabal	NA	NA	Aliased
115	Hass	Seedling	WI	SHSR-03	NA	NA	Aliased
116	Hass	Seedling	WI	Thomas	NA	NA	Aliased
117	Hass	Seedling	WI	V1	1.4160392	0.3142805	Estimable
118	Hass	Seedling	WI	Velvick	1.3482792	0.3104182	Estimable
119	Hass	Seedling	WI	Zutano	NA	NA	Aliased
120	Hass	Seedling	WI	Peasley	NA	NA	Aliased
121	Hass	Seedling	WI	Reed	NA	NA	Aliased
122	Hass	Seedling	WI	SHSR-02	NA	NA	Aliased
123	Hass	Seedling	WI	Toro Canyon	NA	NA	Aliased
124	Hass	Seedling	WI	Velvick/Hazard	1.2427412	0.3158711	Estimable
125	Hass	Seedling	WI	Edranol	NA	NA	Aliased
126	Hass	Seedling	WI	Parida	NA	NA	Aliased
127	Hass	Seedling	WI	Plowman	NA	NA	Aliased
128	Hass	Seedling	WI	Shepard	NA	NA	Aliased
129	Hass	Seedling	WI	Hass	NA	NA	Aliased
130	Hass	Seedling	WI	Barr Duke	NA	NA	Aliased
131	Hass	Seedling	WI	SHSR-01	NA	NA	Aliased
132	Hass	Seedling	WI	Rigato	NA	NA	Aliased
133	Shepard	Clonal	G	A10	1.5614452	0.5200055	Estimable
134	Shepard	Clonal	G	A8	NA	NA	Aliased
135	Shepard	Clonal	G	Duke 7	NA	NA	Aliased
136	Shepard	Clonal	G	Nabal	1.1775290	0.5282457	Estimable
137	Shepard	Clonal	G	SHSR-03	NA	NA	Aliased
138	Shepard	Clonal	G	Thomas	NA	NA	Aliased
139	Shepard	Clonal	G	V1	NA	NA	Aliased
140	Shepard	Clonal	G	Velvick	NA	NA	Aliased
141	Shepard	Clonal	G	Zutano	NA	NA	Aliased
142	Shepard	Clonal	G	Peasley	NA	NA	Aliased
143	Shepard	Clonal	G	Reed	NA	NA	Aliased
144	Shepard	Clonal	G	SHSR-02	NA	NA	Aliased
145	Shepard	Clonal	G	Toro Canyon	NA	NA	Aliased
146	Shepard	Clonal	G	Velvick/Hazard	NA	NA	Aliased
147	Shepard	Clonal	G	Edranol	NA	NA	Aliased
148	Shepard	Clonal	G	Parida	NA	NA	Aliased
149	Shepard	Clonal	G	Plowman	NA	NA	Aliased
150	Shepard	Clonal	G	Shepard	NA	NA	Aliased
151	Shepard	Clonal	G	Hass	NA	NA	Aliased
152	Shepard	Clonal	G	Barr Duke	NA	NA	Aliased
153	Shepard	Clonal	G	SHSR-01	NA	NA	Aliased
154	Shepard	Clonal	G	Rigato	NA	NA	Aliased
155	Shepard	Clonal	M	A10	NA	NA	Aliased
156	Shepard	Clonal	M	A8	NA	NA	Aliased
157	Shepard	Clonal	M	Duke 7	1.9199804	0.5248478	Estimable
158	Shepard	Clonal	M	Nabal	NA	NA	Aliased
159	Shepard	Clonal	M	SHSR-03	1.6899148	0.5223379	Estimable
160	Shepard	Clonal	M	Thomas	1.2726003	0.5221596	Estimable
161	Shepard	Clonal	M	V1	NA	NA	Aliased
162	Shepard	Clonal	M	Velvick	NA	NA	Aliased
163	Shepard	Clonal	M	Zutano	1.3688143	0.5221606	Estimable
164	Shepard	Clonal	M	Peasley	NA	NA	Aliased
165	Shepard	Clonal	M	Reed	NA	NA	Aliased
166	Shepard	Clonal	M	SHSR-02	NA	NA	Aliased
167	Shepard	Clonal	M	Toro Canyon	NA	NA	Aliased
168	Shepard	Clonal	M	Velvick/Hazard	NA	NA	Aliased
169	Shepard	Clonal	M	Edranol	NA	NA	Aliased

```
170 Shepard   Clonal    M         Parida             NA            NA    Aliased
171 Shepard   Clonal    M        Plowman             NA            NA    Aliased
172 Shepard   Clonal    M        Shepard      1.5269195     0.5200082  Estimable
173 Shepard   Clonal    M           Hass             NA            NA    Aliased
174 Shepard   Clonal    M      Barr Duke      1.6184392     0.5201568  Estimable
175 Shepard   Clonal    M        SHSR-01             NA            NA    Aliased
176 Shepard   Clonal    M         Rigato             NA            NA    Aliased
177 Shepard   Clonal   WI            A10             NA            NA    Aliased
178 Shepard   Clonal   WI             A8             NA            NA    Aliased
179 Shepard   Clonal   WI         Duke 7             NA            NA    Aliased
180 Shepard   Clonal   WI          Nabal             NA            NA    Aliased
181 Shepard   Clonal   WI        SHSR-03             NA            NA    Aliased
182 Shepard   Clonal   WI         Thomas             NA            NA    Aliased
183 Shepard   Clonal   WI             V1             NA            NA    Aliased
184 Shepard   Clonal   WI        Velvick      1.6635691     0.5200029  Estimable
185 Shepard   Clonal   WI         Zutano             NA            NA    Aliased
186 Shepard   Clonal   WI        Peasley             NA            NA    Aliased
187 Shepard   Clonal   WI           Reed             NA            NA    Aliased
188 Shepard   Clonal   WI        SHSR-02             NA            NA    Aliased
189 Shepard   Clonal   WI    Toro Canyon             NA            NA    Aliased
190 Shepard   Clonal   WI Velvick/Hazard             NA            NA    Aliased
191 Shepard   Clonal   WI        Edranol             NA            NA    Aliased
192 Shepard   Clonal   WI         Parida             NA            NA    Aliased
193 Shepard   Clonal   WI        Plowman             NA            NA    Aliased
194 Shepard   Clonal   WI        Shepard             NA            NA    Aliased
195 Shepard   Clonal   WI           Hass             NA            NA    Aliased
196 Shepard   Clonal   WI      Barr Duke             NA            NA    Aliased
197 Shepard   Clonal   WI        SHSR-01             NA            NA    Aliased
198 Shepard   Clonal   WI         Rigato             NA            NA    Aliased
199 Shepard Seedling    G            A10      1.2388867     0.3949482  Estimable
200 Shepard Seedling    G             A8      1.3434106     0.4320594  Estimable
201 Shepard Seedling    G         Duke 7             NA            NA    Aliased
202 Shepard Seedling    G          Nabal      1.2660061     0.3939396  Estimable
203 Shepard Seedling    G        SHSR-03             NA            NA    Aliased
204 Shepard Seedling    G         Thomas             NA            NA    Aliased
205 Shepard Seedling    G             V1             NA            NA    Aliased
206 Shepard Seedling    G        Velvick             NA            NA    Aliased
207 Shepard Seedling    G         Zutano             NA            NA    Aliased
208 Shepard Seedling    G        Peasley             NA            NA    Aliased
209 Shepard Seedling    G           Reed      1.4117804     0.3977850  Estimable
210 Shepard Seedling    G        SHSR-02      1.4000195     0.3938375  Estimable
211 Shepard Seedling    G    Toro Canyon             NA            NA    Aliased
212 Shepard Seedling    G Velvick/Hazard             NA            NA    Aliased
213 Shepard Seedling    G        Edranol      1.6685761     0.4022806  Estimable
214 Shepard Seedling    G         Parida             NA            NA    Aliased
215 Shepard Seedling    G        Plowman      1.3687702     0.4000116  Estimable
216 Shepard Seedling    G        Shepard             NA            NA    Aliased
217 Shepard Seedling    G           Hass             NA            NA    Aliased
218 Shepard Seedling    G      Barr Duke             NA            NA    Aliased
219 Shepard Seedling    G        SHSR-01             NA            NA    Aliased
220 Shepard Seedling    G         Rigato             NA            NA    Aliased
221 Shepard Seedling    M            A10             NA            NA    Aliased
222 Shepard Seedling    M             A8             NA            NA    Aliased
223 Shepard Seedling    M         Duke 7      1.2181418     0.4180734  Estimable
224 Shepard Seedling    M          Nabal             NA            NA    Aliased
225 Shepard Seedling    M        SHSR-03      1.3374781     0.4223102  Estimable
226 Shepard Seedling    M         Thomas             NA            NA    Aliased
227 Shepard Seedling    M             V1             NA            NA    Aliased
228 Shepard Seedling    M        Velvick             NA            NA    Aliased
229 Shepard Seedling    M         Zutano      1.6670668     0.4309775  Estimable
230 Shepard Seedling    M        Peasley             NA            NA    Aliased
231 Shepard Seedling    M           Reed             NA            NA    Aliased
232 Shepard Seedling    M        SHSR-02             NA            NA    Aliased
233 Shepard Seedling    M    Toro Canyon      1.2947985     0.4051033  Estimable
234 Shepard Seedling    M Velvick/Hazard             NA            NA    Aliased
235 Shepard Seedling    M        Edranol             NA            NA    Aliased
236 Shepard Seedling    M         Parida      1.3461654     0.4151125  Estimable
237 Shepard Seedling    M        Plowman             NA            NA    Aliased
238 Shepard Seedling    M        Shepard      1.3251074     0.4020884  Estimable
239 Shepard Seedling    M           Hass             NA            NA    Aliased
240 Shepard Seedling    M      Barr Duke             NA            NA    Aliased
241 Shepard Seedling    M        SHSR-01             NA            NA    Aliased
242 Shepard Seedling    M         Rigato             NA            NA    Aliased
243 Shepard Seedling   WI            A10             NA            NA    Aliased
244 Shepard Seedling   WI             A8             NA            NA    Aliased
245 Shepard Seedling   WI         Duke 7             NA            NA    Aliased
246 Shepard Seedling   WI          Nabal             NA            NA    Aliased
247 Shepard Seedling   WI        SHSR-03             NA            NA    Aliased
248 Shepard Seedling   WI         Thomas             NA            NA    Aliased
249 Shepard Seedling   WI             V1      1.4577948     0.4231140  Estimable
250 Shepard Seedling   WI        Velvick      1.4231524     0.3942768  Estimable
251 Shepard Seedling   WI         Zutano             NA            NA    Aliased
252 Shepard Seedling   WI        Peasley             NA            NA    Aliased
253 Shepard Seedling   WI           Reed             NA            NA    Aliased
254 Shepard Seedling   WI        SHSR-02             NA            NA    Aliased
255 Shepard Seedling   WI    Toro Canyon             NA            NA    Aliased
256 Shepard Seedling   WI Velvick/Hazard             NA            NA    Aliased
257 Shepard Seedling   WI        Edranol             NA            NA    Aliased
258 Shepard Seedling   WI         Parida             NA            NA    Aliased
259 Shepard Seedling   WI        Plowman             NA            NA    Aliased
260 Shepard Seedling   WI        Shepard             NA            NA    Aliased
261 Shepard Seedling   WI           Hass             NA            NA    Aliased
262 Shepard Seedling   WI      Barr Duke             NA            NA    Aliased
263 Shepard Seedling   WI        SHSR-01             NA            NA    Aliased
264 Shepard Seedling   WI         Rigato             NA            NA    Aliased

$avsed
  overall
0.4061827
```



The main effects for Variety, Propagation and Race were not significant.

```
  Variety predicted.value standard.error est.status
1    Hass        1.172335      0.2653643  Estimable
2 Shepard        1.440265      0.3511912  Estimable

$avsed
  overall
0.3100825
```

```
      Prop predicted.value standard.error est.status
1   Clonal        1.149064      0.3093004  Estimable
2 Seedling        1.397030      0.2891891  Estimable

$avsed
  overall
0.2755185
```

```
  Race predicted.value standard.error est.status
1    G        1.231812      0.2622868  Estimable
2    M        1.341489      0.2776613  Estimable
3   WI        1.318809      0.2632491  Estimable

$avsed
  overall
0.0797476
```

Time 3

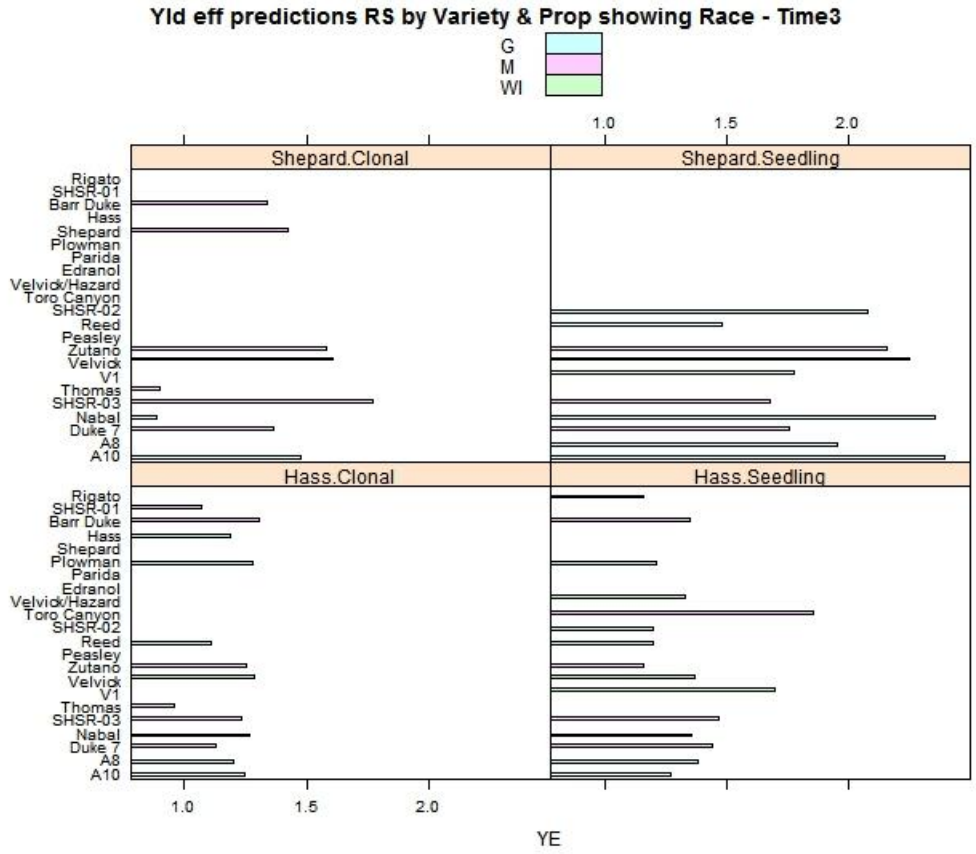
```
                     Df denDF   F.inc           Pr
(Intercept)           1   2.0  9.1970 9.395657e-02
```

```
Variety                1  40.4 25.4600 9.980137e-06
Prop                   1  47.2 14.4200 4.181522e-04
Race                   2  76.9  3.3180 4.150035e-02
Variety:Prop           1  19.4  6.9990 1.577090e-02
Race:Trt              16 184.7  2.1850 6.945370e-03
Variety:Race           2 102.6  1.4610 2.367509e-01
Prop:Race              2 160.2  0.6998 4.982080e-01
Variety:Race:Trt       9 144.4  1.4440 1.744770e-01
Prop:Race:Trt          7 167.0  1.9370 6.675088e-02
Variety:Prop:Race      2  99.9  4.0580 2.021420e-02
Variety:Prop:Race:Trt  3  93.2  1.2420 2.989637e-01
```

At time 3 there was no YE data for Childers – so this site has been excluded.

There was a significant Variety:Prop:Race interaction with predicted values as follows:

```
   Variety     Prop Race predicted.value standard.error est.status
1     Hass   Clonal    G        1.214763      0.4281279  Estimable
2     Hass   Clonal    M        1.158236      0.4312232  Estimable
3     Hass   Clonal   WI        1.285019      0.4293337  Estimable
4     Hass Seedling    G        1.254025      0.4291912  Estimable
5     Hass Seedling    M        1.454718      0.4325889  Estimable
6     Hass Seedling   WI        1.463604      0.4397338  Estimable
7  Shepard   Clonal    G        1.181421      0.4663383  Estimable
8  Shepard   Clonal    M        1.394942      0.4552618  Estimable
9  Shepard   Clonal   WI        1.607060      0.4779758  Estimable
10 Shepard Seedling    G        2.049006      0.4579261  Estimable
11 Shepard Seedling    M        1.864075      0.4765277  Estimable
12 Shepard Seedling   WI        2.010802      0.4900335  Estimable

$avsed
  overall
0.2029054
```



The Variety, Propagation and Race main effects were all significant.

Shepard Scion had significantly higher yield efficiency than Hass Scion.

```
  Variety predicted.value standard.error est.status
1    Hass        1.284485      0.4278522  Estimable
2 Shepard        1.694653      0.4389070  Estimable

$avsed
 overall
0.108217
```

The Seedling RS had significantly higher yield efficiency than the Clonal RS at Time 3.

```
      Prop predicted.value standard.error est.status
1   Clonal        1.266480      0.4318327  Estimable
2 Seedling        1.612058      0.4302550  Estimable

$avsed
   overall
0.08129138
```

```
  Race predicted.value standard.error est.status
1    G        1.433731      0.4297679  Estimable
2    M        1.409244      0.4315669  Estimable
3   WI        1.614928      0.4357809  Estimable

$avsed
   overall
0.08797891
```

Combined analysis across 3 times.

A combined analysis across all 3 times was performed for each trait. Due to the extreme unbalanced nature of the data the conditional Wald tests were unable to be obtained. Sequential Wald tests are presented however these must be used with caution as each term is tested in the model not accounting for terms below it.

1.Yield

Model:

*METY3a.asr<-asreml(SumYld~ Variety*Prop*(Race/Trt)*Tm,*

random =~ Site/Wplot/Rep/Plant,

rcov=~at(SiteScion):ar1h(Tm):ar1(Col):ar1(Row),

data=Ysumsub,na.method.X="include",workspace=2e8,maxiter=30)

This model enables the spatial and temporal correlation between repeated measurements to be modelled (at the residual level), while fitting the Scion Variety, Propagation, Race, Trt(Rootstock) and Time as fixed effects.

Wald tests may be used to test the significance of Scion Variety, Propagation, Race etc..

Note conditional Wald tests are unable to be obtained as the denominator degrees of freedom is unable to be calculated (due to the model being so unbalanced and complex). The sequential Wald tests based on ChiSq (below) will have to be used. These tests are not adjusted for terms below each term so the final test (Variety.Prop.Race.Trt.Tm is fine but tests above this term should be considered carefully). Here there is a significant Variety:Prop:Race:Trt:Tm interaction so focus on these predictions rather than those above this term.

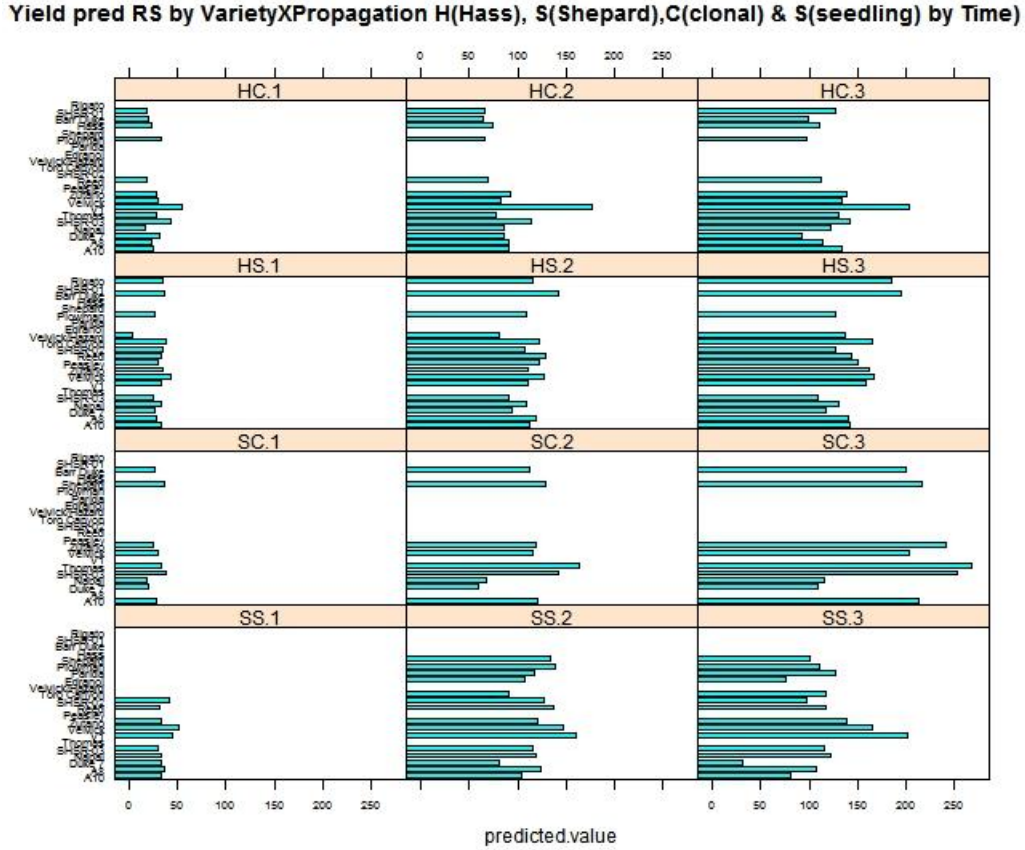
```
Terms added sequentially; adjusted for those above

                        Df Sum of Sq Wald statistic Pr(Chisq)
(Intercept)              1     22.42          22.42 2.192e-06 ***
Variety                  1    118.58         118.58 < 2.2e-16 ***
Prop                     1     11.79          11.79 0.0005956 ***
Race                     2     19.88          19.88 4.824e-05 ***
Tm                       2   2900.10        2900.10 < 2.2e-16 ***
Variety:Prop             1      0.96           0.96 0.3270908
Race:Trt                19     98.15          98.15 1.155e-12 ***
Variety:Race             2      3.09           3.09 0.2131896
Prop:Race                2     15.12          15.12 0.0005216 ***
Variety:Tm               2     18.47          18.47 9.754e-05 ***
Prop:Tm                  2     71.69          71.69 2.220e-16 ***
Race:Tm                  4     45.43          45.43 3.239e-09 ***
Variety:Race:Trt        11     13.97          13.97 0.2344353
```

```
Prop:Race:Trt              9     51.47          51.47 5.705e-08 ***
Variety:Prop:Race          2      7.02           7.02 0.0298486 *
Variety:Prop:Tm            2    113.20         113.20 < 2.2e-16 ***
Race:Trt:Tm               36    117.75         117.75 1.295e-10 ***
Variety:Race:Tm            4     12.99          12.99 0.0113183 *
Prop:Race:Tm               4      4.68           4.68 0.3215518
Variety:Prop:Race:Trt      3      3.33           3.33 0.3434680
Variety:Race:Trt:Tm       20     59.54          59.54 8.380e-06 ***
Prop:Race:Trt:Tm          17     71.99          71.99 9.759e-09 ***
Variety:Prop:Race:Tm       4      3.54           3.54 0.4725243
Variety:Prop:Race:Trt:Tm   6     21.73          21.73 0.0013551 **
residual (MS)                     1.00
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
Predictions from the model:


  Variety predicted.value standard.error est.status
1    Hass        89.41237       8.391195  Estimable
2 Shepard       104.56018       8.738165  Estimable

$avsed
 overall
3.394023


      Prop predicted.value standard.error est.status
1   Clonal        94.15651       8.520418  Estimable
2 Seedling        97.22552       8.527810  Estimable

$avsed
 overall
3.209625


   Variety     Prop Race predicted.value standard.error est.status
1     Hass   Clonal    G        72.79126       8.566358  Estimable
2     Hass   Clonal    M        77.78851       8.703022  Estimable
3     Hass   Clonal   WI       113.68551       9.795449  Estimable
4     Hass Seedling    G        96.86025       8.802300  Estimable
5     Hass Seedling    M        97.95861       9.138544  Estimable
6     Hass Seedling   WI        95.61542       9.144826  Estimable
7  Shepard   Clonal    G        94.17119      10.895013  Estimable
8  Shepard   Clonal    M       121.64093       9.555726  Estimable
9  Shepard   Clonal   WI       116.56223      12.026576  Estimable
10 Shepard Seedling    G        91.70843       9.039755  Estimable
11 Shepard Seedling    M        92.48489      10.597546  Estimable
12 Shepard Seedling   WI       128.59134      11.724702  Estimable

$avsed
overall
7.64381


   Variety     Prop Race Tm predicted.value standard.error est.status
1     Hass   Clonal    G  1        23.42207       8.371389  Estimable
2     Hass   Clonal    G  2        79.73482       9.007965  Estimable
3     Hass   Clonal    G  3       115.21690       9.490640  Estimable
4     Hass   Clonal    M  1        28.36023       8.420006  Estimable
5     Hass   Clonal    M  2        83.83953       9.117766  Estimable
6     Hass   Clonal    M  3       121.16577      10.094031  Estimable
7     Hass   Clonal   WI  1        42.36529       8.792007  Estimable
```

8	Hass	Clonal	WI	2	130.28098	10.883582	Estimable
9	Hass	Clonal	WI	3	168.41028	12.376488	Estimable
10	Hass	Seedling	G	1	31.61281	8.382863	Estimable
11	Hass	Seedling	G	2	115.65825	9.200866	Estimable
12	Hass	Seedling	G	3	143.30969	10.124237	Estimable
13	Hass	Seedling	M	1	32.13620	8.459856	Estimable
14	Hass	Seedling	M	2	111.83146	9.866878	Estimable
15	Hass	Seedling	M	3	149.90817	11.140383	Estimable
16	Hass	Seedling	WI	1	26.91926	8.556172	Estimable
17	Hass	Seedling	WI	2	105.66860	9.795920	Estimable
18	Hass	Seedling	WI	3	154.25839	10.958927	Estimable
19	Shepard	Clonal	G	1	23.88265	8.612803	Estimable
20	Shepard	Clonal	G	2	94.29025	12.544574	Estimable
21	Shepard	Clonal	G	3	164.34067	15.586771	Estimable
22	Shepard	Clonal	M	1	29.57630	8.415994	Estimable
23	Shepard	Clonal	M	2	120.93139	10.445173	Estimable
24	Shepard	Clonal	M	3	214.41509	12.175717	Estimable
25	Shepard	Clonal	WI	1	30.42660	8.827753	Estimable
26	Shepard	Clonal	WI	2	115.40391	14.115817	Estimable
27	Shepard	Clonal	WI	3	203.85617	18.411762	Estimable
28	Shepard	Seedling	G	1	35.04241	8.551895	Estimable
29	Shepard	Seedling	G	2	122.38005	9.439882	Estimable
30	Shepard	Seedling	G	3	101.51255	10.834306	Estimable
31	Shepard	Seedling	M	1	32.70866	8.669787	Estimable
32	Shepard	Seedling	M	2	109.99023	10.345916	Estimable
33	Shepard	Seedling	M	3	104.86767	15.214671	Estimable
34	Shepard	Seedling	WI	1	48.10012	8.765966	Estimable
35	Shepard	Seedling	WI	2	154.37272	12.164525	Estimable
36	Shepard	Seedling	WI	3	183.30117	20.906930	Estimable

```
$avsed
 overall
10.42189
```



	Variety	Prop	Race	Trt	Tm	predicted.value	standard.error	est.status
1	Hass	Clonal	G	A10	1	25.59000	8.53755	Estimable
2	Hass	Clonal	G	A10	2	91.59864	9.76025	Estimable

3	Hass	Clonal	G	A10	3	133.83526	11.27744	Estimable
4	Hass	Clonal	G	A8	1	24.08300	8.57362	Estimable
5	Hass	Clonal	G	A8	2	91.42681	10.31168	Estimable
6	Hass	Clonal	G	A8	3	113.75596	11.98917	Estimable
7	Hass	Clonal	G	Duke 7	1	NA	NA	Aliased
8	Hass	Clonal	G	Duke 7	2	NA	NA	Aliased
9	Hass	Clonal	G	Duke 7	3	NA	NA	Aliased
10	Hass	Clonal	G	Nabal	1	16.85624	8.85061	Estimable
11	Hass	Clonal	G	Nabal	2	85.97641	10.15587	Estimable
12	Hass	Clonal	G	Nabal	3	122.42641	11.56604	Estimable
13	Hass	Clonal	G	SHSR-03	1	NA	NA	Aliased
14	Hass	Clonal	G	SHSR-03	2	NA	NA	Aliased
15	Hass	Clonal	G	SHSR-03	3	NA	NA	Aliased
16	Hass	Clonal	G	Thomas	1	NA	NA	Aliased
17	Hass	Clonal	G	Thomas	2	NA	NA	Aliased
18	Hass	Clonal	G	Thomas	3	NA	NA	Aliased
19	Hass	Clonal	G	V1	1	NA	NA	Aliased
20	Hass	Clonal	G	V1	2	NA	NA	Aliased
21	Hass	Clonal	G	V1	3	NA	NA	Aliased
22	Hass	Clonal	G	Velvick	1	NA	NA	Aliased
23	Hass	Clonal	G	Velvick	2	NA	NA	Aliased
24	Hass	Clonal	G	Velvick	3	NA	NA	Aliased
25	Hass	Clonal	G	Zutano	1	NA	NA	Aliased
26	Hass	Clonal	G	Zutano	2	NA	NA	Aliased
27	Hass	Clonal	G	Zutano	3	NA	NA	Aliased
28	Hass	Clonal	G	Peasley	1	NA	NA	Aliased
29	Hass	Clonal	G	Peasley	2	NA	NA	Aliased
30	Hass	Clonal	G	Peasley	3	NA	NA	Aliased
31	Hass	Clonal	G	Reed	1	18.71587	8.61295	Estimable
32	Hass	Clonal	G	Reed	2	69.58020	10.19018	Estimable
33	Hass	Clonal	G	Reed	3	112.79094	11.41964	Estimable
34	Hass	Clonal	G	SHSR-02	1	NA	NA	Aliased
35	Hass	Clonal	G	SHSR-02	2	NA	NA	Aliased
36	Hass	Clonal	G	SHSR-02	3	NA	NA	Aliased
37	Hass	Clonal	G	Toro Canyon	1	NA	NA	Aliased
38	Hass	Clonal	G	Toro Canyon	2	NA	NA	Aliased
39	Hass	Clonal	G	Toro Canyon	3	NA	NA	Aliased
40	Hass	Clonal	G	Velvick/Hazard	1	NA	NA	Aliased
41	Hass	Clonal	G	Velvick/Hazard	2	NA	NA	Aliased
42	Hass	Clonal	G	Velvick/Hazard	3	NA	NA	Aliased
43	Hass	Clonal	G	Edranol	1	NA	NA	Aliased
44	Hass	Clonal	G	Edranol	2	NA	NA	Aliased
45	Hass	Clonal	G	Edranol	3	NA	NA	Aliased
46	Hass	Clonal	G	Parida	1	NA	NA	Aliased
47	Hass	Clonal	G	Parida	2	NA	NA	Aliased
48	Hass	Clonal	G	Parida	3	NA	NA	Aliased
49	Hass	Clonal	G	Plowman	1	32.73551	9.90671	Estimable
50	Hass	Clonal	G	Plowman	2	65.96204	12.71389	Estimable
51	Hass	Clonal	G	Plowman	3	97.92055	13.91589	Estimable
52	Hass	Clonal	G	Shepard	1	NA	NA	Aliased
53	Hass	Clonal	G	Shepard	2	NA	NA	Aliased
54	Hass	Clonal	G	Shepard	3	NA	NA	Aliased
55	Hass	Clonal	G	Hass	1	22.55179	8.67613	Estimable
56	Hass	Clonal	G	Hass	2	73.86480	10.66814	Estimable
57	Hass	Clonal	G	Hass	3	110.57231	12.31915	Estimable
58	Hass	Clonal	G	Barr Duke	1	NA	NA	Aliased
59	Hass	Clonal	G	Barr Duke	2	NA	NA	Aliased
60	Hass	Clonal	G	Barr Duke	3	NA	NA	Aliased
61	Hass	Clonal	G	SHSR-01	1	NA	NA	Aliased
62	Hass	Clonal	G	SHSR-01	2	NA	NA	Aliased
63	Hass	Clonal	G	SHSR-01	3	NA	NA	Aliased
64	Hass	Clonal	G	Rigato	1	NA	NA	Aliased
65	Hass	Clonal	G	Rigato	2	NA	NA	Aliased
66	Hass	Clonal	G	Rigato	3	NA	NA	Aliased
67	Hass	Clonal	M	A10	1	NA	NA	Aliased
68	Hass	Clonal	M	A10	2	NA	NA	Aliased
69	Hass	Clonal	M	A10	3	NA	NA	Aliased
70	Hass	Clonal	M	A8	1	NA	NA	Aliased
71	Hass	Clonal	M	A8	2	NA	NA	Aliased
72	Hass	Clonal	M	A8	3	NA	NA	Aliased
73	Hass	Clonal	M	Duke 7	1	30.89274	8.54593	Estimable
74	Hass	Clonal	M	Duke 7	2	85.40693	9.79164	Estimable
75	Hass	Clonal	M	Duke 7	3	91.93299	11.01999	Estimable
76	Hass	Clonal	M	Nabal	1	NA	NA	Aliased
77	Hass	Clonal	M	Nabal	2	NA	NA	Aliased
78	Hass	Clonal	M	Nabal	3	NA	NA	Aliased
79	Hass	Clonal	M	SHSR-03	1	43.25870	9.09987	Estimable
80	Hass	Clonal	M	SHSR-03	2	114.37536	11.25465	Estimable
81	Hass	Clonal	M	SHSR-03	3	141.38080	11.96068	Estimable
82	Hass	Clonal	M	Thomas	1	28.44445	8.73614	Estimable
83	Hass	Clonal	M	Thomas	2	78.40954	12.01576	Estimable
84	Hass	Clonal	M	Thomas	3	130.43520	16.99228	Estimable
85	Hass	Clonal	M	V1	1	NA	NA	Aliased
86	Hass	Clonal	M	V1	2	NA	NA	Aliased
87	Hass	Clonal	M	V1	3	NA	NA	Aliased
88	Hass	Clonal	M	Velvick	1	NA	NA	Aliased
89	Hass	Clonal	M	Velvick	2	NA	NA	Aliased
90	Hass	Clonal	M	Velvick	3	NA	NA	Aliased
91	Hass	Clonal	M	Zutano	1	28.88605	8.51507	Estimable
92	Hass	Clonal	M	Zutano	2	93.19286	9.64495	Estimable
93	Hass	Clonal	M	Zutano	3	138.01758	11.17866	Estimable
94	Hass	Clonal	M	Peasley	1	NA	NA	Aliased
95	Hass	Clonal	M	Peasley	2	NA	NA	Aliased
96	Hass	Clonal	M	Peasley	3	NA	NA	Aliased
97	Hass	Clonal	M	Reed	1	NA	NA	Aliased
98	Hass	Clonal	M	Reed	2	NA	NA	Aliased
99	Hass	Clonal	M	Reed	3	NA	NA	Aliased
100	Hass	Clonal	M	SHSR-02	1	NA	NA	Aliased
101	Hass	Clonal	M	SHSR-02	2	NA	NA	Aliased
102	Hass	Clonal	M	SHSR-02	3	NA	NA	Aliased
103	Hass	Clonal	M	Toro Canyon	1	NA	NA	Aliased
104	Hass	Clonal	M	Toro Canyon	2	NA	NA	Aliased
105	Hass	Clonal	M	Toro Canyon	3	NA	NA	Aliased
106	Hass	Clonal	M	Velvick/Hazard	1	NA	NA	Aliased
107	Hass	Clonal	M	Velvick/Hazard	2	NA	NA	Aliased
108	Hass	Clonal	M	Velvick/Hazard	3	NA	NA	Aliased
109	Hass	Clonal	M	Edranol	1	NA	NA	Aliased
110	Hass	Clonal	M	Edranol	2	NA	NA	Aliased
111	Hass	Clonal	M	Edranol	3	NA	NA	Aliased
112	Hass	Clonal	M	Parida	1	NA	NA	Aliased
113	Hass	Clonal	M	Parida	2	NA	NA	Aliased
114	Hass	Clonal	M	Parida	3	NA	NA	Aliased
115	Hass	Clonal	M	Plowman	1	NA	NA	Aliased
116	Hass	Clonal	M	Plowman	2	NA	NA	Aliased
117	Hass	Clonal	M	Plowman	3	NA	NA	Aliased
118	Hass	Clonal	M	Shepard	1	NA	NA	Aliased

119	Hass	Clonal	M	Shepard	2	NA	NA	Aliased
120	Hass	Clonal	M	Shepard	3	NA	NA	Aliased
121	Hass	Clonal	M	Hass	1	NA	NA	Aliased
122	Hass	Clonal	M	Hass	2	NA	NA	Aliased
123	Hass	Clonal	M	Hass	3	NA	NA	Aliased
124	Hass	Clonal	M	Barr Duke	1	20.49132	8.71507	Estimable
125	Hass	Clonal	M	Barr Duke	2	65.13741	10.92698	Estimable
126	Hass	Clonal	M	Barr Duke	3	98.73862	16.01060	Estimable
127	Hass	Clonal	M	SHSR-01	1	18.18811	11.03849	Estimable
128	Hass	Clonal	M	SHSR-01	2	66.51507	12.90470	Estimable
129	Hass	Clonal	M	SHSR-01	3	126.48944	18.29223	Estimable
130	Hass	Clonal	M	Rigato	1	NA	NA	Aliased
131	Hass	Clonal	M	Rigato	2	NA	NA	Aliased
132	Hass	Clonal	M	Rigato	3	NA	NA	Aliased
133	Hass	Clonal	WI	A10	1	NA	NA	Aliased
134	Hass	Clonal	WI	A10	2	NA	NA	Aliased
135	Hass	Clonal	WI	A10	3	NA	NA	Aliased
136	Hass	Clonal	WI	A8	1	NA	NA	Aliased
137	Hass	Clonal	WI	A8	2	NA	NA	Aliased
138	Hass	Clonal	WI	A8	3	NA	NA	Aliased
139	Hass	Clonal	WI	Duke 7	1	NA	NA	Aliased
140	Hass	Clonal	WI	Duke 7	2	NA	NA	Aliased
141	Hass	Clonal	WI	Duke 7	3	NA	NA	Aliased
142	Hass	Clonal	WI	Nabal	1	NA	NA	Aliased
143	Hass	Clonal	WI	Nabal	2	NA	NA	Aliased
144	Hass	Clonal	WI	Nabal	3	NA	NA	Aliased
145	Hass	Clonal	WI	SHSR-03	1	NA	NA	Aliased
146	Hass	Clonal	WI	SHSR-03	2	NA	NA	Aliased
147	Hass	Clonal	WI	SHSR-03	3	NA	NA	Aliased
148	Hass	Clonal	WI	Thomas	1	NA	NA	Aliased
149	Hass	Clonal	WI	Thomas	2	NA	NA	Aliased
150	Hass	Clonal	WI	Thomas	3	NA	NA	Aliased
151	Hass	Clonal	WI	V1	1	55.10747	10.03513	Estimable
152	Hass	Clonal	WI	V1	2	177.44348	15.39542	Estimable
153	Hass	Clonal	WI	V1	3	203.62107	18.62376	Estimable
154	Hass	Clonal	WI	Velvick	1	29.62311	8.52854	Estimable
155	Hass	Clonal	WI	Velvick	2	83.11848	9.79021	Estimable
156	Hass	Clonal	WI	Velvick	3	133.19948	10.97991	Estimable
157	Hass	Clonal	WI	Zutano	1	NA	NA	Aliased
158	Hass	Clonal	WI	Zutano	2	NA	NA	Aliased
159	Hass	Clonal	WI	Zutano	3	NA	NA	Aliased
160	Hass	Clonal	WI	Peasley	1	NA	NA	Aliased
161	Hass	Clonal	WI	Peasley	2	NA	NA	Aliased
162	Hass	Clonal	WI	Peasley	3	NA	NA	Aliased
163	Hass	Clonal	WI	Reed	1	NA	NA	Aliased
164	Hass	Clonal	WI	Reed	2	NA	NA	Aliased
165	Hass	Clonal	WI	Reed	3	NA	NA	Aliased
166	Hass	Clonal	WI	SHSR-02	1	NA	NA	Aliased
167	Hass	Clonal	WI	SHSR-02	2	NA	NA	Aliased
168	Hass	Clonal	WI	SHSR-02	3	NA	NA	Aliased
169	Hass	Clonal	WI	Toro Canyon	1	NA	NA	Aliased
170	Hass	Clonal	WI	Toro Canyon	2	NA	NA	Aliased
171	Hass	Clonal	WI	Toro Canyon	3	NA	NA	Aliased
172	Hass	Clonal	WI	Velvick/Hazard	1	NA	NA	Aliased
173	Hass	Clonal	WI	Velvick/Hazard	2	NA	NA	Aliased
174	Hass	Clonal	WI	Velvick/Hazard	3	NA	NA	Aliased
175	Hass	Clonal	WI	Edranol	1	NA	NA	Aliased
176	Hass	Clonal	WI	Edranol	2	NA	NA	Aliased
177	Hass	Clonal	WI	Edranol	3	NA	NA	Aliased
178	Hass	Clonal	WI	Parida	1	NA	NA	Aliased
179	Hass	Clonal	WI	Parida	2	NA	NA	Aliased
180	Hass	Clonal	WI	Parida	3	NA	NA	Aliased
181	Hass	Clonal	WI	Plowman	1	NA	NA	Aliased
182	Hass	Clonal	WI	Plowman	2	NA	NA	Aliased
183	Hass	Clonal	WI	Plowman	3	NA	NA	Aliased
184	Hass	Clonal	WI	Shepard	1	NA	NA	Aliased
185	Hass	Clonal	WI	Shepard	2	NA	NA	Aliased
186	Hass	Clonal	WI	Shepard	3	NA	NA	Aliased
187	Hass	Clonal	WI	Hass	1	NA	NA	Aliased
188	Hass	Clonal	WI	Hass	2	NA	NA	Aliased
189	Hass	Clonal	WI	Hass	3	NA	NA	Aliased
190	Hass	Clonal	WI	Barr Duke	1	NA	NA	Aliased
191	Hass	Clonal	WI	Barr Duke	2	NA	NA	Aliased
192	Hass	Clonal	WI	Barr Duke	3	NA	NA	Aliased
193	Hass	Clonal	WI	SHSR-01	1	NA	NA	Aliased
194	Hass	Clonal	WI	SHSR-01	2	NA	NA	Aliased
195	Hass	Clonal	WI	SHSR-01	3	NA	NA	Aliased
196	Hass	Clonal	WI	Rigato	1	NA	NA	Aliased
197	Hass	Clonal	WI	Rigato	2	NA	NA	Aliased
198	Hass	Clonal	WI	Rigato	3	NA	NA	Aliased
199	Hass	Seedling	G	A10	1	33.02366	8.66496	Estimable
200	Hass	Seedling	G	A10	2	112.56850	10.69303	Estimable
201	Hass	Seedling	G	A10	3	142.49567	12.56439	Estimable
202	Hass	Seedling	G	A8	1	27.93621	8.79504	Estimable
203	Hass	Seedling	G	A8	2	119.56064	11.68198	Estimable
204	Hass	Seedling	G	A8	3	140.76913	14.17176	Estimable
205	Hass	Seedling	G	Duke 7	1	NA	NA	Aliased
206	Hass	Seedling	G	Duke 7	2	NA	NA	Aliased
207	Hass	Seedling	G	Duke 7	3	NA	NA	Aliased
208	Hass	Seedling	G	Nabal	1	32.68862	8.65658	Estimable
209	Hass	Seedling	G	Nabal	2	109.70089	10.53867	Estimable
210	Hass	Seedling	G	Nabal	3	129.84469	12.12322	Estimable
211	Hass	Seedling	G	SHSR-03	1	NA	NA	Aliased
212	Hass	Seedling	G	SHSR-03	2	NA	NA	Aliased
213	Hass	Seedling	G	SHSR-03	3	NA	NA	Aliased
214	Hass	Seedling	G	Thomas	1	NA	NA	Aliased
215	Hass	Seedling	G	Thomas	2	NA	NA	Aliased
216	Hass	Seedling	G	Thomas	3	NA	NA	Aliased
217	Hass	Seedling	G	V1	1	NA	NA	Aliased
218	Hass	Seedling	G	V1	2	NA	NA	Aliased
219	Hass	Seedling	G	V1	3	NA	NA	Aliased
220	Hass	Seedling	G	Velvick	1	NA	NA	Aliased
221	Hass	Seedling	G	Velvick	2	NA	NA	Aliased
222	Hass	Seedling	G	Velvick	3	NA	NA	Aliased
223	Hass	Seedling	G	Zutano	1	NA	NA	Aliased
224	Hass	Seedling	G	Zutano	2	NA	NA	Aliased
225	Hass	Seedling	G	Zutano	3	NA	NA	Aliased
226	Hass	Seedling	G	Peasley	1	29.41708	10.48645	Estimable
227	Hass	Seedling	G	Peasley	2	123.08643	16.95152	Estimable
228	Hass	Seedling	G	Peasley	3	149.65287	25.32490	Estimable
229	Hass	Seedling	G	Reed	1	32.54147	9.03018	Estimable
230	Hass	Seedling	G	Reed	2	128.71499	12.41138	Estimable
231	Hass	Seedling	G	Reed	3	144.07274	14.41928	Estimable
232	Hass	Seedling	G	SHSR-02	1	35.60962	8.63858	Estimable
233	Hass	Seedling	G	SHSR-02	2	106.76402	10.44280	Estimable
234	Hass	Seedling	G	SHSR-02	3	127.68812	11.90799	Estimable

235	Hass Seedling	G	Toro Canyon	1	NA	NA	Aliased
236	Hass Seedling	G	Toro Canyon	2	NA	NA	Aliased
237	Hass Seedling	G	Toro Canyon	3	NA	NA	Aliased
238	Hass Seedling	G	Velvick/Hazard	1	NA	NA	Aliased
239	Hass Seedling	G	Velvick/Hazard	2	NA	NA	Aliased
240	Hass Seedling	G	Velvick/Hazard	3	NA	NA	Aliased
241	Hass Seedling	G	Edranol	1	NA	NA	Aliased
242	Hass Seedling	G	Edranol	2	NA	NA	Aliased
243	Hass Seedling	G	Edranol	3	NA	NA	Aliased
244	Hass Seedling	G	Parida	1	NA	NA	Aliased
245	Hass Seedling	G	Parida	2	NA	NA	Aliased
246	Hass Seedling	G	Parida	3	NA	NA	Aliased
247	Hass Seedling	G	Plowman	1	27.16802	9.13543	Estimable
248	Hass Seedling	G	Plowman	2	109.27245	12.04319	Estimable
249	Hass Seedling	G	Plowman	3	127.57521	14.01206	Estimable
250	Hass Seedling	G	Shepard	1	NA	NA	Aliased
251	Hass Seedling	G	Shepard	2	NA	NA	Aliased
252	Hass Seedling	G	Shepard	3	NA	NA	Aliased
253	Hass Seedling	G	Hass	1	NA	NA	Aliased
254	Hass Seedling	G	Hass	2	NA	NA	Aliased
255	Hass Seedling	G	Hass	3	NA	NA	Aliased
256	Hass Seedling	G	Barr Duke	1	NA	NA	Aliased
257	Hass Seedling	G	Barr Duke	2	NA	NA	Aliased
258	Hass Seedling	G	Barr Duke	3	NA	NA	Aliased
259	Hass Seedling	G	SHSR-01	1	NA	NA	Aliased
260	Hass Seedling	G	SHSR-01	2	NA	NA	Aliased
261	Hass Seedling	G	SHSR-01	3	NA	NA	Aliased
262	Hass Seedling	G	Rigato	1	34.51781	9.22900	Estimable
263	Hass Seedling	G	Rigato	2	115.59808	16.61695	Estimable
264	Hass Seedling	G	Rigato	3	184.37912	23.62497	Estimable
265	Hass Seedling	M	A10	1	NA	NA	Aliased
266	Hass Seedling	M	A10	2	NA	NA	Aliased
267	Hass Seedling	M	A10	3	NA	NA	Aliased
268	Hass Seedling	M	A8	1	NA	NA	Aliased
269	Hass Seedling	M	A8	2	NA	NA	Aliased
270	Hass Seedling	M	A8	3	NA	NA	Aliased
271	Hass Seedling	M	Duke 7	1	25.94509	8.82383	Estimable
272	Hass Seedling	M	Duke 7	2	94.75739	11.48874	Estimable
273	Hass Seedling	M	Duke 7	3	117.68678	13.18619	Estimable
274	Hass Seedling	M	Nabal	1	NA	NA	Aliased
275	Hass Seedling	M	Nabal	2	NA	NA	Aliased
276	Hass Seedling	M	Nabal	3	NA	NA	Aliased
277	Hass Seedling	M	SHSR-03	1	25.56596	9.46071	Estimable
278	Hass Seedling	M	SHSR-03	2	90.22095	13.14981	Estimable
279	Hass Seedling	M	SHSR-03	3	109.44428	15.10464	Estimable
280	Hass Seedling	M	Thomas	1	NA	NA	Aliased
281	Hass Seedling	M	Thomas	2	NA	NA	Aliased
282	Hass Seedling	M	Thomas	3	NA	NA	Aliased
283	Hass Seedling	M	V1	1	NA	NA	Aliased
284	Hass Seedling	M	V1	2	NA	NA	Aliased
285	Hass Seedling	M	V1	3	NA	NA	Aliased
286	Hass Seedling	M	Velvick	1	NA	NA	Aliased
287	Hass Seedling	M	Velvick	2	NA	NA	Aliased
288	Hass Seedling	M	Velvick	3	NA	NA	Aliased
289	Hass Seedling	M	Zutano	1	34.15508	8.96963	Estimable
290	Hass Seedling	M	Zutano	2	110.81508	13.38446	Estimable
291	Hass Seedling	M	Zutano	3	161.00293	16.24109	Estimable
292	Hass Seedling	M	Peasley	1	NA	NA	Aliased
293	Hass Seedling	M	Peasley	2	NA	NA	Aliased
294	Hass Seedling	M	Peasley	3	NA	NA	Aliased
295	Hass Seedling	M	Reed	1	NA	NA	Aliased
296	Hass Seedling	M	Reed	2	NA	NA	Aliased
297	Hass Seedling	M	Reed	3	NA	NA	Aliased
298	Hass Seedling	M	SHSR-02	1	NA	NA	Aliased
299	Hass Seedling	M	SHSR-02	2	NA	NA	Aliased
300	Hass Seedling	M	SHSR-02	3	NA	NA	Aliased
301	Hass Seedling	M	Toro Canyon	1	38.76548	9.27099	Estimable
302	Hass Seedling	M	Toro Canyon	2	121.75879	12.14975	Estimable
303	Hass Seedling	M	Toro Canyon	3	165.80785	14.81782	Estimable
304	Hass Seedling	M	Velvick/Hazard	1	NA	NA	Aliased
305	Hass Seedling	M	Velvick/Hazard	2	NA	NA	Aliased
306	Hass Seedling	M	Velvick/Hazard	3	NA	NA	Aliased
307	Hass Seedling	M	Edranol	1	NA	NA	Aliased
308	Hass Seedling	M	Edranol	2	NA	NA	Aliased
309	Hass Seedling	M	Edranol	3	NA	NA	Aliased
310	Hass Seedling	M	Parida	1	NA	NA	Aliased
311	Hass Seedling	M	Parida	2	NA	NA	Aliased
312	Hass Seedling	M	Parida	3	NA	NA	Aliased
313	Hass Seedling	M	Plowman	1	NA	NA	Aliased
314	Hass Seedling	M	Plowman	2	NA	NA	Aliased
315	Hass Seedling	M	Plowman	3	NA	NA	Aliased
316	Hass Seedling	M	Shepard	1	NA	NA	Aliased
317	Hass Seedling	M	Shepard	2	NA	NA	Aliased
318	Hass Seedling	M	Shepard	3	NA	NA	Aliased
319	Hass Seedling	M	Hass	1	NA	NA	Aliased
320	Hass Seedling	M	Hass	2	NA	NA	Aliased
321	Hass Seedling	M	Hass	3	NA	NA	Aliased
322	Hass Seedling	M	Barr Duke	1	36.24936	9.23987	Estimable
323	Hass Seedling	M	Barr Duke	2	141.60510	17.03969	Estimable
324	Hass Seedling	M	Barr Duke	3	195.59904	24.47893	Estimable
325	Hass Seedling	M	SHSR-01	1	NA	NA	Aliased
326	Hass Seedling	M	SHSR-01	2	NA	NA	Aliased
327	Hass Seedling	M	SHSR-01	3	NA	NA	Aliased
328	Hass Seedling	M	Rigato	1	NA	NA	Aliased
329	Hass Seedling	M	Rigato	2	NA	NA	Aliased
330	Hass Seedling	M	Rigato	3	NA	NA	Aliased
331	Hass Seedling	WI	A10	1	NA	NA	Aliased
332	Hass Seedling	WI	A10	2	NA	NA	Aliased
333	Hass Seedling	WI	A10	3	NA	NA	Aliased
334	Hass Seedling	WI	A8	1	NA	NA	Aliased
335	Hass Seedling	WI	A8	2	NA	NA	Aliased
336	Hass Seedling	WI	A8	3	NA	NA	Aliased
337	Hass Seedling	WI	Duke 7	1	NA	NA	Aliased
338	Hass Seedling	WI	Duke 7	2	NA	NA	Aliased
339	Hass Seedling	WI	Duke 7	3	NA	NA	Aliased
340	Hass Seedling	WI	Nabal	1	NA	NA	Aliased
341	Hass Seedling	WI	Nabal	2	NA	NA	Aliased
342	Hass Seedling	WI	Nabal	3	NA	NA	Aliased
343	Hass Seedling	WI	SHSR-03	1	NA	NA	Aliased
344	Hass Seedling	WI	SHSR-03	2	NA	NA	Aliased
345	Hass Seedling	WI	SHSR-03	3	NA	NA	Aliased
346	Hass Seedling	WI	Thomas	1	NA	NA	Aliased
347	Hass Seedling	WI	Thomas	2	NA	NA	Aliased
348	Hass Seedling	WI	Thomas	3	NA	NA	Aliased
349	Hass Seedling	WI	V1	1	33.72103	9.17556	Estimable
350	Hass Seedling	WI	V1	2	110.01981	12.24308	Estimable

351	Hass	Seedling	WI	V1	3	158.67835	15.61684	Estimable
352	Hass	Seedling	WI	Velvick	1	43.55928	8.64624	Estimable
353	Hass	Seedling	WI	Velvick	2	126.68633	10.55261	Estimable
354	Hass	Seedling	WI	Velvick	3	166.42616	12.09570	Estimable
355	Hass	Seedling	WI	Zutano	1	NA	NA	Aliased
356	Hass	Seedling	WI	Zutano	2	NA	NA	Aliased
357	Hass	Seedling	WI	Zutano	3	NA	NA	Aliased
358	Hass	Seedling	WI	Peasley	1	NA	NA	Aliased
359	Hass	Seedling	WI	Peasley	2	NA	NA	Aliased
360	Hass	Seedling	WI	Peasley	3	NA	NA	Aliased
361	Hass	Seedling	WI	Reed	1	NA	NA	Aliased
362	Hass	Seedling	WI	Reed	2	NA	NA	Aliased
363	Hass	Seedling	WI	Reed	3	NA	NA	Aliased
364	Hass	Seedling	WI	SHSR-02	1	NA	NA	Aliased
365	Hass	Seedling	WI	SHSR-02	2	NA	NA	Aliased
366	Hass	Seedling	WI	SHSR-02	3	NA	NA	Aliased
367	Hass	Seedling	WI	Toro Canyon	1	NA	NA	Aliased
368	Hass	Seedling	WI	Toro Canyon	2	NA	NA	Aliased
369	Hass	Seedling	WI	Toro Canyon	3	NA	NA	Aliased
370	Hass	Seedling	WI	Velvick/Hazard	1	3.47747	9.51331	Estimable
371	Hass	Seedling	WI	Velvick/Hazard	2	80.29965	13.32536	Estimable
372	Hass	Seedling	WI	Velvick/Hazard	3	137.67067	15.62845	Estimable
373	Hass	Seedling	WI	Edranol	1	NA	NA	Aliased
374	Hass	Seedling	WI	Edranol	2	NA	NA	Aliased
375	Hass	Seedling	WI	Edranol	3	NA	NA	Aliased
376	Hass	Seedling	WI	Parida	1	NA	NA	Aliased
377	Hass	Seedling	WI	Parida	2	NA	NA	Aliased
378	Hass	Seedling	WI	Parida	3	NA	NA	Aliased
379	Hass	Seedling	WI	Plowman	1	NA	NA	Aliased
380	Hass	Seedling	WI	Plowman	2	NA	NA	Aliased
381	Hass	Seedling	WI	Plowman	3	NA	NA	Aliased
382	Hass	Seedling	WI	Shepard	1	NA	NA	Aliased
383	Hass	Seedling	WI	Shepard	2	NA	NA	Aliased
384	Hass	Seedling	WI	Shepard	3	NA	NA	Aliased
385	Hass	Seedling	WI	Hass	1	NA	NA	Aliased
386	Hass	Seedling	WI	Hass	2	NA	NA	Aliased
387	Hass	Seedling	WI	Hass	3	NA	NA	Aliased
388	Hass	Seedling	WI	Barr Duke	1	NA	NA	Aliased
389	Hass	Seedling	WI	Barr Duke	2	NA	NA	Aliased
390	Hass	Seedling	WI	Barr Duke	3	NA	NA	Aliased
391	Hass	Seedling	WI	SHSR-01	1	NA	NA	Aliased
392	Hass	Seedling	WI	SHSR-01	2	NA	NA	Aliased
393	Hass	Seedling	WI	SHSR-01	3	NA	NA	Aliased
394	Hass	Seedling	WI	Rigato	1	NA	NA	Aliased
395	Hass	Seedling	WI	Rigato	2	NA	NA	Aliased
396	Hass	Seedling	WI	Rigato	3	NA	NA	Aliased
397	Shepard	Clonal	G	A10	1	28.69562	8.82780	Estimable
398	Shepard	Clonal	G	A10	2	121.34950	14.14652	Estimable
399	Shepard	Clonal	G	A10	3	213.16200	18.02433	Estimable
400	Shepard	Clonal	G	A8	1	NA	NA	Aliased
401	Shepard	Clonal	G	A8	2	NA	NA	Aliased
402	Shepard	Clonal	G	A8	3	NA	NA	Aliased
403	Shepard	Clonal	G	Duke 7	1	NA	NA	Aliased
404	Shepard	Clonal	G	Duke 7	2	NA	NA	Aliased
405	Shepard	Clonal	G	Duke 7	3	NA	NA	Aliased
406	Shepard	Clonal	G	Nabal	1	19.06969	8.95262	Estimable
407	Shepard	Clonal	G	Nabal	2	67.23099	15.71998	Estimable
408	Shepard	Clonal	G	Nabal	3	115.51935	20.49002	Estimable
409	Shepard	Clonal	G	SHSR-03	1	NA	NA	Aliased
410	Shepard	Clonal	G	SHSR-03	2	NA	NA	Aliased
411	Shepard	Clonal	G	SHSR-03	3	NA	NA	Aliased
412	Shepard	Clonal	G	Thomas	1	NA	NA	Aliased
413	Shepard	Clonal	G	Thomas	2	NA	NA	Aliased
414	Shepard	Clonal	G	Thomas	3	NA	NA	Aliased
415	Shepard	Clonal	G	V1	1	NA	NA	Aliased
416	Shepard	Clonal	G	V1	2	NA	NA	Aliased
417	Shepard	Clonal	G	V1	3	NA	NA	Aliased
418	Shepard	Clonal	G	Velvick	1	NA	NA	Aliased
419	Shepard	Clonal	G	Velvick	2	NA	NA	Aliased
420	Shepard	Clonal	G	Velvick	3	NA	NA	Aliased
421	Shepard	Clonal	G	Zutano	1	NA	NA	Aliased
422	Shepard	Clonal	G	Zutano	2	NA	NA	Aliased
423	Shepard	Clonal	G	Zutano	3	NA	NA	Aliased
424	Shepard	Clonal	G	Peasley	1	NA	NA	Aliased
425	Shepard	Clonal	G	Peasley	2	NA	NA	Aliased
426	Shepard	Clonal	G	Peasley	3	NA	NA	Aliased
427	Shepard	Clonal	G	Reed	1	NA	NA	Aliased
428	Shepard	Clonal	G	Reed	2	NA	NA	Aliased
429	Shepard	Clonal	G	Reed	3	NA	NA	Aliased
430	Shepard	Clonal	G	SHSR-02	1	NA	NA	Aliased
431	Shepard	Clonal	G	SHSR-02	2	NA	NA	Aliased
432	Shepard	Clonal	G	SHSR-02	3	NA	NA	Aliased
433	Shepard	Clonal	G	Toro Canyon	1	NA	NA	Aliased
434	Shepard	Clonal	G	Toro Canyon	2	NA	NA	Aliased
435	Shepard	Clonal	G	Toro Canyon	3	NA	NA	Aliased
436	Shepard	Clonal	G	Velvick/Hazard	1	NA	NA	Aliased
437	Shepard	Clonal	G	Velvick/Hazard	2	NA	NA	Aliased
438	Shepard	Clonal	G	Velvick/Hazard	3	NA	NA	Aliased
439	Shepard	Clonal	G	Edranol	1	NA	NA	Aliased
440	Shepard	Clonal	G	Edranol	2	NA	NA	Aliased
441	Shepard	Clonal	G	Edranol	3	NA	NA	Aliased
442	Shepard	Clonal	G	Parida	1	NA	NA	Aliased
443	Shepard	Clonal	G	Parida	2	NA	NA	Aliased
444	Shepard	Clonal	G	Parida	3	NA	NA	Aliased
445	Shepard	Clonal	G	Plowman	1	NA	NA	Aliased
446	Shepard	Clonal	G	Plowman	2	NA	NA	Aliased
447	Shepard	Clonal	G	Plowman	3	NA	NA	Aliased
448	Shepard	Clonal	G	Shepard	1	NA	NA	Aliased
449	Shepard	Clonal	G	Shepard	2	NA	NA	Aliased
450	Shepard	Clonal	G	Shepard	3	NA	NA	Aliased
451	Shepard	Clonal	G	Hass	1	NA	NA	Aliased
452	Shepard	Clonal	G	Hass	2	NA	NA	Aliased
453	Shepard	Clonal	G	Hass	3	NA	NA	Aliased
454	Shepard	Clonal	G	Barr Duke	1	NA	NA	Aliased
455	Shepard	Clonal	G	Barr Duke	2	NA	NA	Aliased
456	Shepard	Clonal	G	Barr Duke	3	NA	NA	Aliased
457	Shepard	Clonal	G	SHSR-01	1	NA	NA	Aliased
458	Shepard	Clonal	G	SHSR-01	2	NA	NA	Aliased
459	Shepard	Clonal	G	SHSR-01	3	NA	NA	Aliased
460	Shepard	Clonal	G	Rigato	1	NA	NA	Aliased
461	Shepard	Clonal	G	Rigato	2	NA	NA	Aliased
462	Shepard	Clonal	G	Rigato	3	NA	NA	Aliased
463	Shepard	Clonal	M	A10	1	NA	NA	Aliased
464	Shepard	Clonal	M	A10	2	NA	NA	Aliased
465	Shepard	Clonal	M	A10	3	NA	NA	Aliased
466	Shepard	Clonal	M	A8	1	NA	NA	Aliased

467	Shepard	Clonal	M	A8	2	NA	NA	Aliased
468	Shepard	Clonal	M	A8	3	NA	NA	Aliased
469	Shepard	Clonal	M	Duke 7	1	19.53972	8.88221	Estimable
470	Shepard	Clonal	M	Duke 7	2	59.40006	15.05514	Estimable
471	Shepard	Clonal	M	Duke 7	3	108.94893	19.49079	Estimable
472	Shepard	Clonal	M	Nabal	1	NA	NA	Aliased
473	Shepard	Clonal	M	Nabal	2	NA	NA	Aliased
474	Shepard	Clonal	M	Nabal	3	NA	NA	Aliased
475	Shepard	Clonal	M	SHSR-03	1	37.81275	8.88429	Estimable
476	Shepard	Clonal	M	SHSR-03	2	141.59401	14.62019	Estimable
477	Shepard	Clonal	M	SHSR-03	3	252.29040	18.76632	Estimable
478	Shepard	Clonal	M	Thomas	1	33.02757	8.82845	Estimable
479	Shepard	Clonal	M	Thomas	2	163.70161	14.50565	Estimable
480	Shepard	Clonal	M	Thomas	3	267.60527	18.63837	Estimable
481	Shepard	Clonal	M	V1	1	NA	NA	Aliased
482	Shepard	Clonal	M	V1	2	NA	NA	Aliased
483	Shepard	Clonal	M	V1	3	NA	NA	Aliased
484	Shepard	Clonal	M	Velvick	1	NA	NA	Aliased
485	Shepard	Clonal	M	Velvick	2	NA	NA	Aliased
486	Shepard	Clonal	M	Velvick	3	NA	NA	Aliased
487	Shepard	Clonal	M	Zutano	1	25.10486	8.88223	Estimable
488	Shepard	Clonal	M	Zutano	2	119.61209	14.57439	Estimable
489	Shepard	Clonal	M	Zutano	3	241.26123	18.67163	Estimable
490	Shepard	Clonal	M	Peasley	1	NA	NA	Aliased
491	Shepard	Clonal	M	Peasley	2	NA	NA	Aliased
492	Shepard	Clonal	M	Peasley	3	NA	NA	Aliased
493	Shepard	Clonal	M	Reed	1	NA	NA	Aliased
494	Shepard	Clonal	M	Reed	2	NA	NA	Aliased
495	Shepard	Clonal	M	Reed	3	NA	NA	Aliased
496	Shepard	Clonal	M	SHSR-02	1	NA	NA	Aliased
497	Shepard	Clonal	M	SHSR-02	2	NA	NA	Aliased
498	Shepard	Clonal	M	SHSR-02	3	NA	NA	Aliased
499	Shepard	Clonal	M	Toro Canyon	1	NA	NA	Aliased
500	Shepard	Clonal	M	Toro Canyon	2	NA	NA	Aliased
501	Shepard	Clonal	M	Toro Canyon	3	NA	NA	Aliased
502	Shepard	Clonal	M	Velvick/Hazard	1	NA	NA	Aliased
503	Shepard	Clonal	M	Velvick/Hazard	2	NA	NA	Aliased
504	Shepard	Clonal	M	Velvick/Hazard	3	NA	NA	Aliased
505	Shepard	Clonal	M	Edranol	1	NA	NA	Aliased
506	Shepard	Clonal	M	Edranol	2	NA	NA	Aliased
507	Shepard	Clonal	M	Edranol	3	NA	NA	Aliased
508	Shepard	Clonal	M	Parida	1	NA	NA	Aliased
509	Shepard	Clonal	M	Parida	2	NA	NA	Aliased
510	Shepard	Clonal	M	Parida	3	NA	NA	Aliased
511	Shepard	Clonal	M	Plowman	1	NA	NA	Aliased
512	Shepard	Clonal	M	Plowman	2	NA	NA	Aliased
513	Shepard	Clonal	M	Plowman	3	NA	NA	Aliased
514	Shepard	Clonal	M	Shepard	1	35.76727	8.82799	Estimable
515	Shepard	Clonal	M	Shepard	2	128.50821	14.12745	Estimable
516	Shepard	Clonal	M	Shepard	3	215.99972	17.99701	Estimable
517	Shepard	Clonal	M	Hass	1	NA	NA	Aliased
518	Shepard	Clonal	M	Hass	2	NA	NA	Aliased
519	Shepard	Clonal	M	Hass	3	NA	NA	Aliased
520	Shepard	Clonal	M	Barr Duke	1	26.20565	8.82963	Estimable
521	Shepard	Clonal	M	Barr Duke	2	112.77233	14.28862	Estimable
522	Shepard	Clonal	M	Barr Duke	3	200.38498	18.24730	Estimable
523	Shepard	Clonal	M	SHSR-01	1	NA	NA	Aliased
524	Shepard	Clonal	M	SHSR-01	2	NA	NA	Aliased
525	Shepard	Clonal	M	SHSR-01	3	NA	NA	Aliased
526	Shepard	Clonal	M	Rigato	1	NA	NA	Aliased
527	Shepard	Clonal	M	Rigato	2	NA	NA	Aliased
528	Shepard	Clonal	M	Rigato	3	NA	NA	Aliased
529	Shepard	Clonal	WI	A10	1	NA	NA	Aliased
530	Shepard	Clonal	WI	A10	2	NA	NA	Aliased
531	Shepard	Clonal	WI	A10	3	NA	NA	Aliased
532	Shepard	Clonal	WI	A8	1	NA	NA	Aliased
533	Shepard	Clonal	WI	A8	2	NA	NA	Aliased
534	Shepard	Clonal	WI	A8	3	NA	NA	Aliased
535	Shepard	Clonal	WI	Duke 7	1	NA	NA	Aliased
536	Shepard	Clonal	WI	Duke 7	2	NA	NA	Aliased
537	Shepard	Clonal	WI	Duke 7	3	NA	NA	Aliased
538	Shepard	Clonal	WI	Nabal	1	NA	NA	Aliased
539	Shepard	Clonal	WI	Nabal	2	NA	NA	Aliased
540	Shepard	Clonal	WI	Nabal	3	NA	NA	Aliased
541	Shepard	Clonal	WI	SHSR-03	1	NA	NA	Aliased
542	Shepard	Clonal	WI	SHSR-03	2	NA	NA	Aliased
543	Shepard	Clonal	WI	SHSR-03	3	NA	NA	Aliased
544	Shepard	Clonal	WI	Thomas	1	NA	NA	Aliased
545	Shepard	Clonal	WI	Thomas	2	NA	NA	Aliased
546	Shepard	Clonal	WI	Thomas	3	NA	NA	Aliased
547	Shepard	Clonal	WI	V1	1	NA	NA	Aliased
548	Shepard	Clonal	WI	V1	2	NA	NA	Aliased
549	Shepard	Clonal	WI	V1	3	NA	NA	Aliased
550	Shepard	Clonal	WI	Velvick	1	30.42660	8.82775	Estimable
551	Shepard	Clonal	WI	Velvick	2	115.40391	14.11582	Estimable
552	Shepard	Clonal	WI	Velvick	3	203.85617	18.41176	Estimable
553	Shepard	Clonal	WI	Zutano	1	NA	NA	Aliased
554	Shepard	Clonal	WI	Zutano	2	NA	NA	Aliased
555	Shepard	Clonal	WI	Zutano	3	NA	NA	Aliased
556	Shepard	Clonal	WI	Peasley	1	NA	NA	Aliased
557	Shepard	Clonal	WI	Peasley	2	NA	NA	Aliased
558	Shepard	Clonal	WI	Peasley	3	NA	NA	Aliased
559	Shepard	Clonal	WI	Reed	1	NA	NA	Aliased
560	Shepard	Clonal	WI	Reed	2	NA	NA	Aliased
561	Shepard	Clonal	WI	Reed	3	NA	NA	Aliased
562	Shepard	Clonal	WI	SHSR-02	1	NA	NA	Aliased
563	Shepard	Clonal	WI	SHSR-02	2	NA	NA	Aliased
564	Shepard	Clonal	WI	SHSR-02	3	NA	NA	Aliased
565	Shepard	Clonal	WI	Toro Canyon	1	NA	NA	Aliased
566	Shepard	Clonal	WI	Toro Canyon	2	NA	NA	Aliased
567	Shepard	Clonal	WI	Toro Canyon	3	NA	NA	Aliased
568	Shepard	Clonal	WI	Velvick/Hazard	1	NA	NA	Aliased
569	Shepard	Clonal	WI	Velvick/Hazard	2	NA	NA	Aliased
570	Shepard	Clonal	WI	Velvick/Hazard	3	NA	NA	Aliased
571	Shepard	Clonal	WI	Edranol	1	NA	NA	Aliased
572	Shepard	Clonal	WI	Edranol	2	NA	NA	Aliased
573	Shepard	Clonal	WI	Edranol	3	NA	NA	Aliased
574	Shepard	Clonal	WI	Parida	1	NA	NA	Aliased
575	Shepard	Clonal	WI	Parida	2	NA	NA	Aliased
576	Shepard	Clonal	WI	Parida	3	NA	NA	Aliased
577	Shepard	Clonal	WI	Plowman	1	NA	NA	Aliased
578	Shepard	Clonal	WI	Plowman	2	NA	NA	Aliased
579	Shepard	Clonal	WI	Plowman	3	NA	NA	Aliased
580	Shepard	Clonal	WI	Shepard	1	NA	NA	Aliased
581	Shepard	Clonal	WI	Shepard	2	NA	NA	Aliased
582	Shepard	Clonal	WI	Shepard	3	NA	NA	Aliased

583	Shepard	Clonal	WI	Hass	1	NA	NA	Aliased
584	Shepard	Clonal	WI	Hass	2	NA	NA	Aliased
585	Shepard	Clonal	WI	Hass	3	NA	NA	Aliased
586	Shepard	Clonal	WI	Barr Duke	1	NA	NA	Aliased
587	Shepard	Clonal	WI	Barr Duke	2	NA	NA	Aliased
588	Shepard	Clonal	WI	Barr Duke	3	NA	NA	Aliased
589	Shepard	Clonal	WI	SHSR-01	1	NA	NA	Aliased
590	Shepard	Clonal	WI	SHSR-01	2	NA	NA	Aliased
591	Shepard	Clonal	WI	SHSR-01	3	NA	NA	Aliased
592	Shepard	Clonal	WI	Rigato	1	NA	NA	Aliased
593	Shepard	Clonal	WI	Rigato	2	NA	NA	Aliased
594	Shepard	Clonal	WI	Rigato	3	NA	NA	Aliased
595	Shepard	Seedling	G	A10	1	33.34298	9.11342	Estimable
596	Shepard	Seedling	G	A10	2	103.31706	12.22556	Estimable
597	Shepard	Seedling	G	A10	3	81.62456	13.94359	Estimable
598	Shepard	Seedling	G	A8	1	36.74311	9.41626	Estimable
599	Shepard	Seedling	G	A8	2	123.96836	18.13140	Estimable
600	Shepard	Seedling	G	A8	3	107.54647	38.67164	Estimable
601	Shepard	Seedling	G	Duke 7	1	NA	NA	Aliased
602	Shepard	Seedling	G	Duke 7	2	NA	NA	Aliased
603	Shepard	Seedling	G	Duke 7	3	NA	NA	Aliased
604	Shepard	Seedling	G	Nabal	1	32.65289	9.04414	Estimable
605	Shepard	Seedling	G	Nabal	2	119.22009	12.06143	Estimable
606	Shepard	Seedling	G	Nabal	3	122.07350	13.90361	Estimable
607	Shepard	Seedling	G	SHSR-03	1	NA	NA	Aliased
608	Shepard	Seedling	G	SHSR-03	2	NA	NA	Aliased
609	Shepard	Seedling	G	SHSR-03	3	NA	NA	Aliased
610	Shepard	Seedling	G	Thomas	1	NA	NA	Aliased
611	Shepard	Seedling	G	Thomas	2	NA	NA	Aliased
612	Shepard	Seedling	G	Thomas	3	NA	NA	Aliased
613	Shepard	Seedling	G	V1	1	NA	NA	Aliased
614	Shepard	Seedling	G	V1	2	NA	NA	Aliased
615	Shepard	Seedling	G	V1	3	NA	NA	Aliased
616	Shepard	Seedling	G	Velvick	1	NA	NA	Aliased
617	Shepard	Seedling	G	Velvick	2	NA	NA	Aliased
618	Shepard	Seedling	G	Velvick	3	NA	NA	Aliased
619	Shepard	Seedling	G	Zutano	1	NA	NA	Aliased
620	Shepard	Seedling	G	Zutano	2	NA	NA	Aliased
621	Shepard	Seedling	G	Zutano	3	NA	NA	Aliased
622	Shepard	Seedling	G	Peasley	1	NA	NA	Aliased
623	Shepard	Seedling	G	Peasley	2	NA	NA	Aliased
624	Shepard	Seedling	G	Peasley	3	NA	NA	Aliased
625	Shepard	Seedling	G	Reed	1	31.72148	9.10742	Estimable
626	Shepard	Seedling	G	Reed	2	136.93218	12.32795	Estimable
627	Shepard	Seedling	G	Reed	3	116.37751	14.31688	Estimable
628	Shepard	Seedling	G	SHSR-02	1	40.75157	9.04636	Estimable
629	Shepard	Seedling	G	SHSR-02	2	127.15201	12.06689	Estimable
630	Shepard	Seedling	G	SHSR-02	3	97.29460	13.90275	Estimable
631	Shepard	Seedling	G	Toro Canyon	1	NA	NA	Aliased
632	Shepard	Seedling	G	Toro Canyon	2	NA	NA	Aliased
633	Shepard	Seedling	G	Toro Canyon	3	NA	NA	Aliased
634	Shepard	Seedling	G	Velvick/Hazard	1	NA	NA	Aliased
635	Shepard	Seedling	G	Velvick/Hazard	2	NA	NA	Aliased
636	Shepard	Seedling	G	Velvick/Hazard	3	NA	NA	Aliased
637	Shepard	Seedling	G	Edranol	1	NA	NA	Aliased
638	Shepard	Seedling	G	Edranol	2	107.87686	13.92630	Estimable
639	Shepard	Seedling	G	Edranol	3	75.32662	14.41204	Estimable
640	Shepard	Seedling	G	Parida	1	NA	NA	Aliased
641	Shepard	Seedling	G	Parida	2	NA	NA	Aliased
642	Shepard	Seedling	G	Parida	3	NA	NA	Aliased
643	Shepard	Seedling	G	Plowman	1	NA	NA	Aliased
644	Shepard	Seedling	G	Plowman	2	138.19379	13.92507	Estimable
645	Shepard	Seedling	G	Plowman	3	110.34458	14.41064	Estimable
646	Shepard	Seedling	G	Shepard	1	NA	NA	Aliased
647	Shepard	Seedling	G	Shepard	2	NA	NA	Aliased
648	Shepard	Seedling	G	Shepard	3	NA	NA	Aliased
649	Shepard	Seedling	G	Hass	1	NA	NA	Aliased
650	Shepard	Seedling	G	Hass	2	NA	NA	Aliased
651	Shepard	Seedling	G	Hass	3	NA	NA	Aliased
652	Shepard	Seedling	G	Barr Duke	1	NA	NA	Aliased
653	Shepard	Seedling	G	Barr Duke	2	NA	NA	Aliased
654	Shepard	Seedling	G	Barr Duke	3	NA	NA	Aliased
655	Shepard	Seedling	G	SHSR-01	1	NA	NA	Aliased
656	Shepard	Seedling	G	SHSR-01	2	NA	NA	Aliased
657	Shepard	Seedling	G	SHSR-01	3	NA	NA	Aliased
658	Shepard	Seedling	G	Rigato	1	NA	NA	Aliased
659	Shepard	Seedling	G	Rigato	2	NA	NA	Aliased
660	Shepard	Seedling	G	Rigato	3	NA	NA	Aliased
661	Shepard	Seedling	M	A10	1	NA	NA	Aliased
662	Shepard	Seedling	M	A10	2	NA	NA	Aliased
663	Shepard	Seedling	M	A10	3	NA	NA	Aliased
664	Shepard	Seedling	M	A8	1	NA	NA	Aliased
665	Shepard	Seedling	M	A8	2	NA	NA	Aliased
666	Shepard	Seedling	M	A8	3	NA	NA	Aliased
667	Shepard	Seedling	M	Duke 7	1	33.67914	9.12268	Estimable
668	Shepard	Seedling	M	Duke 7	2	81.61986	16.69049	Estimable
669	Shepard	Seedling	M	Duke 7	3	31.40377	36.49214	Estimable
670	Shepard	Seedling	M	Nabal	1	NA	NA	Aliased
671	Shepard	Seedling	M	Nabal	2	NA	NA	Aliased
672	Shepard	Seedling	M	Nabal	3	NA	NA	Aliased
673	Shepard	Seedling	M	SHSR-03	1	30.67928	9.22354	Estimable
674	Shepard	Seedling	M	SHSR-03	2	116.26120	17.80624	Estimable
675	Shepard	Seedling	M	SHSR-03	3	115.99850	38.07177	Estimable
676	Shepard	Seedling	M	Thomas	1	NA	NA	Aliased
677	Shepard	Seedling	M	Thomas	2	NA	NA	Aliased
678	Shepard	Seedling	M	Thomas	3	NA	NA	Aliased
679	Shepard	Seedling	M	V1	1	NA	NA	Aliased
680	Shepard	Seedling	M	V1	2	NA	NA	Aliased
681	Shepard	Seedling	M	V1	3	NA	NA	Aliased
682	Shepard	Seedling	M	Velvick	1	NA	NA	Aliased
683	Shepard	Seedling	M	Velvick	2	NA	NA	Aliased
684	Shepard	Seedling	M	Velvick	3	NA	NA	Aliased
685	Shepard	Seedling	M	Zutano	1	33.76755	9.12556	Estimable
686	Shepard	Seedling	M	Zutano	2	119.97989	18.00870	Estimable
687	Shepard	Seedling	M	Zutano	3	138.50459	39.10497	Estimable
688	Shepard	Seedling	M	Peasley	1	NA	NA	Aliased
689	Shepard	Seedling	M	Peasley	2	NA	NA	Aliased
690	Shepard	Seedling	M	Peasley	3	NA	NA	Aliased
691	Shepard	Seedling	M	Reed	1	NA	NA	Aliased
692	Shepard	Seedling	M	Reed	2	NA	NA	Aliased
693	Shepard	Seedling	M	Reed	3	NA	NA	Aliased
694	Shepard	Seedling	M	SHSR-02	1	NA	NA	Aliased
695	Shepard	Seedling	M	SHSR-02	2	NA	NA	Aliased
696	Shepard	Seedling	M	SHSR-02	3	NA	NA	Aliased
697	Shepard	Seedling	M	Toro Canyon	1	NA	NA	Aliased
698	Shepard	Seedling	M	Toro Canyon	2	91.47834	14.38759	Estimable

```
699 Shepard Seedling    M    Toro Canyon  3       116.48058       14.90680  Estimable
700 Shepard Seedling    M Velvick/Hazard  1              NA             NA    Aliased
701 Shepard Seedling    M Velvick/Hazard  2              NA             NA    Aliased
702 Shepard Seedling    M Velvick/Hazard  3              NA             NA    Aliased
703 Shepard Seedling    M        Edranol  1              NA             NA    Aliased
704 Shepard Seedling    M        Edranol  2              NA             NA    Aliased
705 Shepard Seedling    M        Edranol  3              NA             NA    Aliased
706 Shepard Seedling    M         Parida  1              NA             NA    Aliased
707 Shepard Seedling    M         Parida  2       117.17971       14.93861  Estimable
708 Shepard Seedling    M         Parida  3       126.89546       15.49717  Estimable
709 Shepard Seedling    M        Plowman  1              NA             NA    Aliased
710 Shepard Seedling    M        Plowman  2              NA             NA    Aliased
711 Shepard Seedling    M        Plowman  3              NA             NA    Aliased
712 Shepard Seedling    M        Shepard  1              NA             NA    Aliased
713 Shepard Seedling    M        Shepard  2       133.42234       14.41259  Estimable
714 Shepard Seedling    M        Shepard  3        99.92314       14.93356  Estimable
715 Shepard Seedling    M           Hass  1              NA             NA    Aliased
716 Shepard Seedling    M           Hass  2              NA             NA    Aliased
717 Shepard Seedling    M           Hass  3              NA             NA    Aliased
718 Shepard Seedling    M      Barr Duke  1              NA             NA    Aliased
719 Shepard Seedling    M      Barr Duke  2              NA             NA    Aliased
720 Shepard Seedling    M      Barr Duke  3              NA             NA    Aliased
721 Shepard Seedling    M        SHSR-01  1              NA             NA    Aliased
722 Shepard Seedling    M        SHSR-01  2              NA             NA    Aliased
723 Shepard Seedling    M        SHSR-01  3              NA             NA    Aliased
724 Shepard Seedling    M         Rigato  1              NA             NA    Aliased
725 Shepard Seedling    M         Rigato  2              NA             NA    Aliased
726 Shepard Seedling    M         Rigato  3              NA             NA    Aliased
727 Shepard Seedling   WI           A10  1              NA             NA    Aliased
728 Shepard Seedling   WI           A10  2              NA             NA    Aliased
729 Shepard Seedling   WI           A10  3              NA             NA    Aliased
730 Shepard Seedling   WI            A8  1              NA             NA    Aliased
731 Shepard Seedling   WI            A8  2              NA             NA    Aliased
732 Shepard Seedling   WI            A8  3              NA             NA    Aliased
733 Shepard Seedling   WI        Duke 7  1              NA             NA    Aliased
734 Shepard Seedling   WI        Duke 7  2              NA             NA    Aliased
735 Shepard Seedling   WI        Duke 7  3              NA             NA    Aliased
736 Shepard Seedling   WI         Nabal  1              NA             NA    Aliased
737 Shepard Seedling   WI         Nabal  2              NA             NA    Aliased
738 Shepard Seedling   WI         Nabal  3              NA             NA    Aliased
739 Shepard Seedling   WI       SHSR-03  1              NA             NA    Aliased
740 Shepard Seedling   WI       SHSR-03  2              NA             NA    Aliased
741 Shepard Seedling   WI       SHSR-03  3              NA             NA    Aliased
742 Shepard Seedling   WI        Thomas  1              NA             NA    Aliased
743 Shepard Seedling   WI        Thomas  2              NA             NA    Aliased
744 Shepard Seedling   WI        Thomas  3              NA             NA    Aliased
745 Shepard Seedling   WI            V1  1        44.27521        9.22565  Estimable
746 Shepard Seedling   WI            V1  2       160.89590       17.06399  Estimable
747 Shepard Seedling   WI            V1  3       201.13820       37.32431  Estimable
748 Shepard Seedling   WI       Velvick  1        51.92502        9.02668  Estimable
749 Shepard Seedling   WI       Velvick  2       147.84955       11.91704  Estimable
750 Shepard Seedling   WI       Velvick  3       165.46415       13.81573  Estimable
751 Shepard Seedling   WI        Zutano  1              NA             NA    Aliased
752 Shepard Seedling   WI        Zutano  2              NA             NA    Aliased
753 Shepard Seedling   WI        Zutano  3              NA             NA    Aliased
754 Shepard Seedling   WI       Peasley  1              NA             NA    Aliased
755 Shepard Seedling   WI       Peasley  2              NA             NA    Aliased
756 Shepard Seedling   WI       Peasley  3              NA             NA    Aliased
757 Shepard Seedling   WI          Reed  1              NA             NA    Aliased
758 Shepard Seedling   WI          Reed  2              NA             NA    Aliased
759 Shepard Seedling   WI          Reed  3              NA             NA    Aliased
760 Shepard Seedling   WI       SHSR-02  1              NA             NA    Aliased
761 Shepard Seedling   WI       SHSR-02  2              NA             NA    Aliased
762 Shepard Seedling   WI       SHSR-02  3              NA             NA    Aliased
763 Shepard Seedling   WI    Toro Canyon  1              NA             NA    Aliased
Ct
765 Shepard Seedling   WI    Toro Canyon  3              NA             NA    Aliased
766 Shepard Seedling   WI Velvick/Hazard  1              NA             NA    Aliased
767 Shepard Seedling   WI Velvick/Hazard  2              NA             NA    Aliased
768 Shepard Seedling   WI Velvick/Hazard  3              NA             NA    Aliased
769 Shepard Seedling   WI        Edranol  1              NA             NA    Aliased
770 Shepard Seedling   WI        Edranol  2              NA             NA    Aliased
771 Shepard Seedling   WI        Edranol  3              NA             NA    Aliased
772 Shepard Seedling   WI         Parida  1              NA             NA    Aliased
773 Shepard Seedling   WI         Parida  2              NA             NA    Aliased
774 Shepard Seedling   WI         Parida  3              NA             NA    Aliased
775 Shepard Seedling   WI        Plowman  1              NA             NA    Aliased
776 Shepard Seedling   WI        Plowman  2              NA             NA    Aliased
777 Shepard Seedling   WI        Plowman  3              NA             NA    Aliased
778 Shepard Seedling   WI        Shepard  1              NA             NA    Aliased
779 Shepard Seedling   WI        Shepard  2              NA             NA    Aliased
780 Shepard Seedling   WI        Shepard  3              NA             NA    Aliased
781 Shepard Seedling   WI           Hass  1              NA             NA    Aliased
782 Shepard Seedling   WI           Hass  2              NA             NA    Aliased
783 Shepard Seedling   WI           Hass  3              NA             NA    Aliased
784 Shepard Seedling   WI      Barr Duke  1              NA             NA    Aliased
785 Shepard Seedling   WI      Barr Duke  2              NA             NA    Aliased
786 Shepard Seedling   WI      Barr Duke  3              NA             NA    Aliased
787 Shepard Seedling   WI        SHSR-01  1              NA             NA    Aliased
788 Shepard Seedling   WI        SHSR-01  2              NA             NA    Aliased
789 Shepard Seedling   WI        SHSR-01  3              NA             NA    Aliased
790 Shepard Seedling   WI         Rigato  1              NA             NA    Aliased
791 Shepard Seedling   WI         Rigato  2              NA             NA    Aliased
792 Shepard Seedling   WI         Rigato  3              NA             NA    Aliased

$avsed
 overall
16.83813
```

A summary of the random effect terms in the model is given below. This gives the temporal (residual) correlation between measurements at each Site/Scion and also the spatial correlation parameter estimates in the Row and Column direction for each site/Scion. They may be of interest.

```
summary(METY3a.asr)$varcomp
                                                  gamma     component    std.error     z.ratio    constraint
Site!Site.var                                 2.677090e+02  2.677090e+02 2.227772e+02  1.20168921      Positive
Site:Wplot!Site.var                           3.336568e-06  3.336568e-06           NA          NA      Boundary
Site:Wplot:Rep!Site.var                       3.738951e-06  3.738951e-06           NA          NA      Boundary
Site:Wplot:Rep:Plant!Site.var                 7.729728e+01  7.729728e+01 9.321744e+00  8.29214792      Positive
SiteScion_Childers Hass_clonal!variance       1.000000e+00  1.000000e+00           NA          NA         Fixed
```

SiteScion_Childers	Hass_clonal!Tm.cor	5.550717e-01	5.550717e-01	6.897780e-02	8.04710609	Unconstrained
SiteScion_Childers	Hass_clonal!Tm.1	2.656437e+02	2.656437e+02	5.424463e+01	4.89714393	Positive
SiteScion_Childers	Hass_clonal!Tm.2	1.781611e+03	1.781611e+03	3.138937e+02	5.67584153	Positive
SiteScion_Childers	Hass_clonal!Tm.3	2.983407e+03	2.983407e+03	5.265444e+02	5.66601223	Positive
SiteScion_Childers	Hass_clonal!Col.cor	1.606808e-01	1.606808e-01	1.068478e-01	1.50382823	Unconstrained
SiteScion_Childers	Hass_clonal!Row.cor	2.126642e-01	2.126642e-01	6.647779e-02	3.19902684	Unconstrained
SiteScion_Childers	Hass_seedling!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Childers	Hass_seedling!Tm.cor	6.013910e-01	6.013910e-01	5.704436e-02	10.54251521	Unconstrained
SiteScion_Childers	Hass_seedling!Tm.1	3.256962e+02	3.256962e+02	5.645356e+01	5.76927609	Positive
SiteScion_Childers	Hass_seedling!Tm.2	2.122564e+03	2.122564e+03	3.343046e+02	6.34919329	Positive
SiteScion_Childers	Hass_seedling!Tm.3	3.992143e+03	3.992143e+03	6.343480e+02	6.29330134	Positive
SiteScion_Childers	Hass_seedling!Col.cor	3.649563e-02	3.649563e-02	9.816522e-02	0.37177762	Unconstrained
SiteScion_Childers	Hass_seedling!Row.cor	-8.233459e-02	-8.233459e-02	6.576289e-02	-1.25199158	Unconstrained
SiteScion_Childers	Shepard_seedling!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Childers	Shepard_seedling!Tm.cor	2.776921e-01	2.776921e-01	1.070553e-01	2.59391136	Unconstrained
SiteScion_Childers	Shepard_seedling!Tm.2	1.165498e+03	1.165498e+03	1.906317e+02	6.11387009	Positive
SiteScion_Childers	Shepard_seedling!Tm.3	1.303384e+03	1.303384e+03	2.162422e+02	6.02742795	Positive
SiteScion_Childers	Shepard_seedling!Col.cor	-2.479194e-02	-2.479194e-02	1.324651e-01	-0.18715824	Unconstrained
SiteScion_Childers	Shepard_seedling!Row.cor	-2.504660e-02	-2.504660e-02	8.807412e-02	-0.28438097	Unconstrained
SiteScion_Hampton	Hass_clonal!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Hampton	Hass_clonal!Tm.cor	2.198722e-01	2.198722e-01	1.018468e-01	2.15885277	Unconstrained
SiteScion_Hampton	Hass_clonal!Tm.1	2.770055e+02	2.770055e+02	5.375546e+01	5.15306635	Positive
SiteScion_Hampton	Hass_clonal!Tm.2	1.069262e+03	1.069262e+03	1.804047e+02	5.92702130	Positive
SiteScion_Hampton	Hass_clonal!Tm.3	8.302091e+02	8.302091e+02	1.682871e+02	4.93328854	Positive
SiteScion_Hampton	Hass_clonal!Col.cor	1.471337e-01	1.471337e-01	8.617689e-02	1.70734574	Unconstrained
SiteScion_Hampton	Hass_clonal!Row.cor	3.671789e-01	3.671789e-01	6.787478e-02	5.40965133	Unconstrained
SiteScion_Hampton	Hass_seedling!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Hampton	Hass_seedling!Tm.cor	4.591999e-01	4.591999e-01	7.292250e-02	6.29709473	Unconstrained
SiteScion_Hampton	Hass_seedling!Tm.1	4.189924e+02	4.189924e+02	7.317011e+01	5.72627869	Positive
SiteScion_Hampton	Hass_seedling!Tm.2	2.223323e+03	2.223323e+03	3.512640e+02	6.32949280	Positive
SiteScion_Hampton	Hass_seedling!Tm.3	2.291363e+03	2.291363e+03	4.054184e+02	5.65184722	Positive
SiteScion_Hampton	Hass_seedling!Col.cor	7.516476e-02	7.516476e-02	7.833072e-02	0.95958205	Unconstrained
SiteScion_Hampton	Hass_seedling!Row.cor	2.537962e-01	2.537962e-01	6.586191e-02	3.85345893	Unconstrained
SiteScion_WA	Hass_clonal!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_WA	Hass_clonal!Tm.cor	1.191799e-01	1.191799e-01	1.122569e-01	1.06167187	Unconstrained
SiteScion_WA	Hass_clonal!Tm.1	4.654002e+02	4.654002e+02	1.294664e+02	3.59475766	Positive
SiteScion_WA	Hass_clonal!Tm.2	9.747858e+02	9.747858e+02	2.215651e+02	4.39954668	Positive
SiteScion_WA	Hass_clonal!Tm.3	3.286164e+03	3.286164e+03	7.587328e+02	4.33112210	Positive
SiteScion_WA	Hass_clonal!Col.cor	4.645712e-01	4.645712e-01	1.007343e-01	4.61184842	Unconstrained
SiteScion_WA	Hass_clonal!Row.cor	6.350537e-01	6.350537e-01	5.733930e-02	11.07536506	Unconstrained
SiteScion_WA	Hass_seedling!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_WA	Hass_seedling!Tm.cor	1.976926e-01	1.976926e-01	1.040322e-01	1.90030138	Unconstrained
SiteScion_WA	Hass_seedling!Tm.1	3.524170e+02	3.524170e+02	1.056150e+02	3.33680975	Positive
SiteScion_WA	Hass_seedling!Tm.2	2.245692e+03	2.245692e+03	4.546091e+02	4.93983125	Positive
SiteScion_WA	Hass_seedling!Tm.3	4.585186e+03	4.585186e+03	1.039818e+03	4.40960641	Positive
SiteScion_WA	Hass_seedling!Col.cor	4.034800e-01	4.034800e-01	9.698648e-02	4.16016773	Unconstrained
SiteScion_WA	Hass_seedling!Row.cor	6.823589e-01	6.823589e-01	5.292870e-02	12.89204029	Unconstrained
SiteScion_Walkamin	Hass_clonal!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Walkamin	Hass_clonal!Tm.cor	3.744148e-01	3.744148e-01	1.145814e-01	3.26767462	Unconstrained
SiteScion_Walkamin	Hass_clonal!Tm.1	3.053792e-02	3.053792e-02	1.128079e+00	0.02707072	Positive
SiteScion_Walkamin	Hass_clonal!Tm.2	1.483958e+03	1.483958e+03	3.142791e+02	4.72178178	Positive
SiteScion_Walkamin	Hass_clonal!Tm.3	9.352082e+03	9.352082e+03	1.701938e+03	5.49496005	Positive
SiteScion_Walkamin	Hass_clonal!Col.cor	3.983173e-01	3.983173e-01	1.082005e-01	3.68128797	Unconstrained
SiteScion_Walkamin	Hass_clonal!Row.cor	4.194679e-01	4.194679e-01	7.441004e-02	5.63724895	Unconstrained
SiteScion_Walkamin	Hass_seedling!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Walkamin	Hass_seedling!Tm.cor	4.412041e-01	4.412041e-01	7.890254e-02	5.59175994	Unconstrained
SiteScion_Walkamin	Hass_seedling!Tm.1	1.241988e+02	1.241988e+02	3.659940e+01	3.39346604	Positive
SiteScion_Walkamin	Hass_seedling!Tm.2	3.685190e+03	3.685190e+03	7.173639e+02	5.13712819	Positive
SiteScion_Walkamin	Hass_seedling!Tm.3	9.076327e+03	9.076327e+03	1.519261e+03	5.97417308	Positive
SiteScion_Walkamin	Hass_seedling!Col.cor	1.954465e-01	1.954465e-01	9.094969e-02	2.14895155	Unconstrained
SiteScion_Walkamin	Hass_seedling!Row.cor	5.649355e-01	5.649355e-01	6.017163e-02	9.38873637	Unconstrained
SiteScion_Walkamin	Shepard_clonal!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Walkamin	Shepard_clonal!Tm.cor	5.789831e-01	5.789831e-01	8.196461e-02	7.06381807	Unconstrained
SiteScion_Walkamin	Shepard_clonal!Tm.1	1.056789e+01	1.056789e+01	1.159483e+01	0.91143182	Positive
SiteScion_Walkamin	Shepard_clonal!Tm.2	1.336661e+03	1.336661e+03	2.372525e+02	5.63392044	Positive
SiteScion_Walkamin	Shepard_clonal!Tm.3	2.689194e+03	2.689194e+03	4.663044e+02	5.76703494	Positive
SiteScion_Walkamin	Shepard_clonal!Col.cor	1.264718e-01	1.264718e-01	1.208035e-01	1.04692133	Unconstrained
SiteScion_Walkamin	Shepard_clonal!Row.cor	3.124408e-01	3.124408e-01	8.486351e-02	3.68168566	Unconstrained
SiteScion_Walkamin	Shepard_seedling!variance	1.000000e+00	1.000000e+00	NA	NA	Fixed
SiteScion_Walkamin	Shepard_seedling!Tm.cor	4.464763e-01	4.464763e-01	8.704904e-02	5.12902045	Unconstrained
SiteScion_Walkamin	Shepard_seedling!Tm.1	6.766028e+01	6.766028e+01	2.543827e+01	2.65978337	Positive
SiteScion_Walkamin	Shepard_seedling!Tm.2	2.566605e+03	2.566605e+03	4.777501e+02	5.37227600	Positive
SiteScion_Walkamin	Shepard_seedling!Tm.3	1.500540e+04	1.500540e+04	2.556600e+03	5.86927847	Positive
SiteScion_Walkamin	Shepard_seedling!Col.cor	2.246496e-01	2.246496e-01	1.098916e-01	2.04428298	Unconstrained
SiteScion_Walkamin	Shepard_seedling!Row.cor	4.674760e-01	4.674760e-01	7.080005e-02	6.60276351	Unconstrained

2. Fruit size

A similar analysis to that above has been conducted for fruit size.

The Variety:Prop:Race:Trt:Tm interaction is on the border of being significant (P=0.05) so I would focus on these predictions. Any tests above this term have not been adjusted for this interaction. The predictions for this 5 way interaction are given bleow in a table and in a bargraph.

Wald tests for fixed effects

Response: AvFS

Terms added sequentially; adjusted for those above

```
                         Df Sum of Sq Wald statistic Pr(Chisq)
(Intercept)               1   210.776        210.776 < 2.2e-16 ***
Variety                   1    10.715         10.715 0.0010625 **
Prop                      1     0.920          0.920 0.3375022
Race                      2    27.433         27.433 1.104e-06 ***
Tm                        2    74.594         74.594 < 2.2e-16 ***
Variety:Prop              1     1.671          1.671 0.1961098
Race:Trt                 19    47.037         47.037 0.0003528 ***
Variety:Race              2     1.304          1.304 0.5209659
Prop:Race                 2     3.539          3.539 0.1703828
Variety:Tm                2    52.627         52.627 3.733e-12 ***
Prop:Tm                   2    38.297         38.297 4.828e-09 ***
Race:Tm                   4    10.186         10.186 0.0374094 *
Variety:Race:Trt         11    15.507         15.507 0.1604288
Prop:Race:Trt             9    29.864         29.864 0.0004627 ***
Variety:Prop:Race         2     3.742          3.742 0.1540028
Variety:Prop:Tm           2     3.559          3.559 0.1687636
Race:Trt:Tm              38   100.843        100.843 1.343e-07 ***
Variety:Race:Tm           4     9.441          9.441 0.0509729 .
Prop:Race:Tm              4    21.568         21.568 0.0002442 ***
Variety:Prop:Race:Trt     3    10.963         10.963 0.0119252 *
Variety:Race:Trt:Tm      22    51.470         51.470 0.0003698 ***
Prop:Race:Trt:Tm         18    37.205         37.205 0.0049275 **
Variety:Prop:Race:Tm      4     6.063          6.063 0.1944815
Variety:Prop:Race:Trt:Tm  6    12.378         12.378 0.0540494 .
residual (MS)                  1.000
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

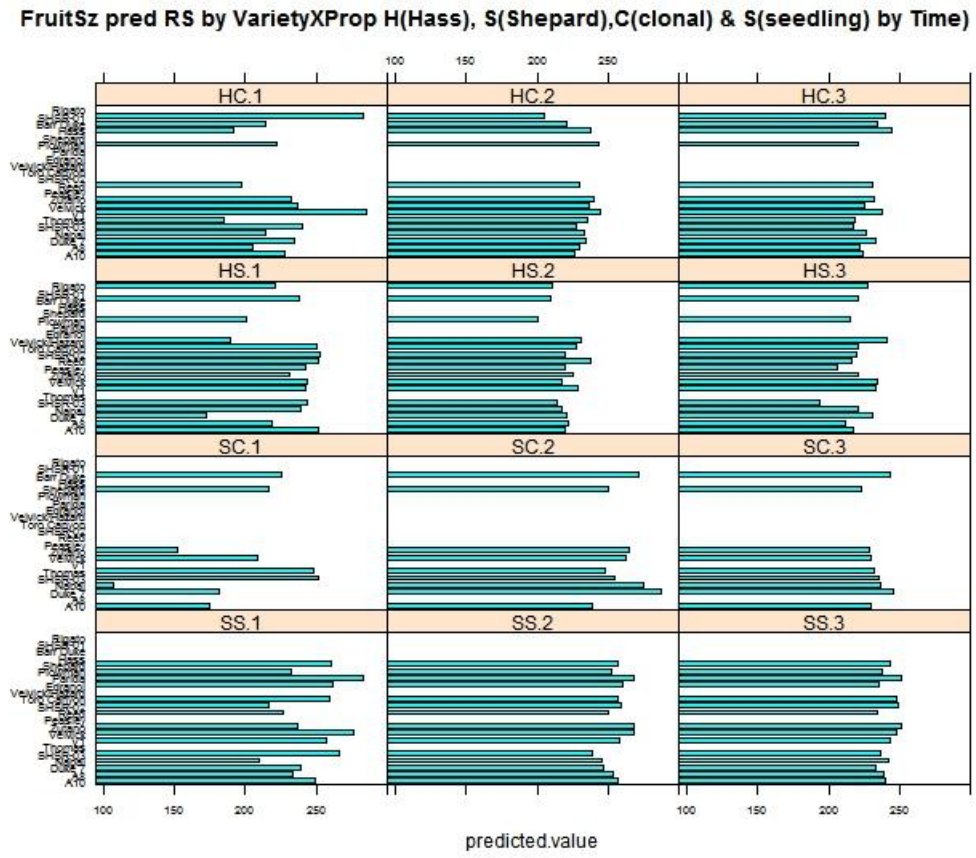
```
>
```

```
  Variety predicted.value standard.error est.status
1    Hass        226.3404       15.96037  Estimable
2 Shepard        241.8304       16.69263  Estimable

$avsed
 overall
6.490261

      Prop predicted.value standard.error est.status
1   Clonal        229.7454       16.31327  Estimable
2 Seedling        235.8063       16.13644  Estimable
$avsed
 overall
5.673128
```

```
   Variety     Prop Race predicted.value standard.error est.status
1     Hass   Clonal    G        223.8103       16.26296  Estimable
2     Hass   Clonal    M        229.4566       16.37601  Estimable
3     Hass   Clonal   WI        244.5040       16.64061  Estimable
4     Hass Seedling    G        223.4540       16.32647  Estimable
5     Hass Seedling    M        221.3856       16.50034  Estimable
6     Hass Seedling   WI        229.0142       16.48548  Estimable
7  Shepard   Clonal    G        210.4946       19.39541  Estimable
8  Shepard   Clonal    M        236.7969       18.52271  Estimable
9  Shepard   Clonal   WI        233.7657       20.28457  Estimable
10 Shepard Seedling    G        242.3374       17.02544  Estimable
11 Shepard Seedling    M        252.4653       17.16635  Estimable
12 Shepard Seedling   WI        258.6195       17.43132  Estimable
$avsed
 overall
9.966172
```

	Variety	Prop	Race	Tm	predicted.value	standard.error	est.status
1	Hass	Clonal	G	1	209.7063	16.90848	Estimable
2	Hass	Clonal	G	2	233.7177	16.29304	Estimable
3	Hass	Clonal	G	3	228.0068	16.33661	Estimable
4	Hass	Clonal	M	1	231.5206	17.55354	Estimable
5	Hass	Clonal	M	2	227.5419	16.52314	Estimable
6	Hass	Clonal	M	3	229.3072	16.46057	Estimable
7	Hass	Clonal	WI	1	261.0449	19.54133	Estimable
8	Hass	Clonal	WI	2	240.7176	16.36280	Estimable
9	Hass	Clonal	WI	3	231.7496	16.41969	Estimable
10	Hass	Seedling	G	1	235.1279	17.10864	Estimable
11	Hass	Seedling	G	2	218.4862	16.31834	Estimable
12	Hass	Seedling	G	3	216.7480	16.50108	Estimable
13	Hass	Seedling	M	1	227.0607	18.17508	Estimable
14	Hass	Seedling	M	2	219.4745	16.46145	Estimable
15	Hass	Seedling	M	3	217.6215	16.60117	Estimable
16	Hass	Seedling	WI	1	224.9024	17.70168	Estimable
17	Hass	Seedling	WI	2	225.7178	16.43570	Estimable
18	Hass	Seedling	WI	3	236.4224	16.98663	Estimable
19	Shepard	Clonal	G	1	140.8971	27.28569	Estimable
20	Shepard	Clonal	G	2	257.1975	18.52491	Estimable
21	Shepard	Clonal	G	3	233.3891	18.23718	Estimable
22	Shepard	Clonal	M	1	212.6117	22.26039	Estimable
23	Shepard	Clonal	M	2	262.8816	18.14072	Estimable
24	Shepard	Clonal	M	3	234.8972	18.02542	Estimable
25	Shepard	Clonal	WI	1	208.5348	31.82395	Estimable
26	Shepard	Clonal	WI	2	262.3732	18.85300	Estimable
27	Shepard	Clonal	WI	3	230.3892	18.47061	Estimable
28	Shepard	Seedling	G	1	232.9901	18.56452	Estimable
29	Shepard	Seedling	G	2	254.3070	17.01543	Estimable
30	Shepard	Seedling	G	3	239.7152	16.93203	Estimable
31	Shepard	Seedling	M	1	257.6767	19.44859	Estimable
32	Shepard	Seedling	M	2	255.8337	17.19503	Estimable
33	Shepard	Seedling	M	3	243.8854	17.04392	Estimable
34	Shepard	Seedling	WI	1	266.9159	20.91014	Estimable
35	Shepard	Seedling	WI	2	263.3144	17.53324	Estimable
36	Shepard	Seedling	WI	3	245.6283	17.29147	Estimable

$avsed
 overall
13.30699



	Variety	Prop	Race	Trt	Tm	predicted.value	standard.error	est.status
1	Hass	Clonal	G	A10	1	228.3874	18.17125	Estimable
2	Hass	Clonal	G	A10	2	226.6390	16.44156	Estimable
3	Hass	Clonal	G	A10	3	223.6826	16.56083	Estimable
4	Hass	Clonal	G	A8	1	205.0950	18.42179	Estimable
5	Hass	Clonal	G	A8	2	230.2329	16.46324	Estimable
6	Hass	Clonal	G	A8	3	221.6651	16.61920	Estimable
7	Hass	Clonal	G	Duke 7	1	NA	NA	Aliased
8	Hass	Clonal	G	Duke 7	2	NA	NA	Aliased
9	Hass	Clonal	G	Duke 7	3	NA	NA	Aliased
10	Hass	Clonal	G	Nabal	1	214.4551	18.58093	Estimable
11	Hass	Clonal	G	Nabal	2	233.4951	16.46824	Estimable
12	Hass	Clonal	G	Nabal	3	226.4378	16.66580	Estimable
13	Hass	Clonal	G	SHSR-03	1	NA	NA	Aliased
14	Hass	Clonal	G	SHSR-03	2	NA	NA	Aliased
15	Hass	Clonal	G	SHSR-03	3	NA	NA	Aliased
16	Hass	Clonal	G	Thomas	1	NA	NA	Aliased
17	Hass	Clonal	G	Thomas	2	NA	NA	Aliased
18	Hass	Clonal	G	Thomas	3	NA	NA	Aliased
19	Hass	Clonal	G	V1	1	NA	NA	Aliased
20	Hass	Clonal	G	V1	2	NA	NA	Aliased
21	Hass	Clonal	G	V1	3	NA	NA	Aliased
22	Hass	Clonal	G	Velvick	1	NA	NA	Aliased
23	Hass	Clonal	G	Velvick	2	NA	NA	Aliased
24	Hass	Clonal	G	Velvick	3	NA	NA	Aliased
25	Hass	Clonal	G	Zutano	1	NA	NA	Aliased
26	Hass	Clonal	G	Zutano	2	NA	NA	Aliased
27	Hass	Clonal	G	Zutano	3	NA	NA	Aliased
28	Hass	Clonal	G	Peasley	1	NA	NA	Aliased
29	Hass	Clonal	G	Peasley	2	NA	NA	Aliased
30	Hass	Clonal	G	Peasley	3	NA	NA	Aliased
31	Hass	Clonal	G	Reed	1	197.5449	18.60442	Estimable
32	Hass	Clonal	G	Reed	2	230.0653	16.98268	Estimable
33	Hass	Clonal	G	Reed	3	231.2667	17.02122	Estimable
34	Hass	Clonal	G	SHSR-02	1	NA	NA	Aliased
35	Hass	Clonal	G	SHSR-02	2	NA	NA	Aliased
36	Hass	Clonal	G	SHSR-02	3	NA	NA	Aliased
37	Hass	Clonal	G	Toro Canyon	1	NA	NA	Aliased
38	Hass	Clonal	G	Toro Canyon	2	NA	NA	Aliased
39	Hass	Clonal	G	Toro Canyon	3	NA	NA	Aliased
40	Hass	Clonal	G	Velvick/Hazard	1	NA	NA	Aliased
41	Hass	Clonal	G	Velvick/Hazard	2	NA	NA	Aliased
42	Hass	Clonal	G	Velvick/Hazard	3	NA	NA	Aliased
43	Hass	Clonal	G	Edranol	1	NA	NA	Aliased
44	Hass	Clonal	G	Edranol	2	NA	NA	Aliased
45	Hass	Clonal	G	Edranol	3	NA	NA	Aliased
46	Hass	Clonal	G	Parida	1	NA	NA	Aliased
47	Hass	Clonal	G	Parida	2	NA	NA	Aliased
48	Hass	Clonal	G	Parida	3	NA	NA	Aliased
49	Hass	Clonal	G	Plowman	1	221.6427	19.82000	Estimable
50	Hass	Clonal	G	Plowman	2	243.7352	17.36280	Estimable

51	Hass	Clonal	G	Plowman	3	220.6851	18.49431	Estimable
52	Hass	Clonal	G	Shepard	1	NA	NA	Aliased
53	Hass	Clonal	G	Shepard	2	NA	NA	Aliased
54	Hass	Clonal	G	Shepard	3	NA	NA	Aliased
55	Hass	Clonal	G	Hass	1	191.1128	18.90290	Estimable
56	Hass	Clonal	G	Hass	2	238.1388	17.09226	Estimable
57	Hass	Clonal	G	Hass	3	244.3034	17.26962	Estimable
58	Hass	Clonal	G	Barr Duke	1	NA	NA	Aliased
59	Hass	Clonal	G	Barr Duke	2	NA	NA	Aliased
60	Hass	Clonal	G	Barr Duke	3	NA	NA	Aliased
61	Hass	Clonal	G	SHSR-01	1	NA	NA	Aliased
62	Hass	Clonal	G	SHSR-01	2	NA	NA	Aliased
63	Hass	Clonal	G	SHSR-01	3	NA	NA	Aliased
64	Hass	Clonal	G	Rigato	1	NA	NA	Aliased
65	Hass	Clonal	G	Rigato	2	NA	NA	Aliased
66	Hass	Clonal	G	Rigato	3	NA	NA	Aliased
67	Hass	Clonal	M	A10	1	NA	NA	Aliased
68	Hass	Clonal	M	A10	2	NA	NA	Aliased
69	Hass	Clonal	M	A10	3	NA	NA	Aliased
70	Hass	Clonal	M	A8	1	NA	NA	Aliased
71	Hass	Clonal	M	A8	2	NA	NA	Aliased
72	Hass	Clonal	M	A8	3	NA	NA	Aliased
73	Hass	Clonal	M	Duke 7	1	234.0931	18.19921	Estimable
74	Hass	Clonal	M	Duke 7	2	234.8142	16.46621	Estimable
75	Hass	Clonal	M	Duke 7	3	233.2133	16.54267	Estimable
76	Hass	Clonal	M	Nabal	1	NA	NA	Aliased
77	Hass	Clonal	M	Nabal	2	NA	NA	Aliased
78	Hass	Clonal	M	Nabal	3	NA	NA	Aliased
79	Hass	Clonal	M	SHSR-03	1	239.8769	18.96173	Estimable
80	Hass	Clonal	M	SHSR-03	2	228.2399	16.49380	Estimable
81	Hass	Clonal	M	SHSR-03	3	217.7362	16.69751	Estimable
82	Hass	Clonal	M	Thomas	1	184.9433	21.96349	Estimable
83	Hass	Clonal	M	Thomas	2	235.5090	16.62043	Estimable
84	Hass	Clonal	M	Thomas	3	218.3536	16.73282	Estimable
85	Hass	Clonal	M	V1	1	NA	NA	Aliased
86	Hass	Clonal	M	V1	2	NA	NA	Aliased
87	Hass	Clonal	M	V1	3	NA	NA	Aliased
88	Hass	Clonal	M	Velvick	1	NA	NA	Aliased
89	Hass	Clonal	M	Velvick	2	NA	NA	Aliased
90	Hass	Clonal	M	Velvick	3	NA	NA	Aliased
91	Hass	Clonal	M	Zutano	1	232.5239	18.10300	Estimable
92	Hass	Clonal	M	Zutano	2	240.6998	16.43429	Estimable
93	Hass	Clonal	M	Zutano	3	231.8374	16.51334	Estimable
94	Hass	Clonal	M	Peasley	1	NA	NA	Aliased
95	Hass	Clonal	M	Peasley	2	NA	NA	Aliased
96	Hass	Clonal	M	Peasley	3	NA	NA	Aliased
97	Hass	Clonal	M	Reed	1	NA	NA	Aliased
98	Hass	Clonal	M	Reed	2	NA	NA	Aliased
99	Hass	Clonal	M	Reed	3	NA	NA	Aliased
100	Hass	Clonal	M	SHSR-02	1	NA	NA	Aliased
101	Hass	Clonal	M	SHSR-02	2	NA	NA	Aliased
102	Hass	Clonal	M	SHSR-02	3	NA	NA	Aliased
103	Hass	Clonal	M	Toro Canyon	1	NA	NA	Aliased
104	Hass	Clonal	M	Toro Canyon	2	NA	NA	Aliased
105	Hass	Clonal	M	Toro Canyon	3	NA	NA	Aliased
106	Hass	Clonal	M	Velvick/Hazard	1	NA	NA	Aliased
107	Hass	Clonal	M	Velvick/Hazard	2	NA	NA	Aliased
108	Hass	Clonal	M	Velvick/Hazard	3	NA	NA	Aliased
109	Hass	Clonal	M	Edranol	1	NA	NA	Aliased
110	Hass	Clonal	M	Edranol	2	NA	NA	Aliased
111	Hass	Clonal	M	Edranol	3	NA	NA	Aliased
112	Hass	Clonal	M	Parida	1	NA	NA	Aliased
113	Hass	Clonal	M	Parida	2	NA	NA	Aliased
114	Hass	Clonal	M	Parida	3	NA	NA	Aliased
115	Hass	Clonal	M	Plowman	1	NA	NA	Aliased
116	Hass	Clonal	M	Plowman	2	NA	NA	Aliased
117	Hass	Clonal	M	Plowman	3	NA	NA	Aliased
118	Hass	Clonal	M	Shepard	1	NA	NA	Aliased
119	Hass	Clonal	M	Shepard	2	NA	NA	Aliased
120	Hass	Clonal	M	Shepard	3	NA	NA	Aliased
121	Hass	Clonal	M	Hass	1	NA	NA	Aliased
122	Hass	Clonal	M	Hass	2	NA	NA	Aliased
123	Hass	Clonal	M	Hass	3	NA	NA	Aliased
124	Hass	Clonal	M	Barr Duke	1	214.5877	22.10332	Estimable
125	Hass	Clonal	M	Barr Duke	2	220.5581	18.55271	Estimable
126	Hass	Clonal	M	Barr Duke	3	234.6669	17.81527	Estimable
127	Hass	Clonal	M	SHSR-01	1	283.0990	32.33218	Estimable
128	Hass	Clonal	M	SHSR-01	2	205.4302	23.70702	Estimable
129	Hass	Clonal	M	SHSR-01	3	240.0358	22.62736	Estimable
130	Hass	Clonal	M	Rigato	1	NA	NA	Aliased
131	Hass	Clonal	M	Rigato	2	NA	NA	Aliased
132	Hass	Clonal	M	Rigato	3	NA	NA	Aliased
133	Hass	Clonal	WI	A10	1	NA	NA	Aliased
134	Hass	Clonal	WI	A10	2	NA	NA	Aliased
135	Hass	Clonal	WI	A10	3	NA	NA	Aliased
136	Hass	Clonal	WI	A8	1	NA	NA	Aliased
137	Hass	Clonal	WI	A8	2	NA	NA	Aliased
138	Hass	Clonal	WI	A8	3	NA	NA	Aliased
139	Hass	Clonal	WI	Duke 7	1	NA	NA	Aliased
140	Hass	Clonal	WI	Duke 7	2	NA	NA	Aliased
141	Hass	Clonal	WI	Duke 7	3	NA	NA	Aliased
142	Hass	Clonal	WI	Nabal	1	NA	NA	Aliased
143	Hass	Clonal	WI	Nabal	2	NA	NA	Aliased
144	Hass	Clonal	WI	Nabal	3	NA	NA	Aliased
145	Hass	Clonal	WI	SHSR-03	1	NA	NA	Aliased
146	Hass	Clonal	WI	SHSR-03	2	NA	NA	Aliased
147	Hass	Clonal	WI	SHSR-03	3	NA	NA	Aliased
148	Hass	Clonal	WI	Thomas	1	NA	NA	Aliased
149	Hass	Clonal	WI	Thomas	2	NA	NA	Aliased

150	Hass	Clonal	WI	Thomas	3	NA	NA	Aliased
151	Hass	Clonal	WI	V1	1	285.1644	25.90097	Estimable
152	Hass	Clonal	WI	V1	2	244.2773	16.62461	Estimable
153	Hass	Clonal	WI	V1	3	237.8548	16.81001	Estimable
154	Hass	Clonal	WI	Velvick	1	236.9255	18.18756	Estimable
155	Hass	Clonal	WI	Velvick	2	237.1579	16.44594	Estimable
156	Hass	Clonal	WI	Velvick	3	225.6444	16.51283	Estimable
157	Hass	Clonal	WI	Zutano	1	NA	NA	Aliased
158	Hass	Clonal	WI	Zutano	2	NA	NA	Aliased
159	Hass	Clonal	WI	Zutano	3	NA	NA	Aliased
160	Hass	Clonal	WI	Peasley	1	NA	NA	Aliased
161	Hass	Clonal	WI	Peasley	2	NA	NA	Aliased
162	Hass	Clonal	WI	Peasley	3	NA	NA	Aliased
163	Hass	Clonal	WI	Reed	1	NA	NA	Aliased
164	Hass	Clonal	WI	Reed	2	NA	NA	Aliased
165	Hass	Clonal	WI	Reed	3	NA	NA	Aliased
166	Hass	Clonal	WI	SHSR-02	1	NA	NA	Aliased
167	Hass	Clonal	WI	SHSR-02	2	NA	NA	Aliased
168	Hass	Clonal	WI	SHSR-02	3	NA	NA	Aliased
169	Hass	Clonal	WI	Toro Canyon	1	NA	NA	Aliased
170	Hass	Clonal	WI	Toro Canyon	2	NA	NA	Aliased
171	Hass	Clonal	WI	Toro Canyon	3	NA	NA	Aliased
172	Hass	Clonal	WI	Velvick/Hazard	1	NA	NA	Aliased
173	Hass	Clonal	WI	Velvick/Hazard	2	NA	NA	Aliased
174	Hass	Clonal	WI	Velvick/Hazard	3	NA	NA	Aliased
175	Hass	Clonal	WI	Edranol	1	NA	NA	Aliased
176	Hass	Clonal	WI	Edranol	2	NA	NA	Aliased
177	Hass	Clonal	WI	Edranol	3	NA	NA	Aliased
178	Hass	Clonal	WI	Parida	1	NA	NA	Aliased
179	Hass	Clonal	WI	Parida	2	NA	NA	Aliased
180	Hass	Clonal	WI	Parida	3	NA	NA	Aliased
181	Hass	Clonal	WI	Plowman	1	NA	NA	Aliased
182	Hass	Clonal	WI	Plowman	2	NA	NA	Aliased
183	Hass	Clonal	WI	Plowman	3	NA	NA	Aliased
184	Hass	Clonal	WI	Shepard	1	NA	NA	Aliased
185	Hass	Clonal	WI	Shepard	2	NA	NA	Aliased
186	Hass	Clonal	WI	Shepard	3	NA	NA	Aliased
187	Hass	Clonal	WI	Hass	1	NA	NA	Aliased
188	Hass	Clonal	WI	Hass	2	NA	NA	Aliased
189	Hass	Clonal	WI	Hass	3	NA	NA	Aliased
190	Hass	Clonal	WI	Barr Duke	1	NA	NA	Aliased
191	Hass	Clonal	WI	Barr Duke	2	NA	NA	Aliased
192	Hass	Clonal	WI	Barr Duke	3	NA	NA	Aliased
193	Hass	Clonal	WI	SHSR-01	1	NA	NA	Aliased
194	Hass	Clonal	WI	SHSR-01	2	NA	NA	Aliased
195	Hass	Clonal	WI	SHSR-01	3	NA	NA	Aliased
196	Hass	Clonal	WI	Rigato	1	NA	NA	Aliased
197	Hass	Clonal	WI	Rigato	2	NA	NA	Aliased
198	Hass	Clonal	WI	Rigato	3	NA	NA	Aliased
199	Hass	Seedling	G	A10	1	251.5080	19.28224	Estimable
200	Hass	Seedling	G	A10	2	219.8047	16.67508	Estimable
201	Hass	Seedling	G	A10	3	216.8928	17.10383	Estimable
202	Hass	Seedling	G	A8	1	219.2648	19.83960	Estimable
203	Hass	Seedling	G	A8	2	221.5919	16.73621	Estimable
204	Hass	Seedling	G	A8	3	211.8257	17.30077	Estimable
205	Hass	Seedling	G	Duke 7	1	NA	NA	Aliased
206	Hass	Seedling	G	Duke 7	2	NA	NA	Aliased
207	Hass	Seedling	G	Duke 7	3	NA	NA	Aliased
208	Hass	Seedling	G	Nabal	1	239.6352	19.16739	Estimable
209	Hass	Seedling	G	Nabal	2	217.6527	16.67401	Estimable
210	Hass	Seedling	G	Nabal	3	220.7638	17.07908	Estimable
211	Hass	Seedling	G	SHSR-03	1	NA	NA	Aliased
212	Hass	Seedling	G	SHSR-03	2	NA	NA	Aliased
213	Hass	Seedling	G	SHSR-03	3	NA	NA	Aliased
214	Hass	Seedling	G	Thomas	1	NA	NA	Aliased
215	Hass	Seedling	G	Thomas	2	NA	NA	Aliased
216	Hass	Seedling	G	Thomas	3	NA	NA	Aliased
217	Hass	Seedling	G	V1	1	NA	NA	Aliased
218	Hass	Seedling	G	V1	2	NA	NA	Aliased
219	Hass	Seedling	G	V1	3	NA	NA	Aliased
220	Hass	Seedling	G	Velvick	1	NA	NA	Aliased
221	Hass	Seedling	G	Velvick	2	NA	NA	Aliased
222	Hass	Seedling	G	Velvick	3	NA	NA	Aliased
223	Hass	Seedling	G	Zutano	1	NA	NA	Aliased
224	Hass	Seedling	G	Zutano	2	NA	NA	Aliased
225	Hass	Seedling	G	Zutano	3	NA	NA	Aliased
226	Hass	Seedling	G	Peasley	1	242.8537	22.97754	Estimable
227	Hass	Seedling	G	Peasley	2	220.3566	17.10258	Estimable
228	Hass	Seedling	G	Peasley	3	205.8660	25.17986	Estimable
229	Hass	Seedling	G	Reed	1	251.8000	20.30768	Estimable
230	Hass	Seedling	G	Reed	2	237.6539	16.80443	Estimable
231	Hass	Seedling	G	Reed	3	216.8110	17.61419	Estimable
232	Hass	Seedling	G	SHSR-02	1	253.2589	19.19969	Estimable
233	Hass	Seedling	G	SHSR-02	2	219.3814	16.66347	Estimable
234	Hass	Seedling	G	SHSR-02	3	219.2287	16.98547	Estimable
235	Hass	Seedling	G	Toro Canyon	1	NA	NA	Aliased
236	Hass	Seedling	G	Toro Canyon	2	NA	NA	Aliased
237	Hass	Seedling	G	Toro Canyon	3	NA	NA	Aliased
238	Hass	Seedling	G	Velvick/Hazard	1	NA	NA	Aliased
239	Hass	Seedling	G	Velvick/Hazard	2	NA	NA	Aliased
240	Hass	Seedling	G	Velvick/Hazard	3	NA	NA	Aliased
241	Hass	Seedling	G	Edranol	1	NA	NA	Aliased
242	Hass	Seedling	G	Edranol	2	NA	NA	Aliased
243	Hass	Seedling	G	Edranol	3	NA	NA	Aliased
244	Hass	Seedling	G	Parida	1	NA	NA	Aliased
245	Hass	Seedling	G	Parida	2	NA	NA	Aliased
246	Hass	Seedling	G	Parida	3	NA	NA	Aliased
247	Hass	Seedling	G	Plowman	1	201.1574	22.51760	Estimable
248	Hass	Seedling	G	Plowman	2	200.2192	18.67822	Estimable

249	Hass	Seedling	G	Plowman	3	214.8919	18.33087	Estimable
250	Hass	Seedling	G	Shepard	1	NA	NA	Aliased
251	Hass	Seedling	G	Shepard	2	NA	NA	Aliased
252	Hass	Seedling	G	Shepard	3	NA	NA	Aliased
253	Hass	Seedling	G	Hass	1	NA	NA	Aliased
254	Hass	Seedling	G	Hass	2	NA	NA	Aliased
255	Hass	Seedling	G	Hass	3	NA	NA	Aliased
256	Hass	Seedling	G	Barr Duke	1	NA	NA	Aliased
257	Hass	Seedling	G	Barr Duke	2	NA	NA	Aliased
258	Hass	Seedling	G	Barr Duke	3	NA	NA	Aliased
259	Hass	Seedling	G	SHSR-01	1	NA	NA	Aliased
260	Hass	Seedling	G	SHSR-01	2	NA	NA	Aliased
261	Hass	Seedling	G	SHSR-01	3	NA	NA	Aliased
262	Hass	Seedling	G	Rigato	1	221.5454	30.24894	Estimable
263	Hass	Seedling	G	Rigato	2	211.2290	18.28561	Estimable
264	Hass	Seedling	G	Rigato	3	227.7039	18.06250	Estimable
265	Hass	Seedling	M	A10	1	NA	NA	Aliased
266	Hass	Seedling	M	A10	2	NA	NA	Aliased
267	Hass	Seedling	M	A10	3	NA	NA	Aliased
268	Hass	Seedling	M	A8	1	NA	NA	Aliased
269	Hass	Seedling	M	A8	2	NA	NA	Aliased
270	Hass	Seedling	M	A8	3	NA	NA	Aliased
271	Hass	Seedling	M	Duke 7	1	172.7269	21.57316	Estimable
272	Hass	Seedling	M	Duke 7	2	221.1805	17.42506	Estimable
273	Hass	Seedling	M	Duke 7	3	231.2197	17.26031	Estimable
274	Hass	Seedling	M	Nabal	1	NA	NA	Aliased
275	Hass	Seedling	M	Nabal	2	NA	NA	Aliased
276	Hass	Seedling	M	Nabal	3	NA	NA	Aliased
277	Hass	Seedling	M	SHSR-03	1	243.2312	20.62459	Estimable
278	Hass	Seedling	M	SHSR-03	2	213.6906	16.90599	Estimable
279	Hass	Seedling	M	SHSR-03	3	194.1934	18.60627	Estimable
280	Hass	Seedling	M	Thomas	1	NA	NA	Aliased
281	Hass	Seedling	M	Thomas	2	NA	NA	Aliased
282	Hass	Seedling	M	Thomas	3	NA	NA	Aliased
283	Hass	Seedling	M	V1	1	NA	NA	Aliased
284	Hass	Seedling	M	V1	2	NA	NA	Aliased
285	Hass	Seedling	M	V1	3	NA	NA	Aliased
286	Hass	Seedling	M	Velvick	1	NA	NA	Aliased
287	Hass	Seedling	M	Velvick	2	NA	NA	Aliased
288	Hass	Seedling	M	Velvick	3	NA	NA	Aliased
289	Hass	Seedling	M	Zutano	1	230.8175	23.15756	Estimable
290	Hass	Seedling	M	Zutano	2	225.8255	17.62894	Estimable
291	Hass	Seedling	M	Zutano	3	220.4107	17.63517	Estimable
292	Hass	Seedling	M	Peasley	1	NA	NA	Aliased
293	Hass	Seedling	M	Peasley	2	NA	NA	Aliased
294	Hass	Seedling	M	Peasley	3	NA	NA	Aliased
295	Hass	Seedling	M	Reed	1	NA	NA	Aliased
296	Hass	Seedling	M	Reed	2	NA	NA	Aliased
297	Hass	Seedling	M	Reed	3	NA	NA	Aliased
298	Hass	Seedling	M	SHSR-02	1	NA	NA	Aliased
299	Hass	Seedling	M	SHSR-02	2	NA	NA	Aliased
300	Hass	Seedling	M	SHSR-02	3	NA	NA	Aliased
301	Hass	Seedling	M	Toro Canyon	1	250.8305	21.80591	Estimable
302	Hass	Seedling	M	Toro Canyon	2	227.2565	17.10072	Estimable
303	Hass	Seedling	M	Toro Canyon	3	220.9652	19.09653	Estimable
304	Hass	Seedling	M	Velvick/Hazard	1	NA	NA	Aliased
305	Hass	Seedling	M	Velvick/Hazard	2	NA	NA	Aliased
306	Hass	Seedling	M	Velvick/Hazard	3	NA	NA	Aliased
307	Hass	Seedling	M	Edranol	1	NA	NA	Aliased
308	Hass	Seedling	M	Edranol	2	NA	NA	Aliased
309	Hass	Seedling	M	Edranol	3	NA	NA	Aliased
310	Hass	Seedling	M	Parida	1	NA	NA	Aliased
311	Hass	Seedling	M	Parida	2	NA	NA	Aliased
312	Hass	Seedling	M	Parida	3	NA	NA	Aliased
313	Hass	Seedling	M	Plowman	1	NA	NA	Aliased
314	Hass	Seedling	M	Plowman	2	NA	NA	Aliased
315	Hass	Seedling	M	Plowman	3	NA	NA	Aliased
316	Hass	Seedling	M	Shepard	1	NA	NA	Aliased
317	Hass	Seedling	M	Shepard	2	NA	NA	Aliased
318	Hass	Seedling	M	Shepard	3	NA	NA	Aliased
319	Hass	Seedling	M	Hass	1	NA	NA	Aliased
320	Hass	Seedling	M	Hass	2	NA	NA	Aliased
321	Hass	Seedling	M	Hass	3	NA	NA	Aliased
322	Hass	Seedling	M	Barr Duke	1	237.6976	30.64136	Estimable
323	Hass	Seedling	M	Barr Duke	2	209.4198	18.35500	Estimable
324	Hass	Seedling	M	Barr Duke	3	221.3188	18.12479	Estimable
325	Hass	Seedling	M	SHSR-01	1	NA	NA	Aliased
326	Hass	Seedling	M	SHSR-01	2	NA	NA	Aliased
327	Hass	Seedling	M	SHSR-01	3	NA	NA	Aliased
328	Hass	Seedling	M	Rigato	1	NA	NA	Aliased
329	Hass	Seedling	M	Rigato	2	NA	NA	Aliased
330	Hass	Seedling	M	Rigato	3	NA	NA	Aliased
331	Hass	Seedling	WI	A10	1	NA	NA	Aliased
332	Hass	Seedling	WI	A10	2	NA	NA	Aliased
333	Hass	Seedling	WI	A10	3	NA	NA	Aliased
334	Hass	Seedling	WI	A8	1	NA	NA	Aliased
335	Hass	Seedling	WI	A8	2	NA	NA	Aliased
336	Hass	Seedling	WI	A8	3	NA	NA	Aliased
337	Hass	Seedling	WI	Duke 7	1	NA	NA	Aliased
338	Hass	Seedling	WI	Duke 7	2	NA	NA	Aliased
339	Hass	Seedling	WI	Duke 7	3	NA	NA	Aliased
340	Hass	Seedling	WI	Nabal	1	NA	NA	Aliased
341	Hass	Seedling	WI	Nabal	2	NA	NA	Aliased
342	Hass	Seedling	WI	Nabal	3	NA	NA	Aliased
343	Hass	Seedling	WI	SHSR-03	1	NA	NA	Aliased
344	Hass	Seedling	WI	SHSR-03	2	NA	NA	Aliased
345	Hass	Seedling	WI	SHSR-03	3	NA	NA	Aliased
346	Hass	Seedling	WI	Thomas	1	NA	NA	Aliased
347	Hass	Seedling	WI	Thomas	2	NA	NA	Aliased

348	Hass	Seedling	WI	Thomas	3	NA	NA	Aliased
349	Hass	Seedling	WI	V1	1	242.1687	21.12521	Estimable
350	Hass	Seedling	WI	V1	2	228.9307	16.98419	Estimable
351	Hass	Seedling	WI	V1	3	233.7862	19.75540	Estimable
352	Hass	Seedling	WI	Velvick	1	243.3409	19.23523	Estimable
353	Hass	Seedling	WI	Velvick	2	217.4009	16.66452	Estimable
354	Hass	Seedling	WI	Velvick	3	233.8270	16.99981	Estimable
355	Hass	Seedling	WI	Zutano	1	NA	NA	Aliased
356	Hass	Seedling	WI	Zutano	2	NA	NA	Aliased
357	Hass	Seedling	WI	Zutano	3	NA	NA	Aliased
358	Hass	Seedling	WI	Peasley	1	NA	NA	Aliased
359	Hass	Seedling	WI	Peasley	2	NA	NA	Aliased
360	Hass	Seedling	WI	Peasley	3	NA	NA	Aliased
361	Hass	Seedling	WI	Reed	1	NA	NA	Aliased
362	Hass	Seedling	WI	Reed	2	NA	NA	Aliased
363	Hass	Seedling	WI	Reed	3	NA	NA	Aliased
364	Hass	Seedling	WI	SHSR-02	1	NA	NA	Aliased
365	Hass	Seedling	WI	SHSR-02	2	NA	NA	Aliased
366	Hass	Seedling	WI	SHSR-02	3	NA	NA	Aliased
367	Hass	Seedling	WI	Toro Canyon	1	NA	NA	Aliased
368	Hass	Seedling	WI	Toro Canyon	2	NA	NA	Aliased
369	Hass	Seedling	WI	Toro Canyon	3	NA	NA	Aliased
370	Hass	Seedling	WI	Velvick/Hazard	1	189.1976	20.72231	Estimable
371	Hass	Seedling	WI	Velvick/Hazard	2	230.8217	16.92531	Estimable
372	Hass	Seedling	WI	Velvick/Hazard	3	241.6540	18.80028	Estimable
373	Hass	Seedling	WI	Edranol	1	NA	NA	Aliased
374	Hass	Seedling	WI	Edranol	2	NA	NA	Aliased
375	Hass	Seedling	WI	Edranol	3	NA	NA	Aliased
376	Hass	Seedling	WI	Parida	1	NA	NA	Aliased
377	Hass	Seedling	WI	Parida	2	NA	NA	Aliased
378	Hass	Seedling	WI	Parida	3	NA	NA	Aliased
379	Hass	Seedling	WI	Plowman	1	NA	NA	Aliased
380	Hass	Seedling	WI	Plowman	2	NA	NA	Aliased
381	Hass	Seedling	WI	Plowman	3	NA	NA	Aliased
382	Hass	Seedling	WI	Shepard	1	NA	NA	Aliased
383	Hass	Seedling	WI	Shepard	2	NA	NA	Aliased
384	Hass	Seedling	WI	Shepard	3	NA	NA	Aliased
385	Hass	Seedling	WI	Hass	1	NA	NA	Aliased
386	Hass	Seedling	WI	Hass	2	NA	NA	Aliased
387	Hass	Seedling	WI	Hass	3	NA	NA	Aliased
388	Hass	Seedling	WI	Barr Duke	1	NA	NA	Aliased
389	Hass	Seedling	WI	Barr Duke	2	NA	NA	Aliased
390	Hass	Seedling	WI	Barr Duke	3	NA	NA	Aliased
391	Hass	Seedling	WI	SHSR-01	1	NA	NA	Aliased
392	Hass	Seedling	WI	SHSR-01	2	NA	NA	Aliased
393	Hass	Seedling	WI	SHSR-01	3	NA	NA	Aliased
394	Hass	Seedling	WI	Rigato	1	NA	NA	Aliased
395	Hass	Seedling	WI	Rigato	2	NA	NA	Aliased
396	Hass	Seedling	WI	Rigato	3	NA	NA	Aliased
397	Shepard	Clonal	G	A10	1	175.0361	31.90394	Estimable
398	Shepard	Clonal	G	A10	2	238.5914	18.85591	Estimable
399	Shepard	Clonal	G	A10	3	229.9908	18.42117	Estimable
400	Shepard	Clonal	G	A8	1	NA	NA	Aliased
401	Shepard	Clonal	G	A8	2	NA	NA	Aliased
402	Shepard	Clonal	G	A8	3	NA	NA	Aliased
403	Shepard	Clonal	G	Duke 7	1	NA	NA	Aliased
404	Shepard	Clonal	G	Duke 7	2	NA	NA	Aliased
405	Shepard	Clonal	G	Duke 7	3	NA	NA	Aliased
406	Shepard	Clonal	G	Nabal	1	106.7582	34.43623	Estimable
407	Shepard	Clonal	G	Nabal	2	275.8036	19.23468	Estimable
408	Shepard	Clonal	G	Nabal	3	236.7874	18.63668	Estimable
409	Shepard	Clonal	G	SHSR-03	1	NA	NA	Aliased
410	Shepard	Clonal	G	SHSR-03	2	NA	NA	Aliased
411	Shepard	Clonal	G	SHSR-03	3	NA	NA	Aliased
412	Shepard	Clonal	G	Thomas	1	NA	NA	Aliased
413	Shepard	Clonal	G	Thomas	2	NA	NA	Aliased
414	Shepard	Clonal	G	Thomas	3	NA	NA	Aliased
415	Shepard	Clonal	G	V1	1	NA	NA	Aliased
416	Shepard	Clonal	G	V1	2	NA	NA	Aliased
417	Shepard	Clonal	G	V1	3	NA	NA	Aliased
418	Shepard	Clonal	G	Velvick	1	NA	NA	Aliased
419	Shepard	Clonal	G	Velvick	2	NA	NA	Aliased
420	Shepard	Clonal	G	Velvick	3	NA	NA	Aliased
421	Shepard	Clonal	G	Zutano	1	NA	NA	Aliased
422	Shepard	Clonal	G	Zutano	2	NA	NA	Aliased
423	Shepard	Clonal	G	Zutano	3	NA	NA	Aliased
424	Shepard	Clonal	G	Peasley	1	NA	NA	Aliased
425	Shepard	Clonal	G	Peasley	2	NA	NA	Aliased
426	Shepard	Clonal	G	Peasley	3	NA	NA	Aliased
427	Shepard	Clonal	G	Reed	1	NA	NA	Aliased
428	Shepard	Clonal	G	Reed	2	NA	NA	Aliased
429	Shepard	Clonal	G	Reed	3	NA	NA	Aliased
430	Shepard	Clonal	G	SHSR-02	1	NA	NA	Aliased
431	Shepard	Clonal	G	SHSR-02	2	NA	NA	Aliased
432	Shepard	Clonal	G	SHSR-02	3	NA	NA	Aliased
433	Shepard	Clonal	G	Toro Canyon	1	NA	NA	Aliased
434	Shepard	Clonal	G	Toro Canyon	2	NA	NA	Aliased
435	Shepard	Clonal	G	Toro Canyon	3	NA	NA	Aliased
436	Shepard	Clonal	G	Velvick/Hazard	1	NA	NA	Aliased
437	Shepard	Clonal	G	Velvick/Hazard	2	NA	NA	Aliased
438	Shepard	Clonal	G	Velvick/Hazard	3	NA	NA	Aliased
439	Shepard	Clonal	G	Edranol	1	NA	NA	Aliased
440	Shepard	Clonal	G	Edranol	2	NA	NA	Aliased
441	Shepard	Clonal	G	Edranol	3	NA	NA	Aliased
442	Shepard	Clonal	G	Parida	1	NA	NA	Aliased
443	Shepard	Clonal	G	Parida	2	NA	NA	Aliased
444	Shepard	Clonal	G	Parida	3	NA	NA	Aliased
445	Shepard	Clonal	G	Plowman	1	NA	NA	Aliased
446	Shepard	Clonal	G	Plowman	2	NA	NA	Aliased

447	Shepard	Clonal	G	Plowman	3	NA	NA	Aliased
448	Shepard	Clonal	G	Shepard	1	NA	NA	Aliased
449	Shepard	Clonal	G	Shepard	2	NA	NA	Aliased
450	Shepard	Clonal	G	Shepard	3	NA	NA	Aliased
451	Shepard	Clonal	G	Hass	1	NA	NA	Aliased
452	Shepard	Clonal	G	Hass	2	NA	NA	Aliased
453	Shepard	Clonal	G	Hass	3	NA	NA	Aliased
454	Shepard	Clonal	G	Barr Duke	1	NA	NA	Aliased
455	Shepard	Clonal	G	Barr Duke	2	NA	NA	Aliased
456	Shepard	Clonal	G	Barr Duke	3	NA	NA	Aliased
457	Shepard	Clonal	G	SHSR-01	1	NA	NA	Aliased
458	Shepard	Clonal	G	SHSR-01	2	NA	NA	Aliased
459	Shepard	Clonal	G	SHSR-01	3	NA	NA	Aliased
460	Shepard	Clonal	G	Rigato	1	NA	NA	Aliased
461	Shepard	Clonal	G	Rigato	2	NA	NA	Aliased
462	Shepard	Clonal	G	Rigato	3	NA	NA	Aliased
463	Shepard	Clonal	M	A10	1	NA	NA	Aliased
464	Shepard	Clonal	M	A10	2	NA	NA	Aliased
465	Shepard	Clonal	M	A10	3	NA	NA	Aliased
466	Shepard	Clonal	M	A8	1	NA	NA	Aliased
467	Shepard	Clonal	M	A8	2	NA	NA	Aliased
468	Shepard	Clonal	M	A8	3	NA	NA	Aliased
469	Shepard	Clonal	M	Duke 7	1	181.1450	32.95549	Estimable
470	Shepard	Clonal	M	Duke 7	2	287.5558	19.07671	Estimable
471	Shepard	Clonal	M	Duke 7	3	245.6845	18.54781	Estimable
472	Shepard	Clonal	M	Nabal	1	NA	NA	Aliased
473	Shepard	Clonal	M	Nabal	2	NA	NA	Aliased
474	Shepard	Clonal	M	Nabal	3	NA	NA	Aliased
475	Shepard	Clonal	M	SHSR-03	1	251.6902	33.01007	Estimable
476	Shepard	Clonal	M	SHSR-03	2	254.8769	18.95580	Estimable
477	Shepard	Clonal	M	SHSR-03	3	235.8907	18.47911	Estimable
478	Shepard	Clonal	M	Thomas	1	247.7456	31.86932	Estimable
479	Shepard	Clonal	M	Thomas	2	247.7631	18.95333	Estimable
480	Shepard	Clonal	M	Thomas	3	232.3561	18.47732	Estimable
481	Shepard	Clonal	M	V1	1	NA	NA	Aliased
482	Shepard	Clonal	M	V1	2	NA	NA	Aliased
483	Shepard	Clonal	M	V1	3	NA	NA	Aliased
484	Shepard	Clonal	M	Velvick	1	NA	NA	Aliased
485	Shepard	Clonal	M	Velvick	2	NA	NA	Aliased
486	Shepard	Clonal	M	Velvick	3	NA	NA	Aliased
487	Shepard	Clonal	M	Zutano	1	152.3090	32.95905	Estimable
488	Shepard	Clonal	M	Zutano	2	264.5540	18.95175	Estimable
489	Shepard	Clonal	M	Zutano	3	229.0296	18.47608	Estimable
490	Shepard	Clonal	M	Peasley	1	NA	NA	Aliased
491	Shepard	Clonal	M	Peasley	2	NA	NA	Aliased
492	Shepard	Clonal	M	Peasley	3	NA	NA	Aliased
493	Shepard	Clonal	M	Reed	1	NA	NA	Aliased
494	Shepard	Clonal	M	Reed	2	NA	NA	Aliased
495	Shepard	Clonal	M	Reed	3	NA	NA	Aliased
496	Shepard	Clonal	M	SHSR-02	1	NA	NA	Aliased
497	Shepard	Clonal	M	SHSR-02	2	NA	NA	Aliased
498	Shepard	Clonal	M	SHSR-02	3	NA	NA	Aliased
499	Shepard	Clonal	M	Toro Canyon	1	NA	NA	Aliased
500	Shepard	Clonal	M	Toro Canyon	2	NA	NA	Aliased
501	Shepard	Clonal	M	Toro Canyon	3	NA	NA	Aliased
502	Shepard	Clonal	M	Velvick/Hazard	1	NA	NA	Aliased
503	Shepard	Clonal	M	Velvick/Hazard	2	NA	NA	Aliased
504	Shepard	Clonal	M	Velvick/Hazard	3	NA	NA	Aliased
505	Shepard	Clonal	M	Edranol	1	NA	NA	Aliased
506	Shepard	Clonal	M	Edranol	2	NA	NA	Aliased
507	Shepard	Clonal	M	Edranol	3	NA	NA	Aliased
508	Shepard	Clonal	M	Parida	1	NA	NA	Aliased
509	Shepard	Clonal	M	Parida	2	NA	NA	Aliased
510	Shepard	Clonal	M	Parida	3	NA	NA	Aliased
511	Shepard	Clonal	M	Plowman	1	NA	NA	Aliased
512	Shepard	Clonal	M	Plowman	2	NA	NA	Aliased
513	Shepard	Clonal	M	Plowman	3	NA	NA	Aliased
514	Shepard	Clonal	M	Shepard	1	216.9828	31.86064	Estimable
515	Shepard	Clonal	M	Shepard	2	250.1380	18.85322	Estimable
516	Shepard	Clonal	M	Shepard	3	222.6552	18.42040	Estimable
517	Shepard	Clonal	M	Hass	1	NA	NA	Aliased
518	Shepard	Clonal	M	Hass	2	NA	NA	Aliased
519	Shepard	Clonal	M	Hass	3	NA	NA	Aliased
520	Shepard	Clonal	M	Barr Duke	1	225.7979	31.99929	Estimable
521	Shepard	Clonal	M	Barr Duke	2	272.4019	18.86754	Estimable
522	Shepard	Clonal	M	Barr Duke	3	243.7673	18.42608	Estimable
523	Shepard	Clonal	M	SHSR-01	1	NA	NA	Aliased
524	Shepard	Clonal	M	SHSR-01	2	NA	NA	Aliased
525	Shepard	Clonal	M	SHSR-01	3	NA	NA	Aliased
526	Shepard	Clonal	M	Rigato	1	NA	NA	Aliased
527	Shepard	Clonal	M	Rigato	2	NA	NA	Aliased
528	Shepard	Clonal	M	Rigato	3	NA	NA	Aliased
529	Shepard	Clonal	WI	A10	1	NA	NA	Aliased
530	Shepard	Clonal	WI	A10	2	NA	NA	Aliased
531	Shepard	Clonal	WI	A10	3	NA	NA	Aliased
532	Shepard	Clonal	WI	A8	1	NA	NA	Aliased
533	Shepard	Clonal	WI	A8	2	NA	NA	Aliased
534	Shepard	Clonal	WI	A8	3	NA	NA	Aliased
535	Shepard	Clonal	WI	Duke 7	1	NA	NA	Aliased
536	Shepard	Clonal	WI	Duke 7	2	NA	NA	Aliased
537	Shepard	Clonal	WI	Duke 7	3	NA	NA	Aliased
538	Shepard	Clonal	WI	Nabal	1	NA	NA	Aliased
539	Shepard	Clonal	WI	Nabal	2	NA	NA	Aliased
540	Shepard	Clonal	WI	Nabal	3	NA	NA	Aliased
541	Shepard	Clonal	WI	SHSR-03	1	NA	NA	Aliased
542	Shepard	Clonal	WI	SHSR-03	2	NA	NA	Aliased
543	Shepard	Clonal	WI	SHSR-03	3	NA	NA	Aliased
544	Shepard	Clonal	WI	Thomas	1	NA	NA	Aliased
545	Shepard	Clonal	WI	Thomas	2	NA	NA	Aliased

546	Shepard	Clonal	WI	Thomas	3	NA	NA	Aliased
547	Shepard	Clonal	WI	V1	1	NA	NA	Aliased
548	Shepard	Clonal	WI	V1	2	NA	NA	Aliased
549	Shepard	Clonal	WI	V1	3	NA	NA	Aliased
550	Shepard	Clonal	WI	Velvick	1	208.5348	31.82395	Estimable
551	Shepard	Clonal	WI	Velvick	2	262.3732	18.85300	Estimable
552	Shepard	Clonal	WI	Velvick	3	230.3892	18.47061	Estimable
553	Shepard	Clonal	WI	Zutano	1	NA	NA	Aliased
554	Shepard	Clonal	WI	Zutano	2	NA	NA	Aliased
555	Shepard	Clonal	WI	Zutano	3	NA	NA	Aliased
556	Shepard	Clonal	WI	Peasley	1	NA	NA	Aliased
557	Shepard	Clonal	WI	Peasley	2	NA	NA	Aliased
558	Shepard	Clonal	WI	Peasley	3	NA	NA	Aliased
559	Shepard	Clonal	WI	Reed	1	NA	NA	Aliased
560	Shepard	Clonal	WI	Reed	2	NA	NA	Aliased
561	Shepard	Clonal	WI	Reed	3	NA	NA	Aliased
562	Shepard	Clonal	WI	SHSR-02	1	NA	NA	Aliased
563	Shepard	Clonal	WI	SHSR-02	2	NA	NA	Aliased
564	Shepard	Clonal	WI	SHSR-02	3	NA	NA	Aliased
565	Shepard	Clonal	WI	Toro Canyon	1	NA	NA	Aliased
566	Shepard	Clonal	WI	Toro Canyon	2	NA	NA	Aliased
567	Shepard	Clonal	WI	Toro Canyon	3	NA	NA	Aliased
568	Shepard	Clonal	WI	Velvick/Hazard	1	NA	NA	Aliased
569	Shepard	Clonal	WI	Velvick/Hazard	2	NA	NA	Aliased
570	Shepard	Clonal	WI	Velvick/Hazard	3	NA	NA	Aliased
571	Shepard	Clonal	WI	Edranol	1	NA	NA	Aliased
572	Shepard	Clonal	WI	Edranol	2	NA	NA	Aliased
573	Shepard	Clonal	WI	Edranol	3	NA	NA	Aliased
574	Shepard	Clonal	WI	Parida	1	NA	NA	Aliased
575	Shepard	Clonal	WI	Parida	2	NA	NA	Aliased
576	Shepard	Clonal	WI	Parida	3	NA	NA	Aliased
577	Shepard	Clonal	WI	Plowman	1	NA	NA	Aliased
578	Shepard	Clonal	WI	Plowman	2	NA	NA	Aliased
579	Shepard	Clonal	WI	Plowman	3	NA	NA	Aliased
580	Shepard	Clonal	WI	Shepard	1	NA	NA	Aliased
581	Shepard	Clonal	WI	Shepard	2	NA	NA	Aliased
582	Shepard	Clonal	WI	Shepard	3	NA	NA	Aliased
583	Shepard	Clonal	WI	Hass	1	NA	NA	Aliased
584	Shepard	Clonal	WI	Hass	2	NA	NA	Aliased
585	Shepard	Clonal	WI	Hass	3	NA	NA	Aliased
586	Shepard	Clonal	WI	Barr Duke	1	NA	NA	Aliased
587	Shepard	Clonal	WI	Barr Duke	2	NA	NA	Aliased
588	Shepard	Clonal	WI	Barr Duke	3	NA	NA	Aliased
589	Shepard	Clonal	WI	SHSR-01	1	NA	NA	Aliased
590	Shepard	Clonal	WI	SHSR-01	2	NA	NA	Aliased
591	Shepard	Clonal	WI	SHSR-01	3	NA	NA	Aliased
592	Shepard	Clonal	WI	Rigato	1	NA	NA	Aliased
593	Shepard	Clonal	WI	Rigato	2	NA	NA	Aliased
594	Shepard	Clonal	WI	Rigato	3	NA	NA	Aliased
595	Shepard	Seedling	G	A10	1	249.6771	22.77735	Estimable
596	Shepard	Seedling	G	A10	2	257.5651	17.76396	Estimable
597	Shepard	Seedling	G	A10	3	240.2853	17.42000	Estimable
598	Shepard	Seedling	G	A8	1	233.6555	27.37591	Estimable
599	Shepard	Seedling	G	A8	2	253.2387	19.21849	Estimable
600	Shepard	Seedling	G	A8	3	238.9554	18.32103	Estimable
601	Shepard	Seedling	G	Duke 7	1	NA	NA	Aliased
602	Shepard	Seedling	G	Duke 7	2	NA	NA	Aliased
603	Shepard	Seedling	G	Duke 7	3	NA	NA	Aliased
604	Shepard	Seedling	G	Nabal	1	209.3309	22.42184	Estimable
605	Shepard	Seedling	G	Nabal	2	246.3354	17.71132	Estimable
606	Shepard	Seedling	G	Nabal	3	242.3871	17.41825	Estimable
607	Shepard	Seedling	G	SHSR-03	1	NA	NA	Aliased
608	Shepard	Seedling	G	SHSR-03	2	NA	NA	Aliased
609	Shepard	Seedling	G	SHSR-03	3	NA	NA	Aliased
610	Shepard	Seedling	G	Thomas	1	NA	NA	Aliased
611	Shepard	Seedling	G	Thomas	2	NA	NA	Aliased
612	Shepard	Seedling	G	Thomas	3	NA	NA	Aliased
613	Shepard	Seedling	G	V1	1	NA	NA	Aliased
614	Shepard	Seedling	G	V1	2	NA	NA	Aliased
615	Shepard	Seedling	G	V1	3	NA	NA	Aliased
616	Shepard	Seedling	G	Velvick	1	NA	NA	Aliased
617	Shepard	Seedling	G	Velvick	2	NA	NA	Aliased
618	Shepard	Seedling	G	Velvick	3	NA	NA	Aliased
619	Shepard	Seedling	G	Zutano	1	NA	NA	Aliased
620	Shepard	Seedling	G	Zutano	2	NA	NA	Aliased
621	Shepard	Seedling	G	Zutano	3	NA	NA	Aliased
622	Shepard	Seedling	G	Peasley	1	NA	NA	Aliased
623	Shepard	Seedling	G	Peasley	2	NA	NA	Aliased
624	Shepard	Seedling	G	Peasley	3	NA	NA	Aliased
625	Shepard	Seedling	G	Reed	1	227.2385	22.87299	Estimable
626	Shepard	Seedling	G	Reed	2	250.7698	17.80582	Estimable
627	Shepard	Seedling	G	Reed	3	233.9146	17.44634	Estimable
628	Shepard	Seedling	G	SHSR-02	1	216.4281	22.61869	Estimable
629	Shepard	Seedling	G	SHSR-02	2	259.6603	17.66882	Estimable
630	Shepard	Seedling	G	SHSR-02	3	249.0536	17.38476	Estimable
631	Shepard	Seedling	G	Toro Canyon	1	NA	NA	Aliased
632	Shepard	Seedling	G	Toro Canyon	2	NA	NA	Aliased
633	Shepard	Seedling	G	Toro Canyon	3	NA	NA	Aliased
634	Shepard	Seedling	G	Velvick/Hazard	1	NA	NA	Aliased
635	Shepard	Seedling	G	Velvick/Hazard	2	NA	NA	Aliased
636	Shepard	Seedling	G	Velvick/Hazard	3	NA	NA	Aliased
637	Shepard	Seedling	G	Edranol	1	262.3406	30.00300	Estimable
638	Shepard	Seedling	G	Edranol	2	260.2122	18.52721	Estimable
639	Shepard	Seedling	G	Edranol	3	235.2283	18.00470	Estimable
640	Shepard	Seedling	G	Parida	1	NA	NA	Aliased
641	Shepard	Seedling	G	Parida	2	NA	NA	Aliased
642	Shepard	Seedling	G	Parida	3	NA	NA	Aliased
643	Shepard	Seedling	G	Plowman	1	232.2598	29.98646	Estimable
644	Shepard	Seedling	G	Plowman	2	252.3677	18.52201	Estimable

645	Shepard	Seedling	G	Plowman	3	238.1821	18.00119	Estimable
646	Shepard	Seedling	G	Shepard	1	NA	NA	Aliased
647	Shepard	Seedling	G	Shepard	2	NA	NA	Aliased
648	Shepard	Seedling	G	Shepard	3	NA	NA	Aliased
649	Shepard	Seedling	G	Hass	1	NA	NA	Aliased
650	Shepard	Seedling	G	Hass	2	NA	NA	Aliased
651	Shepard	Seedling	G	Hass	3	NA	NA	Aliased
652	Shepard	Seedling	G	Barr Duke	1	NA	NA	Aliased
653	Shepard	Seedling	G	Barr Duke	2	NA	NA	Aliased
654	Shepard	Seedling	G	Barr Duke	3	NA	NA	Aliased
655	Shepard	Seedling	G	SHSR-01	1	NA	NA	Aliased
656	Shepard	Seedling	G	SHSR-01	2	NA	NA	Aliased
657	Shepard	Seedling	G	SHSR-01	3	NA	NA	Aliased
658	Shepard	Seedling	G	Rigato	1	NA	NA	Aliased
659	Shepard	Seedling	G	Rigato	2	NA	NA	Aliased
660	Shepard	Seedling	G	Rigato	3	NA	NA	Aliased
661	Shepard	Seedling	M	A10	1	NA	NA	Aliased
662	Shepard	Seedling	M	A10	2	NA	NA	Aliased
663	Shepard	Seedling	M	A10	3	NA	NA	Aliased
664	Shepard	Seedling	M	A8	1	NA	NA	Aliased
665	Shepard	Seedling	M	A8	2	NA	NA	Aliased
666	Shepard	Seedling	M	A8	3	NA	NA	Aliased
667	Shepard	Seedling	M	Duke 7	1	239.7044	25.00260	Estimable
668	Shepard	Seedling	M	Duke 7	2	246.4786	18.76532	Estimable
669	Shepard	Seedling	M	Duke 7	3	232.7178	18.17796	Estimable
670	Shepard	Seedling	M	Nabal	1	NA	NA	Aliased
671	Shepard	Seedling	M	Nabal	2	NA	NA	Aliased
672	Shepard	Seedling	M	Nabal	3	NA	NA	Aliased
673	Shepard	Seedling	M	SHSR-03	1	265.9650	26.04080	Estimable
674	Shepard	Seedling	M	SHSR-03	2	238.7403	19.03547	Estimable
675	Shepard	Seedling	M	SHSR-03	3	236.6424	18.19803	Estimable
676	Shepard	Seedling	M	Thomas	1	NA	NA	Aliased
677	Shepard	Seedling	M	Thomas	2	NA	NA	Aliased
678	Shepard	Seedling	M	Thomas	3	NA	NA	Aliased
679	Shepard	Seedling	M	V1	1	NA	NA	Aliased
680	Shepard	Seedling	M	V1	2	NA	NA	Aliased
681	Shepard	Seedling	M	V1	3	NA	NA	Aliased
682	Shepard	Seedling	M	Velvick	1	NA	NA	Aliased
683	Shepard	Seedling	M	Velvick	2	NA	NA	Aliased
684	Shepard	Seedling	M	Velvick	3	NA	NA	Aliased
685	Shepard	Seedling	M	Zutano	1	236.4912	24.85058	Estimable
686	Shepard	Seedling	M	Zutano	2	268.3546	19.22474	Estimable
687	Shepard	Seedling	M	Zutano	3	251.4164	18.32244	Estimable
688	Shepard	Seedling	M	Peasley	1	NA	NA	Aliased
689	Shepard	Seedling	M	Peasley	2	NA	NA	Aliased
690	Shepard	Seedling	M	Peasley	3	NA	NA	Aliased
691	Shepard	Seedling	M	Reed	1	NA	NA	Aliased
692	Shepard	Seedling	M	Reed	2	NA	NA	Aliased
693	Shepard	Seedling	M	Reed	3	NA	NA	Aliased
694	Shepard	Seedling	M	SHSR-02	1	NA	NA	Aliased
695	Shepard	Seedling	M	SHSR-02	2	NA	NA	Aliased
696	Shepard	Seedling	M	SHSR-02	3	NA	NA	Aliased
697	Shepard	Seedling	M	Toro Canyon	1	259.9082	31.22489	Estimable
698	Shepard	Seedling	M	Toro Canyon	2	256.6034	18.94705	Estimable
699	Shepard	Seedling	M	Toro Canyon	3	247.5672	18.28853	Estimable
700	Shepard	Seedling	M	Velvick/Hazard	1	NA	NA	Aliased
701	Shepard	Seedling	M	Velvick/Hazard	2	NA	NA	Aliased
702	Shepard	Seedling	M	Velvick/Hazard	3	NA	NA	Aliased
703	Shepard	Seedling	M	Edranol	1	NA	NA	Aliased
704	Shepard	Seedling	M	Edranol	2	NA	NA	Aliased
705	Shepard	Seedling	M	Edranol	3	NA	NA	Aliased
706	Shepard	Seedling	M	Parida	1	283.0534	32.73243	Estimable
707	Shepard	Seedling	M	Parida	2	268.1062	18.97155	Estimable
708	Shepard	Seedling	M	Parida	3	251.1126	18.31900	Estimable
709	Shepard	Seedling	M	Plowman	1	NA	NA	Aliased
710	Shepard	Seedling	M	Plowman	2	NA	NA	Aliased
711	Shepard	Seedling	M	Plowman	3	NA	NA	Aliased
712	Shepard	Seedling	M	Shepard	1	260.9379	29.98163	Estimable
713	Shepard	Seedling	M	Shepard	2	256.7194	18.92125	Estimable
714	Shepard	Seedling	M	Shepard	3	243.8564	18.12616	Estimable
715	Shepard	Seedling	M	Hass	1	NA	NA	Aliased
716	Shepard	Seedling	M	Hass	2	NA	NA	Aliased
717	Shepard	Seedling	M	Hass	3	NA	NA	Aliased
718	Shepard	Seedling	M	Barr Duke	1	NA	NA	Aliased
719	Shepard	Seedling	M	Barr Duke	2	NA	NA	Aliased
720	Shepard	Seedling	M	Barr Duke	3	NA	NA	Aliased
721	Shepard	Seedling	M	SHSR-01	1	NA	NA	Aliased
722	Shepard	Seedling	M	SHSR-01	2	NA	NA	Aliased
723	Shepard	Seedling	M	SHSR-01	3	NA	NA	Aliased
724	Shepard	Seedling	M	Rigato	1	NA	NA	Aliased
725	Shepard	Seedling	M	Rigato	2	NA	NA	Aliased
726	Shepard	Seedling	M	Rigato	3	NA	NA	Aliased
727	Shepard	Seedling	WI	A10	1	NA	NA	Aliased
728	Shepard	Seedling	WI	A10	2	NA	NA	Aliased
729	Shepard	Seedling	WI	A10	3	NA	NA	Aliased
730	Shepard	Seedling	WI	A8	1	NA	NA	Aliased
731	Shepard	Seedling	WI	A8	2	NA	NA	Aliased
732	Shepard	Seedling	WI	A8	3	NA	NA	Aliased
733	Shepard	Seedling	WI	Duke 7	1	NA	NA	Aliased
734	Shepard	Seedling	WI	Duke 7	2	NA	NA	Aliased
735	Shepard	Seedling	WI	Duke 7	3	NA	NA	Aliased
736	Shepard	Seedling	WI	Nabal	1	NA	NA	Aliased
737	Shepard	Seedling	WI	Nabal	2	NA	NA	Aliased
738	Shepard	Seedling	WI	Nabal	3	NA	NA	Aliased
739	Shepard	Seedling	WI	SHSR-03	1	NA	NA	Aliased
740	Shepard	Seedling	WI	SHSR-03	2	NA	NA	Aliased
741	Shepard	Seedling	WI	SHSR-03	3	NA	NA	Aliased
742	Shepard	Seedling	WI	Thomas	1	NA	NA	Aliased
743	Shepard	Seedling	WI	Thomas	2	NA	NA	Aliased

```
744 Shepard Seedling   WI         Thomas  3             NA             NA    Aliased
745 Shepard Seedling   WI             V1  1       257.3994       25.77288  Estimable
746 Shepard Seedling   WI             V1  2       258.4429       18.77788  Estimable
747 Shepard Seedling   WI             V1  3       243.4927       18.18222  Estimable
748 Shepard Seedling   WI        Velvick  1       276.4324       22.31932  Estimable
749 Shepard Seedling   WI        Velvick  2       268.1859       17.65543  Estimable
750 Shepard Seedling   WI        Velvick  3       247.7638       17.34553  Estimable
751 Shepard Seedling   WI         Zutano  1             NA             NA    Aliased
752 Shepard Seedling   WI         Zutano  2             NA             NA    Aliased
753 Shepard Seedling   WI         Zutano  3             NA             NA    Aliased
754 Shepard Seedling   WI        Peasley  1             NA             NA    Aliased
755 Shepard Seedling   WI        Peasley  2             NA             NA    Aliased
756 Shepard Seedling   WI        Peasley  3             NA             NA    Aliased
757 Shepard Seedling   WI           Reed  1             NA             NA    Aliased
758 Shepard Seedling   WI           Reed  2             NA             NA    Aliased
759 Shepard Seedling   WI           Reed  3             NA             NA    Aliased
760 Shepard Seedling   WI        SHSR-02  1             NA             NA    Aliased
761 Shepard Seedling   WI        SHSR-02  2             NA             NA    Aliased
762 Shepard Seedling   WI        SHSR-02  3             NA             NA    Aliased
763 Shepard Seedling   WI    Toro Canyon  1             NA             NA    Aliased
764 Shepard Seedling   WI    Toro Canyon  2             NA             NA    Aliased
765 Shepard Seedling   WI    Toro Canyon  3             NA             NA    Aliased
766 Shepard Seedling   WI Velvick/Hazard  1             NA             NA    Aliased
767 Shepard Seedling   WI Velvick/Hazard  2             NA             NA    Aliased
768 Shepard Seedling   WI Velvick/Hazard  3             NA             NA    Aliased
769 Shepard Seedling   WI        Edranol  1             NA             NA    Aliased
770 Shepard Seedling   WI        Edranol  2             NA             NA    Aliased
771 Shepard Seedling   WI        Edranol  3             NA             NA    Aliased
772 Shepard Seedling   WI         Parida  1             NA             NA    Aliased
773 Shepard Seedling   WI         Parida  2             NA             NA    Aliased
774 Shepard Seedling   WI         Parida  3             NA             NA    Aliased
775 Shepard Seedling   WI        Plowman  1             NA             NA    Aliased
776 Shepard Seedling   WI        Plowman  2             NA             NA    Aliased
777 Shepard Seedling   WI        Plowman  3             NA             NA    Aliased
778 Shepard Seedling   WI        Shepard  1             NA             NA    Aliased
779 Shepard Seedling   WI        Shepard  2             NA             NA    Aliased
780 Shepard Seedling   WI        Shepard  3             NA             NA    Aliased
781 Shepard Seedling   WI           Hass  1             NA             NA    Aliased
782 Shepard Seedling   WI           Hass  2             NA             NA    Aliased
783 Shepard Seedling   WI           Hass  3             NA             NA    Aliased
784 Shepard Seedling   WI      Barr Duke  1             NA             NA    Aliased
785 Shepard Seedling   WI      Barr Duke  2             NA             NA    Aliased
786 Shepard Seedling   WI      Barr Duke  3             NA             NA    Aliased
787 Shepard Seedling   WI        SHSR-01  1             NA             NA    Aliased
788 Shepard Seedling   WI        SHSR-01  2             NA             NA    Aliased
789 Shepard Seedling   WI        SHSR-01  3             NA             NA    Aliased
790 Shepard Seedling   WI         Rigato  1             NA             NA    Aliased
791 Shepard Seedling   WI         Rigato  2             NA             NA    Aliased
792 Shepard Seedling   WI         Rigato  3             NA             NA    Aliased

$avsed
 overall
18.62812
```

3. Yield efficiency

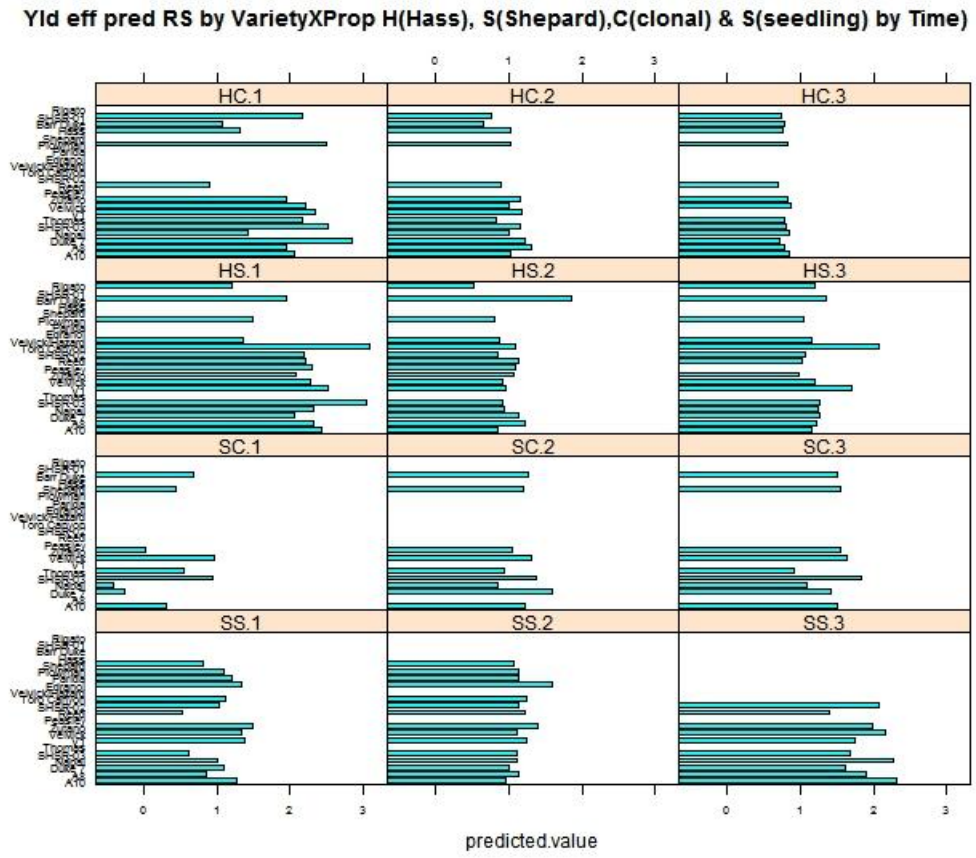
The analysis of Yield efficiency across all 3 times showed a significant Variety:Prop:Race:Trt:Tm interaction (P=0.0063) so these are the predictions you should focus on. They have been given in a table and the graph below.

```
Terms added sequentially; adjusted for those above

                        Df Sum of Sq Wald statistic Pr(Chisq)
(Intercept)              1     18.93          18.93 1.356e-05 ***
Variety                  1      0.00           0.00 0.9818118
```

```
Prop                       1      0.16          0.16 0.6850602
Race                       2      3.57          3.57 0.1680897
Tm                         2    186.13        186.13 < 2.2e-16 ***
Variety:Prop               1      0.13          0.13 0.7179823
Race:Trt                  19     47.70         47.70 0.0002837 ***
Variety:Race               2      2.13          2.13 0.3452871
Prop:Race                  2      1.52          1.52 0.4673762
Variety:Tm                 2    457.57        457.57 < 2.2e-16 ***
Prop:Tm                    2     70.65         70.65 4.441e-16 ***
Race:Tm                    4     28.32         28.32 1.073e-05 ***
Variety:Race:Trt          11      8.49          8.49 0.6690793
Prop:Race:Trt              9     27.61         27.61 0.0011061 **
Variety:Prop:Race          2      3.69          3.69 0.1583579
Variety:Prop:Tm            2      5.84          5.84 0.0540057 .
Race:Trt:Tm               35    115.06        115.06 1.834e-10 ***
Variety:Race:Tm            4      6.08          6.08 0.1934732
Prop:Race:Tm               4      6.16          6.16 0.1872978
Variety:Prop:Race:Trt      3     15.94         15.94 0.0011656 **
Variety:Race:Trt:Tm       20     30.15         30.15 0.0675208 .
Prop:Race:Trt:Tm          16     32.63         32.63 0.0082582 **
Variety:Prop:Race:Tm       4      4.49          4.49 0.3435848
Variety:Prop:Race:Trt:Tm   6     17.98         17.98 0.0062863 **
residual (MS)                     1.00
---
   Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The predictions for interaction terms and main effects are given below.

```
>
```




```
  Variety predicted.value standard.error est.status
1    Hass        1.383983      0.2503549  Estimable
2 Shepard        1.191883      0.2745900  Estimable

$avsed
  overall
0.1537628


      Prop predicted.value standard.error est.status
1   Clonal        1.159742      0.2614296  Estimable
2 Seedling        1.411313      0.2553089  Estimable

$avsed
  overall
0.1305324


   Variety      Prop Race predicted.value standard.error est.status
1     Hass   Clonal    G       1.1750024      0.2614544  Estimable
2     Hass   Clonal    M       1.2849633      0.2684727  Estimable
3     Hass   Clonal   WI       1.5172344      0.2675843  Estimable
4     Hass Seedling    G       1.3834487      0.2613335  Estimable
5     Hass Seedling    M       1.6796723      0.2668524  Estimable
6     Hass Seedling   WI       1.4345020      0.2647364  Estimable
7  Shepard   Clonal    G       0.7589517      0.3340847  Estimable
8  Shepard   Clonal    M       1.0299725      0.3236309  Estimable
9  Shepard   Clonal   WI       1.3012255      0.3451126  Estimable
10 Shepard Seedling    G       1.3325703      0.2860422  Estimable
11 Shepard Seedling    M       1.2381353      0.2902548  Estimable
12 Shepard Seedling   WI       1.4947339      0.3061393  Estimable

$avsed
  overall
0.2144187
```

Variety	Prop	Race	Tm	predicted.value	standard.error	est.status
1 Hass	Clonal	G	1	1.6888913	0.2789077	Estimable
2 Hass	Clonal	G	2	1.0435816	0.2614859	Estimable
3 Hass	Clonal	G	3	0.7925344	0.2607496	Estimable
4 Hass	Clonal	M	1	2.1188714	0.3245265	Estimable
5 Hass	Clonal	M	2	0.9600119	0.2635021	Estimable
6 Hass	Clonal	M	3	0.7760068	0.2680027	Estimable
7 Hass	Clonal	WI	1	2.2756957	0.3056034	Estimable
8 Hass	Clonal	WI	2	1.0870633	0.2708939	Estimable
9 Hass	Clonal	WI	3	0.8606539	0.2628709	Estimable
10 Hass	Seedling	G	1	2.0570353	0.2827709	Estimable
11 Hass	Seedling	G	2	0.9275127	0.2633199	Estimable
12 Hass	Seedling	G	3	1.1347052	0.2639613	Estimable
13 Hass	Seedling	M	1	2.4389107	0.3117927	Estimable
14 Hass	Seedling	M	2	1.2172373	0.2715075	Estimable
15 Hass	Seedling	M	3	1.3828691	0.2686515	Estimable
16 Hass	Seedling	WI	1	2.0436159	0.2900196	Estimable
17 Hass	Seedling	WI	2	0.9120571	0.2650468	Estimable
18 Hass	Seedling	WI	3	1.3478329	0.2798726	Estimable
19 Shepard	Clonal	G	1	-0.0510505	0.3794768	Estimable
20 Shepard	Clonal	G	2	1.0324897	0.3371611	Estimable
21 Shepard	Clonal	G	3	1.2954160	0.3580381	Estimable
22 Shepard	Clonal	M	1	0.3920469	0.3418845	Estimable
23 Shepard	Clonal	M	2	1.2374992	0.3245637	Estimable
24 Shepard	Clonal	M	3	1.4603713	0.3323394	Estimable
25 Shepard	Clonal	WI	1	0.9686641	0.4176402	Estimable
26 Shepard	Clonal	WI	2	1.3039220	0.3479313	Estimable
27 Shepard	Clonal	WI	3	1.6310905	0.3854176	Estimable
28 Shepard	Seedling	G	1	1.0137484	0.2939454	Estimable
29 Shepard	Seedling	G	2	1.1814019	0.2848095	Estimable
30 Shepard	Seedling	G	3	1.9905569	0.3219864	Estimable
31 Shepard	Seedling	M	1	1.0500203	0.3040993	Estimable
32 Shepard	Seedling	M	2	1.1642408	0.2888923	Estimable
33 Shepard	Seedling	M	3	1.7621541	0.3515971	Estimable
34 Shepard	Seedling	WI	1	1.3571398	0.3438695	Estimable
35 Shepard	Seedling	WI	2	1.1750507	0.2994002	Estimable
36 Shepard	Seedling	WI	3	1.9520113	0.3676380	Estimable

$avsed
  overall
0.2591348

	Variety	Prop	Race	Trt	Tm	predicted.value	standard.error	est.status
1	Hass	Clonal	G	A10	1	2.0573229	0.3131065	Estimable
2	Hass	Clonal	G	A10	2	1.0251757	0.2677828	Estimable
3	Hass	Clonal	G	A10	3	0.8372312	0.2635716	Estimable
4	Hass	Clonal	G	A8	1	1.9559845	0.3125015	Estimable
5	Hass	Clonal	G	A8	2	1.3030320	0.2710329	Estimable
6	Hass	Clonal	G	A8	3	0.7824822	0.2635012	Estimable
7	Hass	Clonal	G	Duke 7	1	NA	NA	Aliased
8	Hass	Clonal	G	Duke 7	2	NA	NA	Aliased
9	Hass	Clonal	G	Duke 7	3	NA	NA	Aliased
10	Hass	Clonal	G	Nabal	1	1.4166303	0.3262959	Estimable
11	Hass	Clonal	G	Nabal	2	0.9942359	0.2687763	Estimable
12	Hass	Clonal	G	Nabal	3	0.8395803	0.2638262	Estimable
13	Hass	Clonal	G	SHSR-03	1	NA	NA	Aliased
14	Hass	Clonal	G	SHSR-03	2	NA	NA	Aliased
15	Hass	Clonal	G	SHSR-03	3	NA	NA	Aliased
16	Hass	Clonal	G	Thomas	1	NA	NA	Aliased
17	Hass	Clonal	G	Thomas	2	NA	NA	Aliased
18	Hass	Clonal	G	Thomas	3	NA	NA	Aliased
19	Hass	Clonal	G	V1	1	NA	NA	Aliased
20	Hass	Clonal	G	V1	2	NA	NA	Aliased
21	Hass	Clonal	G	V1	3	NA	NA	Aliased
22	Hass	Clonal	G	Velvick	1	NA	NA	Aliased
23	Hass	Clonal	G	Velvick	2	NA	NA	Aliased
24	Hass	Clonal	G	Velvick	3	NA	NA	Aliased
25	Hass	Clonal	G	Zutano	1	NA	NA	Aliased
26	Hass	Clonal	G	Zutano	2	NA	NA	Aliased
27	Hass	Clonal	G	Zutano	3	NA	NA	Aliased
28	Hass	Clonal	G	Peasley	1	NA	NA	Aliased
29	Hass	Clonal	G	Peasley	2	NA	NA	Aliased
30	Hass	Clonal	G	Peasley	3	NA	NA	Aliased
31	Hass	Clonal	G	Reed	1	0.9007565	0.3491322	Estimable
32	Hass	Clonal	G	Reed	2	0.8896484	0.2726721	Estimable
33	Hass	Clonal	G	Reed	3	0.6960016	0.2627053	Estimable
34	Hass	Clonal	G	SHSR-02	1	NA	NA	Aliased
35	Hass	Clonal	G	SHSR-02	2	NA	NA	Aliased
36	Hass	Clonal	G	SHSR-02	3	NA	NA	Aliased
37	Hass	Clonal	G	Toro Canyon	1	NA	NA	Aliased
38	Hass	Clonal	G	Toro Canyon	2	NA	NA	Aliased
39	Hass	Clonal	G	Toro Canyon	3	NA	NA	Aliased
40	Hass	Clonal	G	Velvick/Hazard	1	NA	NA	Aliased
41	Hass	Clonal	G	Velvick/Hazard	2	NA	NA	Aliased

42	Hass	Clonal	G	Velvick/Hazard	3	NA	NA	Aliased
43	Hass	Clonal	G	Edranol	1	NA	NA	Aliased
44	Hass	Clonal	G	Edranol	2	NA	NA	Aliased
45	Hass	Clonal	G	Edranol	3	NA	NA	Aliased
46	Hass	Clonal	G	Parida	1	NA	NA	Aliased
47	Hass	Clonal	G	Parida	2	NA	NA	Aliased
48	Hass	Clonal	G	Parida	3	NA	NA	Aliased
49	Hass	Clonal	G	Plowman	1	2.4853054	0.4113936	Estimable
50	Hass	Clonal	G	Plowman	2	1.0196141	0.2818211	Estimable
51	Hass	Clonal	G	Plowman	3	0.8339129	0.2645821	Estimable
52	Hass	Clonal	G	Shepard	1	NA	NA	Aliased
53	Hass	Clonal	G	Shepard	2	NA	NA	Aliased
54	Hass	Clonal	G	Shepard	3	NA	NA	Aliased
55	Hass	Clonal	G	Hass	1	1.3173480	0.3515400	Estimable
56	Hass	Clonal	G	Hass	2	1.0297836	0.2756263	Estimable
57	Hass	Clonal	G	Hass	3	0.7659981	0.2635729	Estimable
58	Hass	Clonal	G	Barr Duke	1	NA	NA	Aliased
59	Hass	Clonal	G	Barr Duke	2	NA	NA	Aliased
60	Hass	Clonal	G	Barr Duke	3	NA	NA	Aliased
61	Hass	Clonal	G	SHSR-01	1	NA	NA	Aliased
62	Hass	Clonal	G	SHSR-01	2	NA	NA	Aliased
63	Hass	Clonal	G	SHSR-01	3	NA	NA	Aliased
64	Hass	Clonal	G	Rigato	1	NA	NA	Aliased
65	Hass	Clonal	G	Rigato	2	NA	NA	Aliased
66	Hass	Clonal	G	Rigato	3	NA	NA	Aliased
67	Hass	Clonal	M	A10	1	NA	NA	Aliased
68	Hass	Clonal	M	A10	2	NA	NA	Aliased
69	Hass	Clonal	M	A10	3	NA	NA	Aliased
70	Hass	Clonal	M	A8	1	NA	NA	Aliased
71	Hass	Clonal	M	A8	2	NA	NA	Aliased
72	Hass	Clonal	M	A8	3	NA	NA	Aliased
73	Hass	Clonal	M	Duke 7	1	2.8441244	0.3128873	Estimable
74	Hass	Clonal	M	Duke 7	2	1.2161501	0.2682188	Estimable
75	Hass	Clonal	M	Duke 7	3	0.7190594	0.2628433	Estimable
76	Hass	Clonal	M	Nabal	1	NA	NA	Aliased
77	Hass	Clonal	M	Nabal	2	NA	NA	Aliased
78	Hass	Clonal	M	Nabal	3	NA	NA	Aliased
79	Hass	Clonal	M	SHSR-03	1	2.5140259	0.3293101	Estimable
80	Hass	Clonal	M	SHSR-03	2	1.1653807	0.2724341	Estimable
81	Hass	Clonal	M	SHSR-03	3	0.8025876	0.2632596	Estimable
82	Hass	Clonal	M	Thomas	1	2.1676718	0.3456195	Estimable
83	Hass	Clonal	M	Thomas	2	0.8216644	0.2920414	Estimable
84	Hass	Clonal	M	Thomas	3	0.7843535	0.3946704	Estimable
85	Hass	Clonal	M	V1	1	NA	NA	Aliased
86	Hass	Clonal	M	V1	2	NA	NA	Aliased
87	Hass	Clonal	M	V1	3	NA	NA	Aliased
88	Hass	Clonal	M	Velvick	1	NA	NA	Aliased
89	Hass	Clonal	M	Velvick	2	NA	NA	Aliased
90	Hass	Clonal	M	Velvick	3	NA	NA	Aliased
91	Hass	Clonal	M	Zutano	1	1.9514831	0.3092444	Estimable
92	Hass	Clonal	M	Zutano	2	1.1497625	0.2672332	Estimable
93	Hass	Clonal	M	Zutano	3	0.8350112	0.2640336	Estimable
94	Hass	Clonal	M	Peasley	1	NA	NA	Aliased
95	Hass	Clonal	M	Peasley	2	NA	NA	Aliased
96	Hass	Clonal	M	Peasley	3	NA	NA	Aliased
97	Hass	Clonal	M	Reed	1	NA	NA	Aliased
98	Hass	Clonal	M	Reed	2	NA	NA	Aliased
99	Hass	Clonal	M	Reed	3	NA	NA	Aliased
100	Hass	Clonal	M	SHSR-02	1	NA	NA	Aliased
101	Hass	Clonal	M	SHSR-02	2	NA	NA	Aliased
102	Hass	Clonal	M	SHSR-02	3	NA	NA	Aliased
103	Hass	Clonal	M	Toro Canyon	1	NA	NA	Aliased
104	Hass	Clonal	M	Toro Canyon	2	NA	NA	Aliased
105	Hass	Clonal	M	Toro Canyon	3	NA	NA	Aliased
106	Hass	Clonal	M	Velvick/Hazard	1	NA	NA	Aliased
107	Hass	Clonal	M	Velvick/Hazard	2	NA	NA	Aliased
108	Hass	Clonal	M	Velvick/Hazard	3	NA	NA	Aliased
109	Hass	Clonal	M	Edranol	1	NA	NA	Aliased
110	Hass	Clonal	M	Edranol	2	NA	NA	Aliased
111	Hass	Clonal	M	Edranol	3	NA	NA	Aliased
112	Hass	Clonal	M	Parida	1	NA	NA	Aliased
113	Hass	Clonal	M	Parida	2	NA	NA	Aliased
114	Hass	Clonal	M	Parida	3	NA	NA	Aliased
115	Hass	Clonal	M	Plowman	1	NA	NA	Aliased
116	Hass	Clonal	M	Plowman	2	NA	NA	Aliased
117	Hass	Clonal	M	Plowman	3	NA	NA	Aliased
118	Hass	Clonal	M	Shepard	1	NA	NA	Aliased
119	Hass	Clonal	M	Shepard	2	NA	NA	Aliased
120	Hass	Clonal	M	Shepard	3	NA	NA	Aliased
121	Hass	Clonal	M	Hass	1	NA	NA	Aliased
122	Hass	Clonal	M	Hass	2	NA	NA	Aliased
123	Hass	Clonal	M	Hass	3	NA	NA	Aliased
124	Hass	Clonal	M	Barr Duke	1	1.0619819	0.4074385	Estimable
125	Hass	Clonal	M	Barr Duke	2	0.6430460	0.2933707	Estimable
126	Hass	Clonal	M	Barr Duke	3	0.7743099	0.3018465	Estimable
127	Hass	Clonal	M	SHSR-01	1	2.1739411	1.0346117	Estimable
128	Hass	Clonal	M	SHSR-01	2	0.7640675	0.3120313	Estimable
129	Hass	Clonal	M	SHSR-01	3	0.7407188	0.3265635	Estimable
130	Hass	Clonal	M	Rigato	1	NA	NA	Aliased
131	Hass	Clonal	M	Rigato	2	NA	NA	Aliased
132	Hass	Clonal	M	Rigato	3	NA	NA	Aliased
133	Hass	Clonal	WI	A10	1	NA	NA	Aliased
134	Hass	Clonal	WI	A10	2	NA	NA	Aliased
135	Hass	Clonal	WI	A10	3	NA	NA	Aliased
136	Hass	Clonal	WI	A8	1	NA	NA	Aliased
137	Hass	Clonal	WI	A8	2	NA	NA	Aliased
138	Hass	Clonal	WI	A8	3	NA	NA	Aliased
139	Hass	Clonal	WI	Duke 7	1	NA	NA	Aliased
140	Hass	Clonal	WI	Duke 7	2	NA	NA	Aliased
141	Hass	Clonal	WI	Duke 7	3	NA	NA	Aliased
142	Hass	Clonal	WI	Nabal	1	NA	NA	Aliased
143	Hass	Clonal	WI	Nabal	2	NA	NA	Aliased
144	Hass	Clonal	WI	Nabal	3	NA	NA	Aliased
145	Hass	Clonal	WI	SHSR-03	1	NA	NA	Aliased
146	Hass	Clonal	WI	SHSR-03	2	NA	NA	Aliased
147	Hass	Clonal	WI	SHSR-03	3	NA	NA	Aliased
148	Hass	Clonal	WI	Thomas	1	NA	NA	Aliased
149	Hass	Clonal	WI	Thomas	2	NA	NA	Aliased
150	Hass	Clonal	WI	Thomas	3	NA	NA	Aliased
151	Hass	Clonal	WI	V1	1	2.3348454	0.3745015	Estimable
152	Hass	Clonal	WI	V1	2	1.1799643	0.2964912	Estimable
153	Hass	Clonal	WI	V1	3	NA	NA	Aliased
154	Hass	Clonal	WI	Velvick	1	2.2165460	0.3097609	Estimable
155	Hass	Clonal	WI	Velvick	2	0.9941622	0.2678556	Estimable
156	Hass	Clonal	WI	Velvick	3	0.8606539	0.2628709	Estimable
157	Hass	Clonal	WI	Zutano	1	NA	NA	Aliased

158	Hass	Clonal	WI	Zutano	2	NA	NA	Aliased
159	Hass	Clonal	WI	Zutano	3	NA	NA	Aliased
160	Hass	Clonal	WI	Peasley	1	NA	NA	Aliased
161	Hass	Clonal	WI	Peasley	2	NA	NA	Aliased
162	Hass	Clonal	WI	Peasley	3	NA	NA	Aliased
163	Hass	Clonal	WI	Reed	1	NA	NA	Aliased
164	Hass	Clonal	WI	Reed	2	NA	NA	Aliased
165	Hass	Clonal	WI	Reed	3	NA	NA	Aliased
166	Hass	Clonal	WI	SHSR-02	1	NA	NA	Aliased
167	Hass	Clonal	WI	SHSR-02	2	NA	NA	Aliased
168	Hass	Clonal	WI	SHSR-02	3	NA	NA	Aliased
169	Hass	Clonal	WI	Toro Canyon	1	NA	NA	Aliased
170	Hass	Clonal	WI	Toro Canyon	2	NA	NA	Aliased
171	Hass	Clonal	WI	Toro Canyon	3	NA	NA	Aliased
172	Hass	Clonal	WI	Velvick/Hazard	1	NA	NA	Aliased
173	Hass	Clonal	WI	Velvick/Hazard	2	NA	NA	Aliased
174	Hass	Clonal	WI	Velvick/Hazard	3	NA	NA	Aliased
175	Hass	Clonal	WI	Edranol	1	NA	NA	Aliased
176	Hass	Clonal	WI	Edranol	2	NA	NA	Aliased
177	Hass	Clonal	WI	Edranol	3	NA	NA	Aliased
178	Hass	Clonal	WI	Parida	1	NA	NA	Aliased
179	Hass	Clonal	WI	Parida	2	NA	NA	Aliased
180	Hass	Clonal	WI	Parida	3	NA	NA	Aliased
181	Hass	Clonal	WI	Plowman	1	NA	NA	Aliased
182	Hass	Clonal	WI	Plowman	2	NA	NA	Aliased
183	Hass	Clonal	WI	Plowman	3	NA	NA	Aliased
184	Hass	Clonal	WI	Shepard	1	NA	NA	Aliased
185	Hass	Clonal	WI	Shepard	2	NA	NA	Aliased
186	Hass	Clonal	WI	Shepard	3	NA	NA	Aliased
187	Hass	Clonal	WI	Hass	1	NA	NA	Aliased
188	Hass	Clonal	WI	Hass	2	NA	NA	Aliased
189	Hass	Clonal	WI	Hass	3	NA	NA	Aliased
190	Hass	Clonal	WI	Barr Duke	1	NA	NA	Aliased
191	Hass	Clonal	WI	Barr Duke	2	NA	NA	Aliased
192	Hass	Clonal	WI	Barr Duke	3	NA	NA	Aliased
193	Hass	Clonal	WI	SHSR-01	1	NA	NA	Aliased
194	Hass	Clonal	WI	SHSR-01	2	NA	NA	Aliased
195	Hass	Clonal	WI	SHSR-01	3	NA	NA	Aliased
196	Hass	Clonal	WI	Rigato	1	NA	NA	Aliased
197	Hass	Clonal	WI	Rigato	2	NA	NA	Aliased
198	Hass	Clonal	WI	Rigato	3	NA	NA	Aliased
199	Hass	Seedling	G	A10	1	2.4279928	0.3256875	Estimable
200	Hass	Seedling	G	A10	2	0.8531482	0.2696299	Estimable
201	Hass	Seedling	G	A10	3	1.1465576	0.2724922	Estimable
202	Hass	Seedling	G	A8	1	2.3142242	0.3291888	Estimable
203	Hass	Seedling	G	A8	2	1.2319528	0.2738713	Estimable
204	Hass	Seedling	G	A8	3	1.2127979	0.2739781	Estimable
205	Hass	Seedling	G	Duke 7	1	NA	NA	Aliased
206	Hass	Seedling	G	Duke 7	2	NA	NA	Aliased
207	Hass	Seedling	G	Duke 7	3	NA	NA	Aliased
208	Hass	Seedling	G	Nabal	1	2.3114757	0.3249948	Estimable
209	Hass	Seedling	G	Nabal	2	0.9267466	0.2692875	Estimable
210	Hass	Seedling	G	Nabal	3	1.2505746	0.2719357	Estimable
211	Hass	Seedling	G	SHSR-03	1	NA	NA	Aliased
212	Hass	Seedling	G	SHSR-03	2	NA	NA	Aliased
213	Hass	Seedling	G	SHSR-03	3	NA	NA	Aliased
214	Hass	Seedling	G	Thomas	1	NA	NA	Aliased
215	Hass	Seedling	G	Thomas	2	NA	NA	Aliased
216	Hass	Seedling	G	Thomas	3	NA	NA	Aliased
217	Hass	Seedling	G	V1	1	NA	NA	Aliased
218	Hass	Seedling	G	V1	2	NA	NA	Aliased
219	Hass	Seedling	G	V1	3	NA	NA	Aliased
220	Hass	Seedling	G	Velvick	1	NA	NA	Aliased
221	Hass	Seedling	G	Velvick	2	NA	NA	Aliased
222	Hass	Seedling	G	Velvick	3	NA	NA	Aliased
223	Hass	Seedling	G	Zutano	1	NA	NA	Aliased
224	Hass	Seedling	G	Zutano	2	NA	NA	Aliased
225	Hass	Seedling	G	Zutano	3	NA	NA	Aliased
226	Hass	Seedling	G	Peasley	1	2.3064701	0.3533269	Estimable
227	Hass	Seedling	G	Peasley	2	1.0862614	0.2774630	Estimable
228	Hass	Seedling	G	Peasley	3	NA	NA	Aliased
229	Hass	Seedling	G	Reed	1	2.2096502	0.3389843	Estimable
230	Hass	Seedling	G	Reed	2	1.1366881	0.2759106	Estimable
231	Hass	Seedling	G	Reed	3	1.0154581	0.2745227	Estimable
232	Hass	Seedling	G	SHSR-02	1	2.1929561	0.3234668	Estimable
233	Hass	Seedling	G	SHSR-02	2	0.8548591	0.2689106	Estimable
234	Hass	Seedling	G	SHSR-02	3	1.0669264	0.2710490	Estimable
235	Hass	Seedling	G	Toro Canyon	1	NA	NA	Aliased
236	Hass	Seedling	G	Toro Canyon	2	NA	NA	Aliased
237	Hass	Seedling	G	Toro Canyon	3	NA	NA	Aliased
238	Hass	Seedling	G	Velvick/Hazard	1	NA	NA	Aliased
239	Hass	Seedling	G	Velvick/Hazard	2	NA	NA	Aliased
240	Hass	Seedling	G	Velvick/Hazard	3	NA	NA	Aliased
241	Hass	Seedling	G	Edranol	1	NA	NA	Aliased
242	Hass	Seedling	G	Edranol	2	NA	NA	Aliased
243	Hass	Seedling	G	Edranol	3	NA	NA	Aliased
244	Hass	Seedling	G	Parida	1	NA	NA	Aliased
245	Hass	Seedling	G	Parida	2	NA	NA	Aliased
246	Hass	Seedling	G	Parida	3	NA	NA	Aliased
247	Hass	Seedling	G	Plowman	1	1.4891917	0.5324286	Estimable
248	Hass	Seedling	G	Plowman	2	0.8104103	0.2897786	Estimable
249	Hass	Seedling	G	Plowman	3	1.0449769	0.2751737	Estimable
250	Hass	Seedling	G	Shepard	1	NA	NA	Aliased
251	Hass	Seedling	G	Shepard	2	NA	NA	Aliased
252	Hass	Seedling	G	Shepard	3	NA	NA	Aliased
253	Hass	Seedling	G	Hass	1	NA	NA	Aliased
254	Hass	Seedling	G	Hass	2	NA	NA	Aliased
255	Hass	Seedling	G	Hass	3	NA	NA	Aliased
256	Hass	Seedling	G	Barr Duke	1	NA	NA	Aliased
257	Hass	Seedling	G	Barr Duke	2	NA	NA	Aliased
258	Hass	Seedling	G	Barr Duke	3	NA	NA	Aliased
259	Hass	Seedling	G	SHSR-01	1	NA	NA	Aliased
260	Hass	Seedling	G	SHSR-01	2	NA	NA	Aliased
261	Hass	Seedling	G	SHSR-01	3	NA	NA	Aliased
262	Hass	Seedling	G	Rigato	1	1.2043214	0.5670206	Estimable
263	Hass	Seedling	G	Rigato	2	0.5200354	0.3764238	Estimable
264	Hass	Seedling	G	Rigato	3	1.2056450	0.3203611	Estimable
265	Hass	Seedling	M	A10	1	NA	NA	Aliased
266	Hass	Seedling	M	A10	2	NA	NA	Aliased
267	Hass	Seedling	M	A10	3	NA	NA	Aliased
268	Hass	Seedling	M	A8	1	NA	NA	Aliased
269	Hass	Seedling	M	A8	2	NA	NA	Aliased
270	Hass	Seedling	M	A8	3	NA	NA	Aliased
271	Hass	Seedling	M	Duke 7	1	2.0632088	0.4494142	Estimable
272	Hass	Seedling	M	Duke 7	2	1.1422877	0.2883267	Estimable
273	Hass	Seedling	M	Duke 7	3	1.2582470	0.2715841	Estimable

274	Hass	Seedling	M	Nabal	1	NA	NA	Aliased
275	Hass	Seedling	M	Nabal	2	NA	NA	Aliased
276	Hass	Seedling	M	Nabal	3	NA	NA	Aliased
277	Hass	Seedling	M	SHSR-03	1	3.0302597	0.3434678	Estimable
278	Hass	Seedling	M	SHSR-03	2	0.9208554	0.2766595	Estimable
279	Hass	Seedling	M	SHSR-03	3	1.2574792	0.2746261	Estimable
280	Hass	Seedling	M	Thomas	1	NA	NA	Aliased
281	Hass	Seedling	M	Thomas	2	NA	NA	Aliased
282	Hass	Seedling	M	Thomas	3	NA	NA	Aliased
283	Hass	Seedling	M	V1	1	NA	NA	Aliased
284	Hass	Seedling	M	V1	2	NA	NA	Aliased
285	Hass	Seedling	M	V1	3	NA	NA	Aliased
286	Hass	Seedling	M	Velvick	1	NA	NA	Aliased
287	Hass	Seedling	M	Velvick	2	NA	NA	Aliased
288	Hass	Seedling	M	Velvick	3	NA	NA	Aliased
289	Hass	Seedling	M	Zutano	1	2.0751351	0.4714606	Estimable
290	Hass	Seedling	M	Zutano	2	1.0637612	0.3496475	Estimable
291	Hass	Seedling	M	Zutano	3	0.9791756	0.2746237	Estimable
292	Hass	Seedling	M	Peasley	1	NA	NA	Aliased
293	Hass	Seedling	M	Peasley	2	NA	NA	Aliased
294	Hass	Seedling	M	Peasley	3	NA	NA	Aliased
295	Hass	Seedling	M	Reed	1	NA	NA	Aliased
296	Hass	Seedling	M	Reed	2	NA	NA	Aliased
297	Hass	Seedling	M	Reed	3	NA	NA	Aliased
298	Hass	Seedling	M	SHSR-02	1	NA	NA	Aliased
299	Hass	Seedling	M	SHSR-02	2	NA	NA	Aliased
300	Hass	Seedling	M	SHSR-02	3	NA	NA	Aliased
301	Hass	Seedling	M	Toro Canyon	1	3.0790729	0.3625982	Estimable
302	Hass	Seedling	M	Toro Canyon	2	1.0980427	0.2735510	Estimable
303	Hass	Seedling	M	Toro Canyon	3	2.0641838	0.3604440	Estimable
304	Hass	Seedling	M	Velvick/Hazard	1	NA	NA	Aliased
305	Hass	Seedling	M	Velvick/Hazard	2	NA	NA	Aliased
306	Hass	Seedling	M	Velvick/Hazard	3	NA	NA	Aliased
307	Hass	Seedling	M	Edranol	1	NA	NA	Aliased
308	Hass	Seedling	M	Edranol	2	NA	NA	Aliased
309	Hass	Seedling	M	Edranol	3	NA	NA	Aliased
310	Hass	Seedling	M	Parida	1	NA	NA	Aliased
311	Hass	Seedling	M	Parida	2	NA	NA	Aliased
312	Hass	Seedling	M	Parida	3	NA	NA	Aliased
313	Hass	Seedling	M	Plowman	1	NA	NA	Aliased
314	Hass	Seedling	M	Plowman	2	NA	NA	Aliased
315	Hass	Seedling	M	Plowman	3	NA	NA	Aliased
316	Hass	Seedling	M	Shepard	1	NA	NA	Aliased
317	Hass	Seedling	M	Shepard	2	NA	NA	Aliased
318	Hass	Seedling	M	Shepard	3	NA	NA	Aliased
319	Hass	Seedling	M	Hass	1	NA	NA	Aliased
320	Hass	Seedling	M	Hass	2	NA	NA	Aliased
321	Hass	Seedling	M	Hass	3	NA	NA	Aliased
322	Hass	Seedling	M	Barr Duke	1	1.9468767	0.5762879	Estimable
323	Hass	Seedling	M	Barr Duke	2	1.8612395	0.3805361	Estimable
324	Hass	Seedling	M	Barr Duke	3	1.3552597	0.3232834	Estimable
325	Hass	Seedling	M	SHSR-01	1	NA	NA	Aliased
326	Hass	Seedling	M	SHSR-01	2	NA	NA	Aliased
327	Hass	Seedling	M	SHSR-01	3	NA	NA	Aliased
328	Hass	Seedling	M	Rigato	1	NA	NA	Aliased
329	Hass	Seedling	M	Rigato	2	NA	NA	Aliased
330	Hass	Seedling	M	Rigato	3	NA	NA	Aliased
331	Hass	Seedling	WI	A10	1	NA	NA	Aliased
332	Hass	Seedling	WI	A10	2	NA	NA	Aliased
333	Hass	Seedling	WI	A10	3	NA	NA	Aliased
334	Hass	Seedling	WI	A8	1	NA	NA	Aliased
335	Hass	Seedling	WI	A8	2	NA	NA	Aliased
336	Hass	Seedling	WI	A8	3	NA	NA	Aliased
337	Hass	Seedling	WI	Duke 7	1	NA	NA	Aliased
338	Hass	Seedling	WI	Duke 7	2	NA	NA	Aliased
339	Hass	Seedling	WI	Duke 7	3	NA	NA	Aliased
340	Hass	Seedling	WI	Nabal	1	NA	NA	Aliased
341	Hass	Seedling	WI	Nabal	2	NA	NA	Aliased
342	Hass	Seedling	WI	Nabal	3	NA	NA	Aliased
343	Hass	Seedling	WI	SHSR-03	1	NA	NA	Aliased
344	Hass	Seedling	WI	SHSR-03	2	NA	NA	Aliased
345	Hass	Seedling	WI	SHSR-03	3	NA	NA	Aliased
346	Hass	Seedling	WI	Thomas	1	NA	NA	Aliased
347	Hass	Seedling	WI	Thomas	2	NA	NA	Aliased
348	Hass	Seedling	WI	Thomas	3	NA	NA	Aliased
349	Hass	Seedling	WI	V1	1	2.5072663	0.3538545	Estimable
350	Hass	Seedling	WI	V1	2	0.9489917	0.2737920	Estimable
351	Hass	Seedling	WI	V1	3	1.6949230	0.3874874	Estimable
352	Hass	Seedling	WI	Velvick	1	2.2646005	0.3234442	Estimable
353	Hass	Seedling	WI	Velvick	2	0.9223749	0.2693074	Estimable
354	Hass	Seedling	WI	Velvick	3	1.2056489	0.2708743	Estimable
355	Hass	Seedling	WI	Zutano	1	NA	NA	Aliased
356	Hass	Seedling	WI	Zutano	2	NA	NA	Aliased
357	Hass	Seedling	WI	Zutano	3	NA	NA	Aliased
358	Hass	Seedling	WI	Peasley	1	NA	NA	Aliased
359	Hass	Seedling	WI	Peasley	2	NA	NA	Aliased
360	Hass	Seedling	WI	Peasley	3	NA	NA	Aliased
361	Hass	Seedling	WI	Reed	1	NA	NA	Aliased
362	Hass	Seedling	WI	Reed	2	NA	NA	Aliased
363	Hass	Seedling	WI	Reed	3	NA	NA	Aliased
364	Hass	Seedling	WI	SHSR-02	1	NA	NA	Aliased
365	Hass	Seedling	WI	SHSR-02	2	NA	NA	Aliased
366	Hass	Seedling	WI	SHSR-02	3	NA	NA	Aliased
367	Hass	Seedling	WI	Toro Canyon	1	NA	NA	Aliased
368	Hass	Seedling	WI	Toro Canyon	2	NA	NA	Aliased
369	Hass	Seedling	WI	Toro Canyon	3	NA	NA	Aliased
370	Hass	Seedling	WI	Velvick/Hazard	1	1.3589809	0.3443488	Estimable
371	Hass	Seedling	WI	Velvick/Hazard	2	0.8648046	0.2768319	Estimable
372	Hass	Seedling	WI	Velvick/Hazard	3	1.1429268	0.2785207	Estimable
373	Hass	Seedling	WI	Edranol	1	NA	NA	Aliased
374	Hass	Seedling	WI	Edranol	2	NA	NA	Aliased
375	Hass	Seedling	WI	Edranol	3	NA	NA	Aliased
376	Hass	Seedling	WI	Parida	1	NA	NA	Aliased
377	Hass	Seedling	WI	Parida	2	NA	NA	Aliased
378	Hass	Seedling	WI	Parida	3	NA	NA	Aliased
379	Hass	Seedling	WI	Plowman	1	NA	NA	Aliased
380	Hass	Seedling	WI	Plowman	2	NA	NA	Aliased
381	Hass	Seedling	WI	Plowman	3	NA	NA	Aliased
382	Hass	Seedling	WI	Shepard	1	NA	NA	Aliased
383	Hass	Seedling	WI	Shepard	2	NA	NA	Aliased
384	Hass	Seedling	WI	Shepard	3	NA	NA	Aliased
385	Hass	Seedling	WI	Hass	1	NA	NA	Aliased
386	Hass	Seedling	WI	Hass	2	NA	NA	Aliased
387	Hass	Seedling	WI	Hass	3	NA	NA	Aliased
388	Hass	Seedling	WI	Barr Duke	1	NA	NA	Aliased
389	Hass	Seedling	WI	Barr Duke	2	NA	NA	Aliased

390	Hass	Seedling	WI	Barr Duke	3	NA	NA	Aliased
391	Hass	Seedling	WI	SHSR-01	1	NA	NA	Aliased
392	Hass	Seedling	WI	SHSR-01	2	NA	NA	Aliased
393	Hass	Seedling	WI	SHSR-01	3	NA	NA	Aliased
394	Hass	Seedling	WI	Rigato	1	NA	NA	Aliased
395	Hass	Seedling	WI	Rigato	2	NA	NA	Aliased
396	Hass	Seedling	WI	Rigato	3	NA	NA	Aliased
397	Shepard	Clonal	G	A10	1	0.3146110	0.4182030	Estimable
398	Shepard	Clonal	G	A10	2	1.2158686	0.3480191	Estimable
399	Shepard	Clonal	G	A10	3	1.5102538	0.3795137	Estimable
400	Shepard	Clonal	G	A8	1	NA	NA	Aliased
401	Shepard	Clonal	G	A8	2	NA	NA	Aliased
402	Shepard	Clonal	G	A8	3	NA	NA	Aliased
403	Shepard	Clonal	G	Duke 7	1	NA	NA	Aliased
404	Shepard	Clonal	G	Duke 7	2	NA	NA	Aliased
405	Shepard	Clonal	G	Duke 7	3	NA	NA	Aliased
406	Shepard	Clonal	G	Nabal	1	-0.4167121	0.4374247	Estimable
407	Shepard	Clonal	G	Nabal	2	0.8491108	0.3598252	Estimable
408	Shepard	Clonal	G	Nabal	3	1.0805783	0.4022638	Estimable
409	Shepard	Clonal	G	SHSR-03	1	NA	NA	Aliased
410	Shepard	Clonal	G	SHSR-03	2	NA	NA	Aliased
411	Shepard	Clonal	G	SHSR-03	3	NA	NA	Aliased
412	Shepard	Clonal	G	Thomas	1	NA	NA	Aliased
413	Shepard	Clonal	G	Thomas	2	NA	NA	Aliased
414	Shepard	Clonal	G	Thomas	3	NA	NA	Aliased
415	Shepard	Clonal	G	V1	1	NA	NA	Aliased
416	Shepard	Clonal	G	V1	2	NA	NA	Aliased
417	Shepard	Clonal	G	V1	3	NA	NA	Aliased
418	Shepard	Clonal	G	Velvick	1	NA	NA	Aliased
419	Shepard	Clonal	G	Velvick	2	NA	NA	Aliased
420	Shepard	Clonal	G	Velvick	3	NA	NA	Aliased
421	Shepard	Clonal	G	Zutano	1	NA	NA	Aliased
422	Shepard	Clonal	G	Zutano	2	NA	NA	Aliased
423	Shepard	Clonal	G	Zutano	3	NA	NA	Aliased
424	Shepard	Clonal	G	Peasley	1	NA	NA	Aliased
425	Shepard	Clonal	G	Peasley	2	NA	NA	Aliased
426	Shepard	Clonal	G	Peasley	3	NA	NA	Aliased
427	Shepard	Clonal	G	Reed	1	NA	NA	Aliased
428	Shepard	Clonal	G	Reed	2	NA	NA	Aliased
429	Shepard	Clonal	G	Reed	3	NA	NA	Aliased
430	Shepard	Clonal	G	SHSR-02	1	NA	NA	Aliased
431	Shepard	Clonal	G	SHSR-02	2	NA	NA	Aliased
432	Shepard	Clonal	G	SHSR-02	3	NA	NA	Aliased
433	Shepard	Clonal	G	Toro Canyon	1	NA	NA	Aliased
434	Shepard	Clonal	G	Toro Canyon	2	NA	NA	Aliased
435	Shepard	Clonal	G	Toro Canyon	3	NA	NA	Aliased
436	Shepard	Clonal	G	Velvick/Hazard	1	NA	NA	Aliased
437	Shepard	Clonal	G	Velvick/Hazard	2	NA	NA	Aliased
438	Shepard	Clonal	G	Velvick/Hazard	3	NA	NA	Aliased
439	Shepard	Clonal	G	Edranol	1	NA	NA	Aliased
440	Shepard	Clonal	G	Edranol	2	NA	NA	Aliased
441	Shepard	Clonal	G	Edranol	3	NA	NA	Aliased
442	Shepard	Clonal	G	Parida	1	NA	NA	Aliased
443	Shepard	Clonal	G	Parida	2	NA	NA	Aliased
444	Shepard	Clonal	G	Parida	3	NA	NA	Aliased
445	Shepard	Clonal	G	Plowman	1	NA	NA	Aliased
446	Shepard	Clonal	G	Plowman	2	NA	NA	Aliased
447	Shepard	Clonal	G	Plowman	3	NA	NA	Aliased
448	Shepard	Clonal	G	Shepard	1	NA	NA	Aliased
449	Shepard	Clonal	G	Shepard	2	NA	NA	Aliased
450	Shepard	Clonal	G	Shepard	3	NA	NA	Aliased
451	Shepard	Clonal	G	Hass	1	NA	NA	Aliased
452	Shepard	Clonal	G	Hass	2	NA	NA	Aliased
453	Shepard	Clonal	G	Hass	3	NA	NA	Aliased
454	Shepard	Clonal	G	Barr Duke	1	NA	NA	Aliased
455	Shepard	Clonal	G	Barr Duke	2	NA	NA	Aliased
456	Shepard	Clonal	G	Barr Duke	3	NA	NA	Aliased
457	Shepard	Clonal	G	SHSR-01	1	NA	NA	Aliased
458	Shepard	Clonal	G	SHSR-01	2	NA	NA	Aliased
459	Shepard	Clonal	G	SHSR-01	3	NA	NA	Aliased
460	Shepard	Clonal	G	Rigato	1	NA	NA	Aliased
461	Shepard	Clonal	G	Rigato	2	NA	NA	Aliased
462	Shepard	Clonal	G	Rigato	3	NA	NA	Aliased
463	Shepard	Clonal	M	A10	1	NA	NA	Aliased
464	Shepard	Clonal	M	A10	2	NA	NA	Aliased
465	Shepard	Clonal	M	A10	3	NA	NA	Aliased
466	Shepard	Clonal	M	A8	1	NA	NA	Aliased
467	Shepard	Clonal	M	A8	2	NA	NA	Aliased
468	Shepard	Clonal	M	A8	3	NA	NA	Aliased
469	Shepard	Clonal	M	Duke 7	1	-0.2617537	0.4271418	Estimable
470	Shepard	Clonal	M	Duke 7	2	1.5971704	0.3549482	Estimable
471	Shepard	Clonal	M	Duke 7	3	1.4098590	0.3929571	Estimable
472	Shepard	Clonal	M	Nabal	1	NA	NA	Aliased
473	Shepard	Clonal	M	Nabal	2	NA	NA	Aliased
474	Shepard	Clonal	M	Nabal	3	NA	NA	Aliased
475	Shepard	Clonal	M	SHSR-03	1	0.9502520	0.4264280	Estimable
476	Shepard	Clonal	M	SHSR-03	2	1.3747722	0.3507539	Estimable
477	Shepard	Clonal	M	SHSR-03	3	1.8385374	0.3849698	Estimable
478	Shepard	Clonal	M	Thomas	1	0.5390918	0.4182135	Estimable
479	Shepard	Clonal	M	Thomas	2	0.9453552	0.3511221	Estimable
480	Shepard	Clonal	M	Thomas	3	0.9236177	0.3855979	Estimable
481	Shepard	Clonal	M	V1	1	NA	NA	Aliased
482	Shepard	Clonal	M	V1	2	NA	NA	Aliased
483	Shepard	Clonal	M	V1	3	NA	NA	Aliased
484	Shepard	Clonal	M	Velvick	1	NA	NA	Aliased
485	Shepard	Clonal	M	Velvick	2	NA	NA	Aliased
486	Shepard	Clonal	M	Velvick	3	NA	NA	Aliased
487	Shepard	Clonal	M	Zutano	1	0.0127230	0.4271074	Estimable
488	Shepard	Clonal	M	Zutano	2	1.0403637	0.3509906	Estimable
489	Shepard	Clonal	M	Zutano	3	1.5447463	0.3853475	Estimable
490	Shepard	Clonal	M	Peasley	1	NA	NA	Aliased
491	Shepard	Clonal	M	Peasley	2	NA	NA	Aliased
492	Shepard	Clonal	M	Peasley	3	NA	NA	Aliased
493	Shepard	Clonal	M	Reed	1	NA	NA	Aliased
494	Shepard	Clonal	M	Reed	2	NA	NA	Aliased
495	Shepard	Clonal	M	Reed	3	NA	NA	Aliased
496	Shepard	Clonal	M	SHSR-02	1	NA	NA	Aliased
497	Shepard	Clonal	M	SHSR-02	2	NA	NA	Aliased
498	Shepard	Clonal	M	SHSR-02	3	NA	NA	Aliased
499	Shepard	Clonal	M	Toro Canyon	1	NA	NA	Aliased
500	Shepard	Clonal	M	Toro Canyon	2	NA	NA	Aliased
501	Shepard	Clonal	M	Toro Canyon	3	NA	NA	Aliased
502	Shepard	Clonal	M	Velvick/Hazard	1	NA	NA	Aliased
503	Shepard	Clonal	M	Velvick/Hazard	2	NA	NA	Aliased
504	Shepard	Clonal	M	Velvick/Hazard	3	NA	NA	Aliased
505	Shepard	Clonal	M	Edranol	1	NA	NA	Aliased

506	Shepard	Clonal	M	Edranol	2	NA	NA	Aliased
507	Shepard	Clonal	M	Edranol	3	NA	NA	Aliased
508	Shepard	Clonal	M	Parida	1	NA	NA	Aliased
509	Shepard	Clonal	M	Parida	2	NA	NA	Aliased
510	Shepard	Clonal	M	Parida	3	NA	NA	Aliased
511	Shepard	Clonal	M	Plowman	1	NA	NA	Aliased
512	Shepard	Clonal	M	Plowman	2	NA	NA	Aliased
513	Shepard	Clonal	M	Plowman	3	NA	NA	Aliased
514	Shepard	Clonal	M	Shepard	1	0.4332158	0.4178174	Estimable
515	Shepard	Clonal	M	Shepard	2	1.1950525	0.3479014	Estimable
516	Shepard	Clonal	M	Shepard	3	1.5482391	0.3792932	Estimable
517	Shepard	Clonal	M	Hass	1	NA	NA	Aliased
518	Shepard	Clonal	M	Hass	2	NA	NA	Aliased
519	Shepard	Clonal	M	Hass	3	NA	NA	Aliased
520	Shepard	Clonal	M	Barr Duke	1	0.6787527	0.4176233	Estimable
521	Shepard	Clonal	M	Barr Duke	2	1.2722813	0.3479855	Estimable
522	Shepard	Clonal	M	Barr Duke	3	1.4972282	0.3794438	Estimable
523	Shepard	Clonal	M	SHSR-01	1	NA	NA	Aliased
524	Shepard	Clonal	M	SHSR-01	2	NA	NA	Aliased
525	Shepard	Clonal	M	SHSR-01	3	NA	NA	Aliased
526	Shepard	Clonal	M	Rigato	1	NA	NA	Aliased
527	Shepard	Clonal	M	Rigato	2	NA	NA	Aliased
528	Shepard	Clonal	M	Rigato	3	NA	NA	Aliased
529	Shepard	Clonal	WI	A10	1	NA	NA	Aliased
530	Shepard	Clonal	WI	A10	2	NA	NA	Aliased
531	Shepard	Clonal	WI	A10	3	NA	NA	Aliased
532	Shepard	Clonal	WI	A8	1	NA	NA	Aliased
533	Shepard	Clonal	WI	A8	2	NA	NA	Aliased
534	Shepard	Clonal	WI	A8	3	NA	NA	Aliased
535	Shepard	Clonal	WI	Duke 7	1	NA	NA	Aliased
536	Shepard	Clonal	WI	Duke 7	2	NA	NA	Aliased
537	Shepard	Clonal	WI	Duke 7	3	NA	NA	Aliased
538	Shepard	Clonal	WI	Nabal	1	NA	NA	Aliased
539	Shepard	Clonal	WI	Nabal	2	NA	NA	Aliased
540	Shepard	Clonal	WI	Nabal	3	NA	NA	Aliased
541	Shepard	Clonal	WI	SHSR-03	1	NA	NA	Aliased
542	Shepard	Clonal	WI	SHSR-03	2	NA	NA	Aliased
543	Shepard	Clonal	WI	SHSR-03	3	NA	NA	Aliased
544	Shepard	Clonal	WI	Thomas	1	NA	NA	Aliased
545	Shepard	Clonal	WI	Thomas	2	NA	NA	Aliased
546	Shepard	Clonal	WI	Thomas	3	NA	NA	Aliased
547	Shepard	Clonal	WI	V1	1	NA	NA	Aliased
548	Shepard	Clonal	WI	V1	2	NA	NA	Aliased
549	Shepard	Clonal	WI	V1	3	NA	NA	Aliased
550	Shepard	Clonal	WI	Velvick	1	0.9686641	0.4176402	Estimable
551	Shepard	Clonal	WI	Velvick	2	1.3039220	0.3479313	Estimable
552	Shepard	Clonal	WI	Velvick	3	1.6310905	0.3854176	Estimable
553	Shepard	Clonal	WI	Zutano	1	NA	NA	Aliased
554	Shepard	Clonal	WI	Zutano	2	NA	NA	Aliased
555	Shepard	Clonal	WI	Zutano	3	NA	NA	Aliased
556	Shepard	Clonal	WI	Peasley	1	NA	NA	Aliased
557	Shepard	Clonal	WI	Peasley	2	NA	NA	Aliased
558	Shepard	Clonal	WI	Peasley	3	NA	NA	Aliased
559	Shepard	Clonal	WI	Reed	1	NA	NA	Aliased
560	Shepard	Clonal	WI	Reed	2	NA	NA	Aliased
561	Shepard	Clonal	WI	Reed	3	NA	NA	Aliased
562	Shepard	Clonal	WI	SHSR-02	1	NA	NA	Aliased
563	Shepard	Clonal	WI	SHSR-02	2	NA	NA	Aliased
564	Shepard	Clonal	WI	SHSR-02	3	NA	NA	Aliased
565	Shepard	Clonal	WI	Toro Canyon	1	NA	NA	Aliased
566	Shepard	Clonal	WI	Toro Canyon	2	NA	NA	Aliased
567	Shepard	Clonal	WI	Toro Canyon	3	NA	NA	Aliased
568	Shepard	Clonal	WI	Velvick/Hazard	1	NA	NA	Aliased
569	Shepard	Clonal	WI	Velvick/Hazard	2	NA	NA	Aliased
570	Shepard	Clonal	WI	Velvick/Hazard	3	NA	NA	Aliased
571	Shepard	Clonal	WI	Edranol	1	NA	NA	Aliased
572	Shepard	Clonal	WI	Edranol	2	NA	NA	Aliased
573	Shepard	Clonal	WI	Edranol	3	NA	NA	Aliased
574	Shepard	Clonal	WI	Parida	1	NA	NA	Aliased
575	Shepard	Clonal	WI	Parida	2	NA	NA	Aliased
576	Shepard	Clonal	WI	Parida	3	NA	NA	Aliased
577	Shepard	Clonal	WI	Plowman	1	NA	NA	Aliased
578	Shepard	Clonal	WI	Plowman	2	NA	NA	Aliased
579	Shepard	Clonal	WI	Plowman	3	NA	NA	Aliased
580	Shepard	Clonal	WI	Shepard	1	NA	NA	Aliased
581	Shepard	Clonal	WI	Shepard	2	NA	NA	Aliased
582	Shepard	Clonal	WI	Shepard	3	NA	NA	Aliased
583	Shepard	Clonal	WI	Hass	1	NA	NA	Aliased
584	Shepard	Clonal	WI	Hass	2	NA	NA	Aliased
585	Shepard	Clonal	WI	Hass	3	NA	NA	Aliased
586	Shepard	Clonal	WI	Barr Duke	1	NA	NA	Aliased
587	Shepard	Clonal	WI	Barr Duke	2	NA	NA	Aliased
588	Shepard	Clonal	WI	Barr Duke	3	NA	NA	Aliased
589	Shepard	Clonal	WI	SHSR-01	1	NA	NA	Aliased
590	Shepard	Clonal	WI	SHSR-01	2	NA	NA	Aliased
591	Shepard	Clonal	WI	SHSR-01	3	NA	NA	Aliased
592	Shepard	Clonal	WI	Rigato	1	NA	NA	Aliased
593	Shepard	Clonal	WI	Rigato	2	NA	NA	Aliased
594	Shepard	Clonal	WI	Rigato	3	NA	NA	Aliased
595	Shepard	Seedling	G	A10	1	1.2625410	0.3307669	Estimable
596	Shepard	Seedling	G	A10	2	0.9577045	0.3033360	Estimable
597	Shepard	Seedling	G	A10	3	2.3085130	0.4421687	Estimable
598	Shepard	Seedling	G	A8	1	0.8487528	0.4957508	Estimable
599	Shepard	Seedling	G	A8	2	1.1303099	0.3474107	Estimable
600	Shepard	Seedling	G	A8	3	1.9036029	0.4728298	Estimable
601	Shepard	Seedling	G	Duke 7	1	NA	NA	Aliased
602	Shepard	Seedling	G	Duke 7	2	NA	NA	Aliased
603	Shepard	Seedling	G	Duke 7	3	NA	NA	Aliased
604	Shepard	Seedling	G	Nabal	1	1.0036241	0.3289458	Estimable
605	Shepard	Seedling	G	Nabal	2	1.1019648	0.3019766	Estimable
606	Shepard	Seedling	G	Nabal	3	2.2778745	0.4422195	Estimable
607	Shepard	Seedling	G	SHSR-03	1	NA	NA	Aliased
608	Shepard	Seedling	G	SHSR-03	2	NA	NA	Aliased
609	Shepard	Seedling	G	SHSR-03	3	NA	NA	Aliased
610	Shepard	Seedling	G	Thomas	1	NA	NA	Aliased
611	Shepard	Seedling	G	Thomas	2	NA	NA	Aliased
612	Shepard	Seedling	G	Thomas	3	NA	NA	Aliased
613	Shepard	Seedling	G	V1	1	NA	NA	Aliased
614	Shepard	Seedling	G	V1	2	NA	NA	Aliased
615	Shepard	Seedling	G	V1	3	NA	NA	Aliased
616	Shepard	Seedling	G	Velvick	1	NA	NA	Aliased
617	Shepard	Seedling	G	Velvick	2	NA	NA	Aliased
618	Shepard	Seedling	G	Velvick	3	NA	NA	Aliased
619	Shepard	Seedling	G	Zutano	1	NA	NA	Aliased
620	Shepard	Seedling	G	Zutano	2	NA	NA	Aliased
621	Shepard	Seedling	G	Zutano	3	NA	NA	Aliased

622	Shepard	Seedling	G	Peasley	1	NA	NA	Aliased
623	Shepard	Seedling	G	Peasley	2	NA	NA	Aliased
624	Shepard	Seedling	G	Peasley	3	NA	NA	Aliased
625	Shepard	Seedling	G	Reed	1	0.5319250	0.3369983	Estimable
626	Shepard	Seedling	G	Reed	2	1.2202872	0.3058252	Estimable
627	Shepard	Seedling	G	Reed	3	1.3976762	0.4631251	Estimable
628	Shepard	Seedling	G	SHSR-02	1	1.0272473	0.3292432	Estimable
629	Shepard	Seedling	G	SHSR-02	2	1.1257120	0.3012210	Estimable
630	Shepard	Seedling	G	SHSR-02	3	2.0651180	0.4313889	Estimable
631	Shepard	Seedling	G	Toro Canyon	1	NA	NA	Aliased
632	Shepard	Seedling	G	Toro Canyon	2	NA	NA	Aliased
633	Shepard	Seedling	G	Toro Canyon	3	NA	NA	Aliased
634	Shepard	Seedling	G	Velvick/Hazard	1	NA	NA	Aliased
635	Shepard	Seedling	G	Velvick/Hazard	2	NA	NA	Aliased
636	Shepard	Seedling	G	Velvick/Hazard	3	NA	NA	Aliased
637	Shepard	Seedling	G	Edranol	1	1.3265512	0.3475825	Estimable
638	Shepard	Seedling	G	Edranol	2	1.5907774	0.3219882	Estimable
639	Shepard	Seedling	G	Edranol	3	NA	NA	Aliased
640	Shepard	Seedling	G	Parida	1	NA	NA	Aliased
641	Shepard	Seedling	G	Parida	2	NA	NA	Aliased
642	Shepard	Seedling	G	Parida	3	NA	NA	Aliased
643	Shepard	Seedling	G	Plowman	1	1.0955975	0.3461397	Estimable
644	Shepard	Seedling	G	Plowman	2	1.1430573	0.3208519	Estimable
645	Shepard	Seedling	G	Plowman	3	NA	NA	Aliased
646	Shepard	Seedling	G	Shepard	1	NA	NA	Aliased
647	Shepard	Seedling	G	Shepard	2	NA	NA	Aliased
648	Shepard	Seedling	G	Shepard	3	NA	NA	Aliased
649	Shepard	Seedling	G	Hass	1	NA	NA	Aliased
650	Shepard	Seedling	G	Hass	2	NA	NA	Aliased
651	Shepard	Seedling	G	Hass	3	NA	NA	Aliased
652	Shepard	Seedling	G	Barr Duke	1	NA	NA	Aliased
653	Shepard	Seedling	G	Barr Duke	2	NA	NA	Aliased
654	Shepard	Seedling	G	Barr Duke	3	NA	NA	Aliased
655	Shepard	Seedling	G	SHSR-01	1	NA	NA	Aliased
656	Shepard	Seedling	G	SHSR-01	2	NA	NA	Aliased
657	Shepard	Seedling	G	SHSR-01	3	NA	NA	Aliased
658	Shepard	Seedling	G	Rigato	1	NA	NA	Aliased
659	Shepard	Seedling	G	Rigato	2	NA	NA	Aliased
660	Shepard	Seedling	G	Rigato	3	NA	NA	Aliased
661	Shepard	Seedling	M	A10	1	NA	NA	Aliased
662	Shepard	Seedling	M	A10	2	NA	NA	Aliased
663	Shepard	Seedling	M	A10	3	NA	NA	Aliased
664	Shepard	Seedling	M	A8	1	NA	NA	Aliased
665	Shepard	Seedling	M	A8	2	NA	NA	Aliased
666	Shepard	Seedling	M	A8	3	NA	NA	Aliased
667	Shepard	Seedling	M	Duke 7	1	1.0906945	0.4405554	Estimable
668	Shepard	Seedling	M	Duke 7	2	1.0046201	0.3330011	Estimable
669	Shepard	Seedling	M	Duke 7	3	1.6171194	0.4491340	Estimable
670	Shepard	Seedling	M	Nabal	1	NA	NA	Aliased
671	Shepard	Seedling	M	Nabal	2	NA	NA	Aliased
672	Shepard	Seedling	M	Nabal	3	NA	NA	Aliased
673	Shepard	Seedling	M	SHSR-03	1	0.6040980	0.4520884	Estimable
674	Shepard	Seedling	M	SHSR-03	2	1.1141634	0.3385784	Estimable
675	Shepard	Seedling	M	SHSR-03	3	1.6843775	0.4502448	Estimable
676	Shepard	Seedling	M	Thomas	1	NA	NA	Aliased
677	Shepard	Seedling	M	Thomas	2	NA	NA	Aliased
678	Shepard	Seedling	M	Thomas	3	NA	NA	Aliased
679	Shepard	Seedling	M	V1	1	NA	NA	Aliased
680	Shepard	Seedling	M	V1	2	NA	NA	Aliased
681	Shepard	Seedling	M	V1	3	NA	NA	Aliased
682	Shepard	Seedling	M	Velvick	1	NA	NA	Aliased
683	Shepard	Seedling	M	Velvick	2	NA	NA	Aliased
684	Shepard	Seedling	M	Velvick	3	NA	NA	Aliased
685	Shepard	Seedling	M	Zutano	1	1.4837548	0.4558549	Estimable
686	Shepard	Seedling	M	Zutano	2	1.3969349	0.3468009	Estimable
687	Shepard	Seedling	M	Zutano	3	1.9849653	0.4708301	Estimable
688	Shepard	Seedling	M	Peasley	1	NA	NA	Aliased
689	Shepard	Seedling	M	Peasley	2	NA	NA	Aliased
690	Shepard	Seedling	M	Peasley	3	NA	NA	Aliased
691	Shepard	Seedling	M	Reed	1	NA	NA	Aliased
692	Shepard	Seedling	M	Reed	2	NA	NA	Aliased
693	Shepard	Seedling	M	Reed	3	NA	NA	Aliased
694	Shepard	Seedling	M	SHSR-02	1	NA	NA	Aliased
695	Shepard	Seedling	M	SHSR-02	2	NA	NA	Aliased
696	Shepard	Seedling	M	SHSR-02	3	NA	NA	Aliased
697	Shepard	Seedling	M	Toro Canyon	1	1.1230288	0.3569897	Estimable
698	Shepard	Seedling	M	Toro Canyon	2	1.2542299	0.3281545	Estimable
699	Shepard	Seedling	M	Toro Canyon	3	NA	NA	Aliased
700	Shepard	Seedling	M	Velvick/Hazard	1	NA	NA	Aliased
701	Shepard	Seedling	M	Velvick/Hazard	2	NA	NA	Aliased
702	Shepard	Seedling	M	Velvick/Hazard	3	NA	NA	Aliased
703	Shepard	Seedling	M	Edranol	1	NA	NA	Aliased
704	Shepard	Seedling	M	Edranol	2	NA	NA	Aliased
705	Shepard	Seedling	M	Edranol	3	NA	NA	Aliased
706	Shepard	Seedling	M	Parida	1	1.1925976	0.3720619	Estimable
707	Shepard	Seedling	M	Parida	2	1.1386542	0.3377865	Estimable
708	Shepard	Seedling	M	Parida	3	NA	NA	Aliased
709	Shepard	Seedling	M	Plowman	1	NA	NA	Aliased
710	Shepard	Seedling	M	Plowman	2	NA	NA	Aliased
711	Shepard	Seedling	M	Plowman	3	NA	NA	Aliased
712	Shepard	Seedling	M	Shepard	1	0.8059485	0.3464886	Estimable
713	Shepard	Seedling	M	Shepard	2	1.0768424	0.3250696	Estimable
714	Shepard	Seedling	M	Shepard	3	NA	NA	Aliased
715	Shepard	Seedling	M	Hass	1	NA	NA	Aliased
716	Shepard	Seedling	M	Hass	2	NA	NA	Aliased
717	Shepard	Seedling	M	Hass	3	NA	NA	Aliased
718	Shepard	Seedling	M	Barr Duke	1	NA	NA	Aliased
719	Shepard	Seedling	M	Barr Duke	2	NA	NA	Aliased
720	Shepard	Seedling	M	Barr Duke	3	NA	NA	Aliased
721	Shepard	Seedling	M	SHSR-01	1	NA	NA	Aliased
722	Shepard	Seedling	M	SHSR-01	2	NA	NA	Aliased
723	Shepard	Seedling	M	SHSR-01	3	NA	NA	Aliased
724	Shepard	Seedling	M	Rigato	1	NA	NA	Aliased
725	Shepard	Seedling	M	Rigato	2	NA	NA	Aliased
726	Shepard	Seedling	M	Rigato	3	NA	NA	Aliased
727	Shepard	Seedling	WI	A10	1	NA	NA	Aliased
728	Shepard	Seedling	WI	A10	2	NA	NA	Aliased
729	Shepard	Seedling	WI	A10	3	NA	NA	Aliased
730	Shepard	Seedling	WI	A8	1	NA	NA	Aliased
731	Shepard	Seedling	WI	A8	2	NA	NA	Aliased
732	Shepard	Seedling	WI	A8	3	NA	NA	Aliased
733	Shepard	Seedling	WI	Duke 7	1	NA	NA	Aliased
734	Shepard	Seedling	WI	Duke 7	2	NA	NA	Aliased
735	Shepard	Seedling	WI	Duke 7	3	NA	NA	Aliased
736	Shepard	Seedling	WI	Nabal	1	NA	NA	Aliased
737	Shepard	Seedling	WI	Nabal	2	NA	NA	Aliased

```
738 Shepard Seedling   WI          Nabal  3             NA             NA    Aliased
739 Shepard Seedling   WI        SHSR-03  1             NA             NA    Aliased
740 Shepard Seedling   WI        SHSR-03  2             NA             NA    Aliased
741 Shepard Seedling   WI        SHSR-03  3             NA             NA    Aliased
742 Shepard Seedling   WI         Thomas  1             NA             NA    Aliased
743 Shepard Seedling   WI         Thomas  2             NA             NA    Aliased
744 Shepard Seedling   WI         Thomas  3             NA             NA    Aliased
745 Shepard Seedling   WI             V1  1      1.3839712      0.4588454  Estimable
746 Shepard Seedling   WI             V1  2      1.2460859      0.3347930  Estimable
747 Shepard Seedling   WI             V1  3      1.7349643      0.4547228  Estimable
748 Shepard Seedling   WI        Velvick  1      1.3303084      0.3291650  Estimable
749 Shepard Seedling   WI        Velvick  2      1.1040155      0.3011903  Estimable
750 Shepard Seedling   WI        Velvick  3      2.1690583      0.4172384  Estimable
751 Shepard Seedling   WI         Zutano  1             NA             NA    Aliased
752 Shepard Seedling   WI         Zutano  2             NA             NA    Aliased
753 Shepard Seedling   WI         Zutano  3             NA             NA    Aliased
754 Shepard Seedling   WI        Peasley  1             NA             NA    Aliased
755 Shepard Seedling   WI        Peasley  2             NA             NA    Aliased
756 Shepard Seedling   WI        Peasley  3             NA             NA    Aliased
757 Shepard Seedling   WI           Reed  1             NA             NA    Aliased
758 Shepard Seedling   WI           Reed  2             NA             NA    Aliased
759 Shepard Seedling   WI           Reed  3             NA             NA    Aliased
760 Shepard Seedling   WI        SHSR-02  1             NA             NA    Aliased
761 Shepard Seedling   WI        SHSR-02  2             NA             NA    Aliased
762 Shepard Seedling   WI        SHSR-02  3             NA             NA    Aliased
763 Shepard Seedling   WI    Toro Canyon  1             NA             NA    Aliased
764 Shepard Seedling   WI    Toro Canyon  2             NA             NA    Aliased
765 Shepard Seedling   WI    Toro Canyon  3             NA             NA    Aliased
766 Shepard Seedling   WI Velvick/Hazard  1             NA             NA    Aliased
767 Shepard Seedling   WI Velvick/Hazard  2             NA             NA    Aliased
768 Shepard Seedling   WI Velvick/Hazard  3             NA             NA    Aliased
769 Shepard Seedling   WI        Edranol  1             NA             NA    Aliased
770 Shepard Seedling   WI        Edranol  2             NA             NA    Aliased
771 Shepard Seedling   WI        Edranol  3             NA             NA    Aliased
772 Shepard Seedling   WI         Parida  1             NA             NA    Aliased
773 Shepard Seedling   WI         Parida  2             NA             NA    Aliased
774 Shepard Seedling   WI         Parida  3             NA             NA    Aliased
775 Shepard Seedling   WI        Plowman  1             NA             NA    Aliased
776 Shepard Seedling   WI        Plowman  2             NA             NA    Aliased
777 Shepard Seedling   WI        Plowman  3             NA             NA    Aliased
778 Shepard Seedling   WI        Shepard  1             NA             NA    Aliased
779 Shepard Seedling   WI        Shepard  2             NA             NA    Aliased
780 Shepard Seedling   WI        Shepard  3             NA             NA    Aliased
781 Shepard Seedling   WI           Hass  1             NA             NA    Aliased
782 Shepard Seedling   WI           Hass  2             NA             NA    Aliased
783 Shepard Seedling   WI           Hass  3             NA             NA    Aliased
784 Shepard Seedling   WI      Barr Duke  1             NA             NA    Aliased
785 Shepard Seedling   WI      Barr Duke  2             NA             NA    Aliased
786 Shepard Seedling   WI      Barr Duke  3             NA             NA    Aliased
787 Shepard Seedling   WI        SHSR-01  1             NA             NA    Aliased
788 Shepard Seedling   WI        SHSR-01  2             NA             NA    Aliased
789 Shepard Seedling   WI        SHSR-01  3             NA             NA    Aliased
790 Shepard Seedling   WI         Rigato  1             NA             NA    Aliased
791 Shepard Seedling   WI         Rigato  2             NA             NA    Aliased
792 Shepard Seedling   WI         Rigato  3             NA             NA    Aliased

$avsed
  overall
0.3658752
```

II. Comparing variability of clonal and seedling RS

The issue of variability / uniformity among individuals in a clonal vs seedling rootstock is not a simple one to address especially with the trials set out as they are with clonal and seedling rootstocks in spatially separate trials and different RS grown at each trial.

There are two concepts here –

a. genetic variance between clonal rootstocks (& seedling rootstocks) - but we cannot simply look at the genetic variance at each SiteScion as we have different RS grown at different Site Scions.
b. Variation between genetic effects across times for each RS. So looking at how each RS varies across the measurements and see if there is a difference between the clonal type and seedling type of each RS.

In b. what we are interested in is the between time variability of genetic effects for each RS. The clonal rootstocks do not have any genetic variance within a RS at a particular time (as they are all clones and identical genetically) however the seedling rootstocks are not genetically identical and they will have within RS genetic variance as well as between time variability. Without pedigree information this seedling genetic variance is confounded with the residual variance. I have attempted to set up a simple pedigree

grouping the seedling RS into their “Family” groups and this way we can get an estimate of within RS genetic variance as well as between times and possibly sites.

Initially I have just looked at each site scion separately and the results are not definitive. The models used were :

For clonal trials:

CHC2.asr<-asreml(Yld~Yrf+Trt,

random =~at(Trt):Yrf+ at(Yrf):Rep,

rcov=~at(Yrf):ar1(Col):ar1(Row),

data=CHC,na.method.X='include')

For seedling trials (we have an extra term to include which incorporates the genetic variance within each RS) :

CHS2.asr<-asreml(Yld~ Yrf+Trt,

random =~at(Trt):ped(Trtseed):Yrf + at(Trt):Yrf + at(Yrf):Rep,

rcov=~at(Yrf):ar1(Col):ar1(Row),

control=asreml.control(ginverse=list(Trtseed=seed.ginv), workspace=10e7),

data=CHS,na.method.X="include")

For Childers Hass clonal the following genetic variances were estimated for each RS:

```
at(Trt, A10):Yrf!Yrf.var      8.844838e-06
at(Trt, A8):Yrf!Yrf.var       4.518892e+01
at(Trt, Duke_7):Yrf!Yrf.var   1.350478e-04
at(Trt, Nabal):Yrf!Yrf.var    4.203869e-05
at(Trt, SHSR-03):Yrf!Yrf.var  2.312142e+01
at(Trt, Thomas):Yrf!Yrf.var   5.721338e-07
at(Trt, V1):Yrf!Yrf.var       2.609686e+02
at(Trt, Velvick):Yrf!Yrf.var  3.743755e+02
at(Trt, Zutano):Yrf!Yrf.var   6.059645e+02
```

While for Childers Hass seedling the genetic variances were :

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.var	9.398535e-06	9.398535e-06	NA	NA	Boundary
at(Trt, A8):Yrf!Yrf.var	7.041950e+01	7.041950e+01	108.30475994	0.65019761	Positive
at(Trt, Nabal):Yrf!Yrf.var	6.499508e-07	6.499508e-07	NA	NA	Boundary
at(Trt, SHSR-03):Yrf!Yrf.var	6.522088e+01	6.522088e+01	76.31484662	0.85462892	Positive
at(Trt, V1):Yrf!Yrf.var	6.826879e-05	6.826879e-05	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	6.499508e-07	6.499508e-07	NA	NA	Boundary
at(Trt, Peasley):Yrf!Yrf.var	6.499508e-07	6.499508e-07	NA	NA	Boundary
at(Trt, Reed):Yrf!Yrf.var	1.135113e+02	1.135113e+02	139.65003468	0.81282700	Positive
at(Trt, SHSR-02):Yrf!Yrf.var	6.499508e-07	6.499508e-07	NA	NA	Boundary
at(Trt, Toro Canyon):Yrf!Yrf.var	6.499508e-07	6.499508e-07	NA	NA	Boundary
at(Trt, Velvick/Hazard):Yrf!Yrf.var	4.468875e+01	4.468875e+01	59.00967568	0.75731220	Positive
at(Trt, A10):ped(Trtseed):Yrf!Yrf.var	2.367870e+01	2.367870e+01	13.93230262	1.69955360	Positive
at(Trt, A8):ped(Trtseed):Yrf!Yrf.var	4.145034e+01	4.145034e+01	22.92370951	1.80818654	Positive
at(Trt, Nabal):ped(Trtseed):Yrf!Yrf.var	3.621843e+01	3.621843e+01	18.40793466	1.96754456	Positive
at(Trt, SHSR-03):ped(Trtseed):Yrf!Yrf.var	8.051422e+00	8.051422e+00	6.71227947	1.19950642	Positive
at(Trt, V1):ped(Trtseed):Yrf!Yrf.var	1.234543e+01	1.234543e+01	8.91684169	1.38450736	Positive
at(Trt, Velvick):ped(Trtseed):Yrf!Yrf.var	9.646554e+01	9.646554e+01	43.19736959	2.23313454	Positive
at(Trt, Peasley):ped(Trtseed):Yrf!Yrf.var	6.713868e+01	6.713868e+01	34.22981366	1.96140938	Positive
at(Trt, Reed):ped(Trtseed):Yrf!Yrf.var	2.425378e+00	2.425378e+00	3.96589071	0.61155955	Positive

```
at(Trt, SHSR-02):ped(Trtseed):Yrf!Yrf.var         1.334720e+02  1.334720e+02  61.08562468  2.18499826      Positive
at(Trt, Toro Canyon):ped(Trtseed):Yrf!Yrf.var     7.437707e+01  7.437707e+01  37.85760397  1.96465333      Positive
at(Trt, Velvick/Hazard):ped(Trtseed):Yrf!Yrf.var  4.737093e+00  4.737093e+00   5.59816343  0.84618689      Positive
```

so in summary for the RS in common between the two clonal & seedling trials

RS	Clonal variance	Seedling variance
A10	0	24
A8	45	111
Nabal	0	36
SHSR-03	23	73
V1	261	12
Velvick	374	96

Hence for some of the RS the clonal type was more uniform (with lower genetic variance) than seedling type eg A10, A8, Nabal, SHSR-03 but for others it was the reverse eg V1 & Velvick. This is just a very rough comparison. You may also see this in the graphs of individual RS.

Hampton Hass

If we look at another site eg Hampton Hass clonal the following genetic variances were estimated for each RS

```
                                 gamma     component    std.error     z.ratio    constraint
at(Trt, A10):Yrf!Yrf.var      6.957153e-06  6.957153e-06          NA          NA      Boundary
at(Trt, A8):Yrf!Yrf.var       1.100022e-04  1.100022e-04          NA          NA      Boundary
at(Trt, Duke 7):Yrf!Yrf.var   2.261356e+02  2.261356e+02 174.80129289  1.29367250      Positive
at(Trt, Nabal):Yrf!Yrf.var    2.416032e+01  2.416032e+01  31.05028023  0.77810327      Positive
at(Trt, SHSR-03):Yrf!Yrf.var  6.288391e+01  6.288391e+01  54.19345362  1.16035982      Positive
at(Trt, Velvick):Yrf!Yrf.var  9.016448e-06  9.016448e-06          NA          NA      Boundary
at(Trt, Zutano):Yrf!Yrf.var   4.400090e-07  4.400090e-07          NA          NA      Boundary
at(Trt, Reed):Yrf!Yrf.var     3.957134e+01  3.957134e+01  42.60864687  0.92871617      Positive
at(Trt, Plowman):Yrf!Yrf.var  6.724938e+00  6.724938e+00  20.72356286  0.32450683      Positive
at(Trt, Hass):Yrf!Yrf.var     7.178931e+01  7.178931e+01  60.74934556  1.18172975      Positive
```

while Hampton Hass seedling genetic variances were:

```
at(Trt, A10):Yrf!Yrf.var                          9.221080e-05  9.221080e-05          NA          NA      Boundary
at(Trt, A8):Yrf!Yrf.var                           4.069659e-07  4.069659e-07          NA          NA      Boundary
at(Trt, Duke 7):Yrf!Yrf.var                       1.802037e+01  1.802037e+01  32.8551444  0.54847937      Positive
at(Trt, Nabal):Yrf!Yrf.var                        7.665321e+00  7.665321e+00  40.4936947  0.18929666      Positive
at(Trt, SHSR-03):Yrf!Yrf.var                      6.067666e-05  6.067666e-05          NA          NA      Boundary
at(Trt, Velvick):Yrf!Yrf.var                      1.248851e-05  1.248851e-05          NA          NA      Boundary
at(Trt, Zutano):Yrf!Yrf.var                       2.082128e-06  2.082128e-06          NA          NA      Boundary
at(Trt, Reed):Yrf!Yrf.var                         1.647918e-06  1.647918e-06          NA          NA      Boundary
at(Trt, SHSR-02):Yrf!Yrf.var                      5.148151e+00  5.148151e+00  57.4269091  0.08964701      Positive
at(Trt, Velvick/Hazard):Yrf!Yrf.var               2.055609e+02  2.055609e+02 195.9613642  1.04898695      Positive
at(Trt, Plowman):Yrf!Yrf.var                      9.221080e-05  9.221080e-05          NA          NA      Boundary
at(Trt, A10):ped(Trtseed):Yrf!Yrf.var             9.460065e+01  9.460065e+01  44.2710087  2.13685328      Positive
at(Trt, A8):ped(Trtseed):Yrf!Yrf.var              3.368822e-06  3.368822e-06          NA          NA      Boundary
at(Trt, Duke 7):ped(Trtseed):Yrf!Yrf.var          1.977120e-06  1.977120e-06          NA          NA      Boundary
at(Trt, Nabal):ped(Trtseed):Yrf!Yrf.var           1.393864e+01  1.393864e+01   9.3224684  1.49516652      Positive
at(Trt, SHSR-03):ped(Trtseed):Yrf!Yrf.var         5.812831e+01  5.812831e+01  27.4771810  2.11551203      Positive
at(Trt, Velvick):ped(Trtseed):Yrf!Yrf.var         1.005718e+02  1.005718e+02  50.2748490  2.00043978      Positive
at(Trt, Zutano):ped(Trtseed):Yrf!Yrf.var          6.719073e+01  6.719073e+01  31.9003006  2.10627275      Positive
at(Trt, Reed):ped(Trtseed):Yrf!Yrf.var            1.370307e+01  1.370307e+01   9.7576045  1.40434805      Positive
at(Trt, SHSR-02):ped(Trtseed):Yrf!Yrf.var         4.523055e+01  4.523055e+01  24.6865088  1.83219715      Positive
at(Trt, Velvick/Hazard):ped(Trtseed):Yrf!Yrf.var  8.885227e+00  8.885227e+00   7.2431619  1.22670558      Positive
at(Trt, Plowman):ped(Trtseed):Yrf!Yrf.var         1.009739e-06  1.009739e-06          NA          NA      Boundary
```

at(Trt, A10):ped(Trtseed):Yrf!Yrf.var	9.300040e+01	9.300040e+01	43.1355109	2.15600561	Positive
at(Trt, A8):ped(Trtseed):Yrf!Yrf.var	2.697923e-06	2.697923e-06	NA	NA	Boundary
at(Trt, Duke 7):ped(Trtseed):Yrf!Yrf.var	3.087144e+00	3.087144e+00	3.8633601	0.79908277	Positive
at(Trt, Nabal):ped(Trtseed):Yrf!Yrf.var	1.775641e+01	1.775641e+01	10.6075563	1.67393934	Positive
at(Trt, SHSR-03):ped(Trtseed):Yrf!Yrf.var	5.752842e+01	5.752842e+01	26.6999223	2.15462881	Positive
at(Trt, Velvick):ped(Trtseed):Yrf!Yrf.var	1.054896e+02	1.054896e+02	51.9703772	2.02980184	Positive
at(Trt, Zutano):ped(Trtseed):Yrf!Yrf.var	7.486680e+01	7.486680e+01	34.9417556	2.14261696	Positive
at(Trt, Reed):ped(Trtseed):Yrf!Yrf.var	1.305158e+01	1.305158e+01	9.0527874	1.44171909	Positive
at(Trt, SHSR-02):ped(Trtseed):Yrf!Yrf.var	4.890787e+01	4.890787e+01	25.4543132	1.92139797	Positive
at(Trt, Velvick/Hazard):ped(Trtseed):Yrf!Yrf.var	1.082815e+01	1.082815e+01	8.3525051	1.29639493	Positive
at(Trt, Plowman):ped(Trtseed):Yrf!Yrf.var	2.354828e-06	2.354828e-06	NA	NA	Boundary

so in summary the RS in common between the clonal and seedling trials have variances as follows:

RS	Clonal variance	Seedling variance
A10	0	95
A8	0	0
Duke 7	226	18
Nabal	24	22
SHSR-03	63	58
Velvick	0	101
Zutano	0	67
Reed	40	14
Plowman	7	0

So once again some RS had lower genetic variance as a clonal type than seedling eg A10, Velvick, Zutano while others were the reverse eg Plowman, Duke 7, Reed, etc..

WA Hass

The variances for RS at WA Hass clonal were:

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.var	3.333540e-04	3.333540e-04	NA	NA	Boundary
at(Trt, Duke 7):Yrf!Yrf.var	8.230543e-05	8.230543e-05	NA	NA	Boundary
at(Trt, Nabal):Yrf!Yrf.var	4.541701e-06	4.541701e-06	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	4.541701e-06	4.541701e-06	NA	NA	Boundary
at(Trt, Zutano):Yrf!Yrf.var	9.075351e+01	9.075351e+01	80.5353831	1.1268775	Positive
at(Trt, Reed):Yrf!Yrf.var	7.325619e+00	7.325619e+00	23.5653977	0.3108634	Positive
at(Trt, Hass):Yrf!Yrf.var	4.541701e-06	4.541701e-06	NA	NA	Boundary
at(Trt, Barr Duke):Yrf!Yrf.var	4.541701e-06	4.541701e-06	NA	NA	Boundary
at(Trt, SHSR-01):Yrf!Yrf.var	4.541701e-06	4.541701e-06	NA	NA	Boundary

And for WA Hass seedling:

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.var	4.485833e-05	4.485833e-05	NA	NA	Boundary
at(Trt, Duke 7):Yrf!Yrf.var	7.681151e-01	7.681151e-01	15.2109012	0.05049767	Positive
at(Trt, Nabal):Yrf!Yrf.var	9.392655e-05	9.392655e-05	NA	NA	Boundary
at(Trt, V1):Yrf!Yrf.var	4.485833e-05	4.485833e-05	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	1.330923e-05	1.330923e-05	NA	NA	Boundary
at(Trt, SHSR-02):Yrf!Yrf.var	2.837090e-06	2.837090e-06	NA	NA	Boundary
at(Trt, Toro Canyon):Yrf!Yrf.var	2.837090e-06	2.837090e-06	NA	NA	Boundary
at(Trt, Plowman):Yrf!Yrf.var	5.589063e-06	5.589063e-06	NA	NA	Boundary
at(Trt, A10):ped(Trtseed):Yrf!Yrf.var	1.615786e+01	1.615786e+01	12.0827739	1.33726408	Positive
at(Trt, Duke 7):ped(Trtseed):Yrf!Yrf.var	2.613910e-06	2.613910e-06	NA	NA	Boundary
at(Trt, Nabal):ped(Trtseed):Yrf!Yrf.var	3.555204e-06	3.555204e-06	NA	NA	Boundary
at(Trt, V1):ped(Trtseed):Yrf!Yrf.var	6.426161e+00	6.426161e+00	8.4076584	0.76432237	Positive
at(Trt, Velvick):ped(Trtseed):Yrf!Yrf.var	4.684288e+01	4.684288e+01	26.9389668	1.73885228	Positive
at(Trt, SHSR-02):ped(Trtseed):Yrf!Yrf.var	3.499124e-06	3.499124e-06	NA	NA	Boundary
at(Trt, Toro Canyon):ped(Trtseed):Yrf!Yrf.var	2.759224e-06	2.759224e-06	NA	NA	Boundary
at(Trt, Plowman):ped(Trtseed):Yrf!Yrf.var	8.582007e+01	8.582007e+01	41.4568633	2.07010534	Positive

so in summary the RS in common between the clonal and seedling trials have variances as follows:

RS	Clonal variance	Seedling variance
A10	0	16
Duke 7	0	0.8
Nabal	0	0
Velvick	0	47

So in this case the seedling RS have greater variance than the clonal RS for A10, Velvick & Duke 7 and the same for Nabal

Walkamin Hass

The variances for each RS in Hass clonal trial were:

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.var	2.546970e+02	2.546970e+02	197.2232809	1.29141447	Positive
at(Trt, A8):Yrf!Yrf.var	7.475208e+01	7.475208e+01	66.6820229	1.12102299	Positive
at(Trt, Duke 7):Yrf!Yrf.var	1.094882e-04	1.094882e-04	NA	NA	Boundary
at(Trt, Thomas):Yrf!Yrf.var	4.475845e-03	4.475845e-03	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	6.250707e-05	6.250707e-05	NA	NA	Boundary
at(Trt, Zutano):Yrf!Yrf.var	3.130716e+01	3.130716e+01	37.3367921	0.83850694	Positive
at(Trt, Reed):Yrf!Yrf.var	7.974353e+00	7.974353e+00	12.2568649	0.65060297	Positive
at(Trt, Hass):Yrf!Yrf.var	4.379527e-07	4.379527e-07	NA	NA	Boundary
at(Trt, Barr Duke):Yrf!Yrf.var	4.379527e-07	4.379527e-07	NA	NA	Boundary

While the variances for the RS in Hass seedling trial were:

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, A8):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, Duke 7):Yrf!Yrf.var	7.615832e+01	7.615832e+01	85.2994648	0.89283465	Positive
at(Trt, Nabal):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, Zutano):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, Reed):Yrf!Yrf.var	9.237487e-07	9.237487e-07	NA	NA	Boundary
at(Trt, SHSR-02):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, Barr Duke):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, Rigato):Yrf!Yrf.var	6.194337e-07	6.194337e-07	NA	NA	Boundary
at(Trt, A10):ped(Trtseed):Yrf!Yrf.var	3.393159e-06	3.393159e-06	NA	NA	Boundary
at(Trt, A8):ped(Trtseed):Yrf!Yrf.var	4.979718e+00	4.979718e+00	5.1812215	0.96110887	Positive
at(Trt, Duke 7):ped(Trtseed):Yrf!Yrf.var	2.740847e-06	2.740847e-06	NA	NA	Boundary
at(Trt, Nabal):ped(Trtseed):Yrf!Yrf.var	1.295629e+01	1.295629e+01	8.7550346	1.47986753	Positive
at(Trt, Velvick):ped(Trtseed):Yrf!Yrf.var	6.029579e+01	6.029579e+01	28.1443323	2.14237786	Positive
at(Trt, Zutano):ped(Trtseed):Yrf!Yrf.var	5.141438e+00	5.141438e+00	5.2909520	0.97174149	Positive
at(Trt, Reed):ped(Trtseed):Yrf!Yrf.var	5.053580e+00	5.053580e+00	6.7122936	0.75288420	Positive
at(Trt, SHSR-02):ped(Trtseed):Yrf!Yrf.var	4.133569e+01	4.133569e+01	20.1447387	2.05193471	Positive
at(Trt, Barr Duke):ped(Trtseed):Yrf!Yrf.var	1.976672e+01	1.976672e+01	11.5900887	1.70548464	Positive
at(Trt, Rigato):ped(Trtseed):Yrf!Yrf.var	1.765665e-06	1.765665e-06	NA	NA	Boundary

so in summary the RS in common between the clonal and seedling trials have variances as follows:

RS	Clonal variance	Seedling variance
A10	255	0
A8	75	5
Duke 7	0	76
Velvick	0	60
Zutano	31	5
Reed	8	5
Barr Duke	0	20

So in this case the seedling RS have greater variance than the clonal RS for Duke 7, Velvick, and Barr Duke but the reverse is true for A10, A8, Zutano, Reed.

III. Random effect MET analysis investigating GxE.

A combined analysis across sites has been performed in order to investiagate genotype by environment interaction (GxE). This refers to environment as location (Site) but also Time as well. This allows us to see how RS genotypes may perform differently across different environments. In this analysis RS genotypes are considered random effects and we are modelling the genetic variation between Sites and times.

There is an issue when considering the genetic variance for the Seedling populations as there is within RS genetic variance (due to the RS being seedlings and not all reps being genetically identical). Unfortunately without a pedigree this within RS genetic variance is confounded with the residual variation due to each seedling being coded the same. (just as the clonal RS are). The Clonal RS have no within genetic variance (between reps) as they are considered to be genetically identical. One way around this may be to set up a dummy pedigree linking the RS seedlings within each of their "families".

Another issue is that there are only a relatively small number of RS genotypes being tested in any one trial and different RS are tested at different sites with the concurrence between trials being fairly limited. This may mean the genetic correlations between trials may not be estimated very well.

For the above reasons I have decided to keep the MET analysis separate for clonal trials and seedling trials. As there was only 1 Shepard clonal trial and 4 Hass clonal trials I have also decided to just look at the Hass clonal trials in one analysis. The seedling trials will also be looked at in a separate analysis. Ie 3 data sets : Hass clonal (4 sites) / Hass seedling (4 sites) / Shepard seedling (2 sites - Childers and Walkamin)

The analyses are based on data summed across 2 consecutive years – to remove biennial bearing issue (similar to Verbyla & Cullis 1992, Bevington & Cullis 1990 etc in citrus). WA has no data for Y2007 – so Y78 is just Y2007.

<u>Asreml-R model</u>

A linear mixed model was fitted to the Yield (rolling total over 2 years) over time (3 times) across the 4 sites for each set of data. This model accounts for any spatial correlation between plots within a trial and also accounts for the temporal correlation between the repeated measurement times. The predictions from the 3 analysis times have also been totalled to form the cumulative yield for each variety at each site. This approach allows us to investigate the yield patterns over time (while accounting for spatial correlation and trends) in a more detailed way than analysing cumulative yield at each timepoint. Due to the biennial bearing issues the data was summed over 2 years (year 2007+2008, Year

2009+2010, Year 2011+2012). This is similar to the approach used by Verbyla & Cullis 1990, Bevington & Cullis 1990, Campbell et al 1996 amongst others to remove the problem of biennial or alternate bearing.

Initially a model was fitted with Trt * ExTime as fixed effects (where Trt are the rootstocks and ExTime represents the 4 trial by time (4x3) combinations.) The residual temporal and spatial correlation structure was modelled using a separable ar1h(Time):ar1(Col):ar1(Row) model for each of the sites. The asreml-R code was as follows:

```
METfix1.asr<-asreml(SumYld~ Trt*ExTime,
                    random =~ at(ExTime):Rep,
                    rcov=~at(Site):ar1h(ExTime):ar1(Col):ar1(Row),
                    data=YsumHC,na.method.X="include")
```

Secondly (where there was evidence of GxE – ExTime:Trt effects significant – a random effects model which correlates the genetic effects across sites and times was fitted. An example of this asreml-R model is given below. The genetic correlation structure was modelled using a factor analytic model. The residual temporal x spatial correlation structure was modelled as above in the fixed effect analysis.

```
MET1d.asr<-asreml(SumYld~ ExTime,
                    random =~fa(ExTime,2):Trt+ at(ExTime):Rep,
                    rcov=~at(Site):ar1h(ExTime):ar1(Col):ar1(Row),
                    data=YsumHC,na.method.X="include”)
```

1. Hass Clonal MET analysis across Sites and Times:

Hass clonal across sites – concurrence of varieties

	A10	A8	Duke 7	Nabal	SHSR-03	Thomas	V1	Velvick	Zutano	Reed	Plowman	Hass	Barr Duke	SHSR-01
Childers	30	30	30	30	30	30	30	30	0	0	0	0	0	0
Hampton	30	30	30	30	30	0	0	30	30	30	30	30	0	0
WA	30	0	30	30	0	0	0	30	30	30	0	27	30	27
Walkamin	30	30	30	0	0	30	0	30	30	30	0	30	30	0

Yield

Initial fixed effects analysis :

$Wald

	Df	denDF	F.inc	F.con	Margin	Pr
(Intercept)	1	53.0	1056.000	1056.000		1.138998e-36
Trt	13	210.4	33.610	7.218	A	1.340357e-11
ExTime	11	38.6	195.400	195.400	A	2.678261e-30
Trt:ExTime	86	441.4	2.213	2.213	B	9.272862e-08

Significant Trt:ExTime effects so there is evidence of GxE where varieties are perfomring differently across Sites and/ or times. We will then look at a MET analysis with random genetic effects across the Sites and times.

The results from the random effects model are presented below:

The genetic correlations across sites and harvests (C1=Y2007+Y2008 at Childers etc.) from the fa2 model fitted to the Trt by Experiment Time effects are as follows:

	C1	C2	C3	H1	H2	H3	WA1	WA2	WA3	W1	W2	W3
C1	1.000	0.999	0.981	0.619	0.918	0.610	0.441	0.118	-0.421	0.904	-0.378	0.552
C2	0.999	1.000	0.970	0.595	0.895	0.579	0.391	0.063	-0.470	0.879	-0.428	0.506
C3	0.981	0.970	1.000	0.690	0.977	0.704	0.605	0.306	-0.239	0.969	-0.193	0.702
H1	0.619	0.595	0.690	1.000	0.739	0.614	0.658	0.499	0.128	0.743	0.163	0.699
H2	0.918	0.895	0.977	0.739	1.000	0.778	0.761	0.502	-0.026	0.999	0.021	0.838
H3	0.610	0.579	0.704	0.614	0.778	1.000	0.763	0.619	0.243	0.787	0.280	0.796
WA1	0.441	0.391	0.605	0.658	0.761	0.763	1.000	0.943	0.629	0.782	0.664	0.992
WA2	0.118	0.063	0.306	0.499	0.502	0.619	0.943	1.000	0.851	0.531	0.875	0.893
WA3	-0.421	-0.470	-0.239	0.128	-0.026	0.243	0.629	0.851	1.000	0.008	0.999	0.524
W1	0.904	0.879	0.969	0.743	0.999	0.787	0.782	0.531	0.008	1.000	0.055	0.856
W2	-0.378	-0.428	-0.193	0.163	0.021	0.280	0.664	0.875	0.999	0.055	1.000	0.564
W3	0.552	0.506	0.702	0.699	0.838	0.796	0.992	0.893	0.524	0.856	0.564	1.000

The genetic correlations in the above table tell us how similar(or different) the rootstock varieties are performing across the different Sites and and also times (the 3 times based on the sum over consecutive years). The correlations reflect the rankings of RS varieties within each pair of “trials” (where trial refers to Site x Time). A correlation of 1 reflects the trials have the same ranking of RS varieties while a correlation of -1 reflects the varieties are ranked in completely the reverse. Most correlations will lie within these limits and tell us how similar the rootstocks are performing between the trials. Of course not all trials have the same varieties and there are only a small number of total varieties so these correlations will not be perfect.

So for example if we just look (maybe with a magnifying glass!!) at the top row (of the correlation matrix above) we can see the genetic correlations between C1 (Childers Hass Clonal at time 1 (ie 2007+2008)) with all other trials. That is the genetic correlation between C1 & C2 is 0.999 (therefore the genetic correlation between times 1 and 2 at Childers Hass clonal is 0.999 (very similar). Whereas the genetic correlation between C1 and WA1 (WA Hass clonal at time 1) is only 0.441 so not so similar. This may be a reflection of the different varieties being grown at these trials.

If we look within a Site (eg Childers) we see that the 3 times are very highly correlated with genetic correlation between time1 & 2 =0.999, time 2&3 = 0.970 and time 1 & 3 = 0.981.

	C1	C2	C3
C1	1.000	0.999	0.981
C2	0.999	1.000	0.970
C3	0.981	0.970	1.000

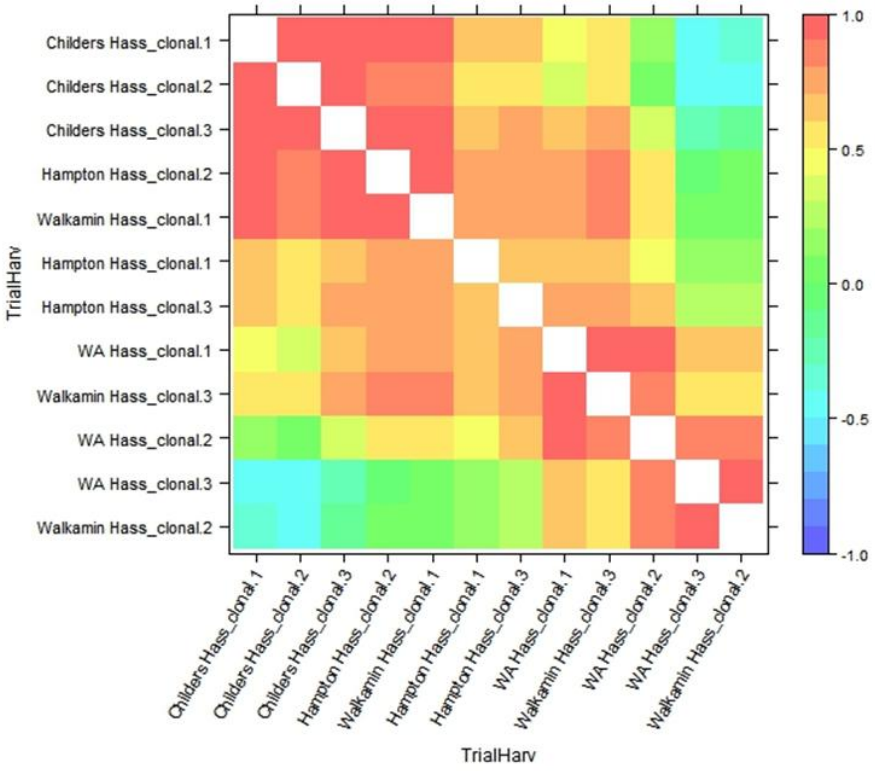
This tells us that the RS geneotypes are performing very similarly over the years at this site and by looking just at time 1 (ie after 2 years 2007&2008) we could very reasonably predict the performance over the next 4 years (up till 2012) and hence the total performance over the trial.

However if we look at another site eg Walkamin

W1	1.000	0.055	0.856
W2	0.055	1.000	0.564
W3	0.856	0.564	1.000

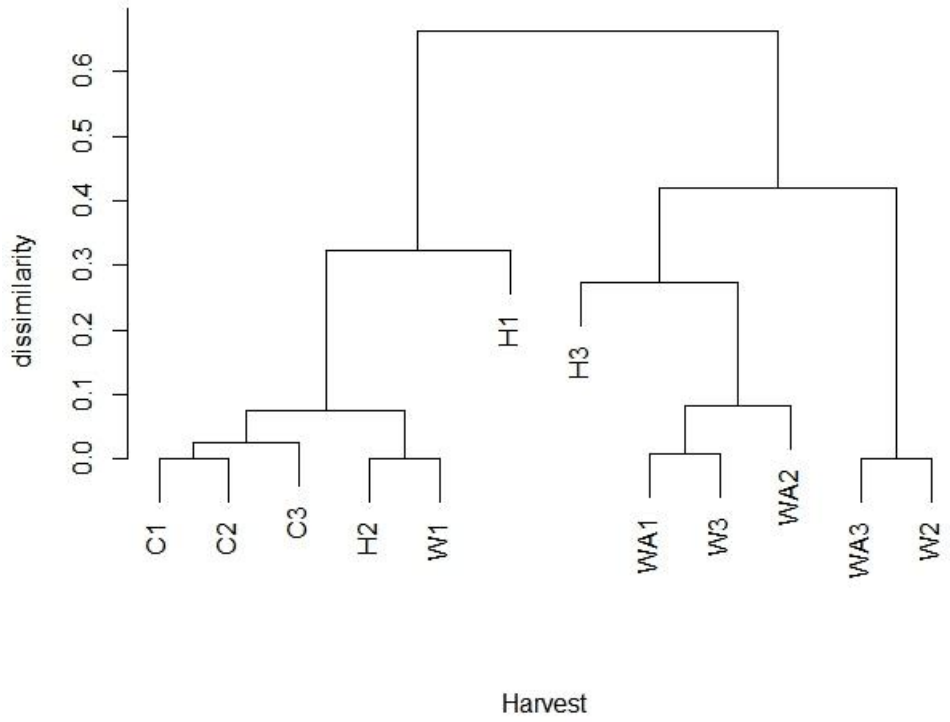
We can see that the genetic correlation between time 1 and time 2 is very low (0.055) whereas the correlation between time 1 and time 3 is reasonably high (0.856). This unusal patten may be something to do with the cyclone that came through and damaged most of the RS trees.

The genetic correlations in the correlkation matrix can be represented in a heat map (below). The heat map shows the correlations between pairs of sites using colours with red being highly correlated and blue being highly negatively correlated with the scale shown on the side. Hence it is just a pictorial representation of the genetic correlation matrix (above). The order of the trials has changed though as they have been grouped into similar groups in the heat map.



A cluster analysis has also been performed based on the genetic correlation matrix. This cluster analysis aims to group the Sites by times into similar groups to aid in interpreatation of GxE. The dendrogram from the cluster analysis shows two main groupings (if we take the cutoff at 0.5 dissimilarity) with the first group consisting of the 3 times at Childers, Hampton 1&2, Walkamin 1, and then the second group as the 3 WA times, Walkamin 2&3 and Hampton 3.

The heatmap & dendrogram show similar findings to what can be seen in the plots of RS predictions below and may just be an extra aid to help with interpretation.



Results from fa2 model fitted to GxE effects

```
$`site %vaf`
       fac_1      fac_2       all
C1  90.0804043  9.9195957 100.00000
C2  86.5831161 13.4168839 100.00000
C3  98.3838082  1.6161918 100.00000
H1  52.2398802  4.4890453  56.72893
H2  99.2345855  0.7654145 100.00000
H3  56.6004615 10.9443540  67.54482
WA1 49.1800919 50.8199081 100.00000
WA2 18.0171496 81.9828504 100.00000
WA3  1.2883588 98.7116412 100.00000
W1  98.5317638  1.4682362 100.00000
W2   0.4462359 99.5537641 100.00000
W3  61.8714751 38.1285249 100.00000

$`total %vaf`
[1] 96.60278

$`rotated loads`
        fac_1       fac_2
C1  11.313465   3.7542869
C2  24.324777   9.5754256
C3  25.322899   3.2456229
H1   7.735932  -2.2677153
H2  13.438690  -1.1802493
H3   9.703841  -4.2670601
WA1  5.024858  -5.1079430
WA2  2.414773  -5.1510374
WA3 -1.222386 -10.6997648
```

```
W1   2.748461  -0.3355053
W2  -1.208546 -18.0513569
W3  18.840029 -14.7897672

$`specific var`
      C1       C2       C3       H1       H2       H3       WA1      WA2      WA3       W1       W2       W3
 0.00000  0.00000  0.00000 49.57021  0.00000 53.99474  0.00000  0.00000  0.00000  0.00000  0.00000  0.00000


>
```

Predictions for each variety at each Site – only those varieties grown at each site

	ExTime	Trt	predicted.value	standard.error	est.status
1	Childers Hass_clonal.1	A10	38.86636	3.939499	Estimable
2	Childers Hass_clonal.1	A8	31.35334	3.948130	Estimable
3	Childers Hass_clonal.1	Duke 7	51.98544	4.006512	Estimable
4	Childers Hass_clonal.1	Nabal	41.10043	4.242124	Estimable
5	Childers Hass_clonal.1	SHSR-03	57.14315	4.285241	Estimable
6	Childers Hass_clonal.1	Thomas	43.55368	4.345546	Estimable
7	Childers Hass_clonal.1	V1	68.48619	4.502107	Estimable
8	Childers Hass_clonal.1	Velvick	56.74448	3.938094	Estimable
9	Childers Hass_clonal.1	Zutano	44.64925	3.911099	Estimable
10	Childers Hass_clonal.1	Reed	NA	NA	Aliased
11	Childers Hass_clonal.1	Plowman	NA	NA	Aliased
12	Childers Hass_clonal.1	Hass	NA	NA	Aliased
13	Childers Hass_clonal.1	Barr Duke	NA	NA	Aliased
14	Childers Hass_clonal.1	SHSR-01	NA	NA	Aliased
15	Childers Hass_clonal.2	A10	119.25846	7.052650	Estimable
16	Childers Hass_clonal.2	A8	103.23230	7.051716	Estimable
17	Childers Hass_clonal.2	Duke 7	150.43214	7.232754	Estimable
18	Childers Hass_clonal.2	Nabal	126.44960	8.024940	Estimable
19	Childers Hass_clonal.2	SHSR-03	159.53808	8.193092	Estimable
20	Childers Hass_clonal.2	Thomas	131.69356	8.009562	Estimable
21	Childers Hass_clonal.2	V1	186.28836	8.570478	Estimable
22	Childers Hass_clonal.2	Velvick	160.22854	7.058577	Estimable
23	Childers Hass_clonal.2	Zutano	131.66863	6.971041	Estimable
24	Childers Hass_clonal.2	Reed	NA	NA	Aliased
25	Childers Hass_clonal.2	Plowman	NA	NA	Aliased
26	Childers Hass_clonal.2	Hass	NA	NA	Aliased
27	Childers Hass_clonal.2	Barr Duke	NA	NA	Aliased
28	Childers Hass_clonal.2	SHSR-01	NA	NA	Aliased
29	Childers Hass_clonal.3	A10	160.41521	9.273759	Estimable
30	Childers Hass_clonal.3	A8	143.00802	9.409427	Estimable
31	Childers Hass_clonal.3	Duke 7	179.26794	9.386888	Estimable
32	Childers Hass_clonal.3	Nabal	156.81180	9.603553	Estimable
33	Childers Hass_clonal.3	SHSR-03	198.08093	9.778104	Estimable
34	Childers Hass_clonal.3	Thomas	162.45643	10.399665	Estimable
35	Childers Hass_clonal.3	V1	215.11685	10.893682	Estimable
36	Childers Hass_clonal.3	Velvick	191.58000	9.218969	Estimable
37	Childers Hass_clonal.3	Zutano	173.54383	9.180228	Estimable
38	Childers Hass_clonal.3	Reed	NA	NA	Aliased
39	Childers Hass_clonal.3	Plowman	NA	NA	Aliased
40	Childers Hass_clonal.3	Hass	NA	NA	Aliased
41	Childers Hass_clonal.3	Barr Duke	NA	NA	Aliased
42	Childers Hass_clonal.3	SHSR-01	NA	NA	Aliased
43	Hampton Hass_clonal.1	A10	42.66339	4.865174	Estimable
44	Hampton Hass_clonal.1	A8	41.13807	4.860925	Estimable
45	Hampton Hass_clonal.1	Duke 7	51.92059	4.855670	Estimable
46	Hampton Hass_clonal.1	Nabal	29.21544	4.895319	Estimable
47	Hampton Hass_clonal.1	SHSR-03	59.27047	4.938217	Estimable
48	Hampton Hass_clonal.1	Thomas	NA	NA	Aliased
49	Hampton Hass_clonal.1	V1	NA	NA	Aliased
50	Hampton Hass_clonal.1	Velvick	44.99539	4.872229	Estimable
51	Hampton Hass_clonal.1	Zutano	45.78066	4.854182	Estimable
52	Hampton Hass_clonal.1	Reed	28.97686	4.949740	Estimable
53	Hampton Hass_clonal.1	Plowman	44.51721	5.087266	Estimable
54	Hampton Hass_clonal.1	Hass	32.29583	4.981570	Estimable
55	Hampton Hass_clonal.1	Barr Duke	NA	NA	Aliased
56	Hampton Hass_clonal.1	SHSR-01	NA	NA	Aliased
57	Hampton Hass_clonal.2	A10	99.40640	5.641882	Estimable
58	Hampton Hass_clonal.2	A8	89.86533	5.761017	Estimable
59	Hampton Hass_clonal.2	Duke 7	103.60121	5.672393	Estimable
60	Hampton Hass_clonal.2	Nabal	92.76246	5.884787	Estimable
61	Hampton Hass_clonal.2	SHSR-03	117.56242	6.182768	Estimable
62	Hampton Hass_clonal.2	Thomas	NA	NA	Aliased
63	Hampton Hass_clonal.2	V1	NA	NA	Aliased
64	Hampton Hass_clonal.2	Velvick	111.03328	5.638585	Estimable
65	Hampton Hass_clonal.2	Zutano	106.45878	5.606020	Estimable
66	Hampton Hass_clonal.2	Reed	77.89326	6.581172	Estimable
67	Hampton Hass_clonal.2	Plowman	88.88004	7.746111	Estimable
68	Hampton Hass_clonal.2	Hass	93.73467	6.757103	Estimable

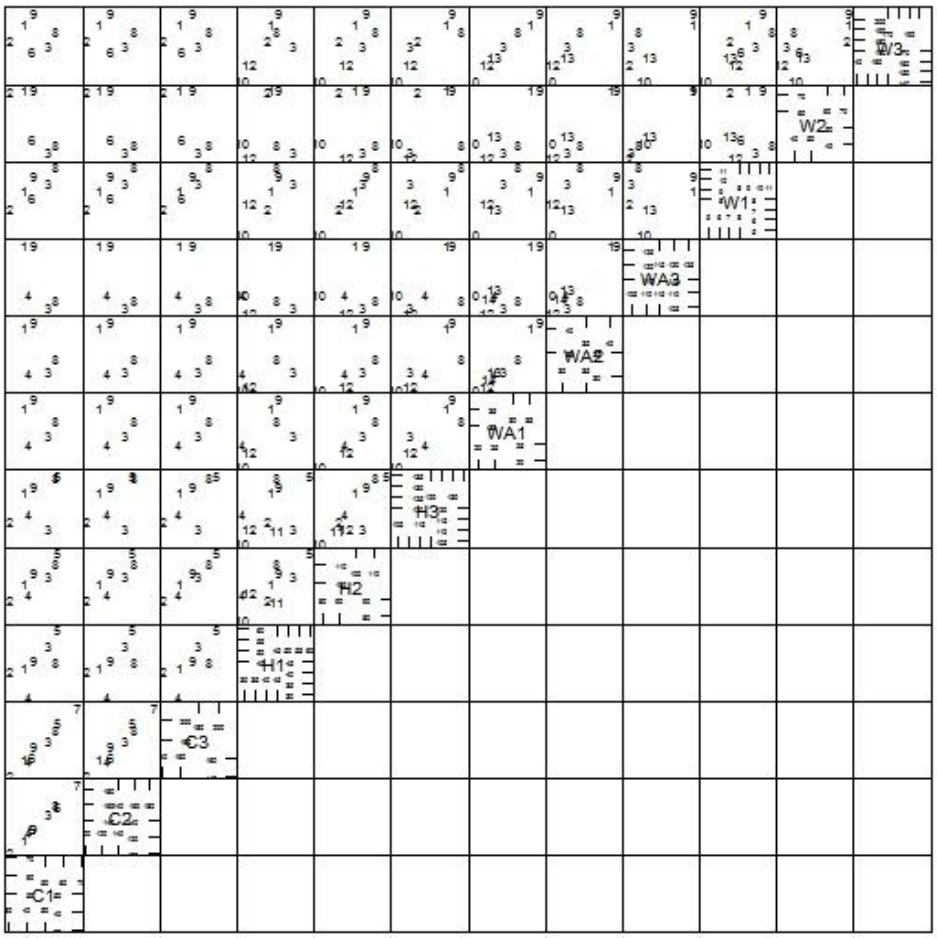
69	Hampton	Hass_clonal.2	Barr Duke	NA	NA	Aliased
70	Hampton	Hass_clonal.2	SHSR-01	NA	NA	Aliased
71	Hampton	Hass_clonal.3	A10	127.28123	8.015001	Estimable
72	Hampton	Hass_clonal.3	A8	114.48002	7.860550	Estimable
73	Hampton	Hass_clonal.3	Duke 7	110.76075	7.612070	Estimable
74	Hampton	Hass_clonal.3	Nabal	117.26826	8.183716	Estimable
75	Hampton	Hass_clonal.3	SHSR-03	135.10142	7.936475	Estimable
76	Hampton	Hass_clonal.3	Thomas	NA	NA	Aliased
77	Hampton	Hass_clonal.3	V1	NA	NA	Aliased
78	Hampton	Hass_clonal.3	Velvick	134.25642	7.625892	Estimable
79	Hampton	Hass_clonal.3	Zutano	130.35859	8.227342	Estimable
80	Hampton	Hass_clonal.3	Reed	104.22326	7.634096	Estimable
81	Hampton	Hass_clonal.3	Plowman	110.19499	8.558102	Estimable
82	Hampton	Hass_clonal.3	Hass	111.36508	8.048994	Estimable
83	Hampton	Hass_clonal.3	Barr Duke	NA	NA	Aliased
84	Hampton	Hass_clonal.3	SHSR-01	NA	NA	Aliased
85	WA	Hass_clonal.1	A10	35.23833	3.220432	Estimable
86	WA	Hass_clonal.1	A8	NA	NA	Aliased
87	WA	Hass_clonal.1	Duke 7	27.38236	3.267189	Estimable
88	WA	Hass_clonal.1	Nabal	25.04559	3.966840	Estimable
89	WA	Hass_clonal.1	SHSR-03	NA	NA	Aliased
90	WA	Hass_clonal.1	Thomas	NA	NA	Aliased
91	WA	Hass_clonal.1	V1	NA	NA	Aliased
92	WA	Hass_clonal.1	Velvick	31.64506	3.281622	Estimable
93	WA	Hass_clonal.1	Zutano	38.03704	3.140635	Estimable
94	WA	Hass_clonal.1	Reed	18.70800	3.493907	Estimable
95	WA	Hass_clonal.1	Plowman	NA	NA	Aliased
96	WA	Hass_clonal.1	Hass	22.67272	3.845532	Estimable
97	WA	Hass_clonal.1	Barr Duke	25.00001	3.940002	Estimable
98	WA	Hass_clonal.1	SHSR-01	23.40366	5.477460	Estimable
99	WA	Hass_clonal.2	A10	40.18369	3.815561	Estimable
100	WA	Hass_clonal.2	A8	NA	NA	Aliased
101	WA	Hass_clonal.2	Duke 7	30.95389	3.840992	Estimable
102	WA	Hass_clonal.2	Nabal	30.82117	4.410089	Estimable
103	WA	Hass_clonal.2	SHSR-03	NA	NA	Aliased
104	WA	Hass_clonal.2	Thomas	NA	NA	Aliased
105	WA	Hass_clonal.2	V1	NA	NA	Aliased
106	WA	Hass_clonal.2	Velvick	33.86345	3.858326	Estimable
107	WA	Hass_clonal.2	Zutano	41.62431	3.763834	Estimable
108	WA	Hass_clonal.2	Reed	27.32102	3.948162	Estimable
109	WA	Hass_clonal.2	Plowman	NA	NA	Aliased
110	WA	Hass_clonal.2	Hass	28.09707	4.171728	Estimable
111	WA	Hass_clonal.2	Barr Duke	31.15166	4.048704	Estimable
112	WA	Hass_clonal.2	SHSR-01	29.61724	5.222577	Estimable
113	WA	Hass_clonal.3	A10	127.15344	8.194415	Estimable
114	WA	Hass_clonal.3	A8	NA	NA	Aliased
115	WA	Hass_clonal.3	Duke 7	104.87439	8.227061	Estimable
116	WA	Hass_clonal.3	Nabal	109.84964	9.305757	Estimable
117	WA	Hass_clonal.3	SHSR-03	NA	NA	Aliased
118	WA	Hass_clonal.3	Thomas	NA	NA	Aliased
119	WA	Hass_clonal.3	V1	NA	NA	Aliased
120	WA	Hass_clonal.3	Velvick	107.64397	8.267727	Estimable
121	WA	Hass_clonal.3	Zutano	126.88612	8.107782	Estimable
122	WA	Hass_clonal.3	Reed	109.39845	8.529549	Estimable
123	WA	Hass_clonal.3	Plowman	NA	NA	Aliased
124	WA	Hass_clonal.3	Hass	103.40333	8.896753	Estimable
125	WA	Hass_clonal.3	Barr Duke	111.42578	8.390019	Estimable
126	WA	Hass_clonal.3	SHSR-01	108.41333	11.369474	Estimable
127	Walkamin	Hass_clonal.1	A10	9.06384	1.094052	Estimable
128	Walkamin	Hass_clonal.1	A8	7.10450	1.118708	Estimable
129	Walkamin	Hass_clonal.1	Duke 7	9.74088	1.100462	Estimable
130	Walkamin	Hass_clonal.1	Nabal	NA	NA	Aliased
131	Walkamin	Hass_clonal.1	SHSR-03	NA	NA	Aliased
132	Walkamin	Hass_clonal.1	Thomas	8.18963	1.282323	Estimable
133	Walkamin	Hass_clonal.1	V1	NA	NA	Aliased
134	Walkamin	Hass_clonal.1	Velvick	11.28765	1.091865	Estimable
135	Walkamin	Hass_clonal.1	Zutano	10.50778	1.077549	Estimable
136	Walkamin	Hass_clonal.1	Reed	4.50645	1.294469	Estimable
137	Walkamin	Hass_clonal.1	Plowman	NA	NA	Aliased
138	Walkamin	Hass_clonal.1	Hass	7.70558	1.342895	Estimable
139	Walkamin	Hass_clonal.1	Barr Duke	7.21285	1.553039	Estimable
140	Walkamin	Hass_clonal.1	SHSR-01	NA	NA	Aliased
141	Walkamin	Hass_clonal.2	A10	72.46175	8.219953	Estimable
142	Walkamin	Hass_clonal.2	A8	71.31478	8.391222	Estimable
143	Walkamin	Hass_clonal.2	Duke 7	35.40166	8.246049	Estimable
144	Walkamin	Hass_clonal.2	Nabal	NA	NA	Aliased
145	Walkamin	Hass_clonal.2	SHSR-03	NA	NA	Aliased
146	Walkamin	Hass_clonal.2	Thomas	43.33360	9.196384	Estimable
147	Walkamin	Hass_clonal.2	V1	NA	NA	Aliased
148	Walkamin	Hass_clonal.2	Velvick	40.47890	8.456150	Estimable
149	Walkamin	Hass_clonal.2	Zutano	72.43099	7.993963	Estimable
150	Walkamin	Hass_clonal.2	Reed	41.45788	9.119080	Estimable
151	Walkamin	Hass_clonal.2	Plowman	NA	NA	Aliased
152	Walkamin	Hass_clonal.2	Hass	32.35502	9.752217	Estimable
153	Walkamin	Hass_clonal.2	Barr Duke	45.62820	8.604630	Estimable
154	Walkamin	Hass_clonal.2	SHSR-01	NA	NA	Aliased
155	Walkamin	Hass_clonal.3	A10	195.96992	14.319985	Estimable

```
156 Walkamin Hass_clonal.3        A8       181.15912      14.571108  Estimable
157 Walkamin Hass_clonal.3    Duke 7       175.29487      14.301679  Estimable
158 Walkamin Hass_clonal.3     Nabal              NA             NA    Aliased
159 Walkamin Hass_clonal.3   SHSR-03              NA             NA    Aliased
160 Walkamin Hass_clonal.3    Thomas       169.65612      15.978113  Estimable
161 Walkamin Hass_clonal.3        V1              NA             NA    Aliased
162 Walkamin Hass_clonal.3   Velvick       189.85979      14.450790  Estimable
163 Walkamin Hass_clonal.3    Zutano       206.28161      14.127858  Estimable
164 Walkamin Hass_clonal.3      Reed       142.00769      15.149656  Estimable
165 Walkamin Hass_clonal.3   Plowman              NA             NA    Aliased
166 Walkamin Hass_clonal.3      Hass       158.63229      15.646141  Estimable
167 Walkamin Hass_clonal.3 Barr Duke       164.24639      16.424146  Estimable
168 Walkamin Hass_clonal.3   SHSR-01              NA             NA    Aliased

$avsed
 overall
10.57744
```

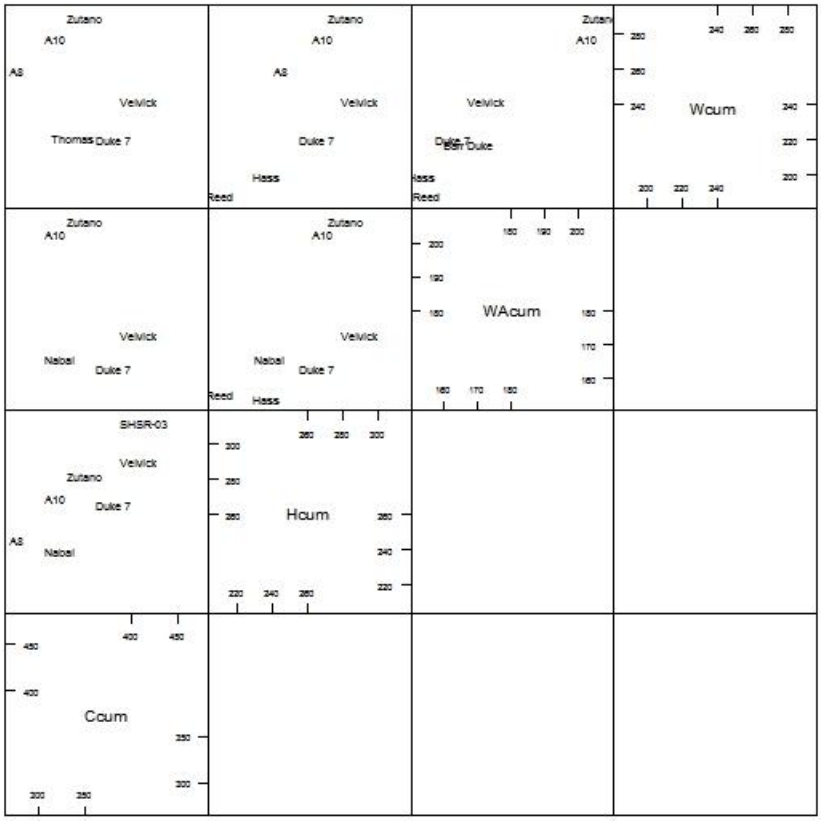
```
Treatment numbers in plot below
   1. A10
   2. A8
   3. Duke 7
   4. Nabal
   5. SHSR-03
   6. Thomas
   7. V1
   8. Velvick
   9. Zutano
   10.  Reed
   11.  Plowman
   12.  Hass
   13.  Barr Duke
   14.  SHSR-01
```

Site codes (C=Childers, H=Hampton, WA=Western Australia, W=Walkamin)

Predictions from MET analysis for Hass clonal

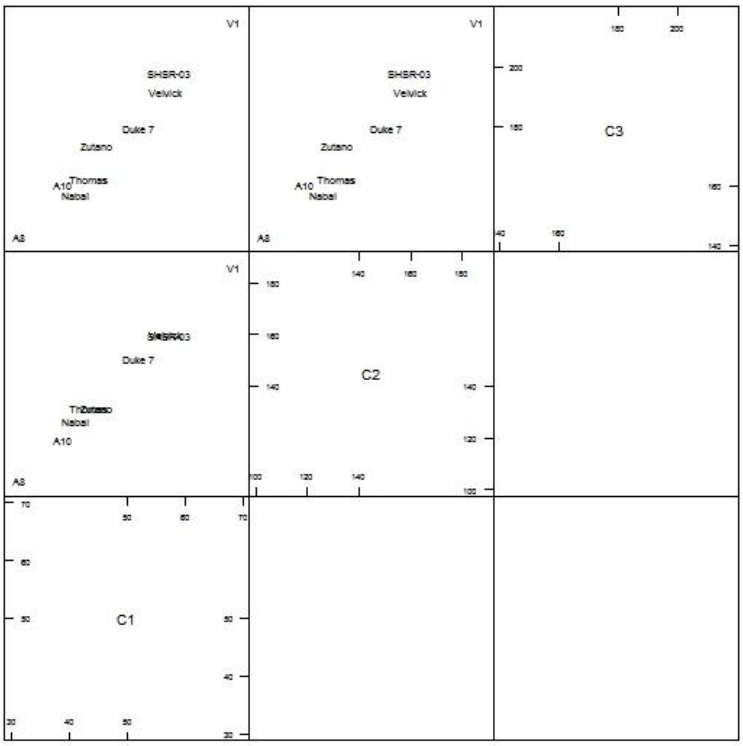


Cummulative yield at each site

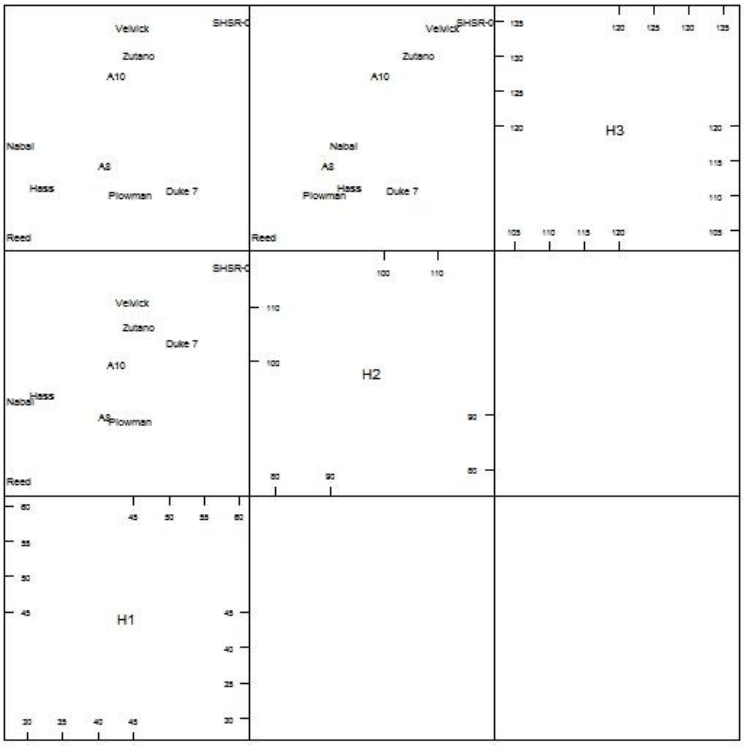

Zutano
A10
A8
Velvick
Thomas
Duke 7
Hass
Reed
Nabal
SHSR-03
Ben Duke
Wcum
WAcum
Hcum
Ccum

Plots of varieties at each Site x Time

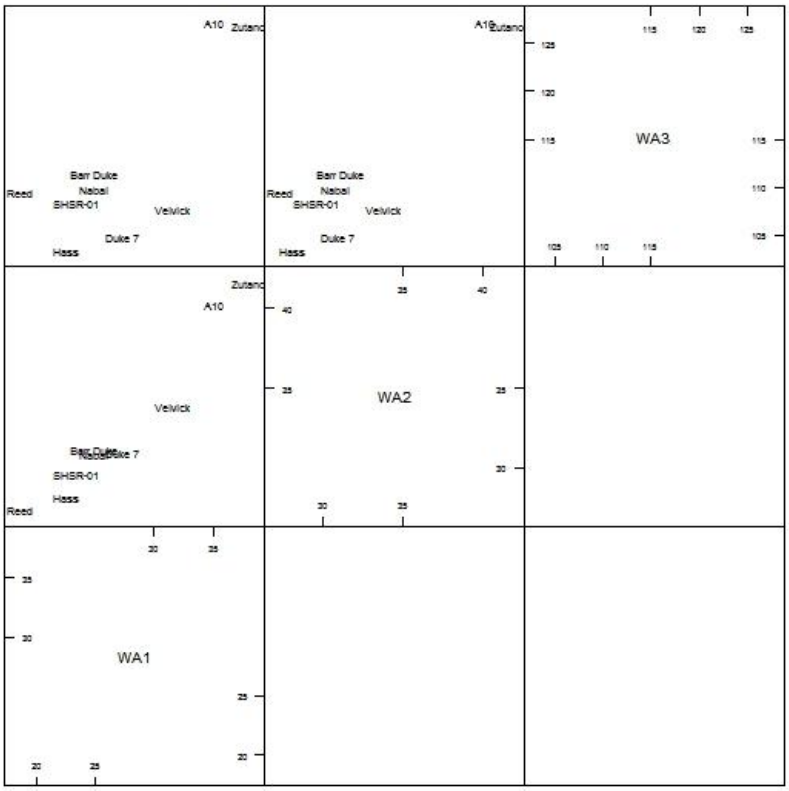
Childers



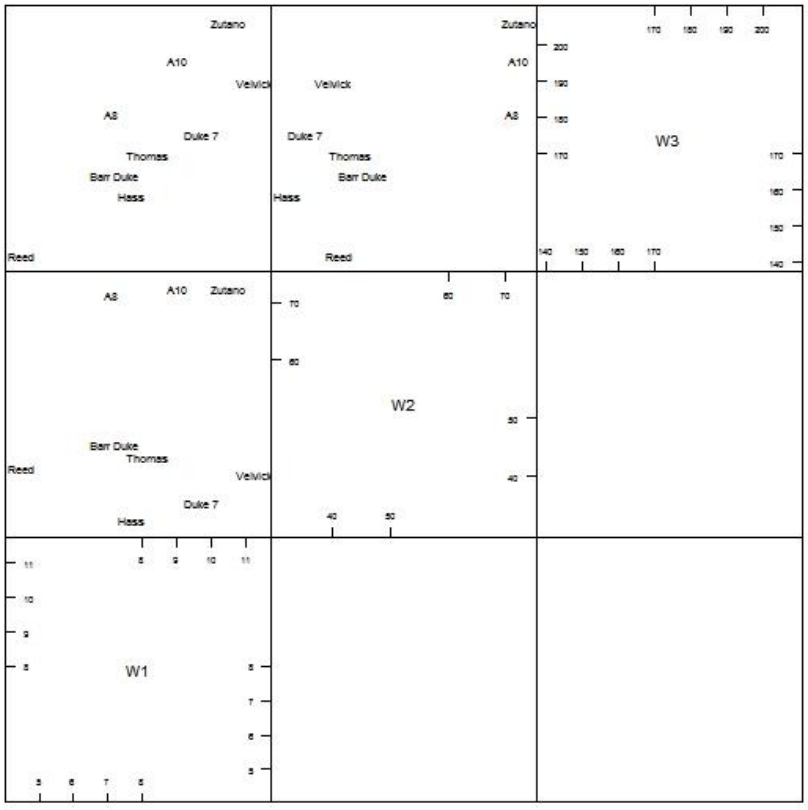
Hampton



WA


A10
Zutano
Barr Duke
Nabal
SHSR-01
Velvick
Reed
Duke 7
Hass
WA3
WA2
WA1

Walkamin


Zutano
A10
Velvick
A8
Duke 7
Thomas
Barr Duke
Hass
Reed
W3
W2
W1

Fruit Size

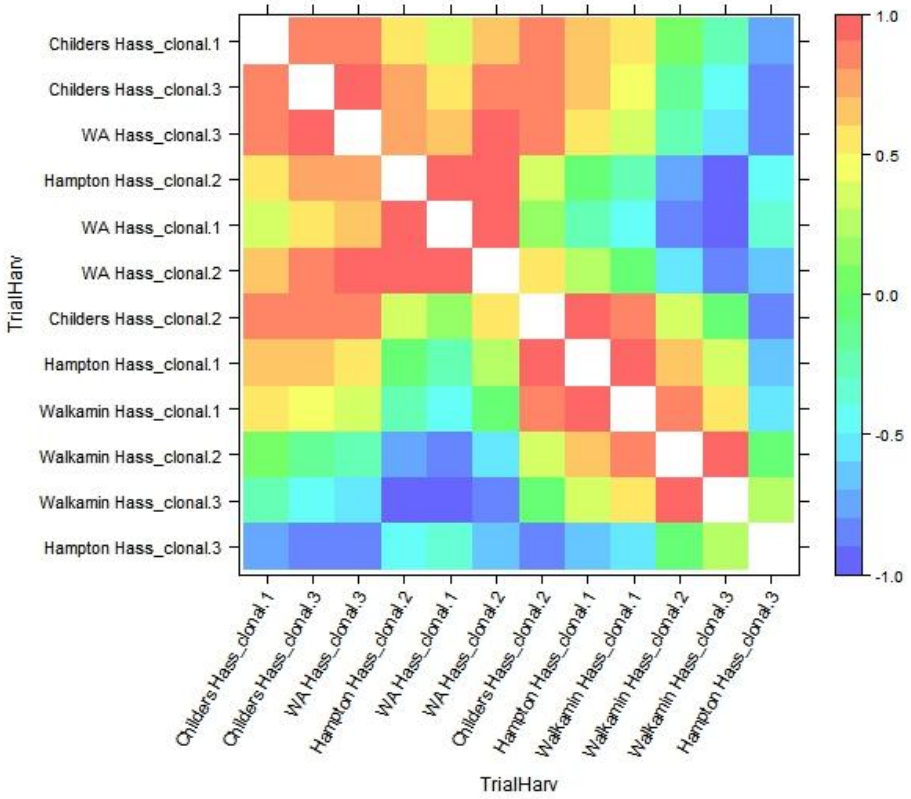
```
$Wald
             Df denDF      F.inc      F.con Margin             Pr
(Intercept)   1  78.1 58500.000 58500.000      A 4.516881e-114
Trt          13 220.4    11.690     4.061      A  5.426074e-06
ExTime       11  50.5    88.560    88.560      A  5.088861e-29
Trt:ExTime   86 440.1     2.133     2.133      B  3.644592e-07
```

Genetic correlations between sites and times

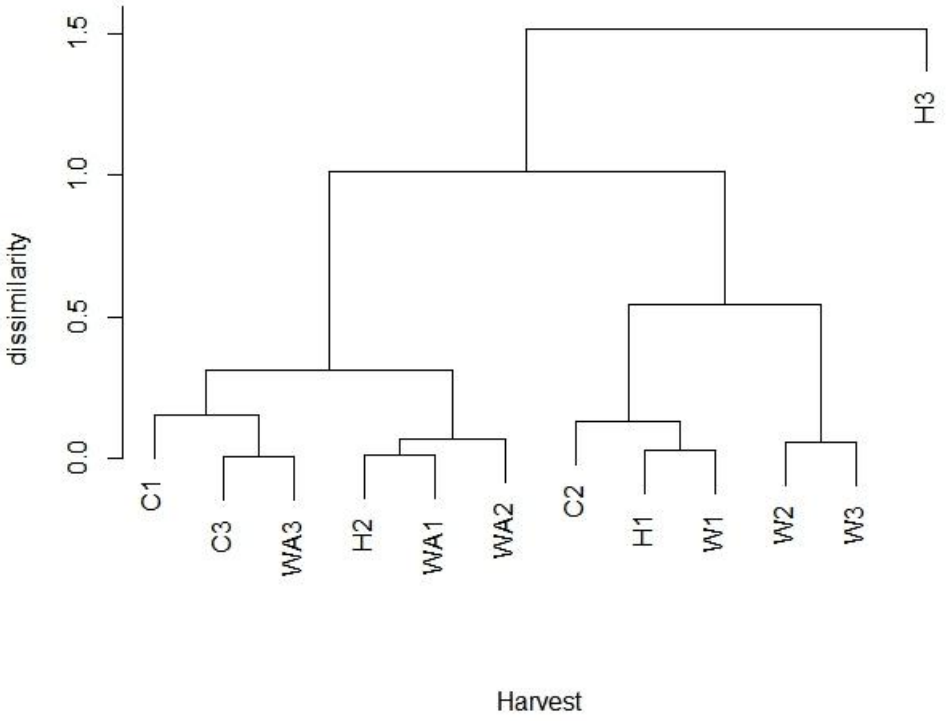
	C1	C2	C3	H1	H2	H3	WA1	WA2	WA3	W1	W2	W3
C1	1.000	0.828	0.858	0.673	0.518	-0.732	0.396	0.691	0.835	0.522	0.030	-0.262
C2	0.828	1.000	0.899	0.929	0.330	-0.808	0.170	0.580	0.838	0.813	0.332	-0.003
C3	0.858	0.899	1.000	0.673	0.710	-0.833	0.585	0.878	0.992	0.475	-0.115	-0.441
H1	0.673	0.929	0.673	1.000	-0.043	-0.660	-0.207	0.237	0.577	0.971	0.657	0.367
H2	0.518	0.330	0.710	-0.043	1.000	-0.497	0.986	0.960	0.791	-0.282	-0.781	-0.945
H3	-0.732	-0.808	-0.833	-0.660	-0.497	1.000	-0.378	-0.668	-0.811	-0.514	-0.037	0.247
WA1	0.396	0.170	0.585	-0.207	0.986	-0.378	1.000	0.901	0.680	-0.436	-0.873	-0.986
WA2	0.691	0.580	0.878	0.237	0.960	-0.668	0.901	1.000	0.930	-0.003	-0.576	-0.816
WA3	0.835	0.838	0.992	0.577	0.791	-0.811	0.680	0.930	1.000	0.363	-0.236	-0.548
W1	0.522	0.813	0.475	0.971	-0.282	-0.514	-0.436	-0.003	0.363	1.000	0.819	0.580
W2	0.030	0.332	-0.115	0.657	-0.781	-0.037	-0.873	-0.576	-0.236	0.819	1.000	0.942
W3	-0.262	-0.003	-0.441	0.367	-0.945	0.247	-0.986	-0.816	-0.548	0.580	0.942	1.000

The genetic correlations between Sites and times for fruit size are given in thae above correlation matrix. Hence at Childers the correlation between genetic effects at time 1 & time 2 is 0.828, and between time 2 & 3 is 0.899 etc..

The genetic correlations can be represented in a heatmap below:



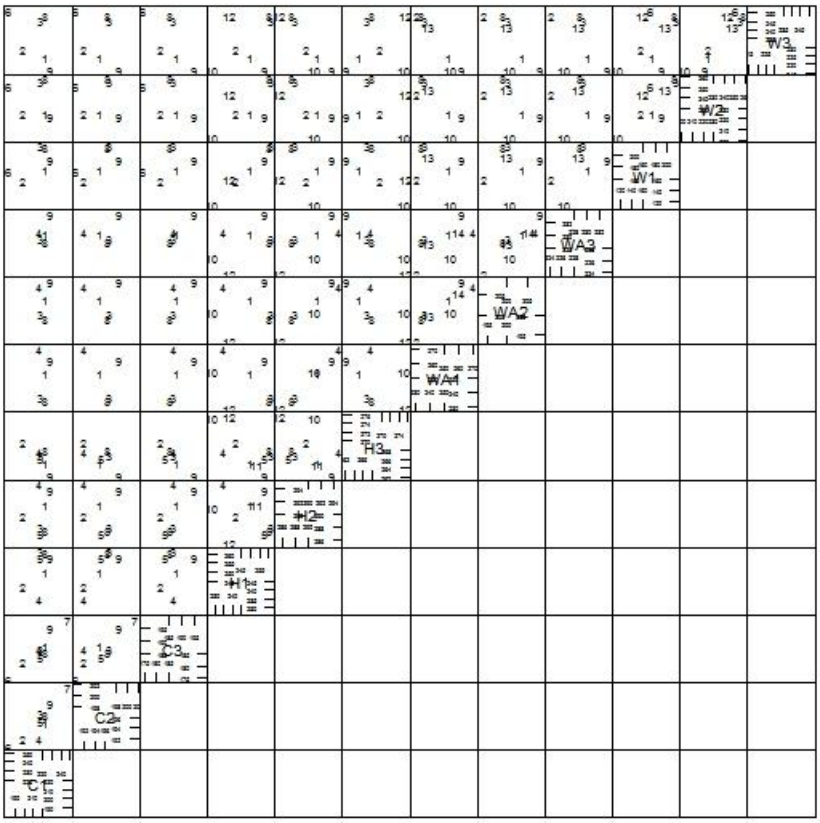
The sites and times can be grouped using a cluster analysis and dendrogram below. This shows Hampton time 3 to be very different from the other sites and times.



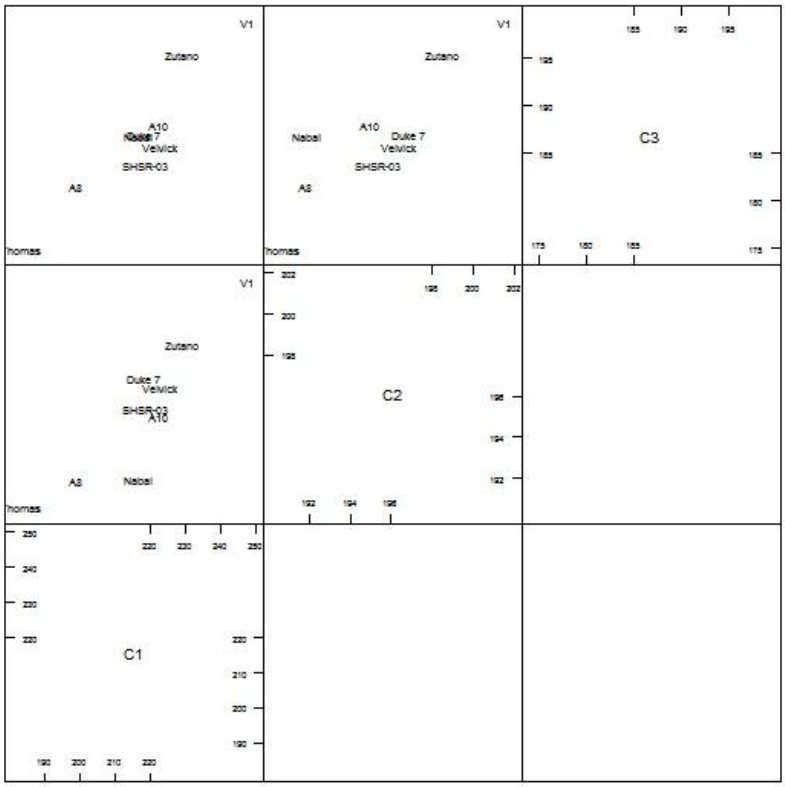
	ExTime	Trt	predicted.value	standard.error	est.status
1	Childers Hass_clonal.1	A10	222.8162	12.600673	Estimable
2	Childers Hass_clonal.1	A8	199.0456	12.637678	Estimable
3	Childers Hass_clonal.1	Duke 7	218.1684	12.830389	Estimable
4	Childers Hass_clonal.1	Nabal	217.1260	12.850040	Estimable
5	Childers Hass_clonal.1	SHSR-03	218.7600	12.890698	Estimable
6	Childers Hass_clonal.1	Thomas	183.3400	12.970093	Estimable
7	Childers Hass_clonal.1	V1	247.9028	13.019796	Estimable
8	Childers Hass_clonal.1	Velvick	223.2131	12.559940	Estimable
9	Childers Hass_clonal.1	Zutano	229.2633	12.563620	Estimable
10	Childers Hass_clonal.1	Reed	NA	NA	Aliased
11	Childers Hass_clonal.1	Plowman	NA	NA	Aliased
12	Childers Hass_clonal.1	Hass	NA	NA	Aliased
13	Childers Hass_clonal.1	Barr Duke	NA	NA	Aliased
14	Childers Hass_clonal.1	SHSR-01	NA	NA	Aliased
15	Childers Hass_clonal.2	A10	195.0270	1.668007	Estimable
16	Childers Hass_clonal.2	A8	191.8776	1.682010	Estimable
17	Childers Hass_clonal.2	Duke 7	196.8800	1.682458	Estimable
18	Childers Hass_clonal.2	Nabal	191.8938	1.896930	Estimable
19	Childers Hass_clonal.2	SHSR-03	195.3864	1.896045	Estimable
20	Childers Hass_clonal.2	Thomas	190.5475	1.783153	Estimable
21	Childers Hass_clonal.2	V1	201.6229	2.204523	Estimable
22	Childers Hass_clonal.2	Velvick	196.4283	1.635835	Estimable
23	Childers Hass_clonal.2	Zutano	198.5546	1.643810	Estimable
24	Childers Hass_clonal.2	Reed	NA	NA	Aliased
25	Childers Hass_clonal.2	Plowman	NA	NA	Aliased
26	Childers Hass_clonal.2	Hass	NA	NA	Aliased
27	Childers Hass_clonal.2	Barr Duke	NA	NA	Aliased
28	Childers Hass_clonal.2	SHSR-01	NA	NA	Aliased
29	Childers Hass_clonal.3	A10	187.8826	3.074194	Estimable
30	Childers Hass_clonal.3	A8	181.4766	3.151709	Estimable
31	Childers Hass_clonal.3	Duke 7	186.9898	3.073283	Estimable
32	Childers Hass_clonal.3	Nabal	186.7877	3.428664	Estimable
33	Childers Hass_clonal.3	SHSR-03	183.7896	3.567748	Estimable
34	Childers Hass_clonal.3	Thomas	174.9117	3.231619	Estimable
35	Childers Hass_clonal.3	V1	198.8035	3.528042	Estimable
36	Childers Hass_clonal.3	Velvick	185.7127	2.962984	Estimable
37	Childers Hass_clonal.3	Zutano	195.4623	2.954002	Estimable
38	Childers Hass_clonal.3	Reed	NA	NA	Aliased
39	Childers Hass_clonal.3	Plowman	NA	NA	Aliased
40	Childers Hass_clonal.3	Hass	NA	NA	Aliased
41	Childers Hass_clonal.3	Barr Duke	NA	NA	Aliased
42	Childers Hass_clonal.3	SHSR-01	NA	NA	Aliased
43	Hampton Hass_clonal.1	A10	250.0347	6.670682	Estimable
44	Hampton Hass_clonal.1	A8	241.9752	6.660766	Estimable
45	Hampton Hass_clonal.1	Duke 7	261.2842	6.688670	Estimable
46	Hampton Hass_clonal.1	Nabal	234.6492	8.096519	Estimable

47	Hampton	Hass_clonal.1	SHSR-03	257.6885	8.259502	Estimable
48	Hampton	Hass_clonal.1	Thomas	NA	NA	Aliased
49	Hampton	Hass_clonal.1	V1	NA	NA	Aliased
50	Hampton	Hass_clonal.1	Velvick	260.6283	6.618048	Estimable
51	Hampton	Hass_clonal.1	Zutano	258.4975	6.624274	Estimable
52	Hampton	Hass_clonal.1	Reed	228.0198	7.201933	Estimable
53	Hampton	Hass_clonal.1	Plowman	253.6800	9.219300	Estimable
54	Hampton	Hass_clonal.1	Hass	238.6650	7.321424	Estimable
55	Hampton	Hass_clonal.1	Barr Duke	NA	NA	Aliased
56	Hampton	Hass_clonal.1	SHSR-01	NA	NA	Aliased
57	Hampton	Hass_clonal.2	A10	291.3975	3.491764	Estimable
58	Hampton	Hass_clonal.2	A8	289.6299	3.495411	Estimable
59	Hampton	Hass_clonal.2	Duke 7	287.9986	3.491144	Estimable
60	Hampton	Hass_clonal.2	Nabal	294.6646	3.806040	Estimable
61	Hampton	Hass_clonal.2	SHSR-03	287.0059	3.941135	Estimable
62	Hampton	Hass_clonal.2	Thomas	NA	NA	Aliased
63	Hampton	Hass_clonal.2	V1	NA	NA	Aliased
64	Hampton	Hass_clonal.2	Velvick	287.4040	3.495457	Estimable
65	Hampton	Hass_clonal.2	Zutano	293.7625	3.481943	Estimable
66	Hampton	Hass_clonal.2	Reed	290.8289	3.591471	Estimable
67	Hampton	Hass_clonal.2	Plowman	291.5263	4.336318	Estimable
68	Hampton	Hass_clonal.2	Hass	285.3058	3.614109	Estimable
69	Hampton	Hass_clonal.2	Barr Duke	NA	NA	Aliased
70	Hampton	Hass_clonal.2	SHSR-01	NA	NA	Aliased
71	Hampton	Hass_clonal.3	A10	265.1162	5.035086	Estimable
72	Hampton	Hass_clonal.3	A8	269.8148	4.982652	Estimable
73	Hampton	Hass_clonal.3	Duke 7	267.0578	4.922249	Estimable
74	Hampton	Hass_clonal.3	Nabal	267.5364	5.100978	Estimable
75	Hampton	Hass_clonal.3	SHSR-03	266.1118	4.994779	Estimable
76	Hampton	Hass_clonal.3	Thomas	NA	NA	Aliased
77	Hampton	Hass_clonal.3	V1	NA	NA	Aliased
78	Hampton	Hass_clonal.3	Velvick	267.8985	4.918213	Estimable
79	Hampton	Hass_clonal.3	Zutano	262.3578	5.082957	Estimable
80	Hampton	Hass_clonal.3	Reed	275.1073	5.017179	Estimable
81	Hampton	Hass_clonal.3	Plowman	264.8925	5.598672	Estimable
82	Hampton	Hass_clonal.3	Hass	275.4417	5.163007	Estimable
83	Hampton	Hass_clonal.3	Barr Duke	NA	NA	Aliased
84	Hampton	Hass_clonal.3	SHSR-01	NA	NA	Aliased
85	WA	Hass_clonal.1	A10	253.5647	7.480975	Estimable
86	WA	Hass_clonal.1	A8	NA	NA	Aliased
87	WA	Hass_clonal.1	Duke 7	236.9498	7.488406	Estimable
88	WA	Hass_clonal.1	Nabal	270.3692	10.286574	Estimable
89	WA	Hass_clonal.1	SHSR-03	NA	NA	Aliased
90	WA	Hass_clonal.1	Thomas	NA	NA	Aliased
91	WA	Hass_clonal.1	V1	NA	NA	Aliased
92	WA	Hass_clonal.1	Velvick	234.5217	7.564172	Estimable
93	WA	Hass_clonal.1	Zutano	262.1539	7.363758	Estimable
94	WA	Hass_clonal.1	Reed	255.1440	8.196356	Estimable
95	WA	Hass_clonal.1	Plowman	NA	NA	Aliased
96	WA	Hass_clonal.1	Hass	229.5382	8.637903	Estimable
97	WA	Hass_clonal.1	Barr Duke	238.8697	8.109147	Estimable
98	WA	Hass_clonal.1	SHSR-01	259.8929	13.611785	Estimable
99	WA	Hass_clonal.2	A10	203.9680	6.471334	Estimable
100	WA	Hass_clonal.2	A8	NA	NA	Aliased
101	WA	Hass_clonal.2	Duke 7	200.1474	6.473810	Estimable
102	WA	Hass_clonal.2	Nabal	207.1096	6.739790	Estimable
103	WA	Hass_clonal.2	SHSR-03	NA	NA	Aliased
104	WA	Hass_clonal.2	Thomas	NA	NA	Aliased
105	WA	Hass_clonal.2	V1	NA	NA	Aliased
106	WA	Hass_clonal.2	Velvick	199.1745	6.478658	Estimable
107	WA	Hass_clonal.2	Zutano	208.5173	6.448659	Estimable
108	WA	Hass_clonal.2	Reed	200.5549	6.655170	Estimable
109	WA	Hass_clonal.2	Plowman	NA	NA	Aliased
110	WA	Hass_clonal.2	Hass	193.4604	6.752322	Estimable
111	WA	Hass_clonal.2	Barr Duke	199.7905	6.693379	Estimable
112	WA	Hass_clonal.2	SHSR-01	205.3698	7.662608	Estimable
113	WA	Hass_clonal.3	A10	230.2829	6.473536	Estimable
114	WA	Hass_clonal.3	A8	NA	NA	Aliased
115	WA	Hass_clonal.3	Duke 7	229.4239	6.477467	Estimable
116	WA	Hass_clonal.3	Nabal	230.4177	6.516385	Estimable
117	WA	Hass_clonal.3	SHSR-03	NA	NA	Aliased
118	WA	Hass_clonal.3	Thomas	NA	NA	Aliased
119	WA	Hass_clonal.3	V1	NA	NA	Aliased
120	WA	Hass_clonal.3	Velvick	228.8771	6.473685	Estimable
121	WA	Hass_clonal.3	Zutano	233.3424	6.465335	Estimable
122	WA	Hass_clonal.3	Reed	226.5279	6.549428	Estimable
123	WA	Hass_clonal.3	Plowman	NA	NA	Aliased
124	WA	Hass_clonal.3	Hass	223.9783	6.588751	Estimable
125	WA	Hass_clonal.3	Barr Duke	228.7120	6.582778	Estimable
126	WA	Hass_clonal.3	SHSR-01	230.5560	6.982139	Estimable
127	Walkamin	Hass_clonal.1	A10	174.1776	12.347222	Estimable
128	Walkamin	Hass_clonal.1	A8	156.2592	11.982550	Estimable
129	Walkamin	Hass_clonal.1	Duke 7	214.5404	12.326609	Estimable
130	Walkamin	Hass_clonal.1	Nabal	NA	NA	Aliased
131	Walkamin	Hass_clonal.1	SHSR-03	NA	NA	Aliased
132	Walkamin	Hass_clonal.1	Thomas	173.3782	13.527231	Estimable
133	Walkamin	Hass_clonal.1	V1	NA	NA	Aliased
134	Walkamin	Hass_clonal.1	Velvick	214.2617	12.056762	Estimable
135	Walkamin	Hass_clonal.1	Zutano	191.6610	11.917424	Estimable
136	Walkamin	Hass_clonal.1	Reed	114.0848	13.623727	Estimable
137	Walkamin	Hass_clonal.1	Plowman	NA	NA	Aliased
138	Walkamin	Hass_clonal.1	Hass	158.3159	14.190680	Estimable
139	Walkamin	Hass_clonal.1	Barr Duke	197.9825	15.104055	Estimable
140	Walkamin	Hass_clonal.1	SHSR-01	NA	NA	Aliased
141	Walkamin	Hass_clonal.2	A10	224.6285	7.807005	Estimable
142	Walkamin	Hass_clonal.2	A8	224.5882	7.575545	Estimable
143	Walkamin	Hass_clonal.2	Duke 7	255.5616	7.734937	Estimable
144	Walkamin	Hass_clonal.2	Nabal	NA	NA	Aliased
145	Walkamin	Hass_clonal.2	SHSR-03	NA	NA	Aliased
146	Walkamin	Hass_clonal.2	Thomas	250.1599	8.485015	Estimable
147	Walkamin	Hass_clonal.2	V1	NA	NA	Aliased
148	Walkamin	Hass_clonal.2	Velvick	257.9310	7.944359	Estimable
149	Walkamin	Hass_clonal.2	Zutano	221.9921	7.537981	Estimable
150	Walkamin	Hass_clonal.2	Reed	202.0975	8.402281	Estimable
151	Walkamin	Hass_clonal.2	Plowman	NA	NA	Aliased
152	Walkamin	Hass_clonal.2	Hass	243.5106	8.779992	Estimable
153	Walkamin	Hass_clonal.2	Barr Duke	247.8453	8.031835	Estimable
154	Walkamin	Hass_clonal.2	SHSR-01	NA	NA	Aliased
155	Walkamin	Hass_clonal.3	A10	224.0358	5.636214	Estimable
156	Walkamin	Hass_clonal.3	A8	228.9779	5.443784	Estimable
157	Walkamin	Hass_clonal.3	Duke 7	245.5933	5.508532	Estimable
158	Walkamin	Hass_clonal.3	Nabal	NA	NA	Aliased
159	Walkamin	Hass_clonal.3	SHSR-03	NA	NA	Aliased
160	Walkamin	Hass_clonal.3	Thomas	251.3190	6.154669	Estimable
161	Walkamin	Hass_clonal.3	V1	NA	NA	Aliased
162	Walkamin	Hass_clonal.3	Velvick	248.1822	5.798859	Estimable

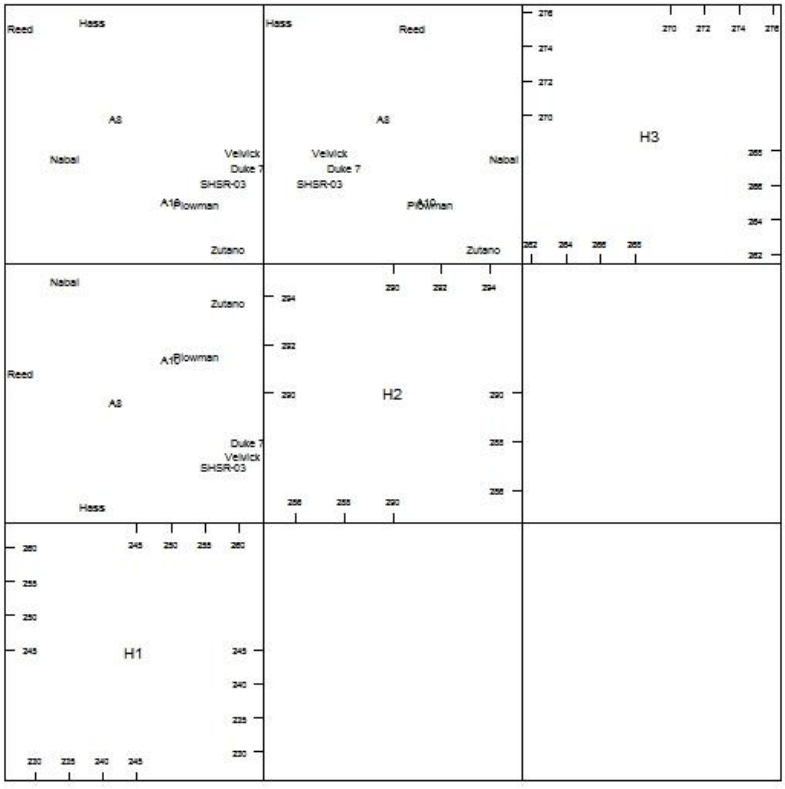
```
163 Walkamin Hass_clonal.3     Zutano        216.3778        5.388936  Estimable
164 Walkamin Hass_clonal.3       Reed        216.8725        6.587697  Estimable
165 Walkamin Hass_clonal.3    Plowman              NA              NA    Aliased
166 Walkamin Hass_clonal.3       Hass        248.4616        6.864571  Estimable
167 Walkamin Hass_clonal.3 Barr Duke        242.0211        6.146433  Estimable
168 Walkamin Hass_clonal.3    SHSR-01              NA              NA    Aliased

$avsed
 overall
10.63541
```



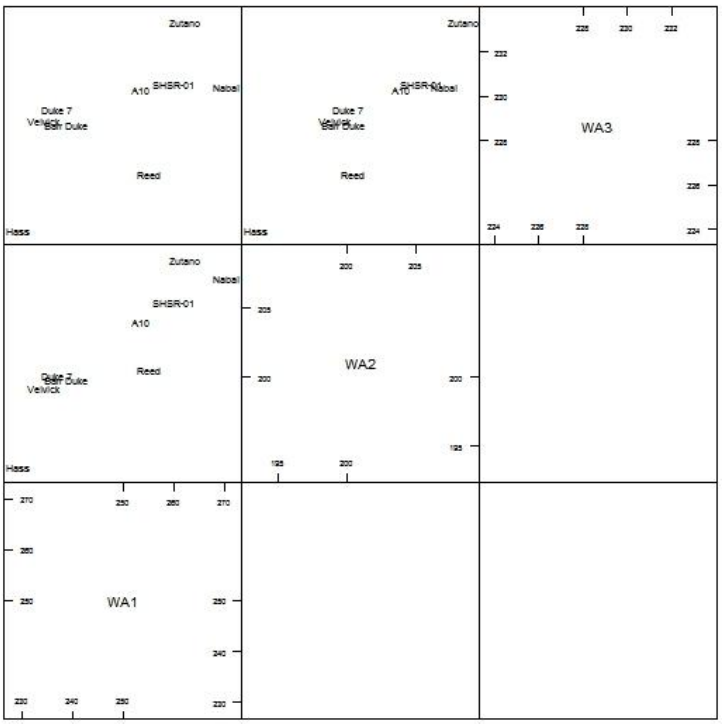
Childers



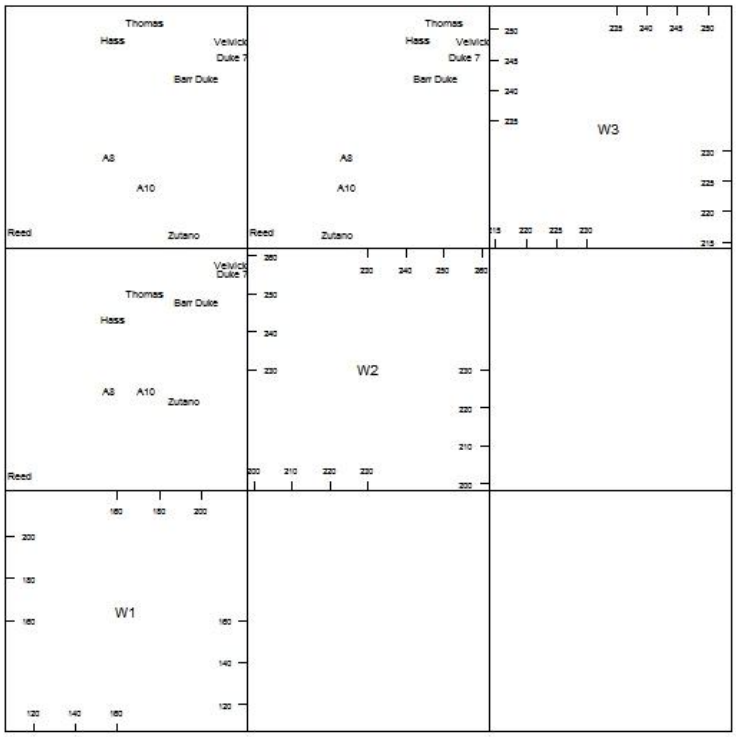
Hampton



WA


Zutano
SHSR-01
A10
Nabal
Duke 7
Velvick
Barr Duke
Reed
Hass
WA3
WA2
WA1

Walkamin


Thomas
Hass
Velvick
Duke 7
Barr Duke
A8
A10
Reed
Zutano
W3
W2
W1

Yield efficiency

Note that some Sites do not have YE data at some times:

Childers Hass clonal – no YE2012 (so no Tm3)

Childers Hass seedling – No YE2011 YE2012 (so no Tm3)

Childers Shepard seedling – No YE2008 (so Tm1 is just 2007) No 2011 or 2012 (so no Tm3)

WA Hass seedling – no YE2007 (so Tm1 is just 2008)

WA Hass clonal – no YE2007 (so Tm1 is just 2008)

1. Hass clonal

```
Fixed effect analysis$Wald
             Df denDF    F.inc    F.con Margin           Pr
(Intercept)   1  57.5 2345.000 2345.000        2.535391e-48
Trt          13 137.9    4.927    1.883      A 3.702815e-02
ExTime       10  31.3   67.680   67.680      A 2.303264e-18
Trt:ExTime   78 418.1    2.763    2.763      B 3.538244e-11
```

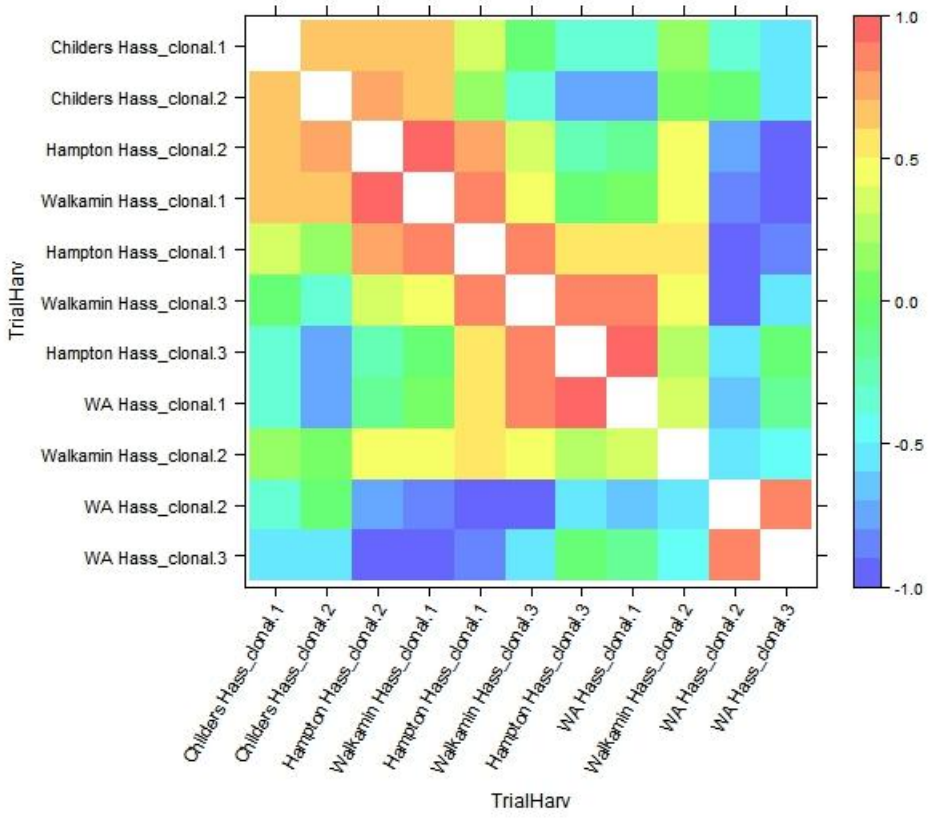
The fixed effect analysis shows evidence of GxE so we then fitted a MET analysis modelling the random genetic effects across Sites and Times. A factor analytic model of order 2 (fa2) model was used to model the gxe effects.

The genetic correlation matrix from this analysis is given below. At Childers the genetic correlation between times 1 & 2 was 0.666. The genetic correlation between Childers 1 and WA (at all 3 times) was negative indicating varieties that perfomed well at Childers did not perform so well at WA.

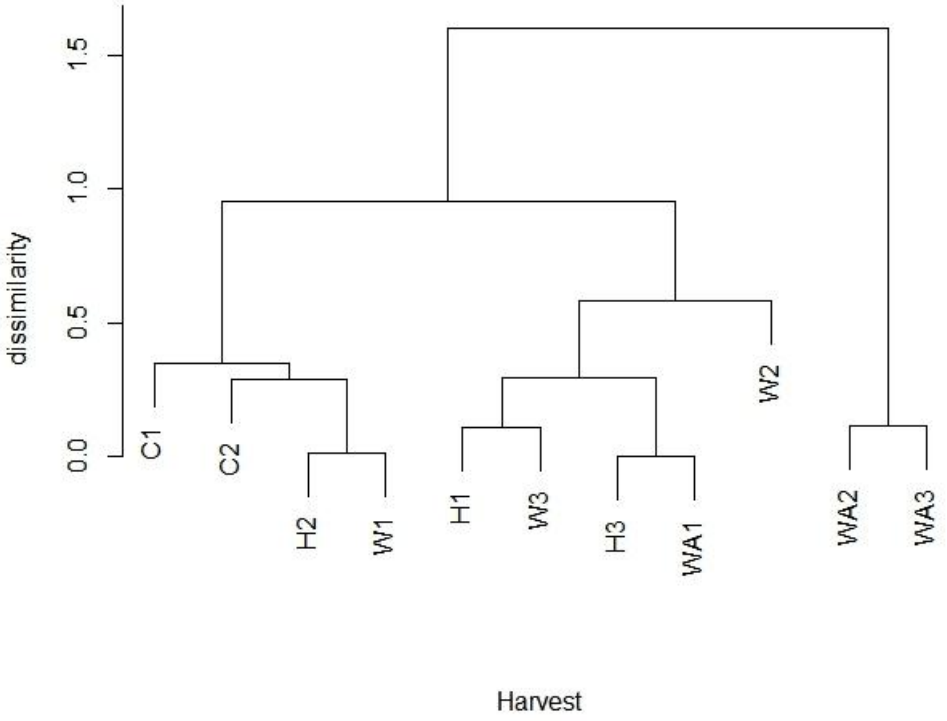
```
Genetic correlation matrix
```

	C1	C2	H1	H2	H3	WA1	WA2	WA3	W1	W2	W3
C1	1.000	0.666	0.325	0.669	-0.376	-0.327	-0.307	-0.572	0.624	0.179	0.000
C2	0.666	1.000	0.120	0.767	-0.791	-0.740	-0.092	-0.550	0.658	0.063	-0.348
H1	0.325	0.120	1.000	0.730	0.512	0.578	-1.000	-0.895	0.827	0.558	0.889
H2	0.669	0.767	0.730	1.000	-0.214	-0.136	-0.710	-0.958	0.988	0.404	0.335
H3	-0.376	-0.791	0.512	-0.214	1.000	0.997	-0.536	-0.076	-0.059	0.290	0.849
WA1	-0.327	-0.740	0.578	-0.136	0.997	1.000	-0.601	-0.155	0.020	0.327	0.888
WA2	-0.307	-0.092	-1.000	-0.710	-0.536	-0.601	1.000	0.883	-0.811	-0.558	-0.901
WA3	-0.572	-0.550	-0.895	-0.958	-0.076	-0.155	0.883	1.000	-0.991	-0.498	-0.592
W1	0.624	0.658	0.827	0.988	-0.059	0.020	-0.811	-0.991	1.000	0.459	0.478
W2	0.179	0.063	0.558	0.404	0.290	0.327	-0.558	-0.498	0.459	1.000	0.498
W3	0.000	-0.348	0.889	0.335	0.849	0.888	-0.901	-0.592	0.478	0.498	1.000

The genetic correlations can be expressed in pictorial form in the following heatmap.



A cluster analysis based on the genetic correlation matrix results in the following dendrogram:



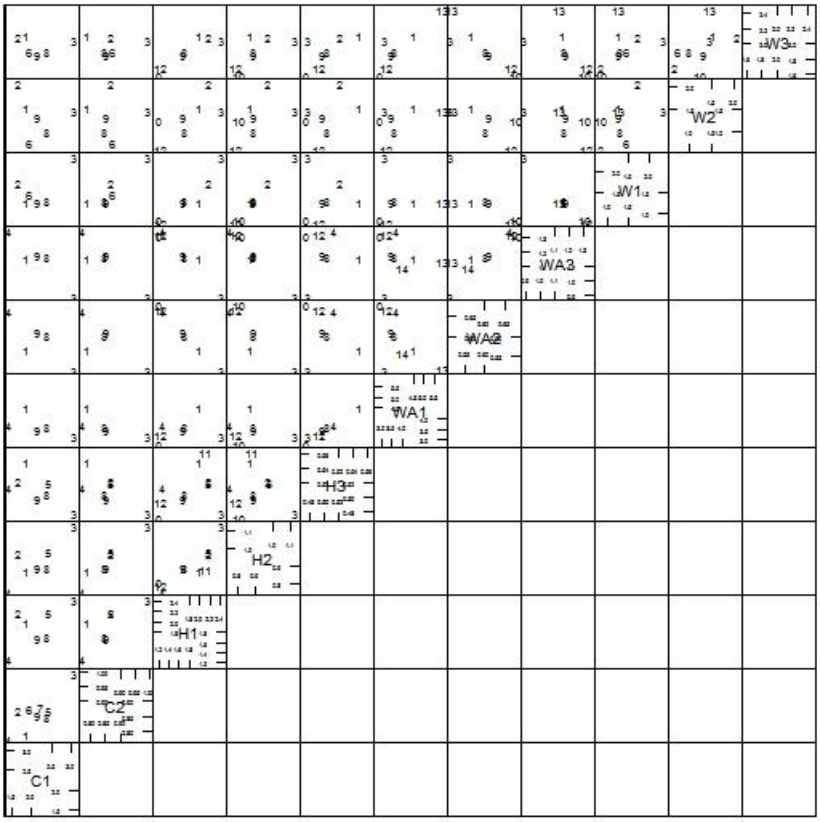
>

The predictions (BLUPs) for each RS at each Site by time are given as follows.

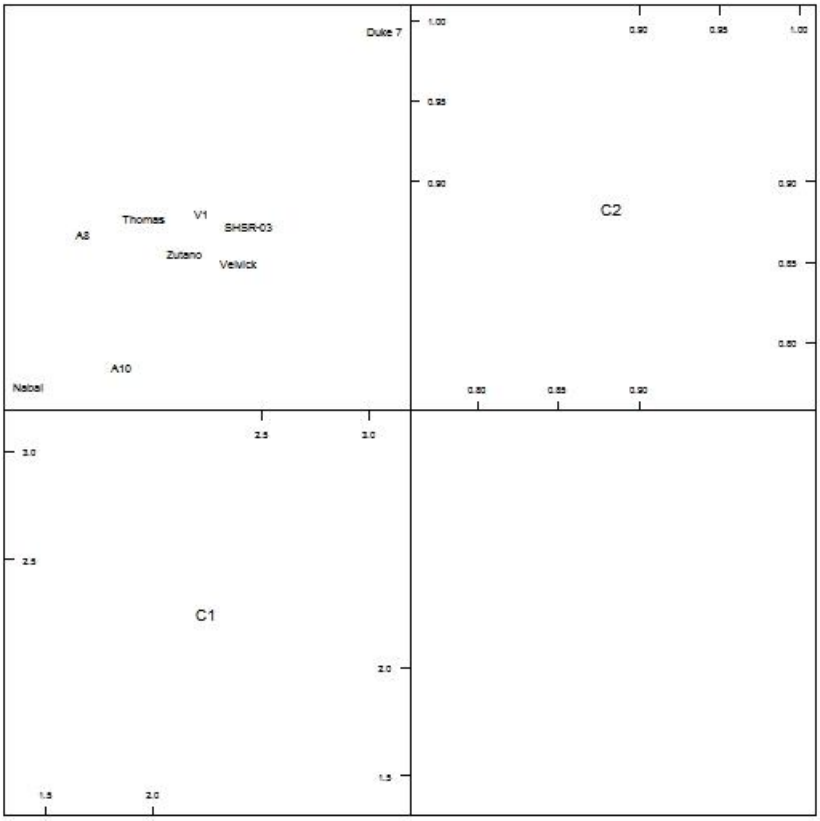
	ExTime	Trt	predicted.value	standard.error	est.status
1	Childers Hass_clonal.1	A10	1.853622	0.2291438	Estimable
2	Childers Hass_clonal.1	A8	1.678010	0.2293836	Estimable
3	Childers Hass_clonal.1	Duke 7	3.070271	0.2356314	Estimable
4	Childers Hass_clonal.1	Nabal	1.426741	0.2286245	Estimable
5	Childers Hass_clonal.1	SHSR-03	2.444548	0.2292531	Estimable
6	Childers Hass_clonal.1	Thomas	1.960173	0.2412012	Estimable
7	Childers Hass_clonal.1	V1	2.223998	0.2323671	Estimable
8	Childers Hass_clonal.1	Velvick	2.394338	0.2272808	Estimable
9	Childers Hass_clonal.1	Zutano	2.142258	0.2273693	Estimable
10	Childers Hass_clonal.1	Reed	NA	NA	Aliased
11	Childers Hass_clonal.1	Plowman	NA	NA	Aliased
12	Childers Hass_clonal.1	Hass	NA	NA	Aliased
13	Childers Hass_clonal.1	Barr Duke	NA	NA	Aliased
14	Childers Hass_clonal.1	SHSR-01	NA	NA	Aliased
15	Childers Hass_clonal.2	A10	0.785222	0.0675143	Estimable
16	Childers Hass_clonal.2	A8	0.867676	0.0691733	Estimable
17	Childers Hass_clonal.2	Duke 7	0.993602	0.0676546	Estimable
18	Childers Hass_clonal.2	Nabal	0.773132	0.0698261	Estimable
19	Childers Hass_clonal.2	SHSR-03	0.872219	0.0721635	Estimable
20	Childers Hass_clonal.2	Thomas	0.877304	0.0746923	Estimable
21	Childers Hass_clonal.2	V1	0.880564	0.0801558	Estimable
22	Childers Hass_clonal.2	Velvick	0.849317	0.0673418	Estimable
23	Childers Hass_clonal.2	Zutano	0.855678	0.0674001	Estimable
24	Childers Hass_clonal.2	Reed	NA	NA	Aliased
25	Childers Hass_clonal.2	Plowman	NA	NA	Aliased
26	Childers Hass_clonal.2	Hass	NA	NA	Aliased
27	Childers Hass_clonal.2	Barr Duke	NA	NA	Aliased
28	Childers Hass_clonal.2	SHSR-01	NA	NA	Aliased
29	Hampton Hass_clonal.1	A10	1.989274	0.2134518	Estimable
30	Hampton Hass_clonal.1	A8	2.183093	0.2239187	Estimable
31	Hampton Hass_clonal.1	Duke 7	2.424132	0.2110838	Estimable
32	Hampton Hass_clonal.1	Nabal	1.269691	0.2380919	Estimable
33	Hampton Hass_clonal.1	SHSR-03	2.187887	0.2661237	Estimable
34	Hampton Hass_clonal.1	Thomas	NA	NA	Aliased
35	Hampton Hass_clonal.1	V1	NA	NA	Aliased
36	Hampton Hass_clonal.1	Velvick	1.730056	0.2110155	Estimable
37	Hampton Hass_clonal.1	Zutano	1.667983	0.2085970	Estimable
38	Hampton Hass_clonal.1	Reed	1.161733	0.2172559	Estimable
39	Hampton Hass_clonal.1	Plowman	2.114581	0.2703354	Estimable
40	Hampton Hass_clonal.1	Hass	1.231910	0.2231165	Estimable
41	Hampton Hass_clonal.1	Barr Duke	NA	NA	Aliased
42	Hampton Hass_clonal.1	SHSR-01	NA	NA	Aliased
43	Hampton Hass_clonal.2	A10	0.871713	0.0556930	Estimable
44	Hampton Hass_clonal.2	A8	0.973405	0.0566282	Estimable
45	Hampton Hass_clonal.2	Duke 7	1.120741	0.0555819	Estimable
46	Hampton Hass_clonal.2	Nabal	0.756546	0.0622003	Estimable
47	Hampton Hass_clonal.2	SHSR-03	0.978155	0.0654630	Estimable
48	Hampton Hass_clonal.2	Thomas	NA	NA	Aliased
49	Hampton Hass_clonal.2	V1	NA	NA	Aliased
50	Hampton Hass_clonal.2	Velvick	0.891309	0.0551678	Estimable
51	Hampton Hass_clonal.2	Zutano	0.887980	0.0552112	Estimable
52	Hampton Hass_clonal.2	Reed	0.810865	0.0574519	Estimable
53	Hampton Hass_clonal.2	Plowman	0.877377	0.0723547	Estimable
54	Hampton Hass_clonal.2	Hass	0.787048	0.0591033	Estimable
55	Hampton Hass_clonal.2	Barr Duke	NA	NA	Aliased
56	Hampton Hass_clonal.2	SHSR-01	NA	NA	Aliased
57	Hampton Hass_clonal.3	A10	0.547487	0.0234412	Estimable
58	Hampton Hass_clonal.3	A8	0.521290	0.0252820	Estimable
59	Hampton Hass_clonal.3	Duke 7	0.478252	0.0228414	Estimable
60	Hampton Hass_clonal.3	Nabal	0.513231	0.0245297	Estimable
61	Hampton Hass_clonal.3	SHSR-03	0.519523	0.0267945	Estimable
62	Hampton Hass_clonal.3	Thomas	NA	NA	Aliased
63	Hampton Hass_clonal.3	V1	NA	NA	Aliased
64	Hampton Hass_clonal.3	Velvick	0.504533	0.0229461	Estimable
65	Hampton Hass_clonal.3	Zutano	0.498264	0.0234337	Estimable
66	Hampton Hass_clonal.3	Reed	0.472200	0.0235027	Estimable
67	Hampton Hass_clonal.3	Plowman	0.560666	0.0300298	Estimable
68	Hampton Hass_clonal.3	Hass	0.493111	0.0254835	Estimable
69	Hampton Hass_clonal.3	Barr Duke	NA	NA	Aliased
70	Hampton Hass_clonal.3	SHSR-01	NA	NA	Aliased
71	WA Hass_clonal.1	A10	4.521853	0.4368250	Estimable
72	WA Hass_clonal.1	A8	NA	NA	Aliased
73	WA Hass_clonal.1	Duke 7	3.172524	0.4393653	Estimable
74	WA Hass_clonal.1	Nabal	3.686288	0.4666459	Estimable
75	WA Hass_clonal.1	SHSR-03	NA	NA	Aliased
76	WA Hass_clonal.1	Thomas	NA	NA	Aliased
77	WA Hass_clonal.1	V1	NA	NA	Aliased
78	WA Hass_clonal.1	Velvick	3.589609	0.4422750	Estimable
79	WA Hass_clonal.1	Zutano	3.449263	0.4275138	Estimable
80	WA Hass_clonal.1	Reed	2.821032	0.4644467	Estimable

```
81        WA Hass_clonal.1   Plowman          NA          NA   Aliased
82        WA Hass_clonal.1      Hass    3.264719   0.5264475 Estimable
83        WA Hass_clonal.1 Barr Duke    5.845269   0.5288683 Estimable
84        WA Hass_clonal.1   SHSR-01    4.029953   0.6486446 Estimable
85        WA Hass_clonal.2       A10    0.567603   0.0639131 Estimable
86        WA Hass_clonal.2        A8          NA          NA   Aliased
87        WA Hass_clonal.2    Duke 7    0.515360   0.0639811 Estimable
88        WA Hass_clonal.2     Nabal    0.661399   0.0654815 Estimable
89        WA Hass_clonal.2   SHSR-03          NA          NA   Aliased
90        WA Hass_clonal.2    Thomas          NA          NA   Aliased
91        WA Hass_clonal.2        V1          NA          NA   Aliased
92        WA Hass_clonal.2   Velvick    0.602902   0.0639877 Estimable
93        WA Hass_clonal.2    Zutano    0.611158   0.0635920 Estimable
94        WA Hass_clonal.2      Reed    0.677242   0.0644007 Estimable
95        WA Hass_clonal.2   Plowman          NA          NA   Aliased
96        WA Hass_clonal.2      Hass    0.667227   0.0654067 Estimable
97        WA Hass_clonal.2 Barr Duke    0.518493   0.0658593 Estimable
98        WA Hass_clonal.2   SHSR-01    0.558724   0.0740267 Estimable
99        WA Hass_clonal.3       A10    1.158092   0.0696565 Estimable
100       WA Hass_clonal.3        A8          NA          NA   Aliased
101       WA Hass_clonal.3    Duke 7    0.896989   0.0700740 Estimable
102       WA Hass_clonal.3     Nabal    1.341905   0.0783056 Estimable
103       WA Hass_clonal.3   SHSR-03          NA          NA   Aliased
104       WA Hass_clonal.3    Thomas          NA          NA   Aliased
105       WA Hass_clonal.3        V1          NA          NA   Aliased
106       WA Hass_clonal.3   Velvick    1.173240   0.0696381 Estimable
107       WA Hass_clonal.3    Zutano    1.183571   0.0682957 Estimable
108       WA Hass_clonal.3      Reed    1.309620   0.0723585 Estimable
109       WA Hass_clonal.3   Plowman          NA          NA   Aliased
110       WA Hass_clonal.3      Hass    1.321000   0.0761554 Estimable
111       WA Hass_clonal.3 Barr Duke    1.139338   0.0779996 Estimable
112       WA Hass_clonal.3   SHSR-01    1.090752   0.1158451 Estimable
113 Walkamin Hass_clonal.1       A10    1.274945   0.1936186 Estimable
114 Walkamin Hass_clonal.1        A8    1.714816   0.1973980 Estimable
115 Walkamin Hass_clonal.1    Duke 7    2.342562   0.1936354 Estimable
116 Walkamin Hass_clonal.1     Nabal          NA          NA   Aliased
117 Walkamin Hass_clonal.1   SHSR-03          NA          NA   Aliased
118 Walkamin Hass_clonal.1    Thomas    1.468380   0.2413540 Estimable
119 Walkamin Hass_clonal.1        V1          NA          NA   Aliased
120 Walkamin Hass_clonal.1   Velvick    1.288434   0.1893808 Estimable
121 Walkamin Hass_clonal.1    Zutano    1.260643   0.1875695 Estimable
122 Walkamin Hass_clonal.1      Reed    0.840734   0.2039324 Estimable
123 Walkamin Hass_clonal.1   Plowman          NA          NA   Aliased
124 Walkamin Hass_clonal.1      Hass    0.765489   0.2140869 Estimable
125 Walkamin Hass_clonal.1 Barr Duke    1.245620   0.2307527 Estimable
126 Walkamin Hass_clonal.1   SHSR-01          NA          NA   Aliased
127 Walkamin Hass_clonal.2       A10    1.537742   0.2270683 Estimable
128 Walkamin Hass_clonal.2        A8    2.068436   0.2209904 Estimable
129 Walkamin Hass_clonal.2    Duke 7    1.475451   0.2262478 Estimable
130 Walkamin Hass_clonal.2     Nabal          NA          NA   Aliased
131 Walkamin Hass_clonal.2   SHSR-03          NA          NA   Aliased
132 Walkamin Hass_clonal.2    Thomas    0.764551   0.2458911 Estimable
133 Walkamin Hass_clonal.2        V1          NA          NA   Aliased
134 Walkamin Hass_clonal.2   Velvick    0.999385   0.2189861 Estimable
135 Walkamin Hass_clonal.2    Zutano    1.341813   0.2182739 Estimable
136 Walkamin Hass_clonal.2      Reed    1.252771   0.2572933 Estimable
137 Walkamin Hass_clonal.2   Plowman          NA          NA   Aliased
138 Walkamin Hass_clonal.2      Hass    0.620150   0.2585512 Estimable
139 Walkamin Hass_clonal.2 Barr Duke    1.476413   0.2322712 Estimable
140 Walkamin Hass_clonal.2   SHSR-01          NA          NA   Aliased
141 Walkamin Hass_clonal.3       A10    2.115342   0.1235124 Estimable
142 Walkamin Hass_clonal.3        A8    2.095314   0.1323304 Estimable
143 Walkamin Hass_clonal.3    Duke 7    2.036501   0.1212082 Estimable
144 Walkamin Hass_clonal.3     Nabal          NA          NA   Aliased
145 Walkamin Hass_clonal.3   SHSR-03          NA          NA   Aliased
146 Walkamin Hass_clonal.3    Thomas    1.902160   0.1764113 Estimable
147 Walkamin Hass_clonal.3        V1          NA          NA   Aliased
148 Walkamin Hass_clonal.3   Velvick    1.889325   0.1242788 Estimable
149 Walkamin Hass_clonal.3    Zutano    1.848234   0.1203055 Estimable
150 Walkamin Hass_clonal.3      Reed    1.594293   0.1288543 Estimable
151 Walkamin Hass_clonal.3   Plowman          NA          NA   Aliased
152 Walkamin Hass_clonal.3      Hass    1.685557   0.1362466 Estimable
153 Walkamin Hass_clonal.3 Barr Duke    2.433784   0.1430868 Estimable
154 Walkamin Hass_clonal.3   SHSR-01          NA          NA   Aliased

$avsed
  overall
0.2903141
```

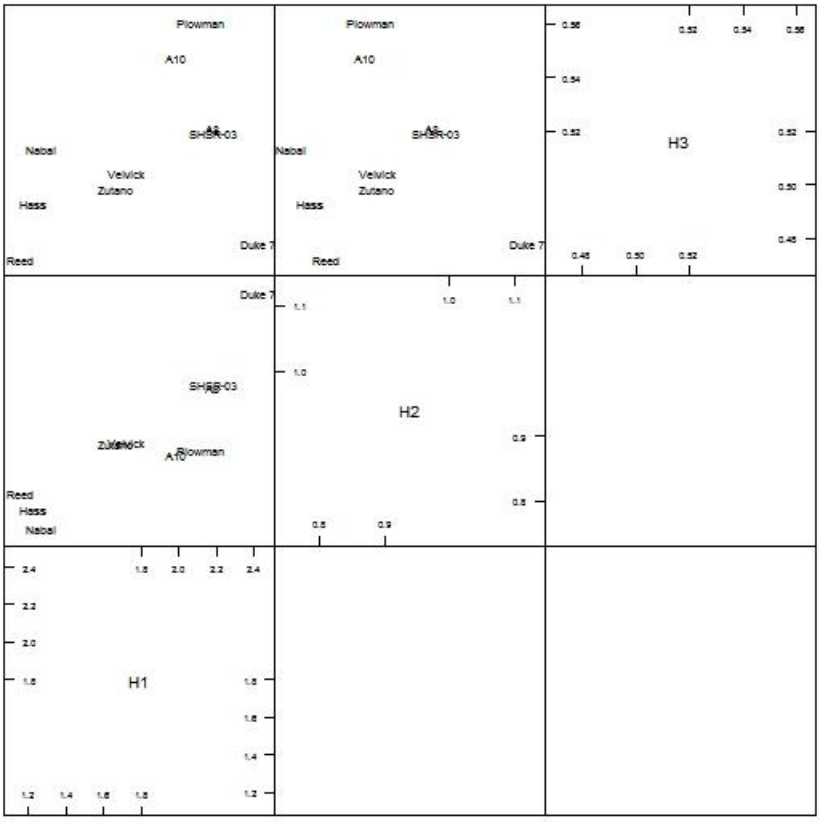
A plot of the Rootstocks at each Ste by time is given below.



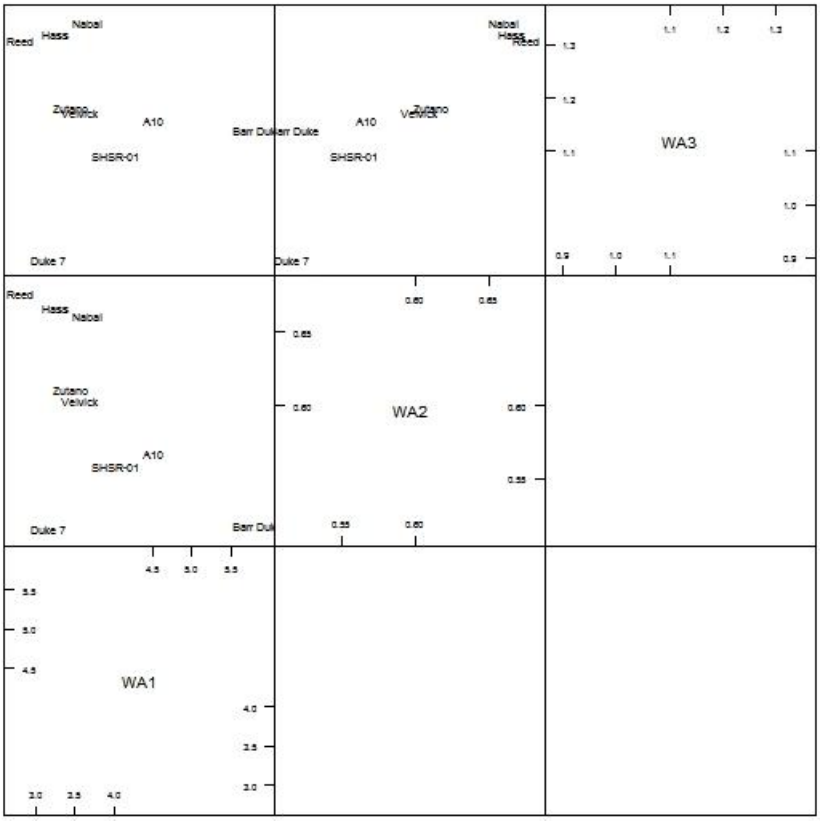
Childers


Duke 7
Thomas
V1
A8
SHBR-03
Zutano
Velvick
A10
Nabal
C2
C1

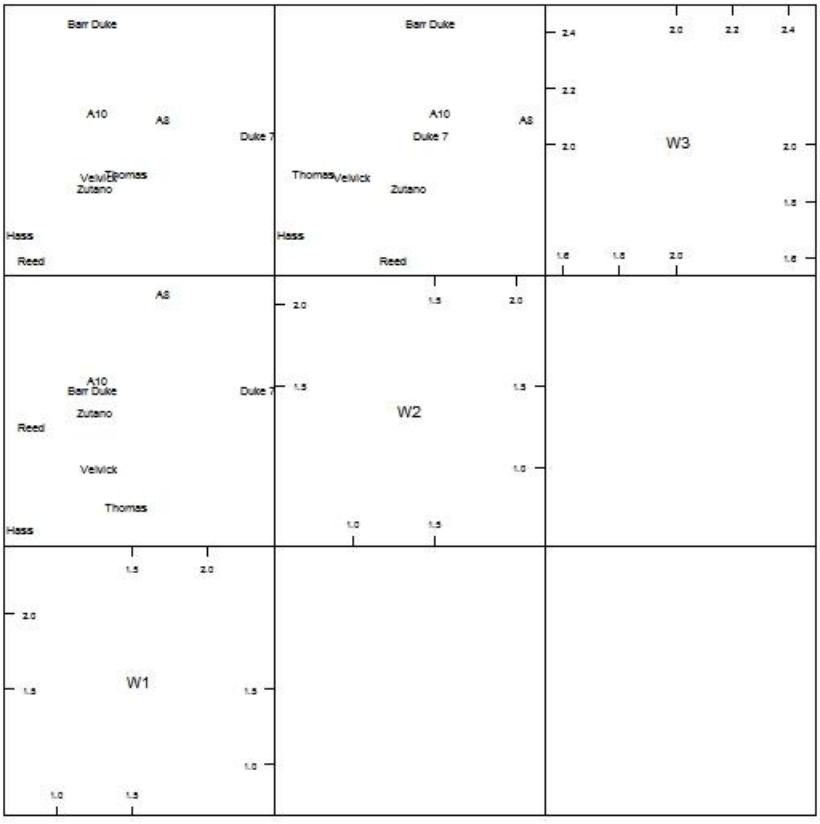
Hampton


Plowman
A10
SHBR-03
Nabal
Velvick
Zutano
Hsss
Reed
Duke 7
H3
H2
H1

WA


Natoal
Hass
Reed
Zutano
Velvick
A10
Barr Duke
SHSR-01
Duke 7
WA3
WA2
WA1

Walkamin


Barr Duke
A10
A8
Duke 7
Velvick
Thomas
Zutano
Hass
Reed
W3
W2
W1

Seedling “trials”

The seedling populations are different to the clonal genotypes in that they have within RS genetic variation. To get accurate estimates of genetic variance this requires either a pedigree or some way of separating out the within genetic variance from the residual variance.

2. **Hass seedling across sites –** concurrence of varieties

	A10	A8	Duke 7	Nabal	SHSR-03	V1	Velvick	Zutano	Peasley	Reed	SHSR-02	Toro Canyon	Velvick/Hazard	Plowman	Barr	Duke	Rigato
Childers	30	30	0	30	30	30	30	0	30	30	30	30	30	0	0	0	
Hampton	27	30	30	30	30	0	30	30	0	30	30	0	30	30	0	0	
WA	30	0	30	30	0	30	30	0	0	0	30	30	0	30	0	0	
Walkamin	30	30	30	30	0	0	30	30	0	30	30	0	0	0	30	30	

Yield

Initial fixed effects analysis:

$Wald

	Df	denDF	F.inc	F.con	Margin	Pr
(Intercept)	1	58.0	1540.000	1540.000		1.812546e-43
Trt	15	245.8	7.817	5.048	A	1.141504e-08
ExTime	11	55.9	215.100	215.100	A	1.440796e-41
Trt:ExTime	93	577.6	1.329	1.329	B	2.881747e-02

2. **Hass seedling across sites –** concurrence of varieties

	A10	A8	Duke 7	Nabal	SHSR-03	V1	Velvick	Zutano	Peasley	Reed	SHSR-02	Toro Canyon	Velvick/Hazard	Plowman	Barr	Duke	Rigato
Childers	30	30	0	30	30	30	30	0	30	30	30	30	30	0	0	0	
Hampton	27	30	30	30	30	0	30	30	0	30	30	0	30	30	0	0	
WA	30	0	30	30	0	30	30	0	0	0	30	30	0	30	0	0	
Walkamin	30	30	30	30	0	0	30	30	0	30	30	0	0	0	30	30	

Initial fixed effects analysis:

$Wald

	Df	denDF	F.inc	F.con	Margin	Pr
(Intercept)	1	58.0	1540.000	1540.000		1.812546e-43
Trt	15	245.8	7.817	5.048	A	1.141504e-08
ExTime	11	55.9	215.100	215.100	A	1.440796e-41
Trt:ExTime	93	577.6	1.329	1.329	B	2.881747e-02

Fixed effect means

	Trt	ExTime	predicted.value	standard.error	est.status
1	A10	Childers	Hass_seedling.1	45.05347	5.859890	Estimable
2	A10	Childers	Hass_seedling.2	124.83435	12.371978	Estimable
3	A10	Childers	Hass_seedling.3	166.46488	21.513621	Estimable
4	A10	Hampton	Hass_seedling.1	50.63977	6.940058	Estimable
5	A10	Hampton	Hass_seedling.2	105.04303	15.558913	Estimable
6	A10	Hampton	Hass_seedling.3	118.38118	15.530983	Estimable
7	A10	WA	Hass_seedling.1	31.99544	5.473184	Estimable
8	A10	WA	Hass_seedling.2	39.19840	8.137157	Estimable
9	A10	WA	Hass_seedling.3	84.92581	15.724573	Estimable
10	A10	Walkamin	Hass_seedling.1	11.05364	4.388267	Estimable
11	A10	Walkamin	Hass_seedling.2	89.08174	14.880750	Estimable
12	A10	Walkamin	Hass_seedling.3	233.89350	19.899424	Estimable
13	A8	Childers	Hass_seedling.1	55.68593	5.944010	Estimable
14	A8	Childers	Hass_seedling.2	168.91128	12.554853	Estimable
15	A8	Childers	Hass_seedling.3	191.88846	19.544901	Estimable
16	A8	Hampton	Hass_seedling.1	29.48829	6.614614	Estimable
17	A8	Hampton	Hass_seedling.2	91.90814	14.304088	Estimable
18	A8	Hampton	Hass_seedling.3	136.29929	15.331179	Estimable
19	A8	WA	Hass_seedling.1	NA	NA	Aliased
20	A8	WA	Hass_seedling.2	NA	NA	Aliased
21	A8	WA	Hass_seedling.3	NA	NA	Aliased
22	A8	Walkamin	Hass_seedling.1	7.62729	4.360892	Estimable

23	A8	Walkamin	Hass_seedling.2	90.79413	14.789798	Estimable
24	A8	Walkamin	Hass_seedling.3	186.60029	19.782509	Estimable
25	Duke 7	Childers	Hass_seedling.1	NA	NA	Aliased
26	Duke 7	Childers	Hass_seedling.2	NA	NA	Aliased
27	Duke 7	Childers	Hass_seedling.3	NA	NA	Aliased
28	Duke 7	Hampton	Hass_seedling.1	22.70093	6.588393	Estimable
29	Duke 7	Hampton	Hass_seedling.2	87.29940	14.255169	Estimable
30	Duke 7	Hampton	Hass_seedling.3	98.39573	13.798454	Estimable
31	Duke 7	WA	Hass_seedling.1	22.86951	5.795103	Estimable
32	Duke 7	WA	Hass_seedling.2	24.61127	8.616068	Estimable
33	Duke 7	WA	Hass_seedling.3	88.47130	16.647310	Estimable
34	Duke 7	Walkamin	Hass_seedling.1	6.34037	4.872942	Estimable
35	Duke 7	Walkamin	Hass_seedling.2	46.30897	16.541920	Estimable
36	Duke 7	Walkamin	Hass_seedling.3	169.31454	22.118662	Estimable
37	Nabal	Childers	Hass_seedling.1	56.50712	5.861157	Estimable
38	Nabal	Childers	Hass_seedling.2	158.59150	12.375234	Estimable
39	Nabal	Childers	Hass_seedling.3	187.06029	18.605150	Estimable
40	Nabal	Hampton	Hass_seedling.1	43.85129	6.588688	Estimable
41	Nabal	Hampton	Hass_seedling.2	108.72124	14.254924	Estimable
42	Nabal	Hampton	Hass_seedling.3	130.10601	14.454629	Estimable
43	Nabal	WA	Hass_seedling.1	27.30633	5.200144	Estimable
44	Nabal	WA	Hass_seedling.2	34.02942	7.731490	Estimable
45	Nabal	WA	Hass_seedling.3	53.87394	14.942983	Estimable
46	Nabal	Walkamin	Hass_seedling.1	12.17560	4.595388	Estimable
47	Nabal	Walkamin	Hass_seedling.2	59.06762	16.216040	Estimable
48	Nabal	Walkamin	Hass_seedling.3	200.82613	21.940823	Estimable
49	SHSR-03	Childers	Hass_seedling.1	41.74372	5.854524	Estimable
50	SHSR-03	Childers	Hass_seedling.2	117.08430	12.358590	Estimable
51	SHSR-03	Childers	Hass_seedling.3	129.68308	21.489577	Estimable
52	SHSR-03	Hampton	Hass_seedling.1	40.00998	6.588382	Estimable
53	SHSR-03	Hampton	Hass_seedling.2	81.38358	14.254317	Estimable
54	SHSR-03	Hampton	Hass_seedling.3	108.26437	13.254380	Estimable
55	SHSR-03	WA	Hass_seedling.1	NA	NA	Aliased
56	SHSR-03	WA	Hass_seedling.2	NA	NA	Aliased
57	SHSR-03	WA	Hass_seedling.3	NA	NA	Aliased
58	SHSR-03	Walkamin	Hass_seedling.1	NA	NA	Aliased
59	SHSR-03	Walkamin	Hass_seedling.2	NA	NA	Aliased
60	SHSR-03	Walkamin	Hass_seedling.3	NA	NA	Aliased
61	V1	Childers	Hass_seedling.1	53.41327	5.850120	Estimable
62	V1	Childers	Hass_seedling.2	139.53117	12.349909	Estimable
63	V1	Childers	Hass_seedling.3	180.58687	20.003675	Estimable
64	V1	Hampton	Hass_seedling.1	NA	NA	Aliased
65	V1	Hampton	Hass_seedling.2	NA	NA	Aliased
66	V1	Hampton	Hass_seedling.3	NA	NA	Aliased
67	V1	WA	Hass_seedling.1	27.92423	5.813176	Estimable
68	V1	WA	Hass_seedling.2	34.26346	9.662574	Estimable
69	V1	WA	Hass_seedling.3	118.53430	19.124639	Estimable
70	V1	Walkamin	Hass_seedling.1	NA	NA	Aliased
71	V1	Walkamin	Hass_seedling.2	NA	NA	Aliased
72	V1	Walkamin	Hass_seedling.3	NA	NA	Aliased
73	Velvick	Childers	Hass_seedling.1	65.47106	5.889386	Estimable
74	Velvick	Childers	Hass_seedling.2	177.28783	12.433958	Estimable
75	Velvick	Childers	Hass_seedling.3	215.95404	18.640252	Estimable
76	Velvick	Hampton	Hass_seedling.1	63.13559	6.615836	Estimable
77	Velvick	Hampton	Hass_seedling.2	118.21298	14.834660	Estimable
78	Velvick	Hampton	Hass_seedling.3	140.45475	14.641933	Estimable
79	Velvick	WA	Hass_seedling.1	38.47229	5.481218	Estimable
80	Velvick	WA	Hass_seedling.2	31.72439	8.149073	Estimable
81	Velvick	WA	Hass_seedling.3	104.04733	15.747202	Estimable
82	Velvick	Walkamin	Hass_seedling.1	23.88757	4.363252	Estimable
83	Velvick	Walkamin	Hass_seedling.2	111.15765	14.803047	Estimable
84	Velvick	Walkamin	Hass_seedling.3	258.72829	19.796022	Estimable
85	Zutano	Childers	Hass_seedling.1	NA	NA	Aliased
86	Zutano	Childers	Hass_seedling.2	NA	NA	Aliased
87	Zutano	Childers	Hass_seedling.3	NA	NA	Aliased
88	Zutano	Hampton	Hass_seedling.1	55.72431	6.616363	Estimable
89	Zutano	Hampton	Hass_seedling.2	120.13239	14.841262	Estimable
90	Zutano	Hampton	Hass_seedling.3	138.68647	15.446793	Estimable
91	Zutano	WA	Hass_seedling.1	NA	NA	Aliased
92	Zutano	WA	Hass_seedling.2	NA	NA	Aliased
93	Zutano	WA	Hass_seedling.3	NA	NA	Aliased
94	Zutano	Walkamin	Hass_seedling.1	10.69144	4.368875	Estimable
95	Zutano	Walkamin	Hass_seedling.2	82.16696	14.815173	Estimable
96	Zutano	Walkamin	Hass_seedling.3	250.08149	20.535267	Estimable
97	Peasley	Childers	Hass_seedling.1	46.51551	5.931833	Estimable
98	Peasley	Childers	Hass_seedling.2	138.35425	12.528458	Estimable
99	Peasley	Childers	Hass_seedling.3	164.09900	21.541519	Estimable
100	Peasley	Hampton	Hass_seedling.1	NA	NA	Aliased
101	Peasley	Hampton	Hass_seedling.2	NA	NA	Aliased
102	Peasley	Hampton	Hass_seedling.3	NA	NA	Aliased
103	Peasley	WA	Hass_seedling.1	NA	NA	Aliased
104	Peasley	WA	Hass_seedling.2	NA	NA	Aliased
105	Peasley	WA	Hass_seedling.3	NA	NA	Aliased
106	Peasley	Walkamin	Hass_seedling.1	NA	NA	Aliased
107	Peasley	Walkamin	Hass_seedling.2	NA	NA	Aliased
108	Peasley	Walkamin	Hass_seedling.3	NA	NA	Aliased
109	Reed	Childers	Hass_seedling.1	61.98341	5.797275	Estimable

```
110           Reed Childers Hass_seedling.2       177.92475      12.234763  Estimable
111           Reed Childers Hass_seedling.3       202.10700      18.523291  Estimable
112           Reed  Hampton Hass_seedling.1        37.33482       7.396406  Estimable
113           Reed  Hampton Hass_seedling.2       116.85192      15.825883  Estimable
114           Reed  Hampton Hass_seedling.3       123.03597      14.887846  Estimable
115           Reed        WA Hass_seedling.1              NA             NA    Aliased
116           Reed        WA Hass_seedling.2              NA             NA    Aliased
117           Reed        WA Hass_seedling.3              NA             NA    Aliased
118           Reed Walkamin Hass_seedling.1         6.92202       6.137178  Estimable
119           Reed Walkamin Hass_seedling.2        62.85376      20.878206  Estimable
120           Reed Walkamin Hass_seedling.3       190.83686      27.915809  Estimable
121        SHSR-02 Childers Hass_seedling.1        41.52650       5.917923  Estimable
122        SHSR-02 Childers Hass_seedling.2       128.57291      12.497575  Estimable
123        SHSR-02 Childers Hass_seedling.3       164.63164      18.129935  Estimable
124        SHSR-02  Hampton Hass_seedling.1        56.88028       6.614881  Estimable
125        SHSR-02  Hampton Hass_seedling.2       103.06604      14.306884  Estimable
126        SHSR-02  Hampton Hass_seedling.3       115.91128      14.526476  Estimable
127        SHSR-02        WA Hass_seedling.1        33.79523       5.200062  Estimable
128        SHSR-02        WA Hass_seedling.2        30.59421       7.731247  Estimable
129        SHSR-02        WA Hass_seedling.3        83.93905      14.942388  Estimable
130        SHSR-02 Walkamin Hass_seedling.1        17.71454       4.340863  Estimable
131        SHSR-02 Walkamin Hass_seedling.2        91.89859      14.716164  Estimable
132        SHSR-02 Walkamin Hass_seedling.3       205.18609      19.676868  Estimable
133    Toro Canyon Childers Hass_seedling.1        59.62147       6.473586  Estimable
134    Toro Canyon Childers Hass_seedling.2       160.11541      13.677440  Estimable
135    Toro Canyon Childers Hass_seedling.3       178.82407      19.862959  Estimable
136    Toro Canyon  Hampton Hass_seedling.1              NA             NA    Aliased
137    Toro Canyon  Hampton Hass_seedling.2              NA             NA    Aliased
138    Toro Canyon  Hampton Hass_seedling.3              NA             NA    Aliased
139    Toro Canyon        WA Hass_seedling.1        31.87880       5.814160  Estimable
140    Toro Canyon        WA Hass_seedling.2        29.55630       8.644176  Estimable
141    Toro Canyon        WA Hass_seedling.3       106.65676      16.702436  Estimable
142    Toro Canyon Walkamin Hass_seedling.1              NA             NA    Aliased
143    Toro Canyon Walkamin Hass_seedling.2              NA             NA    Aliased
144    Toro Canyon Walkamin Hass_seedling.3              NA             NA    Aliased
145 Velvick/Hazard Childers Hass_seedling.1        20.39745       5.840458  Estimable
146 Velvick/Hazard Childers Hass_seedling.2       111.96956      12.328801  Estimable
147 Velvick/Hazard Childers Hass_seedling.3       157.71782      18.524053  Estimable
148 Velvick/Hazard  Hampton Hass_seedling.1        16.66282       6.940384  Estimable
149 Velvick/Hazard  Hampton Hass_seedling.2        75.67830      14.934441  Estimable
150 Velvick/Hazard  Hampton Hass_seedling.3       133.62085      15.393945  Estimable
151 Velvick/Hazard        WA Hass_seedling.1              NA             NA    Aliased
152 Velvick/Hazard        WA Hass_seedling.2              NA             NA    Aliased
153 Velvick/Hazard        WA Hass_seedling.3              NA             NA    Aliased
154 Velvick/Hazard Walkamin Hass_seedling.1              NA             NA    Aliased
155 Velvick/Hazard Walkamin Hass_seedling.2              NA             NA    Aliased
156 Velvick/Hazard Walkamin Hass_seedling.3              NA             NA    Aliased
157        Plowman Childers Hass_seedling.1              NA             NA    Aliased
158        Plowman Childers Hass_seedling.2              NA             NA    Aliased
159        Plowman Childers Hass_seedling.3              NA             NA    Aliased
160        Plowman  Hampton Hass_seedling.1        38.10181       6.587752  Estimable
161        Plowman  Hampton Hass_seedling.2        92.54279      14.771780  Estimable
162        Plowman  Hampton Hass_seedling.3       125.83489      15.428250  Estimable
163        Plowman        WA Hass_seedling.1        22.69778       5.200063  Estimable
164        Plowman        WA Hass_seedling.2        42.45144       8.046968  Estimable
165        Plowman        WA Hass_seedling.3        85.32175      15.699271  Estimable
166        Plowman Walkamin Hass_seedling.1              NA             NA    Aliased
167        Plowman Walkamin Hass_seedling.2              NA             NA    Aliased
168        Plowman Walkamin Hass_seedling.3              NA             NA    Aliased
169     Barr Duke Childers Hass_seedling.1              NA             NA    Aliased
170     Barr Duke Childers Hass_seedling.2              NA             NA    Aliased
171     Barr Duke Childers Hass_seedling.3              NA             NA    Aliased
172     Barr Duke  Hampton Hass_seedling.1              NA             NA    Aliased
173     Barr Duke  Hampton Hass_seedling.2              NA             NA    Aliased
174     Barr Duke  Hampton Hass_seedling.3              NA             NA    Aliased
175     Barr Duke        WA Hass_seedling.1              NA             NA    Aliased
176     Barr Duke        WA Hass_seedling.2              NA             NA    Aliased
177     Barr Duke        WA Hass_seedling.3              NA             NA    Aliased
178     Barr Duke Walkamin Hass_seedling.1        16.04188       4.362130  Estimable
179     Barr Duke Walkamin Hass_seedling.2       103.20461      14.792024  Estimable
180     Barr Duke Walkamin Hass_seedling.3       260.00286      19.789552  Estimable
181        Rigato Childers Hass_seedling.1              NA             NA    Aliased
182        Rigato Childers Hass_seedling.2              NA             NA    Aliased
183        Rigato Childers Hass_seedling.3              NA             NA    Aliased
184        Rigato  Hampton Hass_seedling.1              NA             NA    Aliased
185        Rigato  Hampton Hass_seedling.2              NA             NA    Aliased
186        Rigato  Hampton Hass_seedling.3              NA             NA    Aliased
187        Rigato        WA Hass_seedling.1              NA             NA    Aliased
188        Rigato        WA Hass_seedling.2              NA             NA    Aliased
189        Rigato        WA Hass_seedling.3              NA             NA    Aliased
190        Rigato Walkamin Hass_seedling.1        16.72480       4.364519  Estimable
191        Rigato Walkamin Hass_seedling.2        88.89822      14.801678  Estimable
192        Rigato Walkamin Hass_seedling.3       256.78842      19.792037  Estimable

$avsed
 overall
```

18.72268

Random effects analysis:

The results included below in this section are based on an analysis similar to the clonal trial analyses. It looks at the genetic variance and correlations between the Trt effects ignoring the fact that the seedling populations also may have within RS genetic variation. This may be a big assumption and so this may be approximate. It may be best to just look at the fixed effect means across sites and times (above).

Ideally I would have liked to fit a model that incorporates this added within RS genetic variance but I am still working on this.

The planned approach is as follows:

A dummy pedigree was created to set up family groups of seedling RS with all RS seedlings having a unique identifier. Parents were assumed to be unrelated (same as we have assumed in the clonal analyses). Using this pedigree it should allow us to separate the within RS genetic variance from residual variance. It may be a little approximate but the best we can do.

The asreml model could be as follows:

```
MET2b.asr<-asreml(SumYld~ ExTime,
        random =~fa(ExTime,2):ped(Trtseed) + fa(ExTime,2):Trt + at(ExTime):Rep,
        rcov=~at(Site):ar1h(ExTime):ar1(Col):ar1(Row),
        control=asreml.control(ginverse=list(Trtseed=seed.ginv), workspace=10e7),
        data=YsumHS,na.method.X="include"…)
```

This model will give us two separate genetic covariance matrices (one for the additive genetic component between sites and times - using the variation between seedlings within a RS) and the second one looking at the genetic variances and covariances between RS ("Families") over sites and times. We will focus on the second one as this may be more comparable to the clonal RS genetic covariance matrices.

[This analysis has been removed as I am not sure of how it relates to the clonal trials]

Genetic correlations between sites and harvests

	C1	C2	C3	H1	H2	H3	WA1	WA2	WA3	W1	W2	W3
C1	1.000	0.935	0.957	0.601	0.926	0.975	0.715	-0.861	0.486	0.641	0.569	0.733
C2	0.935	1.000	0.998	0.279	0.731	0.834	0.421	-0.985	0.333	0.327	0.273	0.444
C3	0.957	0.998	1.000	0.345	0.776	0.870	0.483	-0.971	0.366	0.392	0.333	0.505
H1	0.601	0.279	0.345	1.000	0.859	0.762	0.988	-0.111	0.567	0.999	0.927	0.984
H2	0.926	0.731	0.776	0.859	1.000	0.986	0.927	-0.604	0.580	0.884	0.804	0.936
H3	0.975	0.834	0.870	0.762	0.986	1.000	0.852	-0.728	0.550	0.794	0.716	0.865
WA1	0.715	0.421	0.483	0.988	0.927	0.852	1.000	-0.260	0.588	0.995	0.919	1.000
WA2	-0.861	-0.985	-0.971	-0.111	-0.604	-0.728	-0.260	1.000	-0.244	-0.161	-0.118	-0.284
WA3	0.486	0.333	0.366	0.567	0.580	0.550	0.588	-0.244	1.000	0.575	0.528	0.590
W1	0.641	0.327	0.392	0.999	0.884	0.794	0.995	-0.161	0.575	1.000	0.927	0.992
W2	0.569	0.273	0.333	0.927	0.804	0.716	0.919	-0.118	0.528	0.927	1.000	0.915
W3	0.733	0.444	0.505	0.984	0.936	0.865	1.000	-0.284	0.590	0.992	0.915	1.000

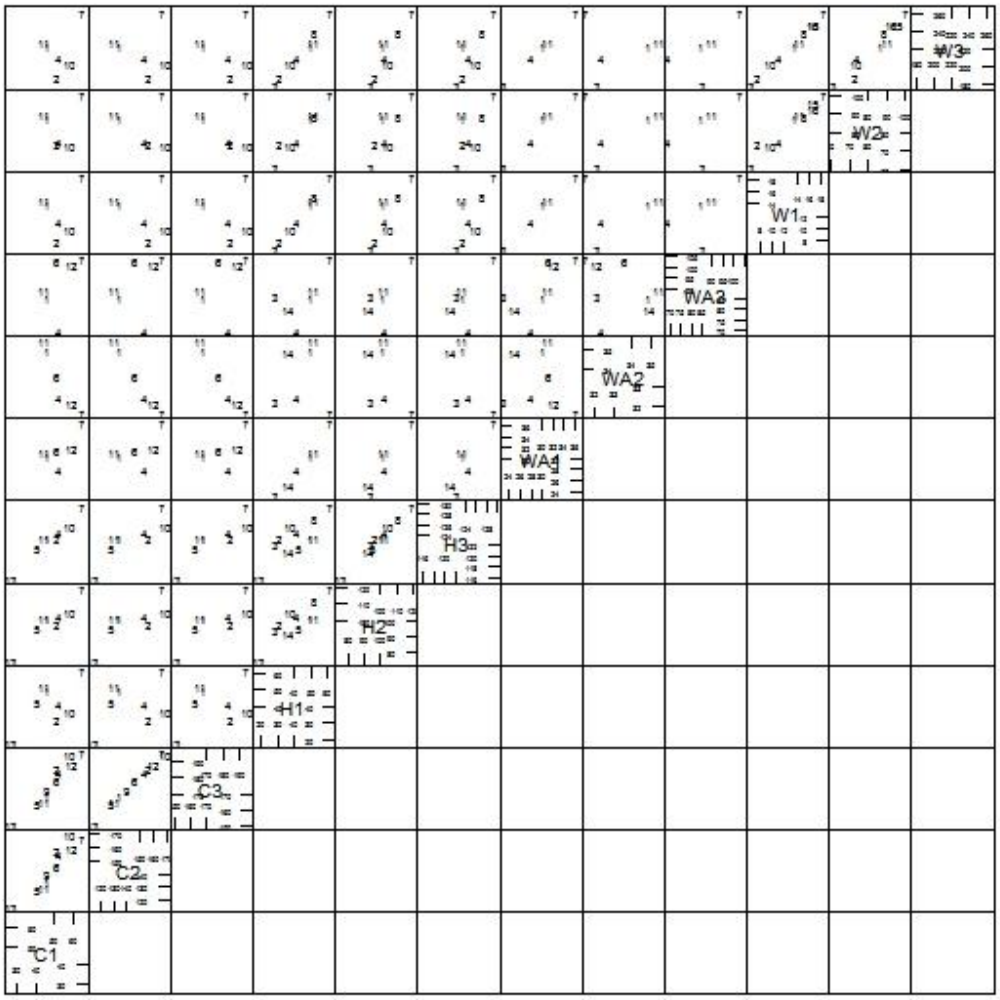
WA 2 (ie 2009+2010) negatively correlated with all other Experiment x Times.?

Predictions for each variety at each site

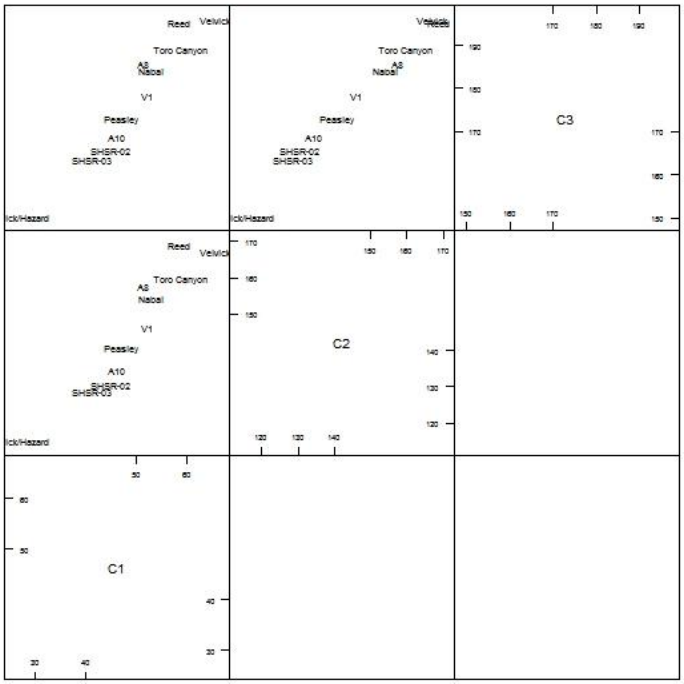
	ExTime	Trt	predicted.value	standard.error	est.status
1	Childers Hass_seedling.1	A10	46.39886	4.504268	Estimable
2	Childers Hass_seedling.1	A8	51.64686	4.667588	Estimable
3	Childers Hass_seedling.1	Duke 7	NA	NA	Aliased
4	Childers Hass_seedling.1	Nabal	53.30401	4.485731	Estimable
5	Childers Hass_seedling.1	SHSR-03	41.44401	4.791073	Estimable
6	Childers Hass_seedling.1	V1	52.36127	4.832910	Estimable
7	Childers Hass_seedling.1	Velvick	65.79178	4.509581	Estimable
8	Childers Hass_seedling.1	Zutano	NA	NA	Aliased
9	Childers Hass_seedling.1	Peasley	47.07080	5.237092	Estimable
10	Childers Hass_seedling.1	Reed	58.85697	4.680699	Estimable
11	Childers Hass_seedling.1	SHSR-02	45.17036	4.516090	Estimable
12	Childers Hass_seedling.1	Toro Canyon	58.89926	5.143175	Estimable
13	Childers Hass_seedling.1	Velvick/Hazard	26.83466	4.802351	Estimable
14	Childers Hass_seedling.1	Plowman	NA	NA	Aliased
15	Childers Hass_seedling.1	Barr Duke	NA	NA	Aliased
16	Childers Hass_seedling.1	Rigato	NA	NA	Aliased
17	Childers Hass_seedling.2	A10	134.46379	9.287693	Estimable
18	Childers Hass_seedling.2	A8	157.46857	9.450597	Estimable
19	Childers Hass_seedling.2	Duke 7	NA	NA	Aliased
20	Childers Hass_seedling.2	Nabal	154.47509	9.211032	Estimable
21	Childers Hass_seedling.2	SHSR-03	128.47367	9.425257	Estimable
22	Childers Hass_seedling.2	V1	146.20133	9.728837	Estimable
23	Childers Hass_seedling.2	Velvick	167.13247	9.288010	Estimable
24	Childers Hass_seedling.2	Zutano	NA	NA	Aliased
25	Childers Hass_seedling.2	Peasley	140.80636	9.888469	Estimable
26	Childers Hass_seedling.2	Reed	169.19663	9.386288	Estimable
27	Childers Hass_seedling.2	SHSR-02	130.46055	9.287960	Estimable
28	Childers Hass_seedling.2	Toro Canyon	159.74074	10.395326	Estimable
29	Childers Hass_seedling.2	Velvick/Hazard	114.87856	9.434788	Estimable
30	Childers Hass_seedling.2	Plowman	NA	NA	Aliased
31	Childers Hass_seedling.2	Barr Duke	NA	NA	Aliased
32	Childers Hass_seedling.2	Rigato	NA	NA	Aliased
33	Childers Hass_seedling.3	A10	168.76581	10.132325	Estimable
34	Childers Hass_seedling.3	A8	185.55646	10.247834	Estimable
35	Childers Hass_seedling.3	Duke 7	NA	NA	Aliased
36	Childers Hass_seedling.3	Nabal	184.01808	10.097250	Estimable
37	Childers Hass_seedling.3	SHSR-03	163.40239	10.243081	Estimable
38	Childers Hass_seedling.3	V1	178.24026	10.349585	Estimable
39	Childers Hass_seedling.3	Velvick	195.90872	10.139524	Estimable
40	Childers Hass_seedling.3	Zutano	NA	NA	Aliased
41	Childers Hass_seedling.3	Peasley	173.18100	10.464634	Estimable
42	Childers Hass_seedling.3	Reed	195.36930	10.210423	Estimable
43	Childers Hass_seedling.3	SHSR-02	165.75684	10.143496	Estimable
44	Childers Hass_seedling.3	Toro Canyon	189.07531	10.753036	Estimable
45	Childers Hass_seedling.3	Velvick/Hazard	150.30029	10.253209	Estimable
46	Childers Hass_seedling.3	Plowman	NA	NA	Aliased
47	Childers Hass_seedling.3	Barr Duke	NA	NA	Aliased
48	Childers Hass_seedling.3	Rigato	NA	NA	Aliased
49	Hampton Hass_seedling.1	A10	50.00324	4.522835	Estimable
50	Hampton Hass_seedling.1	A8	32.08234	4.614089	Estimable
51	Hampton Hass_seedling.1	Duke 7	28.91979	4.645373	Estimable
52	Hampton Hass_seedling.1	Nabal	41.75276	4.452784	Estimable
53	Hampton Hass_seedling.1	SHSR-03	43.41640	5.390957	Estimable
54	Hampton Hass_seedling.1	V1	NA	NA	Aliased
55	Hampton Hass_seedling.1	Velvick	61.99949	4.415065	Estimable
56	Hampton Hass_seedling.1	Zutano	53.12819	4.831223	Estimable
57	Hampton Hass_seedling.1	Peasley	NA	NA	Aliased
58	Hampton Hass_seedling.1	Reed	37.16691	5.250104	Estimable
59	Hampton Hass_seedling.1	SHSR-02	52.13317	4.397217	Estimable
60	Hampton Hass_seedling.1	Toro Canyon	NA	NA	Aliased
61	Hampton Hass_seedling.1	Velvick/Hazard	17.91765	5.592622	Estimable

62	Hampton	Hass_seedling.1	Plowman	36.24394	5.231646	Estimable
63	Hampton	Hass_seedling.1	Barr Duke	NA	NA	Aliased
64	Hampton	Hass_seedling.1	Rigato	NA	NA	Aliased
65	Hampton	Hass_seedling.2	A10	101.71188	7.713164	Estimable
66	Hampton	Hass_seedling.2	A8	97.63998	7.793021	Estimable
67	Hampton	Hass_seedling.2	Duke 7	94.28553	8.526890	Estimable
68	Hampton	Hass_seedling.2	Nabal	102.78333	7.691603	Estimable
69	Hampton	Hass_seedling.2	SHSR-03	95.69758	8.051266	Estimable
70	Hampton	Hass_seedling.2	V1	NA	NA	Aliased
71	Hampton	Hass_seedling.2	Velvick	119.47032	7.687889	Estimable
72	Hampton	Hass_seedling.2	Zutano	111.96359	8.913965	Estimable
73	Hampton	Hass_seedling.2	Peasley	NA	NA	Aliased
74	Hampton	Hass_seedling.2	Reed	104.50431	7.979053	Estimable
75	Hampton	Hass_seedling.2	SHSR-02	101.79894	7.674607	Estimable
76	Hampton	Hass_seedling.2	Toro Canyon	NA	NA	Aliased
77	Hampton	Hass_seedling.2	Velvick/Hazard	75.41553	8.109645	Estimable
78	Hampton	Hass_seedling.2	Plowman	92.13727	8.871625	Estimable
79	Hampton	Hass_seedling.2	Barr Duke	NA	NA	Aliased
80	Hampton	Hass_seedling.2	Rigato	NA	NA	Aliased
81	Hampton	Hass_seedling.3	A10	123.44663	4.397621	Estimable
82	Hampton	Hass_seedling.3	A8	123.45607	4.407536	Estimable
83	Hampton	Hass_seedling.3	Duke 7	122.39854	4.626501	Estimable
84	Hampton	Hass_seedling.3	Nabal	124.63484	4.390863	Estimable
85	Hampton	Hass_seedling.3	SHSR-03	121.63471	4.450536	Estimable
86	Hampton	Hass_seedling.3	V1	NA	NA	Aliased
87	Hampton	Hass_seedling.3	Velvick	129.48109	4.393127	Estimable
88	Hampton	Hass_seedling.3	Zutano	127.27923	4.716773	Estimable
89	Hampton	Hass_seedling.3	Peasley	NA	NA	Aliased
90	Hampton	Hass_seedling.3	Reed	125.74753	4.440157	Estimable
91	Hampton	Hass_seedling.3	SHSR-02	123.28602	4.388691	Estimable
92	Hampton	Hass_seedling.3	Toro Canyon	NA	NA	Aliased
93	Hampton	Hass_seedling.3	Velvick/Hazard	115.82611	4.453066	Estimable
94	Hampton	Hass_seedling.3	Plowman	120.86268	4.687854	Estimable
95	Hampton	Hass_seedling.3	Barr Duke	NA	NA	Aliased
96	Hampton	Hass_seedling.3	Rigato	NA	NA	Aliased
97	WA	Hass_seedling.1	A10	30.42669	2.485271	Estimable
98	WA	Hass_seedling.1	A8	NA	NA	Aliased
99	WA	Hass_seedling.1	Duke 7	23.14574	2.592413	Estimable
100	WA	Hass_seedling.1	Nabal	28.11723	2.461322	Estimable
101	WA	Hass_seedling.1	SHSR-03	NA	NA	Aliased
102	WA	Hass_seedling.1	V1	31.36797	3.345744	Estimable
103	WA	Hass_seedling.1	Velvick	36.40588	2.465040	Estimable
104	WA	Hass_seedling.1	Zutano	NA	NA	Aliased
105	WA	Hass_seedling.1	Peasley	NA	NA	Aliased
106	WA	Hass_seedling.1	Reed	NA	NA	Aliased
107	WA	Hass_seedling.1	SHSR-02	31.07224	2.444644	Estimable
108	WA	Hass_seedling.1	Toro Canyon	32.04588	3.365412	Estimable
109	WA	Hass_seedling.1	Velvick/Hazard	NA	NA	Aliased
110	WA	Hass_seedling.1	Plowman	25.03346	2.722958	Estimable
111	WA	Hass_seedling.1	Barr Duke	NA	NA	Aliased
112	WA	Hass_seedling.1	Rigato	NA	NA	Aliased
113	WA	Hass_seedling.2	A10	34.94327	3.114862	Estimable
114	WA	Hass_seedling.2	A8	NA	NA	Aliased
115	WA	Hass_seedling.2	Duke 7	32.17508	3.361901	Estimable
116	WA	Hass_seedling.2	Nabal	32.40238	3.106111	Estimable
117	WA	Hass_seedling.2	SHSR-03	NA	NA	Aliased
118	WA	Hass_seedling.2	V1	33.63279	3.160729	Estimable
119	WA	Hass_seedling.2	Velvick	31.55904	3.112740	Estimable
120	WA	Hass_seedling.2	Zutano	NA	NA	Aliased
121	WA	Hass_seedling.2	Peasley	NA	NA	Aliased
122	WA	Hass_seedling.2	Reed	NA	NA	Aliased
123	WA	Hass_seedling.2	SHSR-02	35.46595	3.101570	Estimable
124	WA	Hass_seedling.2	Toro Canyon	32.08918	3.170029	Estimable
125	WA	Hass_seedling.2	Velvick/Hazard	NA	NA	Aliased
126	WA	Hass_seedling.2	Plowman	34.86938	3.366462	Estimable
127	WA	Hass_seedling.2	Barr Duke	NA	NA	Aliased
128	WA	Hass_seedling.2	Rigato	NA	NA	Aliased
129	WA	Hass_seedling.3	A10	85.17083	10.766968	Estimable
130	WA	Hass_seedling.3	A8	NA	NA	Aliased
131	WA	Hass_seedling.3	Duke 7	86.22884	11.116210	Estimable
132	WA	Hass_seedling.3	Nabal	69.67701	10.458892	Estimable
133	WA	Hass_seedling.3	SHSR-03	NA	NA	Aliased
134	WA	Hass_seedling.3	V1	102.91394	12.014173	Estimable
135	WA	Hass_seedling.3	Velvick	103.98951	10.742898	Estimable
136	WA	Hass_seedling.3	Zutano	NA	NA	Aliased
137	WA	Hass_seedling.3	Peasley	NA	NA	Aliased
138	WA	Hass_seedling.3	Reed	NA	NA	Aliased
139	WA	Hass_seedling.3	SHSR-02	89.52791	10.452452	Estimable
140	WA	Hass_seedling.3	Toro Canyon	101.00069	11.254314	Estimable
141	WA	Hass_seedling.3	Velvick/Hazard	NA	NA	Aliased
142	WA	Hass_seedling.3	Plowman	80.09932	10.784722	Estimable
143	WA	Hass_seedling.3	Barr Duke	NA	NA	Aliased
144	WA	Hass_seedling.3	Rigato	NA	NA	Aliased
145	Walkamin	Hass_seedling.1	A10	13.79541	2.246516	Estimable
146	Walkamin	Hass_seedling.1	A8	7.83820	2.282588	Estimable
147	Walkamin	Hass_seedling.1	Duke 7	6.68247	2.320414	Estimable
148	Walkamin	Hass_seedling.1	Nabal	11.16955	2.258287	Estimable

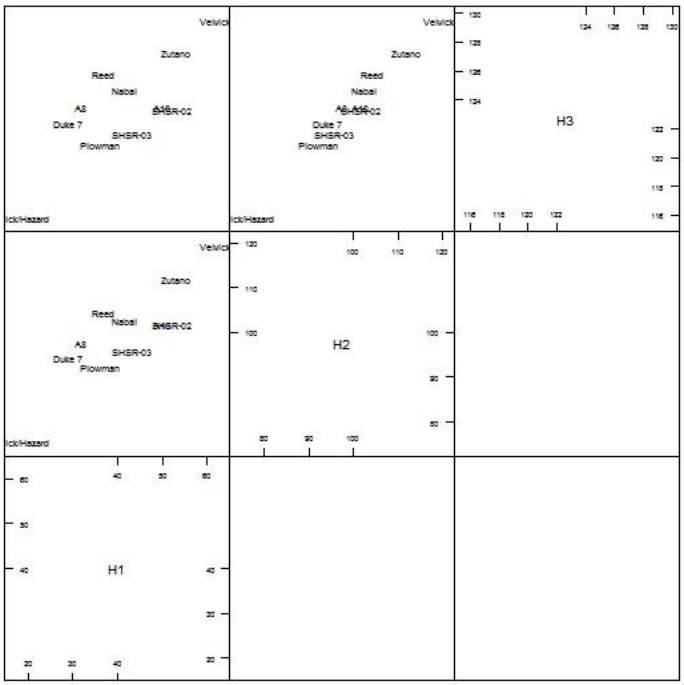
```
149 Walkamin Hass_seedling.1         SHSR-03              NA             NA    Aliased
150 Walkamin Hass_seedling.1              V1              NA             NA    Aliased
151 Walkamin Hass_seedling.1         Velvick        18.37885       2.237449  Estimable
152 Walkamin Hass_seedling.1          Zutano        15.21229       2.336322  Estimable
153 Walkamin Hass_seedling.1         Peasley              NA             NA    Aliased
154 Walkamin Hass_seedling.1            Reed         9.75462       2.488619  Estimable
155 Walkamin Hass_seedling.1         SHSR-02        14.48771       2.228689  Estimable
156 Walkamin Hass_seedling.1    Toro Canyon              NA             NA    Aliased
157 Walkamin Hass_seedling.1 Velvick/Hazard              NA             NA    Aliased
158 Walkamin Hass_seedling.1         Plowman              NA             NA    Aliased
159 Walkamin Hass_seedling.1      Barr Duke        16.49661       2.747904  Estimable
160 Walkamin Hass_seedling.1          Rigato        16.63390       2.746455  Estimable
161 Walkamin Hass_seedling.2             A10        87.34278       8.610041  Estimable
162 Walkamin Hass_seedling.2              A8        73.49590       8.711306  Estimable
163 Walkamin Hass_seedling.2          Duke 7        61.54597       8.924046  Estimable
164 Walkamin Hass_seedling.2           Nabal        74.64648       8.779457  Estimable
165 Walkamin Hass_seedling.2         SHSR-03              NA             NA    Aliased
166 Walkamin Hass_seedling.2              V1              NA             NA    Aliased
167 Walkamin Hass_seedling.2         Velvick       100.74358       8.591780  Estimable
168 Walkamin Hass_seedling.2          Zutano        89.02269       8.830880  Estimable
169 Walkamin Hass_seedling.2         Peasley              NA             NA    Aliased
170 Walkamin Hass_seedling.2            Reed        73.08291       9.542518  Estimable
171 Walkamin Hass_seedling.2         SHSR-02        90.12630       8.577313  Estimable
172 Walkamin Hass_seedling.2    Toro Canyon              NA             NA    Aliased
173 Walkamin Hass_seedling.2 Velvick/Hazard              NA             NA    Aliased
174 Walkamin Hass_seedling.2         Plowman              NA             NA    Aliased
175 Walkamin Hass_seedling.2      Barr Duke        95.75924       9.987728  Estimable
176 Walkamin Hass_seedling.2          Rigato        92.61057       9.989191  Estimable
177 Walkamin Hass_seedling.3             A10       222.95346      12.170662  Estimable
178 Walkamin Hass_seedling.3              A8       187.73304      12.524723  Estimable
179 Walkamin Hass_seedling.3          Duke 7       178.92731      13.255615  Estimable
180 Walkamin Hass_seedling.3           Nabal       209.63370      12.354856  Estimable
181 Walkamin Hass_seedling.3         SHSR-03              NA             NA    Aliased
182 Walkamin Hass_seedling.3              V1              NA             NA    Aliased
183 Walkamin Hass_seedling.3         Velvick       261.30272      12.089524  Estimable
184 Walkamin Hass_seedling.3          Zutano       238.47165      13.709232  Estimable
185 Walkamin Hass_seedling.3         Peasley              NA             NA    Aliased
186 Walkamin Hass_seedling.3            Reed       203.33617      14.255608  Estimable
187 Walkamin Hass_seedling.3         SHSR-02       226.74945      12.021855  Estimable
188 Walkamin Hass_seedling.3    Toro Canyon              NA             NA    Aliased
189 Walkamin Hass_seedling.3 Velvick/Hazard              NA             NA    Aliased
190 Walkamin Hass_seedling.3         Plowman              NA             NA    Aliased
191 Walkamin Hass_seedling.3      Barr Duke       246.01501      16.586784  Estimable
192 Walkamin Hass_seedling.3          Rigato       247.59371      16.593039  Estimable

$avsed
 overall
10.92323
```



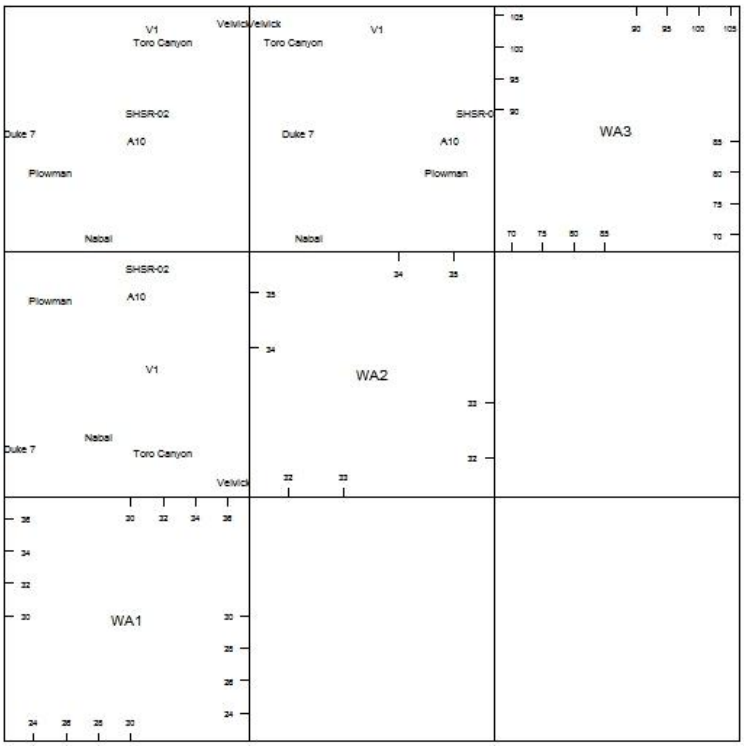
Childers


Reed
Velvick
Toro Canyon
A8
Nabal
V1
Peasley
A10
SHSR-02
SHSR-03
lck/Hazard
C3
C2
C1

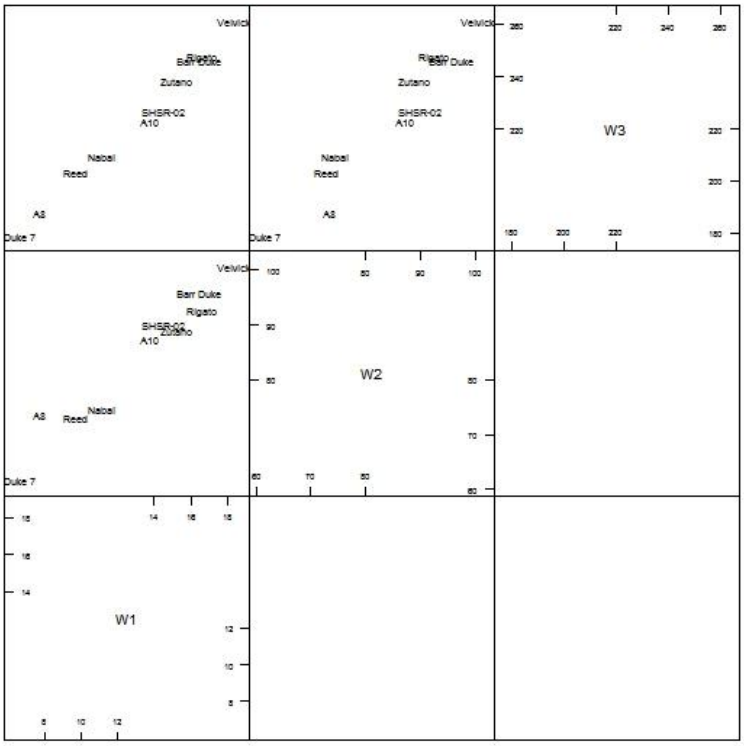
Hampton


Velvick
Zutano
Reed
Nabal
A8
Duke 7
SHSR-03
Plowman
lck/Hazard
H3
H2
H1

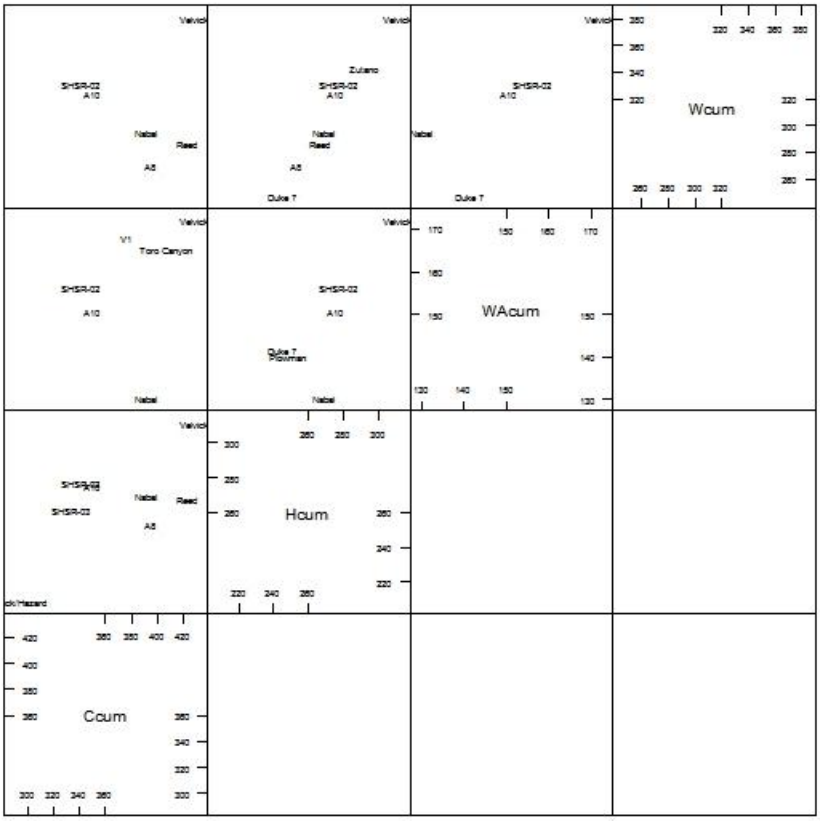
WA



Walkamin



Cummulative yield across times for each site



2. Shepard seedling (at Childers and Walkamin)

Concurrence of varieties across sites

```
           A10 A8 Duke 7 Nabal SHSR-03 V1 Velvick Zutano Reed SHSR-02 Toro
Canyon Edranol Parida Plowman Shepard
  Childers  30  0      0    30       0  0      30      0   30       30
30      30     30      30       30
  Walkamin  30 30     30    30      30 30      30     30   30       30
0       0      0       0       0
```

Initial fixed effect analysis

```
$Wald
             Df denDF   F.inc   F.con Margin            Pr
(Intercept)   1  12.1 283.500 283.500        9.063715e-10
Trt          14 127.5   2.393   1.707      A 6.171514e-02
ExTime        5  24.0 432.600 432.600      A 1.032739e-22
Trt:ExTime   40 245.8   3.202   3.202      B 1.503164e-08
```

Fixed effect means :

```
          Trt                       ExTime predicted.value standard.error est.status
1         A10 Childers Shepard_seedling.1         3.68522       1.298944  Estimable
2         A10 Childers Shepard_seedling.2       127.22778      11.102678  Estimable
3         A10 Childers Shepard_seedling.3        96.10618      11.473361  Estimable
4         A10 Walkamin Shepard_seedling.1        15.66520       3.943993  Estimable
5         A10 Walkamin Shepard_seedling.2        93.78217      15.881626  Estimable
6         A10 Walkamin Shepard_seedling.3       184.88425      25.576510  Estimable
7          A8 Childers Shepard_seedling.1              NA             NA    Aliased
```

```
8           A8 Childers Shepard_seedling.2             NA             NA    Aliased
9           A8 Childers Shepard_seedling.3             NA             NA    Aliased
10          A8 Walkamin Shepard_seedling.1       20.79917       4.427257  Estimable
11          A8 Walkamin Shepard_seedling.2      124.58339      16.927167  Estimable
12          A8 Walkamin Shepard_seedling.3      180.51116      27.154742  Estimable
13      Duke 7 Childers Shepard_seedling.1             NA             NA    Aliased
14      Duke 7 Childers Shepard_seedling.2             NA             NA    Aliased
15      Duke 7 Childers Shepard_seedling.3             NA             NA    Aliased
16      Duke 7 Walkamin Shepard_seedling.1       17.89170       3.741229  Estimable
17      Duke 7 Walkamin Shepard_seedling.2       79.82210      15.046130  Estimable
18      Duke 7 Walkamin Shepard_seedling.3      128.85947      25.311883  Estimable
19       Nabal Childers Shepard_seedling.1        5.42160       1.297369  Estimable
20       Nabal Childers Shepard_seedling.2      134.88432      11.087719  Estimable
21       Nabal Childers Shepard_seedling.3      139.86721      11.457368  Estimable
22       Nabal Walkamin Shepard_seedling.1       15.43827       3.740613  Estimable
23       Nabal Walkamin Shepard_seedling.2      103.57103      15.043252  Estimable
24       Nabal Walkamin Shepard_seedling.3      169.77962      25.301845  Estimable
25     SHSR-03 Childers Shepard_seedling.1             NA             NA    Aliased
26     SHSR-03 Childers Shepard_seedling.2             NA             NA    Aliased
27     SHSR-03 Childers Shepard_seedling.3             NA             NA    Aliased
28     SHSR-03 Walkamin Shepard_seedling.1       14.41736       3.967862  Estimable
29     SHSR-03 Walkamin Shepard_seedling.2      106.78125      15.897929  Estimable
30     SHSR-03 Walkamin Shepard_seedling.3      187.47841      25.580325  Estimable
31          V1 Childers Shepard_seedling.1             NA             NA    Aliased
32          V1 Childers Shepard_seedling.2             NA             NA    Aliased
33          V1 Childers Shepard_seedling.3             NA             NA    Aliased
34          V1 Walkamin Shepard_seedling.1       28.39382       3.957182  Estimable
35          V1 Walkamin Shepard_seedling.2      165.11631      15.221070  Estimable
36          V1 Walkamin Shepard_seedling.3      277.05825      25.445314  Estimable
37     Velvick Childers Shepard_seedling.1        5.79709       1.299574  Estimable
38     Velvick Childers Shepard_seedling.2      167.72691      11.108948  Estimable
39     Velvick Childers Shepard_seedling.3      176.26983      11.479745  Estimable
40     Velvick Walkamin Shepard_seedling.1       35.40544       3.716906  Estimable
41     Velvick Walkamin Shepard_seedling.2      145.05951      14.375805  Estimable
42     Velvick Walkamin Shepard_seedling.3      287.47192      22.763621  Estimable
43      Zutano Childers Shepard_seedling.1             NA             NA    Aliased
44      Zutano Childers Shepard_seedling.2             NA             NA    Aliased
45      Zutano Childers Shepard_seedling.3             NA             NA    Aliased
46      Zutano Walkamin Shepard_seedling.1       16.67504       3.723634  Estimable
47      Zutano Walkamin Shepard_seedling.2      106.15163      16.506185  Estimable
48      Zutano Walkamin Shepard_seedling.3      203.61334      27.036092  Estimable
49        Reed Childers Shepard_seedling.1        1.59209       1.355738  Estimable
50        Reed Childers Shepard_seedling.2      142.90091      11.617181  Estimable
51        Reed Childers Shepard_seedling.3      123.19923      12.008441  Estimable
52        Reed Walkamin Shepard_seedling.1       17.29387       3.918978  Estimable
53        Reed Walkamin Shepard_seedling.2      148.24418      15.766034  Estimable
54        Reed Walkamin Shepard_seedling.3      234.74756      25.370887  Estimable
55     SHSR-02 Childers Shepard_seedling.1        3.92329       1.299171  Estimable
56     SHSR-02 Childers Shepard_seedling.2      143.12880      11.106797  Estimable
57     SHSR-02 Childers Shepard_seedling.3      100.39698      11.477612  Estimable
58     SHSR-02 Walkamin Shepard_seedling.1       26.36977       3.753956  Estimable
59     SHSR-02 Walkamin Shepard_seedling.2      133.94418      14.498750  Estimable
60     SHSR-02 Walkamin Shepard_seedling.3      275.43445      24.011497  Estimable
61 Toro Canyon Childers Shepard_seedling.1        3.79035       1.353485  Estimable
62 Toro Canyon Childers Shepard_seedling.2      110.25508      11.598642  Estimable
63 Toro Canyon Childers Shepard_seedling.3      135.62387      11.991327  Estimable
64 Toro Canyon Walkamin Shepard_seedling.1             NA             NA    Aliased
65 Toro Canyon Walkamin Shepard_seedling.2             NA             NA    Aliased
66 Toro Canyon Walkamin Shepard_seedling.3             NA             NA    Aliased
67     Edranol Childers Shepard_seedling.1        6.03616       1.298612  Estimable
68     Edranol Childers Shepard_seedling.2      123.57366      11.099239  Estimable
69     Edranol Childers Shepard_seedling.3       90.59794      11.469314  Estimable
70     Edranol Walkamin Shepard_seedling.1             NA             NA    Aliased
71     Edranol Walkamin Shepard_seedling.2             NA             NA    Aliased
72     Edranol Walkamin Shepard_seedling.3             NA             NA    Aliased
73      Parida Childers Shepard_seedling.1        4.45066       1.417957  Estimable
74      Parida Childers Shepard_seedling.2      135.06525      12.186094  Estimable
75      Parida Childers Shepard_seedling.3      145.18879      12.605540  Estimable
76      Parida Walkamin Shepard_seedling.1             NA             NA    Aliased
77      Parida Walkamin Shepard_seedling.2             NA             NA    Aliased
78      Parida Walkamin Shepard_seedling.3             NA             NA    Aliased
79     Plowman Childers Shepard_seedling.1        4.75310       1.296910  Estimable
80     Plowman Childers Shepard_seedling.2      153.80607      11.083271  Estimable
81     Plowman Childers Shepard_seedling.3      124.42407      11.452186  Estimable
82     Plowman Walkamin Shepard_seedling.1             NA             NA    Aliased
83     Plowman Walkamin Shepard_seedling.2             NA             NA    Aliased
84     Plowman Walkamin Shepard_seedling.3             NA             NA    Aliased
85     Shepard Childers Shepard_seedling.1        3.93931       1.297770  Estimable
86     Shepard Childers Shepard_seedling.2      150.72620      11.666051  Estimable
87     Shepard Childers Shepard_seedling.3      114.67441      12.082791  Estimable
88     Shepard Walkamin Shepard_seedling.1             NA             NA    Aliased
89     Shepard Walkamin Shepard_seedling.2             NA             NA    Aliased
90     Shepard Walkamin Shepard_seedling.3             NA             NA    Aliased

$avsed
 overall
19.85033
```

Random effects analysis:

Genetic correlations from fa2 model

	C1	C2	C3	W1	W2	W3
C1	1.00000000	0.0225874	0.1584196	0.3280678	-0.3041726	-0.07226717
C2	0.02258740	1.0000000	0.4219046	0.9518234	0.9455034	0.99549852
C3	0.15841956	0.4219046	1.0000000	0.4472469	0.3504196	0.40589047
W1	0.32806776	0.9518234	0.4472469	1.0000000	0.8001044	0.91847569
W2	-0.30417257	0.9455034	0.3504196	0.8001044	1.0000000	0.97210784
W3	-0.07226717	0.9954985	0.4058905	0.9184757	0.9721078	1.00000000

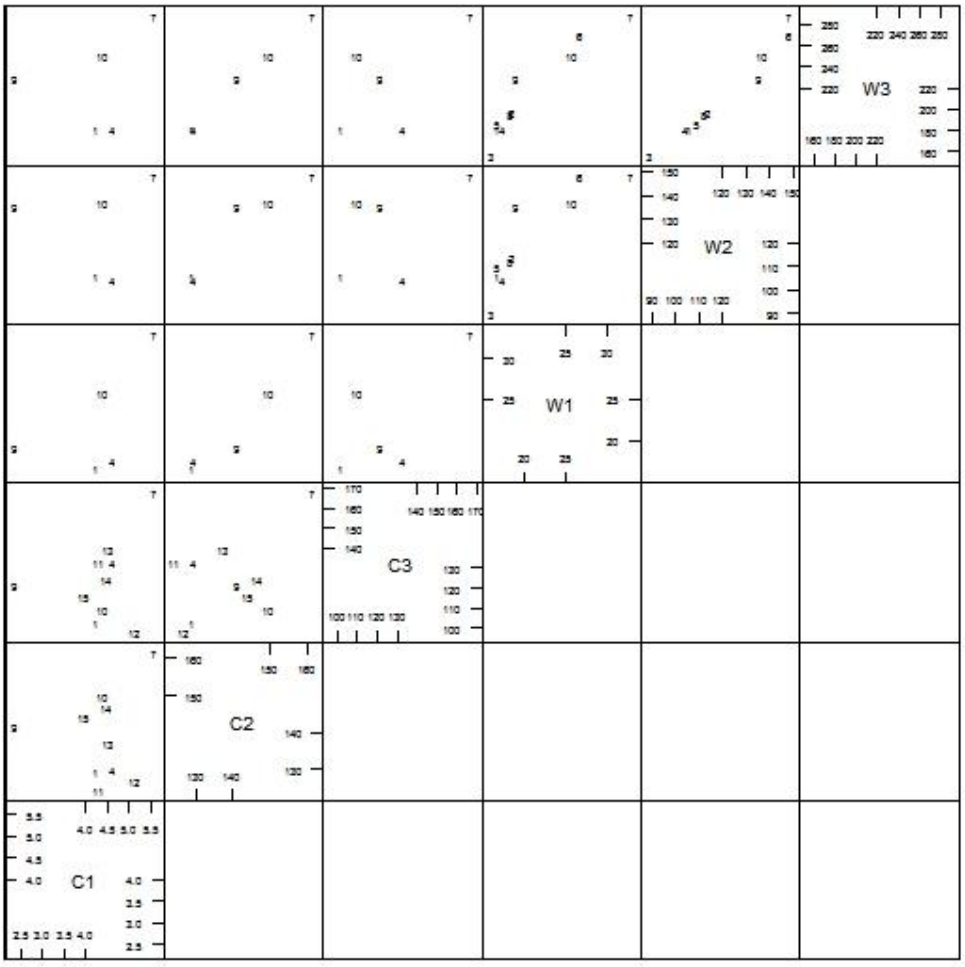
The Walkamin harvests are highly correlated with each other but the harvests at Childers are not. Harvest C1 is negatively correlated with W2.

Predictions for each variety at each site

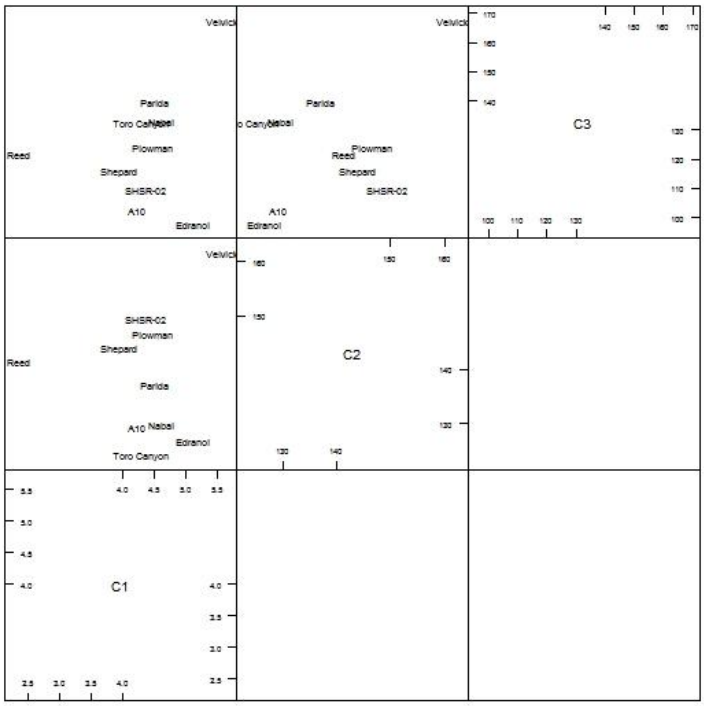
	ExTime	Trt	predicted.value	standard.error	est.status
1	Childers Shepard_seedling.1	A10	4.24968	0.906762	Estimable
2	Childers Shepard_seedling.1	A8	NA	NA	Aliased
3	Childers Shepard_seedling.1	Duke 7	NA	NA	Aliased
4	Childers Shepard_seedling.1	Nabal	4.63498	0.900354	Estimable
5	Childers Shepard_seedling.1	SHSR-03	NA	NA	Aliased
6	Childers Shepard_seedling.1	V1	NA	NA	Aliased
7	Childers Shepard_seedling.1	Velvick	5.59199	0.896575	Estimable
8	Childers Shepard_seedling.1	Zutano	NA	NA	Aliased
9	Childers Shepard_seedling.1	Reed	2.36774	0.920612	Estimable
10	Childers Shepard_seedling.1	SHSR-02	4.36607	0.898389	Estimable
11	Childers Shepard_seedling.1	Toro Canyon	4.30290	1.007425	Estimable
12	Childers Shepard_seedling.1	Edranol	5.14097	0.987317	Estimable
13	Childers Shepard_seedling.1	Parida	4.52103	1.030815	Estimable
14	Childers Shepard_seedling.1	Plowman	4.47425	0.986296	Estimable
15	Childers Shepard_seedling.1	Shepard	3.95684	0.987659	Estimable
16	Childers Shepard_seedling.2	A10	129.26755	6.484739	Estimable
17	Childers Shepard_seedling.2	A8	NA	NA	Aliased
18	Childers Shepard_seedling.2	Duke 7	NA	NA	Aliased
19	Childers Shepard_seedling.2	Nabal	129.68581	6.428009	Estimable
20	Childers Shepard_seedling.2	SHSR-03	NA	NA	Aliased
21	Childers Shepard_seedling.2	V1	NA	NA	Aliased
22	Childers Shepard_seedling.2	Velvick	161.75108	6.344106	Estimable
23	Childers Shepard_seedling.2	Zutano	NA	NA	Aliased
24	Childers Shepard_seedling.2	Reed	141.40192	6.546822	Estimable
25	Childers Shepard_seedling.2	SHSR-02	149.53312	6.408749	Estimable
26	Childers Shepard_seedling.2	Toro Canyon	124.07270	8.865175	Estimable
27	Childers Shepard_seedling.2	Edranol	126.72944	8.626726	Estimable
28	Childers Shepard_seedling.2	Parida	137.22676	9.143435	Estimable
29	Childers Shepard_seedling.2	Plowman	146.60432	8.614157	Estimable
30	Childers Shepard_seedling.2	Shepard	144.08979	8.886042	Estimable
31	Childers Shepard_seedling.3	A10	102.26013	10.150532	Estimable
32	Childers Shepard_seedling.3	A8	NA	NA	Aliased
33	Childers Shepard_seedling.3	Duke 7	NA	NA	Aliased
34	Childers Shepard_seedling.3	Nabal	133.19479	10.137645	Estimable
35	Childers Shepard_seedling.3	SHSR-03	NA	NA	Aliased
36	Childers Shepard_seedling.3	V1	NA	NA	Aliased
37	Childers Shepard_seedling.3	Velvick	167.47559	10.164519	Estimable
38	Childers Shepard_seedling.3	Zutano	NA	NA	Aliased
39	Childers Shepard_seedling.3	Reed	121.52753	10.553177	Estimable
40	Childers Shepard_seedling.3	SHSR-02	109.41008	10.161988	Estimable
41	Childers Shepard_seedling.3	Toro Canyon	132.42216	10.759750	Estimable
42	Childers Shepard_seedling.3	Edranol	97.83196	10.359427	Estimable
43	Childers Shepard_seedling.3	Parida	139.58352	11.229329	Estimable
44	Childers Shepard_seedling.3	Plowman	123.92558	10.348426	Estimable
45	Childers Shepard_seedling.3	Shepard	116.00595	10.805580	Estimable
46	Walkamin Shepard_seedling.1	A10	16.65786	2.730423	Estimable
47	Walkamin Shepard_seedling.1	A8	18.62929	3.165914	Estimable
48	Walkamin Shepard_seedling.1	Duke 7	15.91122	2.873804	Estimable
49	Walkamin Shepard_seedling.1	Nabal	17.44322	2.666919	Estimable
50	Walkamin Shepard_seedling.1	SHSR-03	16.66238	2.968596	Estimable
51	Walkamin Shepard_seedling.1	V1	26.76211	2.960491	Estimable
52	Walkamin Shepard_seedling.1	Velvick	32.95544	2.619951	Estimable
53	Walkamin Shepard_seedling.1	Zutano	18.39801	2.890846	Estimable
54	Walkamin Shepard_seedling.1	Reed	19.01885	2.733501	Estimable
55	Walkamin Shepard_seedling.1	SHSR-02	25.69793	2.645198	Estimable
56	Walkamin Shepard_seedling.1	Toro Canyon	NA	NA	Aliased
57	Walkamin Shepard_seedling.1	Edranol	NA	NA	Aliased
58	Walkamin Shepard_seedling.1	Parida	NA	NA	Aliased
59	Walkamin Shepard_seedling.1	Plowman	NA	NA	Aliased
60	Walkamin Shepard_seedling.1	Shepard	NA	NA	Aliased
61	Walkamin Shepard_seedling.2	A10	105.92741	10.893438	Estimable
62	Walkamin Shepard_seedling.2	A8	113.86117	12.447907	Estimable

```
63 Walkamin Shepard_seedling.2      Duke 7         89.44805      11.704599  Estimable
64 Walkamin Shepard_seedling.2       Nabal        104.33489      10.700830  Estimable
65 Walkamin Shepard_seedling.2     SHSR-03        109.60311      12.003901  Estimable
66 Walkamin Shepard_seedling.2          V1        148.38515      11.769179  Estimable
67 Walkamin Shepard_seedling.2     Velvick        148.19953      10.448057  Estimable
68 Walkamin Shepard_seedling.2      Zutano        112.45478      12.232237  Estimable
69 Walkamin Shepard_seedling.2        Reed        135.55658      10.930380  Estimable
70 Walkamin Shepard_seedling.2     SHSR-02        136.48627      10.501287  Estimable
71 Walkamin Shepard_seedling.2 Toro Canyon               NA             NA    Aliased
72 Walkamin Shepard_seedling.2     Edranol               NA             NA    Aliased
73 Walkamin Shepard_seedling.2      Parida               NA             NA    Aliased
74 Walkamin Shepard_seedling.2     Plowman               NA             NA    Aliased
75 Walkamin Shepard_seedling.2     Shepard               NA             NA    Aliased
76 Walkamin Shepard_seedling.3         A10        181.08225      18.324376  Estimable
77 Walkamin Shepard_seedling.3          A8        197.86258      21.438009  Estimable
78 Walkamin Shepard_seedling.3      Duke 7        155.91887      19.743541  Estimable
79 Walkamin Shepard_seedling.3       Nabal        181.13257      17.971704  Estimable
80 Walkamin Shepard_seedling.3     SHSR-03        186.22596      20.262291  Estimable
81 Walkamin Shepard_seedling.3          V1        269.59208      20.019692  Estimable
82 Walkamin Shepard_seedling.3     Velvick        287.25936      17.232913  Estimable
83 Walkamin Shepard_seedling.3      Zutano        195.23008      20.532902  Estimable
84 Walkamin Shepard_seedling.3        Reed        229.27309      18.360165  Estimable
85 Walkamin Shepard_seedling.3     SHSR-02        249.90313      17.546271  Estimable
86 Walkamin Shepard_seedling.3 Toro Canyon               NA             NA    Aliased
87 Walkamin Shepard_seedling.3     Edranol               NA             NA    Aliased
88 Walkamin Shepard_seedling.3      Parida               NA             NA    Aliased
89 Walkamin Shepard_seedling.3     Plowman               NA             NA    Aliased
90 Walkamin Shepard_seedling.3     Shepard               NA             NA    Aliased
```

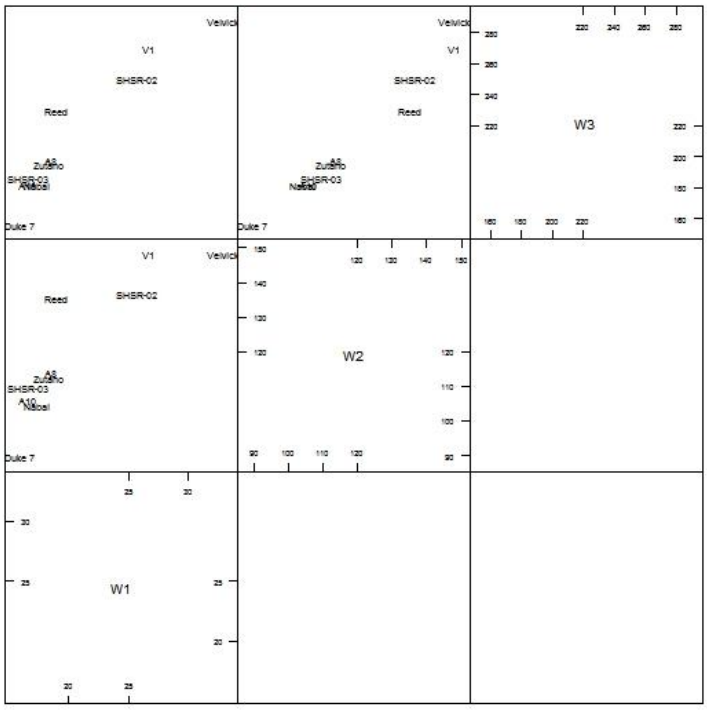
```
$avsed
 overall
14.72291
```



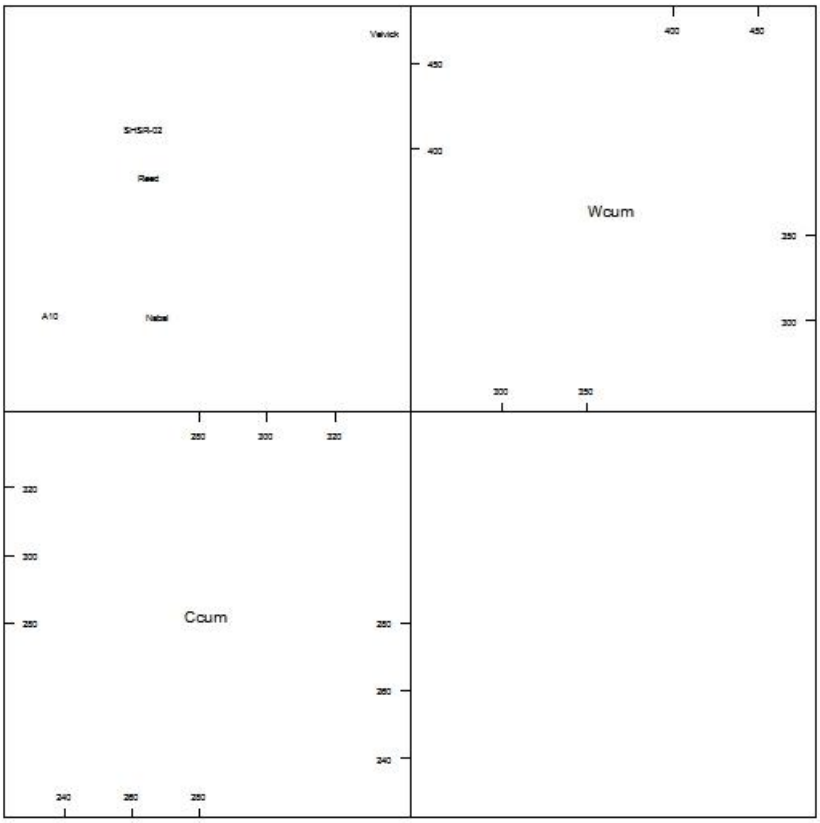
Childers



Walkamin



Cummulative yield across times



IV. Precosity results

A very rough analysis has been run to get an idea of precocity – the set up of trials wasn't really designed to test the effects of Scion & Propagation on precocity. This has been done using a generalised linear model assuming a binomial distribution and logit link. This is because the data consists of 1's (tree fruited in first year =2007) and 0',s (tree did not fruit in first year but fruited in a later year). Note a GLMM (generalised linear mixed model) analysis was attempted in order to accommodate the random effect terms however I could not get this to converge and so resorted to the more approximate analysis using a GLM.

The predictions for precocity for each Rootstock for the different Scion / Propagation type across Sites are given below:

The predicted values are the proportion of plots that fruited in the first year (2007). Note this analysis does not include WA data as there was no yield data at 2007.

Most trees fruited in the first year so the values are close to 1 for most of the varieties. The ones that may be of interest are those that are closer to 0 ie they were late fruiters (well most of the trees didn't

fruit in the first year 2007).
Eg

Duke 7 (Hass seedling)	0.2819	
Nabal (Shepard clonal)	0.3243	
Reed (Hass clonal)	0.3855	
Velvick/Hazard (Hass clonal)		0.1488

Response variate: prec

Trt	A10		A8	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.8354	0.07075	0.7352	0.07829
Hass_seedling	0.9220	0.05151	0.7720	0.07550
Shepard_clonal	0.7063	0.11313	*	*
Shepard_seedling	0.9080	0.06035	0.9241	0.07239

Trt	Barr Duke		Duke 7	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.8148	0.09615	0.8317	0.07218
Hass_seedling	0.8925	0.07127	0.2819	0.10164
Shepard_clonal	0.8348	0.08668	0.5746	0.14476
Shepard_seedling	*	*	0.8925	0.07127

Trt	Edranol		Hass	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.9995	0.00892	0.5787	0.11450
Hass_seedling	*	*	*	*
Shepard_clonal	*	*	*	*
Shepard_seedling	*	*	*	*

Trt	NA		Nabal	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	*	*	0.6245	0.11297
Hass_seedling	*	*	0.9167	0.05466
Shepard_clonal	*	*	0.3243	0.20233
Shepard_seedling	*	*	0.7433	0.08494

Trt	Parida		Peasley	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.9995	0.00998	0.9994	0.01080
Hass_seedling	*	*	*	*
Shepard_clonal	*	*	*	*
Shepard_seedling	*	*	*	*

Trt	Plowman		Reed	
	Prediction	s.e.	Prediction	s.e.
Scion				

Hass_clonal	0.9995	0.00939	0.3855	0.10982
Hass_seedling	0.5389	0.17064	0.7850	0.08684
Shepard_clonal	*	*	*	*
Shepard_seedling	0.8172	0.14431	0.7627	0.08738

Trt	Rigato		Shepard	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.6953	0.20982	0.9995	0.00892
Hass_seedling	*	*	*	*
Shepard_clonal	*	*	0.8348	0.08668
Shepard_seedling	*	*	*	*

Trt	SHSR-02		SHSR-03	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.6127	0.21194	0.9997	0.00424
Hass_seedling	0.9612	0.03750	0.8684	0.11046
Shepard_clonal	*	*	0.9999	0.00104
Shepard_seedling	*	*	0.9999	0.00104

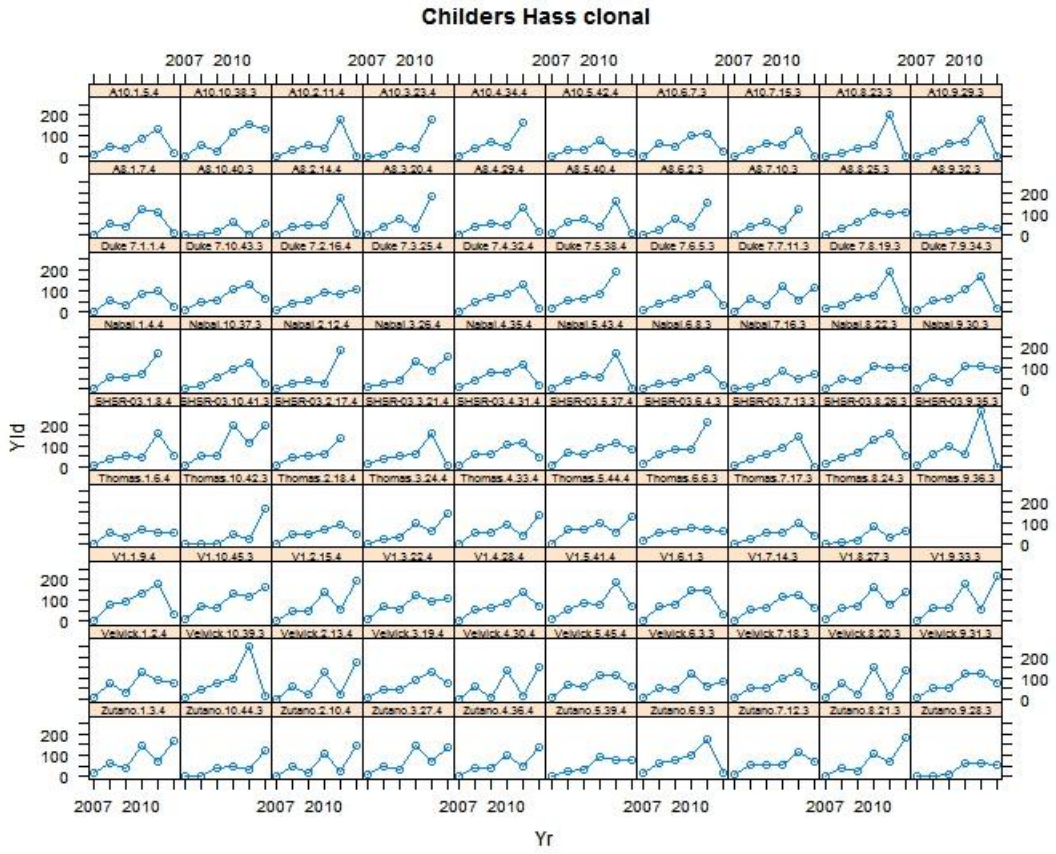
Trt	Thomas		Toro Canyon	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.5276	0.10689	0.9995	0.00941
Hass_seedling	*	*	0.9998	0.00486
Shepard_clonal	0.8925	0.07127	*	*
Shepard_seedling	*	*	*	*

Trt	V1		Velvick	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.9998	0.00435	0.9227	0.05107
Hass_seedling	0.8172	0.14431	0.8845	0.06018
Shepard_clonal	*	*	0.7063	0.11313
Shepard_seedling	0.9413	0.05657	0.9577	0.04088

TrtVelvick/Hazard			Zutano	
	Prediction	s.e.	Prediction	s.e.
Scion				
Hass_clonal	0.1488	0.12279	0.8091	0.07177
Hass_seedling	*	*	0.7555	0.09159
Shepard_clonal	*	*	0.5746	0.14476
Shepard_seedling	*	*	0.8348	0.08668

V. Biennial bearing

Investigation into Biennial Bearing



If we consider the plot of raw data for each variety (rep) over time above (for Childers Hass Clonal) we see evidence of biennial bearing in many of the varieties especially towards the 2-3 later years. In some of the trees it seems as though the up down trend in yield starts earlier than others eg Velvick 8.20.3 (also a couple of other Velvick trees) while in others it seems to only appear at the last 2-3 timepoints (eg A10 2.11.4 and other A10 trees). There could be a variety effect on this time of starting biennial bearing and the extent of biennial bearing. Unfortunately the number of measurements (6) may not be sufficiently long for us to really test this effect.

<u>Biennial bearing index approach</u>

The BBI (biennial bearing index of Hoblyn 1936) has been calculated for each tree (where sufficient data is available) based on the formula

$$I = \frac{1}{n-1}\sum_{i=2}^{n} |y_i - y_{i-1}| / (y_i + y_{i-1})$$

An I value close to 1 indicates extremely inconsistent cropping from one year to the next (irregular bearing) while a value close to 0 indicates consistent cropping. Note this index has its limitations (see Durand) and on its own does not really prove biennial or alternate bearing – just irregular bearing. However it is a standard index that is calculated for this purpose.

The BBI index for yield has been calculated for each tree for two time periods (2007 -2012 and also 2009-2012 where the alternate pattern seemed more pronounced). The BBI values have been averaged for each Site/Scion/Rootstock type and variety in the table below. The resampling test of

Huff 2001, was performed to assess the significance of the index I. This resampling test is based on randomly re-rordering the 6 years yields and recalculating the index. This process was performed 5000 times, with the 5000 I values forming a sample distribution for the alternate bearing index. This distribution was then used to test the null hypothesis that the yields were not random and were from an alternate bearing process. The BBI for a tree was considered significant if it was more extreme than 95% of the values of the resampled distribution. There were only a small number of trees that had significant BBI (5 trees over whole period 2007-2012 and 16 trees over period 2009-2012) based on this test. As you can see below the Huff significance values are quite high and not significant (significant if <0.05).

While the significance test based on resampling has not shown significant overall biennial bearing for any of the varieties at any of the trials here – I believe this is mainly due to the short time period of measurement and the fact that the alternate bearing pattern appeared mainly at the last few harvests (before the trial ended). Re-ordering 6 timepoints (which only have 720 distinct orderings) 5000 times will results in the same ordering being used many times – and I am not sure how accurate this method will be for small numbers of harvests.

		2007-2012		2009-2012	
SiteScion	**Treatments.**	**BBI2007-2012**	**Huff sig**	**BBI2009-2012**	**Huff sig**
Childers Hass_clonal	A10	0.465	0.541	0.434	0.407
	A8	0.510	0.572	0.481	0.335
	Duke 7	0.408	0.567	0.359	0.336
	Nabal	0.408	0.614	0.319	0.345
	SHSR-03	0.406	0.557	0.388	0.323
	Thomas	0.395	0.577	0.319	0.226
	V1	0.372	0.534	0.317	0.230
	Velvick	0.494	0.397	0.457	0.227
	Zutano	0.437	0.538	0.388	0.270
Childers Hass_clonal Total		**0.431**	**0.540**	**0.383**	**0.294**
Childers Hass_seedling	A10	0.430	0.515	0.462	0.269
	A8	0.411	0.536	0.357	0.357
	Nabal	0.386	0.564	0.359	0.352
	Peasley	0.498	0.488	0.503	0.342
	Reed	0.400	0.472	0.344	0.155
	SHSR-02	0.474	0.466	0.503	0.277
	SHSR-03	0.346	0.570	0.369	0.368
	Toro Canyon	0.380	0.594	0.370	0.328
	V1	0.469	0.453	0.453	0.216
	Velvick	0.431	0.515	0.427	0.337
	Velvick/Hazard	0.544	0.478	0.427	0.269
Childers Hass_seedling Total		**0.435**	**0.512**	**0.414**	**0.295**
Childers Shepard_seedling	A10	0.509	0.542	0.215	0.296
	Edranol	0.565	0.448	0.275	0.274

	Nabal	0.512	0.553	0.253	0.318
	Parida	0.530	0.529	0.217	0.353
	Plowman	0.525	0.528	0.242	0.275
	Reed	0.512	0.597	0.260	0.270
	Shepard	0.536	0.531	0.226	0.228
	SHSR-02	0.473	0.609	0.289	0.313
	Toro Canyon	0.564	0.489	0.273	0.253
	Velvick	0.520	0.532	0.200	0.286
Childers Shepard_seedling Total		**0.524**	**0.536**	**0.245**	**0.286**
Hampton Hass_clonal	A10	0.565	0.467	0.669	0.328
	A8	0.635	0.328	0.732	0.277
	Duke 7	0.746	0.205	0.887	0.128
	Hass	0.612	0.278	0.673	0.145
	Nabal	0.688	0.331	0.743	0.224
	Plowman	0.747	0.180	0.888	0.134
	Reed	0.694	0.226	0.735	0.184
	SHSR-03	0.615	0.330	0.695	0.237
	Velvick	0.677	0.302	0.783	0.207
	Zutano	0.626	0.331	0.730	0.224
Hampton Hass_clonal Total		**0.663**	**0.293**	**0.754**	**0.206**
Hampton Hass_seedling	A10	0.531	0.448	0.558	0.331
	A8	0.577	0.430	0.577	0.279
	Duke 7	0.612	0.456	0.644	0.222
	Nabal	0.441	0.513	0.407	0.298
	Plowman	0.613	0.410	0.639	0.261
	Reed	0.606	0.364	0.624	0.281
	SHSR-02	0.691	0.254	0.760	0.187
	SHSR-03	0.550	0.410	0.606	0.265
	Velvick	0.623	0.355	0.666	0.239
	Velvick/Hazard	0.565	0.486	0.547	0.292
	Zutano	0.520	0.435	0.524	0.331
Hampton Hass_seedling Total		**0.576**	**0.413**	**0.598**	**0.269**
WA Hass_clonal	A10			0.579	0.327
	Barr Duke			0.597	0.379
	Duke 7			0.710	0.223
	Hass			0.475	0.451
	Nabal			0.446	0.431
	Reed			0.533	0.386
	SHSR-01			0.537	0.381
	Velvick			0.504	0.384
	Zutano			0.547	0.347
WA Hass_clonal Total				0.553	0.359
WA Hass_seedling	A10			0.525	0.372
	Duke 7			0.729	0.280
	Nabal			0.578	0.338
	Plowman				
	SHSR-02			0.425	0.481
	Toro Canyon			0.681	0.306
	V1				
	Velvick			0.438	0.507
WA Hass_seedling Total					
Walkamin Hass_clonal	A10	0.468	0.708	0.374	0.452

	A8	0.461	0.717	0.306	0.491
	Barr Duke	0.517	0.689	0.408	0.527
	Duke 7	0.384	0.766	0.382	0.539
	Hass	0.605	0.597	0.466	0.533
	Reed	0.482	0.750	0.439	0.467
	Thomas	0.434	0.764	0.372	0.565
	Velvick	0.540	0.544	0.465	0.444
	Zutano	0.503	0.658	0.396	0.499
Walkamin Hass_clonal Total		**0.483**	**0.691**	**0.394**	**0.502**
Walkamin Hass_seedling	A10	0.396	0.789	0.290	0.512
	A8	0.446	0.737	0.294	0.480
	Barr Duke	0.431	0.761	0.363	0.485
	Duke 7	0.488	0.761	0.411	0.522
	Nabal	0.428	0.746	0.354	0.518
	Reed	0.509	0.716	0.350	0.533
	Rigato	0.466	0.706	0.416	0.481
	SHSR-02	0.411	0.722	0.311	0.465
	Velvick	0.382	0.772	0.293	0.523
	Zutano	0.396	0.805	0.309	0.532
Walkamin Hass_seedling Total		**0.431**	**0.753**	**0.337**	**0.503**
Walkamin Shepard_clonal	A10	0.420	0.719	0.260	0.457
	Barr Duke	0.490	0.671	0.313	0.455
	Duke 7	0.448	0.767	0.360	0.470
	Nabal	0.424	0.765	0.251	0.562
	Shepard	0.384	0.727	0.247	0.450
	SHSR-03	0.361	0.769	0.233	0.519
	Thomas	0.407	0.727	0.244	0.437
	Velvick	0.400	0.713	0.237	0.475
	Zutano	0.437	0.731	0.267	0.491
Walkamin Shepard_clonal Total		**0.419**	**0.730**	**0.268**	**0.477**
Walkamin Shepard_seedling	A10	0.403	0.759	0.336	0.449
	A8	0.359	0.698	0.206	0.345
	Duke 7	0.329	0.727	0.195	0.445
	Nabal	0.373	0.718	0.237	0.398
	Reed	0.391	0.687	0.172	0.499
	SHSR-02	0.356	0.741	0.264	0.442
	SHSR-03	0.390	0.696	0.274	0.371
	V1	0.381	0.710	0.268	0.425
	Velvick	0.373	0.716	0.272	0.490
	Zutano	0.345	0.754	0.232	0.445
Walkamin Shepard_seedling Total		**0.370**	**0.720**	**0.247**	**0.433**

General mixed model approach to investigate possible biennial bearing at both genetic and residual levels

A linear mixed model was fitted to each SiteScion data separately to investigate biennial bearing on a site basis. The mixed model allowed for correlation between times (6 times) at the residual level (as well as modelling any spatial correlation) and also modelled the genetic correlation between the 6 times. By looking at the genetic and residual correlations between successive times may allow an insight into whether there is evidence of biennial bearing at a site and between what times and whether this may be a consistent effect across all RS (so more environmental) or whether there is any genetic basis for biennial bearing.

The model fitted at each Site Scion was :

HHC9test2.asr<-asreml(Yld~Yrf,

random =~ fa(Yrf,2):Trt+at(Yrf):Rep,

rcov=~corgh(Yrf):id(Col):ar1(Row),data=HHC,na.method.X='include',

R.param=HHC9test.asr$R.param, G.param=HHC9test.asr$G.param)

Hass clonal

(I have only looked at the Hass clonal trials as the seedling trials will need to have the pedigree included to accurately estimate the RS genetic variance)

Childers

The residual correlations were as follows (off diagonal terms with variances on the diagonal):

	2007	2008	2009	2010	2011	2012
2007	13.05286032	0.2238022	0.3964344	0.08848208	0.2575102	-0.06281776
2008	0.22380219	215.0490373	0.2771710	0.44742482	0.1154510	0.19895321
2009	0.39643436	0.2771710	353.6786641	-0.21447399	0.7601737	-0.50942199
2010	0.08848208	0.4474248	-0.2144740	857.64865122	-0.4407359	0.67442121
2011	0.25751015	0.1154510	0.7601737	-0.44073586	2779.0472915	-0.68038110
2012	-0.06281776	0.1989532	-0.5094220	0.67442121	-0.6803811	2764.90066468

So it can be seen the residual correlations between successive times after 2009 are negative

(2007&2008 =0.22, 2008&2009=0.28, 2009&2010= -0.21, 2010&2011=0.-0.44, 2011&2012=-0.68)

indicating that the binennial bearing pattern became clear after this time. It also indicates that it is a consistent factor at this site.

The overall mean effects for each time were:

	solution	std error	z ratio
Yrf_2007	0.000000	NA	NA
Yrf_2008	38.439102	3.8306181	10.034700
Yrf_2009	45.655004	2.6863768	16.995011
Yrf_2010	85.495233	7.4336412	11.501124
Yrf_2011	108.093093	8.3213287	12.989884
Yrf_2012	59.495789	12.0305914	4.945375

Indicating an increasing mean level up until 2011 when it dropped to a low level in 2012.

The genetic correlations were as follows:

	2007	2008	2009	2010	2011	2012
2007	1.0000000	0.8161250	0.8165033	0.7517935	0.5395906	0.2583266
2008	0.8161250	1.0000000	0.9999993	0.9855902	0.2975971	0.6163982
2009	0.8165033	0.9999993	1.0000000	0.9853833	0.2987608	0.6154377
2010	0.7517935	0.9855902	0.9853833	1.0000000	0.1318222	0.7407111
2011	0.5395906	0.2975971	0.2987608	0.1318222	1.0000000	-0.5683188
2012	0.2583266	0.6163982	0.6154377	0.7407111	-0.5683188	1.0000000

So the genetic effects were highly correlated between successive times initially (ie. 0.816,0.99,0.985) and then 0.132 (between 2010 & 2011) and -0.568 (between 2011 & 2012) . So we can perhaps see that there is some difference in the RS and how they are performing under the biennial bearing.

Hampton

The residual correlations were as follows (off diagonal terms with variances on the diagonal):

	2007	2008	2009	2010	2011	2012
2007	36.14715858	0.09499979	0.22596825	-0.13091552	-0.11133674	-0.17213532
2008	0.09499979	260.93884596	0.38990203	0.02737107	-0.16823507	0.12369283
2009	0.22596825	0.38990203	1122.11030084	-0.41555106	-0.05732825	-0.17272686
2010	-0.13091552	0.02737107	-0.41555106	540.63318372	0.31747386	0.38844070
2011	-0.11133674	-0.16823507	-0.05732825	0.31747386	730.53325296	0.01184431
2012	-0.17213532	0.12369283	-0.17272686	0.38844070	0.01184431	46.84533070

So the residual correlations between successive times are:

2007&2008 =0.09, 2008&2009=0.39, 2009&2010= -0.41, 2010&2011=0.31, 2011&2012=0.01

So for 2009 & 2010 the residual correlation is negative however between other times the correlation is positive.

The genetic correlation matrix is given by:

$Cmat

	2007	2008	2009	2010	2011	2012
2007	1.0000000	0.9626244	0.9820236	0.4263143	0.6310553	-0.9862597
2008	0.9626244	1.0000000	0.9964431	0.1653853	0.4042226	-0.9941410
2009	0.9820236	0.9964431	1.0000000	0.2479045	0.4780612	-0.9997136
2010	0.4263143	0.1653853	0.2479045	1.0000000	0.9478485	-0.2710188
2011	0.6310553	0.4042226	0.4780612	0.9478485	1.0000000	-0.4984117
2012	-0.9862597	-0.9941410	-0.9997136	-0.2710188	-0.4984117	1.0000000

The overall mean effects for each Year were:

	solution	std error	z ratio
Yrf_2007	0.000000	NA	NA
Yrf_2008	27.427225	2.980841	9.201171
Yrf_2009	67.583487	4.236457	15.952834
Yrf_2010	16.111262	4.943364	3.259170
Yrf_2011	108.508120	6.524350	16.631253
Yrf_2012	-4.058679	1.923084	-2.110505

So we can see the mean level is increasing for the first 3 years (2001,2008,2009) and then decreases in 2010, then increases 2011 then decreases in 2012. So there is clearly evidence of a biennial bearing pattern from 2009 onwards (can be seen in the graphs of each variety over time).

The genetic and residual correlations suggest that this pattern is consistent across RS except for the final times (between 2011 & 2012) where there is a clear negative correlation (-0.498) between genetic effects (so those that were high in 2011 are low in 2012 etc) which may indicate some genetic differences in the impact of biennial bearing.

WA (No Yld for 2007)

The residual correlations between times at WA are given below. We can see that the correlations between successive times are all positive.

	2008	2009	2010	2011	2012
2008	281.0119640	0.5084094	0.3979758	0.4307309	0.4280433
2009	0.5084094	49.8146672	0.3516079	0.3011892	0.3265857
2010	0.3979758	0.3516079	339.7631747	0.6957597	0.2984151
2011	0.4307309	0.3011892	0.6957597	471.7263959	0.1919391
2012	0.4280433	0.3265857	0.2984151	0.1919391	1084.8249989

The overall mean effects over time are :

Yrf_2008	0.000000	NA	NA
Yrf_2009	-20.895838	3.394628	-6.1555597
Yrf_2010	-1.518468	2.929497	-0.5183374
Yrf_2011	-7.030737	3.378582	-2.0809727
Yrf_2012	65.385107	7.104518	9.2033132

Which shows a pattern of decreasing mean then increasing etc.. as in a biennial bearing pattern.

The genetic correlations are as follows:

	2008	2009	2010	2011	2012
2008	1.00000000	-0.2770052	0.99625573	0.6927759	0.01141095
2009	-0.27700519	1.0000000	-0.35904023	0.3491979	0.95764497
2010	0.99625573	-0.3590402	1.00000000	0.6414958	-0.07508151
2011	0.69277591	0.3491979	0.64149577	1.0000000	0.57100543
2012	0.01141095	0.9576450	-0.07508151	0.5710054	1.00000000

The genetic correlations between successive times at the start are negative (eg 2008 & 2009 = -0.277 and 2009 & 2010 = -0.36) indicating that the RS rankings are changing over the early times – maybe not all RS are following the biennial bearing pattern in the same manner at the start? Then after 2010 the genetic correlations are positive between successive times indicating that the RS are following a similar pattern.

Walkamin

The residual correlations are given below. All the correlations are positive between consecutive times.

	2007	2008	2009	2010	2011	2012
2007	3.6096232	0.44861570	0.1894134	0.2149194	0.2298429	1.717604e-01
2008	0.4486157	49.47136043	0.4566308	0.2434618	0.1676387	9.466452e-02
2009	0.1894134	0.45663084	90.5418603	0.7128704	0.6637954	3.941442e-01

```
2010 0.2149194  0.24346176  0.7128704 480.1161090   0.5767609 3.012241e-01
2011 0.2298429  0.16763873  0.6637954   0.5767609 909.7803588 6.272904e-01
2012 0.1717604  0.09466452  0.3941442   0.3012241   0.6272904 1.949786e+03
```

The mean overall level for each time is as follows:

```
             solution std error   z ratio
Yrf_2007      0.000000        NA        NA
Yrf_2008      6.140430 0.9514757  6.453586
Yrf_2009     10.227887 1.3747537  7.439796
Yrf_2010     39.118448 5.3780861  7.273675
Yrf_2011     65.134532 4.8227963 13.505553
Yrf_2012    108.975012 7.9924974 13.634663
```

So the mean level is increasing over time.

The genetic correlations between times are :

```
            2007       2008       2009        2010       2011        2012
2007  1.0000000  0.7799621 -0.7070897 -0.89576170 -0.2107097  0.47271009
2008  0.7799621  1.0000000 -0.1089661 -0.44359044  0.4474305  0.92018577
2009 -0.7070897 -0.1089661  1.0000000  0.92158803  0.8402387  0.28888185
2010 -0.8957617 -0.4435904  0.9215880  1.00000000  0.5871676 -0.06427547
2011 -0.2107097  0.4474305  0.8402387  0.58716755  1.0000000  0.76182888
2012  0.4727101  0.9201858  0.2888819 -0.06427547  0.7618289  1.00000000
```

So except for between 2008 & 2009 (where the correlation is -0.1) the genetic correlations between successive times are positive and fairly high (eg 0.78, 0.92, 0.59, 0.76) indicating that the RS rankings are fairly consistent across times. It does not appear that biennial bearing has a big impact on this trial.

For those sites where biennial bearing appeared to have an impact a further analysis was conducted to look at the individual RS and see if they have any differing impact of biennial bearing.

<u>Mixed model analysis (along the lines of Durand) to look at individual genetic effects & their biennial bearing</u>

A linear mixed model has been fitted to the yield data to account for the linear trend (overall mean trend and trend for each Treatment) and then the deviations from this linear trend have been investigated. An ar1 (autoregressive model) has been fitted to these deviation terms for each Treatment. The idea is that those treatments that have biennial bearing will have significant deviations from the treatment linear trend and that these deviations at each time will be negatively correlated with the deviations at the next time.

The asreml-R model fitted was as follows:

CHC9.asr<-asreml(Yld~Yr+Trt+Trt:Yr,

random =~ at(Trt):ar1v(Yrf)+at(Yrf):Rep,

rcov=~at(Yrf):id(Col):ar1(Row),

data=CHC,na.method.X='include')

(Note it would also be good to fit an ar1 model to the residual time component – however this caused problems with some varieties as the individual trees were out of sync with the majority. This may be addressed by including a factor that groups those trees in one phase (up down up etc…) and others in the opposite phase (down up down etc…). This issue does raise the question in the analyses below as to whether the biennial bearing is infact genetic or environmental and we cannot fit the models to test this? Anyway it may give an idea of RS that may be doing something different to the rest (those with positive ar1 correlation parameters) and may have less of a tendency for biennial bearing.

- Childers Hass Clonal

Looking at the variance components & ar1 correlation parameters from this analysis below we see that for treatments A10, A8, Duke 7, SHSR-03, V1, Velvick, Zutano there is significant deviation from the linear trend and that the ar1 correlation parameter for each of these is negative (-0.599,-0.523,-0.646, -0.147?, -0.995?,-0.892,-0.844 respectively). This indicates that the correlation between successive times (after removing the linear trend) is negative for most treatments – which indicates biennial bearing. The treatments Nabal, Thomas did not show this.

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.cor	-5.994024e-01	-5.994024e-01	0.6682306	-0.8969993	Unconstrained
at(Trt, A10):Yrf!Yrf.var	2.340553e+02	2.340553e+02	287.5825940	0.8138716	Positive
at(Trt, A8):Yrf!Yrf.cor	-5.232969e-01	-5.232969e-01	1.6244827	-0.3221314	Unconstrained
at(Trt, A8):Yrf!Yrf.var	1.482948e+01	1.482948e+01	44.8103872	0.3309385	Positive
at(Trt, Duke 7):Yrf!Yrf.cor	-6.461642e-01	-6.461642e-01	NA	NA	Boundary
at(Trt, Duke 7):Yrf!Yrf.var	1.841247e+01	1.841247e+01	35.9145416	0.5126744	Positive
at(Trt, Nabal):Yrf!Yrf.cor	-6.864294e-01	-6.864294e-01	NA	NA	Fixed
at(Trt, Nabal):Yrf!Yrf.var	3.742545e-06	3.742545e-06	NA	NA	Boundary
at(Trt, SHSR-03):Yrf!Yrf.cor	-1.474064e-01	-1.474064e-01	NA	NA	Boundary
at(Trt, SHSR-03):Yrf!Yrf.var	2.623637e+01	2.623637e+01	53.8458249	0.4872499	Positive
at(Trt, Thomas):Yrf!Yrf.cor	-9.950000e-01	-9.950000e-01	NA	NA	Fixed
at(Trt, Thomas):Yrf!Yrf.var	5.401913e-07	5.401913e-07	NA	NA	Boundary
at(Trt, V1):Yrf!Yrf.cor	-9.950000e-01	-9.950000e-01	NA	NA	Boundary
at(Trt, V1):Yrf!Yrf.var	1.037473e+02	1.037473e+02	152.4598641	0.6804894	Positive
at(Trt, Velvick):Yrf!Yrf.cor	-8.921671e-01	-8.921671e-01	0.2103737	-4.2408684	Unconstrained
at(Trt, Velvick):Yrf!Yrf.var	2.822115e+02	2.822115e+02	348.5936010	0.8095717	Positive
at(Trt, Zutano):Yrf!Yrf.cor	-8.440324e-01	-8.440324e-01	0.3134968	-2.6923158	Unconstrained
at(Trt, Zutano):Yrf!Yrf.var	3.937137e+02	3.937137e+02	540.9913472	0.7277634	Positive
at(Yrf, 2007):Rep!Rep.var	1.747033e+00	1.747033e+00	1.5098016	1.1571275	Positive
at(Yrf, 2008):Rep!Rep.var	6.348630e+01	6.348630e+01	42.0815368	1.5086498	Positive
at(Yrf, 2009):Rep!Rep.var	3.071838e+01	3.071838e+01	27.9850687	1.0976702	Positive
at(Yrf, 2010):Rep!Rep.var	3.353659e+01	3.353659e+01	47.7954770	0.7016687	Positive
at(Yrf, 2011):Rep!Rep.var	5.401913e-07	5.401913e-07	NA	NA	Boundary
at(Yrf, 2012):Rep!Rep.var	4.983665e+03	4.983665e+03	2441.9519183	2.0408530	Positive
Yrf_2007!variance	1.277655e+01	1.277655e+01	2.1699516	5.8879438	Positive
Yrf_2007!Row.cor	-4.583856e-02	-4.583856e-02	0.1509335	-0.3037003	Unconstrained
Yrf_2008!variance	2.157413e+02	2.157413e+02	35.9796578	5.9962010	Positive
Yrf_2008!Row.cor	-1.255295e-01	-1.255295e-01	0.1309625	-0.9585148	Unconstrained
Yrf_2009!variance	2.985073e+02	2.985073e+02	49.8785900	5.9846787	Positive
Yrf_2009!Row.cor	-1.583222e-01	-1.583222e-01	0.1175481	-1.3468711	Unconstrained
Yrf_2010!variance	8.516574e+02	8.516574e+02	143.8340576	5.9211106	Positive
Yrf_2010!Row.cor	-2.279090e-01	-2.279090e-01	0.1215026	-1.8757535	Unconstrained
Yrf_2011!variance	2.880596e+03	2.880596e+03	479.4752576	6.0078090	Positive
Yrf_2011!Row.cor	-2.307501e-01	-2.307501e-01	0.1190255	-1.9386608	Unconstrained
Yrf_2012!variance	2.863696e+03	2.863696e+03	519.6488788	5.5108281	Positive
Yrf_2012!Row.cor	-4.492994e-02	-4.492994e-02	0.1743123	-0.2577554	Unconstrained

- Hampton Hass clonal
  A similar model was fitted to the Hampton Hass clonal data.
  The following RS had negative ar1 correlation parameters:

A10, A8, Nabal, SHSR-03, Zutano, Plowman (so indicate biennial bearing)
But the following did not (Duke 7, Velvick, Reed, Hass).

at(Trt, A10):Yrf!Yrf.cor	-6.609353e-01	-6.609353e-01	NA	NA	Fixed
at(Trt, A10):Yrf!Yrf.var	1.392870e-04	1.392870e-04	NA	NA	Boundary
at(Trt, A8):Yrf!Yrf.cor	-2.887289e-01	-2.887289e-01	NA	NA	Boundary
at(Trt, A8):Yrf!Yrf.var	5.851767e+00	5.851767e+00	19.2431415	0.3040962	Positive
at(Trt, Duke 7):Yrf!Yrf.cor	1.928903e-01	1.928903e-01	1.5717007	0.1227271	Unconstrained
at(Trt, Duke 7):Yrf!Yrf.var	3.130390e+02	3.130390e+02	564.3536981	0.5546858	Positive
at(Trt, Nabal):Yrf!Yrf.cor	-9.950000e-01	-9.950000e-01	NA	NA	Boundary
at(Trt, Nabal):Yrf!Yrf.var	1.684885e+01	1.684885e+01	32.9267895	0.5117064	Positive
at(Trt, SHSR-03):Yrf!Yrf.cor	-4.210955e-01	-4.210955e-01	NA	NA	Boundary
at(Trt, SHSR-03):Yrf!Yrf.var	1.413620e+02	1.413620e+02	122.8893846	1.1503188	Positive
at(Trt, Velvick):Yrf!Yrf.cor	9.458759e-02	9.458759e-02	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	7.427272e+01	7.427272e+01	82.3408675	0.9020153	Positive
at(Trt, Zutano):Yrf!Yrf.cor	-8.540037e-01	-8.540037e-01	NA	NA	Boundary
at(Trt, Zutano):Yrf!Yrf.var	2.213182e+01	2.213182e+01	47.2211300	0.4686847	Positive
at(Trt, Reed):Yrf!Yrf.cor	4.000000e-01	4.000000e-01	NA	NA	Fixed
at(Trt, Reed):Yrf!Yrf.var	6.172825e-06	6.172825e-06	NA	NA	Boundary
at(Trt, Plowman):Yrf!Yrf.cor	-5.118124e-02	-5.118124e-02	NA	NA	Boundary
at(Trt, Plowman):Yrf!Yrf.var	2.877601e+01	2.877601e+01	40.8470776	0.7044814	Positive
at(Trt, Hass):Yrf!Yrf.cor	5.187445e-01	5.187445e-01	NA	NA	Fixed
at(Trt, Hass):Yrf!Yrf.var	1.544529e-06	1.544529e-06	NA	NA	Boundary
at(Yrf, 2007):Rep!Rep.var	1.029997e+01	1.029997e+01	6.5104544	1.5820669	Positive
at(Yrf, 2008):Rep!Rep.var	4.333107e+02	4.333107e+02	242.0123377	1.7904488	Positive
at(Yrf, 2009):Rep!Rep.var	3.700502e+03	3.700502e+03	1789.9328717	2.0673969	Positive
at(Yrf, 2010):Rep!Rep.var	3.606931e+02	3.606931e+02	218.1857436	1.6531468	Positive
at(Yrf, 2011):Rep!Rep.var	1.143137e+04	1.143137e+04	5153.6658340	2.2181038	Positive
at(Yrf, 2012):Rep!Rep.var	5.422153e-06	5.422153e-06	NA	NA	Boundary
Yrf_2007!variance	3.188867e+01	3.188867e+01	5.0395763	6.3276488	Positive
Yrf_2007!Row.cor	-2.447239e-02	-2.447239e-02	0.1319058	-0.1855292	Unconstrained
Yrf_2008!variance	3.041801e+02	3.041801e+02	73.8268689	4.1201818	Positive
Yrf_2008!Row.cor	5.199535e-01	5.199535e-01	0.1103986	4.7097827	Unconstrained
Yrf_2009!variance	1.212783e+03	1.212783e+03	270.1444749	4.4893883	Positive
Yrf_2009!Row.cor	4.161075e-01	4.161075e-01	0.1310065	3.1762350	Unconstrained
Yrf_2010!variance	5.707948e+02	5.707948e+02	108.2235139	5.2742215	Positive
Yrf_2010!Row.cor	3.360284e-01	3.360284e-01	0.1132307	2.9676429	Unconstrained
Yrf_2011!variance	7.040690e+02	7.040690e+02	109.0115302	6.4586657	Positive
Yrf_2011!Row.cor	-5.689313e-02	-5.689313e-02	0.1197713	-0.4750147	Unconstrained
Yrf_2012!variance	4.357721e+01	4.357721e+01	8.0299107	5.4268609	Positive
Yrf_2012!Row.cor	9.333114e-02	9.333114e-02	0.1568173	0.5951583	Unconstrained

- WA Hass clonal
  The ar1 correlation parameters for the following RS genotypes were negative (indicating biennial bearing) : A10, Duke 7, Nabal, Zutano
  (while the following did not Velvick, Reed, Hass, Barr Duke)

```
> summary(WAHC9.asr)$varcomp
```

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.cor	-3.244140e-01	-3.244140e-01	NA	NA	Boundary
at(Trt, A10):Yrf!Yrf.var	2.815049e+01	2.815049e+01	51.3759373	0.5479315	Positive
at(Trt, Duke 7):Yrf!Yrf.cor	-8.586527e-01	-8.586527e-01	NA	NA	Boundary
at(Trt, Duke 7):Yrf!Yrf.var	2.371406e+01	2.371406e+01	41.9035683	0.5659197	Positive
at(Trt, Nabal):Yrf!Yrf.cor	-7.933375e-01	-7.933375e-01	NA	NA	Fixed
at(Trt, Nabal):Yrf!Yrf.var	1.832811e-06	1.832811e-06	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.cor	9.733395e-01	9.733395e-01	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	7.632801e+02	7.632801e+02	1685.7226297	0.4527910	Positive
at(Trt, Zutano):Yrf!Yrf.cor	-6.131972e-01	-6.131972e-01	0.8164903	-0.7510159	Unconstrained
at(Trt, Zutano):Yrf!Yrf.var	1.089914e+02	1.089914e+02	113.3275275	0.9617382	Positive
at(Trt, Reed):Yrf!Yrf.cor	9.613707e-01	9.613707e-01	NA	NA	Fixed
at(Trt, Reed):Yrf!Yrf.var	8.519002e-03	8.519002e-03	NA	NA	Boundary
at(Trt, Hass):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Fixed
at(Trt, Hass):Yrf!Yrf.var	1.007216e-05	1.007216e-05	NA	NA	Boundary
at(Trt, Barr Duke):Yrf!Yrf.cor	1.784748e-02	1.784748e-02	NA	NA	Fixed
at(Trt, Barr Duke):Yrf!Yrf.var	3.135990e-06	3.135990e-06	NA	NA	Boundary
at(Trt, SHSR-01):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Fixed
at(Trt, SHSR-01):Yrf!Yrf.var	5.712326e-07	5.712326e-07	NA	NA	Boundary

- Walkamin Hass clonal

Despite there not being a lot of evidence for biennial bearing at Walkamin in Hass Clonal (previous analysis) the model was fitted to look at each RS individually. All of the ar1 correlation parameters for these RS were positive. This supports the earlier analysis by showing no evidence of genetic effect on biennial bearing at this trial.

	gamma	component	std.error	z.ratio	constraint
at(Trt, A10):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Boundary
at(Trt, A10):Yrf!Yrf.var	9.740457e+03	9.740457e+03	8.201286e+03	1.18767442	Positive
at(Trt, A8):Yrf!Yrf.cor	8.216324e-01	8.216324e-01	NA	NA	Boundary
at(Trt, A8):Yrf!Yrf.var	3.186061e+02	3.186061e+02	3.151520e+02	1.01096003	Positive
at(Trt, Duke 7):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Boundary
at(Trt, Duke 7):Yrf!Yrf.var	4.297239e+03	4.297239e+03	4.617688e+03	0.93060392	Positive
at(Trt, Thomas):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Boundary
at(Trt, Thomas):Yrf!Yrf.var	1.043256e+04	1.043256e+04	9.813423e+03	1.06309043	Positive
at(Trt, Velvick):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Boundary
at(Trt, Velvick):Yrf!Yrf.var	1.333148e+04	1.333148e+04	1.112316e+04	1.19853341	Positive
at(Trt, Zutano):Yrf!Yrf.cor	9.708528e-01	9.708528e-01	NA	NA	Boundary
at(Trt, Zutano):Yrf!Yrf.var	2.426712e+03	2.426712e+03	2.347681e+03	1.03366360	Positive
at(Trt, Reed):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Boundary
at(Trt, Reed):Yrf!Yrf.var	4.420084e+03	4.420084e+03	4.927743e+03	0.89697948	Positive
at(Trt, Hass):Yrf!Yrf.cor	9.888889e-01	9.888889e-01	NA	NA	Boundary
at(Trt, Hass):Yrf!Yrf.var	4.632308e+03	4.632308e+03	5.651374e+03	0.81967813	Positive

```
at(Trt, Barr Duke):Yrf!Yrf.cor  9.888889e-01  9.888889e-01           NA           NA      Boundary
at(Trt, Barr Duke):Yrf!Yrf.var  4.593496e+03  4.593496e+03 4.700312e+03  0.97727472      Positive
```

VI. Multi-trait MET analysis

An MET analysis using combined data across the 3 traits (Yld, FS, YE) was conducted to estimate the genetic correlations between traits and to identify RS that performed well across all traits.

The analysis was done for Hass Clonal trials (Childers, Hampton, Walkamin and WA).

The asreml model used was :

```
METallfa3.asr<-asreml(dat~ ExTimeTr,
                      random =~fa(ExTimeTr,3):Trt+ at(ExTimeTr):Rep,
                      rcov=~at(SiteScionTr):ar1h(Tm):ar1(Col):ar1(Row),
                      data=sumall1,na.method.X="include")
```

where ExTimeTr has 33 levels :

```
levels(sumall1$ExTimeTr)
 [1] "Childers Hass_clonal.1.FS"  "Childers Hass_clonal.1.YE"  "Childers Hass_clonal.1.Yld"
"Childers Hass_clonal.2.FS"  "Childers Hass_clonal.2.YE"  "Childers Hass_clonal.2.Yld"
"Hampton Hass_clonal.1.FS"
 [8] "Hampton Hass_clonal.1.YE"   "Hampton Hass_clonal.1.Yld"  "Hampton Hass_clonal.2.FS"
"Hampton Hass_clonal.2.YE"   "Hampton Hass_clonal.2.Yld"  "Hampton Hass_clonal.3.FS"
"Hampton Hass_clonal.3.YE"
[15] "Hampton Hass_clonal.3.Yld"  "WA Hass_clonal.1.FS"        "WA Hass_clonal.1.YE"
"WA Hass_clonal.1.Yld"       "WA Hass_clonal.2.FS"        "WA Hass_clonal.2.YE"        "WA
Hass_clonal.2.Yld"
[22] "WA Hass_clonal.3.FS"        "WA Hass_clonal.3.YE"        "WA Hass_clonal.3.Yld"
"Walkamin Hass_clonal.1.FS"  "Walkamin Hass_clonal.1.YE"  "Walkamin Hass_clonal.1.Yld"
"Walkamin Hass_clonal.2.FS"
[29] "Walkamin Hass_clonal.2.YE"  "Walkamin Hass_clonal.2.Yld" "Walkamin Hass_clonal.3.FS"
"Walkamin Hass_clonal.3.YE"  "Walkamin Hass_clonal.3.Yld"
```

The genetic correlation matrix between rootstocks for the 33 Site, Time, Trait combinations is presented below:

	CHC1FS	CHC1YE	CHC1YD	CHC2FS	CHC2YE	CHC2YD	HHC1FS	HHC1YE	HHC1YD	HHC2FS	HHC2YE	HHC2YD	HHC3FS	HHC3YE	HHC3YD	WHC1FS	WHC1YE	WHC1YD	WHC2FS	WHC2YE	WHC2YD	WHC3FS	WHC3YE	WHC3YD	WkHC1FS	WkHC1YE	WkHC1YD	WkHC2FS	WkHC2YE	WkHC2YD	WkHC3FS	WkHC3YE	WkHC3YD
CHC1FS	1	0.61	0.9	0.96	0.71	0.96	-0.67	-0.86	-0.7	0.17	-0.5	-0.49	0.95	-0.79	-0.49	-0.47	0.03	-0.66	-0.96	-0.78	-0.91	-0.45	0.15	-0.19	-0.39	-0.79	-0.76	-0.16	-0.29	-0.54	0	0.02	-0.92
CHC1YE	0.61	1	0.86	0.7	0.86	0.78	0.05	-0.12	0.13	-0.47	0.38	0.2	0.57	-0.58	-0.24	-0.79	0.1	-0.21	-0.67	-0.72	-0.78	-0.3	-0.11	-0.52	0.38	-0.03	0.03	0.65	-0.65	-0.92	0.74	0.08	-0.53
CHC1YD	0.9	0.86	1	0.97	0.77	0.99	-0.29	-0.6	-0.33	-0.11	-0.14	-0.07	0.79	-0.65	-0.24	-0.79	0.04	-0.36	-0.86	-0.72	-0.87	-0.59	0.22	-0.21	-0.05	-0.53	-0.4	0.29	-0.64	-0.86	0.42	-0.14	-0.74
CHC2FS	0.96	0.7	0.97	1	0.66	0.99	-0.45	-0.78	-0.54	0.08	-0.39	-0.24	0.84	-0.64	-0.26	-0.69	0.01	-0.44	-0.88	-0.67	-0.84	-0.64	0.33	-0.07	-0.26	-0.73	-0.59	0.06	-0.54	-0.72	0.2	-0.2	-0.79
CHC2YE	0.71	0.86	0.77	0.66	1	0.76	-0.39	-0.28	-0.18	-0.32	0.16	-0.28	0.81	-0.9	-0.7	-0.4	0.14	-0.66	-0.86	-0.97	-0.94	0.06	-0.46	-0.79	0.15	-0.15	-0.31	0.26	-0.19	-0.62	0.38	0.5	-0.81
CHC2YD	0.96	0.78	0.99	0.99	0.76	1	-0.44	-0.71	-0.48	-0.01	-0.28	-0.23	0.87	-0.71	-0.34	-0.69	0.04	-0.48	-0.92	-0.75	-0.9	-0.56	0.21	-0.2	-0.18	-0.65	-0.55	0.13	-0.53	-0.76	0.27	-0.1	-0.83
HHC1FS	-0.67	0.05	-0.29	-0.45	-0.39	-0.44	1	0.8	0.93	-0.47	0.76	0.97	-0.79	0.75	0.78	-0.34	-0.02	0.92	0.7	0.6	0.6	-0.15	0.21	0.24	0.69	0.74	0.96	0.78	-0.5	-0.24	0.65	-0.44	0.82
HHC1YE	-0.86	-0.12	-0.6	-0.78	-0.28	-0.71	0.8	1	0.93	-0.52	0.87	0.65	-0.77	0.54	0.34	0.17	0.05	0.59	0.74	0.43	0.59	0.48	-0.38	-0.2	0.72	0.99	0.93	0.56	0.05	0.14	0.43	0.16	0.76
HHC1YD	-0.7	0.13	-0.33	-0.54	-0.18	-0.48	0.93	0.93	1	-0.61	0.93	0.86	-0.71	0.55	0.51	-0.19	0.04	0.73	0.63	0.4	0.48	0.17	-0.16	-0.11	0.81	0.92	0.99	0.81	-0.31	-0.19	0.68	-0.08	0.72
HHC2FS	0.17	-0.47	-0.11	0.08	-0.32	-0.01	-0.47	-0.52	-0.61	1	-0.71	-0.46	0.13	0.03	-0.03	0.31	-0.09	-0.2	-0.05	0.16	0.09	-0.15	0.32	0.43	-0.62	-0.57	-0.54	-0.67	0.29	0.41	-0.64	-0.17	-0.13
HHC2YE	-0.5	0.38	-0.14	-0.39	0.16	-0.28	0.76	0.87	0.93	-0.71	1	0.7	-0.44	0.22	0.2	-0.23	0.1	0.45	0.36	0.05	0.17	0.3	-0.41	-0.44	0.86	0.91	0.88	0.84	-0.27	-0.32	0.76	0.19	0.44
HHC2YD	-0.49	0.2	-0.07	-0.24	-0.28	-0.23	0.97	0.65	0.86	-0.46	0.7	1	-0.66	0.67	0.81	-0.54	-0.03	0.91	0.55	0.51	0.45	-0.35	0.35	0.29	0.66	0.6	0.89	0.85	-0.69	-0.44	0.74	-0.56	0.7
HHC3FS	0.95	0.57	0.79	0.84	0.81	0.87	-0.79	-0.77	-0.71	0.13	-0.44	-0.66	1	-0.94	-0.73	-0.25	0.07	-0.85	-0.99	-0.91	-0.96	-0.15	-0.15	-0.44	-0.37	-0.68	-0.79	-0.25	-0.04	-0.39	-0.09	0.32	-1
HHC3YE	-0.79	-0.58	-0.65	-0.64	-0.9	-0.71	0.75	0.54	0.55	0.03	0.22	0.67	-0.94	1	0.9	0.08	-0.12	0.92	0.93	0.98	0.94	-0.17	0.48	0.72	0.2	0.42	0.66	0.19	-0.14	0.3	0.04	-0.62	0.96
HHC3YD	-0.49	-0.24	-0.24	-0.26	-0.7	-0.34	0.78	0.34	0.51	-0.03	0.2	0.81	-0.73	0.9	1	-0.35	-0.13	0.96	0.68	0.83	0.69	-0.56	0.74	0.79	0.23	0.22	0.6	0.41	-0.55	-0.12	0.29	-0.87	0.79
WHC1FS	-0.47	-0.79	-0.79	-0.69	-0.4	-0.69	-0.34	0.17	-0.19	0.31	-0.23	-0.54	-0.25	0.08	-0.35	1	0	-0.28	0.37	0.23	0.42	0.79	-0.5	-0.11	-0.3	0.16	-0.17	-0.71	0.97	0.96	-0.75	0.55	0.18
WHC1YE	0.03	0.1	0.04	0.01	0.14	0.04	-0.02	0.05	0.04	-0.09	0.1	-0.03	0.07	-0.12	-0.13	0	1	-0.09	-0.07	-0.13	-0.1	0.11	-0.16	-0.18	0.08	0.07	0.02	0.06	0.03	-0.04	0.06	0.15	-0.08
WHC1YD	-0.66	-0.21	-0.36	-0.44	-0.66	-0.48	0.92	0.59	0.73	-0.2	0.45	0.91	-0.85	0.92	0.96	-0.28	-0.09	1	0.79	0.82	0.75	-0.35	0.52	0.6	0.43	0.49	0.81	0.55	-0.48	-0.09	0.41	-0.7	0.89
WHC2FS	-0.96	-0.67	-0.86	-0.88	-0.86	-0.92	0.7	0.74	0.63	-0.05	0.36	0.55	-0.99	0.93	0.68	0.37	-0.07	0.79	1	0.92	0.98	0.21	0.12	0.45	0.29	0.64	0.72	0.13	0.16	0.51	-0.03	-0.27	0.98
WHC2YE	-0.78	-0.72	-0.72	-0.67	-0.97	-0.75	0.6	0.43	0.4	0.16	0.05	0.51	-0.91	0.98	0.83	0.23	-0.13	0.82	0.92	1	0.96	-0.12	0.48	0.77	0.05	0.31	0.51	-0.01	0.01	0.45	-0.15	-0.58	0.91
WHC2YD	-0.91	-0.78	-0.87	-0.84	-0.94	-0.9	0.6	0.59	0.48	0.09	0.17	0.45	-0.96	0.94	0.69	0.42	-0.1	0.75	0.98	0.96	1	0.14	0.23	0.58	0.13	0.48	0.58	-0.03	0.2	0.59	-0.18	-0.35	0.95
WHC3FS	-0.45	-0.3	-0.59	-0.64	0.06	-0.56	-0.15	0.48	0.17	-0.15	0.3	-0.35	-0.15	-0.17	-0.56	0.79	0.11	-0.35	0.21	-0.12	0.14	1	-0.91	-0.64	0.16	0.54	0.12	-0.25	0.83	0.61	-0.27	0.88	0.07
WHC3YE	0.15	-0.11	0.22	0.33	-0.46	0.21	0.21	-0.38	-0.16	0.32	-0.41	0.35	-0.15	0.48	0.74	-0.5	-0.16	0.52	0.12	0.48	0.23	-0.91	1	0.9	-0.27	-0.49	-0.06	0.04	-0.61	-0.26	0.02	-0.97	0.22
WHC3YD	-0.19	-0.52	-0.21	-0.07	-0.79	-0.2	0.24	-0.2	-0.11	0.43	-0.44	0.29	-0.44	0.72	0.79	-0.11	-0.18	0.6	0.45	0.77	0.58	-0.64	0.9	1	-0.33	-0.33	0.02	-0.19	-0.27	0.16	-0.25	-0.88	0.48
WkHC1FS	-0.39	0.38	-0.05	-0.26	0.15	-0.18	0.69	0.72	0.81	-0.62	0.86	0.66	-0.37	0.2	0.23	-0.3	0.08	0.43	0.29	0.05	0.13	0.16	-0.27	-0.33	1	0.75	0.76	0.78	-0.33	-0.36	0.71	0.08	0.38
WkHC1YE	-0.79	-0.03	-0.53	-0.73	-0.15	-0.65	0.74	0.99	0.92	-0.57	0.91	0.6	-0.68	0.42	0.22	0.16	0.07	0.49	0.64	0.31	0.48	0.54	-0.49	-0.33	0.75	1	0.9	0.58	0.07	0.09	0.46	0.27	0.66
WkHC1YD	-0.76	0.03	-0.4	-0.59	-0.31	-0.55	0.96	0.93	0.99	-0.54	0.88	0.89	-0.79	0.66	0.6	-0.17	0.02	0.81	0.72	0.51	0.58	0.12	-0.06	0.02	0.76	0.9	1	0.76	-0.31	-0.13	0.62	-0.18	0.81
WkHC2FS	-0.16	0.65	0.29	0.06	0.26	0.13	0.78	0.56	0.81	-0.67	0.84	0.85	-0.25	0.19	0.41	-0.71	0.06	0.55	0.13	-0.01	-0.03	-0.25	0.04	-0.19	0.78	0.58	0.76	1	-0.74	-0.74	0.95	-0.23	0.29
WkHC2YE	-0.29	-0.65	-0.64	-0.54	-0.19	-0.53	-0.5	0.05	-0.31	0.29	-0.27	-0.69	-0.04	-0.14	-0.55	0.97	0.03	-0.48	0.16	0.01	0.2	0.83	-0.61	-0.27	-0.33	0.07	-0.31	-0.74	1	0.89	-0.75	0.69	-0.04
WkHC2YD	-0.54	-0.92	-0.86	-0.72	-0.62	-0.76	-0.24	0.14	-0.19	0.41	-0.32	-0.44	-0.39	0.3	-0.12	0.96	-0.04	-0.09	0.51	0.45	0.59	0.61	-0.26	0.16	-0.36	0.09	-0.13	-0.74	0.89	1	-0.79	0.31	0.33

WkHC3FS	0	0.74	0.42	0.2	0.38	0.27	0.65	0.43	0.68	-0.64	0.76	0.74	-0.09	0.04	0.29	-0.75	0.06	0.41	-0.03	-0.15	-0.18	-0.27	0.02	-0.25	0.71	0.46	0.62	0.95	-0.75	-0.79	1	-0.18	0.13
WkHC3YE	0.02	0.08	-0.14	-0.2	0.5	-0.1	-0.44	0.16	-0.08	-0.17	0.19	-0.56	0.32	-0.62	-0.87	0.55	0.15	-0.7	-0.27	-0.58	-0.35	0.88	-0.97	-0.88	0.08	0.27	-0.18	-0.23	0.69	0.31	-0.18	1	-0.39
WkHC3YD	-0.92	-0.53	-0.74	-0.79	-0.81	-0.83	0.82	0.76	0.72	-0.13	0.44	0.7	-1	0.96	0.79	0.18	-0.08	0.89	0.98	0.91	0.95	0.07	0.22	0.48	0.38	0.66	0.81	0.29	-0.04	0.33	0.13	-0.39	1

To make things easier to see I have also done this for each Site Scion.

So for **Childers Hass Clonal:**

The genetic correlation matrix between traits and times (only 2 times for Childers Hass Clonal YE).

	CHC1.FS	CHC1.YE	CHC1.Yld	CHC2.FS	CHC2.YE	CHC2.Yld	CHC3.FS	CHC3.Yld
CHC1.FS	1.000000000	0.6176621	0.9871159	0.6051222	0.009957882	0.9459634	0.5625344	0.9193547
CHC1.YE	0.617662106	1.0000000	0.6288178	0.4688637	0.125600453	0.6230221	0.4220826	0.6148480
CHC1.Yld	0.987115949	0.6288178	1.0000000	0.7247122	0.169828223	0.9856614	0.6552460	0.9704610
CHC2.FS	0.605122175	0.4688637	0.7247122	1.0000000	0.802118885	0.8305881	0.8377619	0.8695442
CHC2.YE	0.009957882	0.1256005	0.1698282	0.8021189	1.000000000	0.3336772	0.6302904	0.4025651
CHC2.Yld	0.945963359	0.6230221	0.9856614	0.8305881	0.333677245	1.0000000	0.7347171	0.9972547
CHC3.FS	0.562534447	0.4220826	0.6552460	0.8377619	0.630290449	0.7347171	1.0000000	0.7629520
CHC3.Yld	0.919354668	0.6148480	0.9704610	0.8695442	0.402565102	0.9972547	0.7629520	1.0000000

So we can see that the genetic correlation between Fruit Size and Yield Efficiency at time 1 is 0.618, and Fruit size and Yield at time 1 is 0.987. Fruit Size at time1 is highly correlated with Yield at time 3 (0.92) so could be used as a good early predictor of later yield.

We can do a similar analysis for the other sites:

Hampton Hass Clonal:

The genetic correlations between traits at Hampton (Hass Clonal) are given below. The correlation between FS at time 1 and FS at time 2 is negative (-0.491) which is a little strange but may be due to frost or something? The FS at time 1 is also negatively correlated with the Fruit size at time 3.

	HHC1.FS	HHC1.YE	HHC1.Yld	HHC2.FS	HHC2.YE	HHC2.Yld	HHC3.FS	HHC3.YE	HHC3.Yld
HHC1.FS	1.0000000	0.79322609	0.9381003	-0.49139623	0.84572785	0.9676906	-0.5529588	0.37758337	0.49760276
HHC1.YE	0.7932261	1.00000000	0.9434884	-0.52472689	0.82157019	0.6156031	-0.7333829	0.30752980	0.05397607
HHC1.Yld	0.9381003	0.94348840	1.0000000	-0.55214681	0.92784939	0.8300964	-0.6005568	0.25386582	0.20868137
HHC2.FS	-0.4913962	-0.52472689	-0.5521468	1.00000000	-0.54829167	-0.4260743	0.2673034	-0.03597846	-0.01136670
HHC2.YE	0.8457279	0.82157019	0.9278494	-0.54829167	1.00000000	0.7734668	-0.2668672	-0.11510753	-0.03098468
HHC2.Yld	0.9676906	0.61560314	0.8300964	-0.42607430	0.77346675	1.0000000	-0.3900996	0.32910367	0.59758187
HHC3.FS	-0.5529588	-0.73338291	-0.6005568	0.26730338	-0.26686720	-0.3900996	1.0000000	-0.84307036	-0.45376380
HHC3.YE	0.3775834	0.30752980	0.2538658	-0.03597846	-0.11510753	0.3291037	-0.8430704	1.00000000	0.79417135
HHC3.Yld	0.4976028	0.05397607	0.2086814	-0.01136670	-0.03098468	0.5975819	-0.4537638	0.79417135	1.00000000

Walkamin Hass Clonal

The genetic correlations between traits and times at Walkamin Hass Clonal are as follows:

	WHC1.FS	WHC1.YE	WHC1.Yld	WHC2.FS	WHC2.YE	WHC2.Yld	WHC3.FS	WHC3.YE	WHC3.Yld
WHC1.FS	1.00	0.87	0.91	0.68	0.07	0.13	0.55	0.45	0.79
WHC1.YE	0.87	1.00	0.96	0.52	0.37	0.43	0.36	0.68	0.98
WHC1.Yld	0.91	0.96	1.00	0.72	0.11	0.18	0.58	0.52	0.89
WHC2.FS	0.68	0.52	0.72	1.00	-0.60	-0.55	0.95	-0.08	0.33
WHC2.YE	0.07	0.37	0.11	-0.60	1.00	1.00	-0.70	0.71	0.56
WHC2.Yld	0.13	0.43	0.18	-0.55	1.00	1.00	-0.65	0.74	0.61
WHC3.FS	0.55	0.36	0.58	0.95	-0.70	-0.65	1.00	-0.20	0.16
WHC3.YE	0.45	0.68	0.52	-0.08	0.71	0.74	-0.20	1.00	0.76
WHC3.Yld	0.79	0.98	0.89	0.33	0.56	0.61	0.16	0.76	1.00

WA Hass Clonal

The genetic correlations between traits and times at WA Hass clonal are given below. The genetic correlation between Fruit Size at time 1 is not highly correlated with Yld at time 3 (-0.04) as was observed at some of the other sites. The genetic correlation between Fruit size at time 1 and yield

efficiency at time 1 was highly negative (-0.91). So if RS were selected based on Yield efficiency at time 1 (in this trial) they are likely to have small fruit size.

	WAHC1.FS	WAHC1.YE	WAHC1.Yld	WAHC2.FS	WAHC2.YE	WAHC2.Yld	WAHC3.FS	WAHC3.YE	WAHC3.Yld
WAHC1.FS	1.00	-0.91	-0.43	0.65	0.04	0.14	-0.25	-0.49	-0.04
WAHC1.YE	-0.91	1.00	0.02	-0.91	-0.45	-0.53	0.26	0.09	-0.38
WAHC1.Yld	-0.43	0.02	1.00	0.40	0.89	0.83	0.02	1.00	0.92
WAHC2.FS	0.65	-0.91	0.40	1.00	0.78	0.84	-0.23	0.34	0.73
WAHC2.YE	0.04	-0.45	0.89	0.78	1.00	0.99	-0.11	0.85	1.00
WAHC2.Yld	0.14	-0.53	0.83	0.84	0.99	1.00	-0.13	0.79	0.98
WAHC3.FS	-0.25	0.26	0.02	-0.23	-0.11	-0.13	1.00	0.04	-0.09
WAHC3.YE	-0.49	0.09	1.00	0.34	0.85	0.79	0.04	1.00	0.89
WAHC3.Yld	-0.04	-0.38	0.92	0.73	1.00	0.98	-0.09	0.89	1.00

Walkamin Shepard Clonal

	WSC1.FS	WSC1.YE	WSC1.Yld	WSC2.FS	WSC2.YE	WSC2.Yld	WSC3.FS	WSC3.YE	WSC3.Yld
WSC1.FS	1.000	0.999	0.881	-0.536	0.406	0.781	-0.174	0.633	0.769
WSC1.YE	0.999	1.000	0.897	-0.571	0.365	0.808	-0.213	0.616	0.796
WSC1.Yld	0.881	0.897	1.000	-0.766	0.016	0.922	-0.479	0.420	0.911
WSC2.FS	-0.536	-0.571	-0.766	1.000	0.499	-0.909	0.776	-0.049	-0.903
WSC2.YE	0.406	0.365	0.016	0.499	1.000	-0.254	0.724	0.595	-0.259
WSC2.Yld	0.781	0.808	0.922	-0.909	-0.254	1.000	-0.679	0.263	0.991
WSC3.FS	-0.174	-0.213	-0.479	0.776	0.724	-0.679	1.000	0.211	-0.678
WSC3.YE	0.633	0.616	0.420	-0.049	0.595	0.263	0.211	1.000	0.255
WSC3.Yld	0.769	0.796	0.911	-0.903	-0.259	0.991	-0.678	0.255	1.000

VII. Investigation into spatial correlation at the different trials and whether this changed over time

The trees were planted at different spacings at each of the locations. I have looked into the spatial correlations between neighbouring plots at each time to see if there was any effect of planting density on spatial correlation.

```
Ytest2.asr<-asreml(Yld~at(ExptTime):Trt,
        random =~at(ExptTime):Rep ,
        rcov=~at(ExptTime):ar1(Col):ar1(Row),
        data=Y.longs3,na.method.X='include')
```

The spatial correlations in the Row direction (most trials had limited column numbers so the column spatial correlation was not investigated) are presented below. It is intereating to note that almost all of the spatial correlation parameters at Childers are negative. This could indicate competition effects between trees at this site.

I am assuming the between tree spacing (within a row) is 5m while at Hampton and Walkamin this spacing is 6 m so perhaps the spacing is having some effect? I will look at the effect of competition at this site and see if I come up with anything.

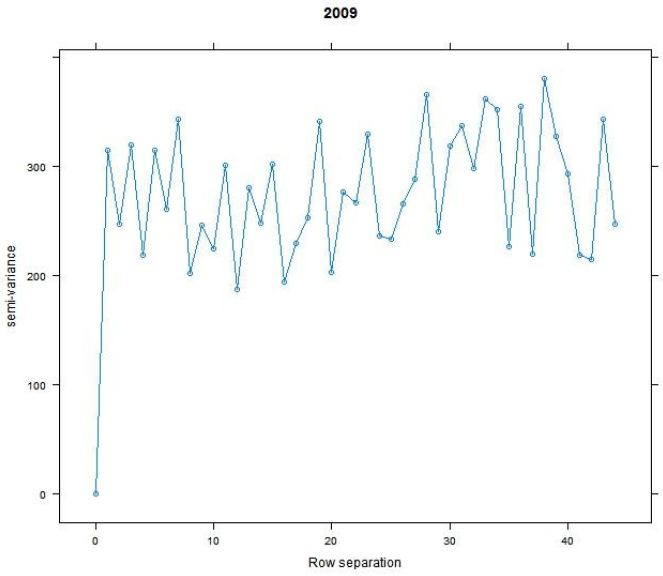
The spacing at WA is even smaller (3m) but the negative spatial correlation parameters are not so prolific at this site.

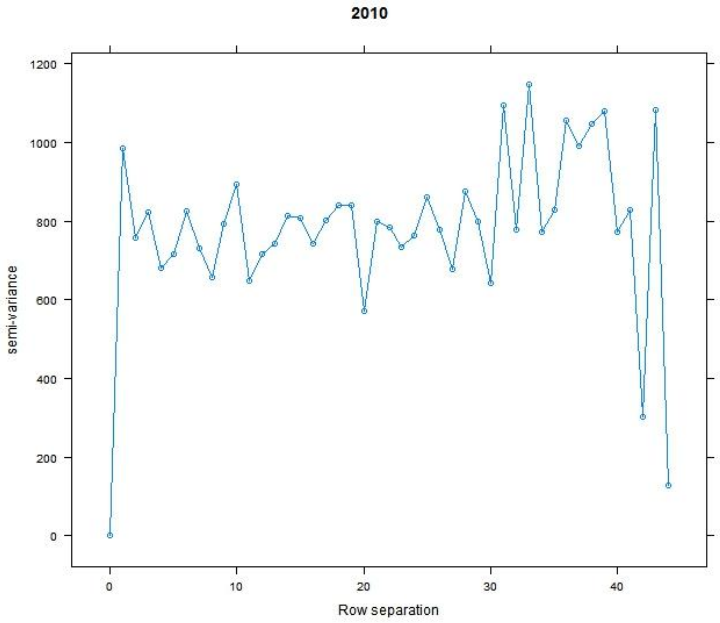
Site Scion Year	Row spatial correlation	se
ExptTime_Childers Hass_clonal 2007!Row.cor	-0.045	0.151
ExptTime_Childers Hass_clonal 2008!Row.cor	-0.105	0.136
ExptTime_Childers Hass_clonal 2009!Row.cor	-0.120	0.122
ExptTime_Childers Hass_clonal 2010!Row.cor	-0.192	0.130
ExptTime_Childers Hass_clonal 2011!Row.cor	-0.203	0.124
ExptTime_Childers Hass_clonal 2012!Row.cor	-0.041	0.177
ExptTime_Childers Hass_seedling 2007!Row.cor	0.053	0.106
ExptTime_Childers Hass_seedling 2008!Row.cor	-0.273	0.105
ExptTime_Childers Hass_seedling 2009!Row.cor	-0.224	0.097
ExptTime_Childers Hass_seedling 2010!Row.cor	-0.122	0.116
ExptTime_Childers Hass_seedling 2011!Row.cor	-0.277	0.105
ExptTime_Childers Hass_seedling 2012!Row.cor	-0.136	0.144

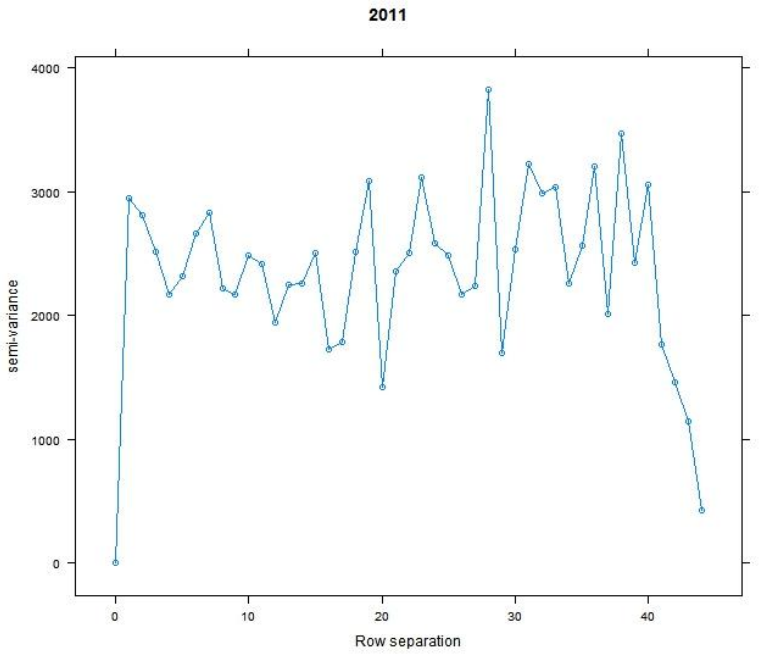
ExptTime_Childers Shepard_seedling 2007!Row.cor	-0.037	0.140
ExptTime_Childers Shepard_seedling 2009!Row.cor	-0.381	0.103
ExptTime_Childers Shepard_seedling 2010!Row.cor	-0.132	0.114
ExptTime_Childers Shepard_seedling 2011!Row.cor	-0.300	0.121
ExptTime_Childers Shepard_seedling 2012!Row.cor	0.119	0.122
ExptTime_Hampton Hass_clonal 2007!Row.cor	-0.024	0.132
ExptTime_Hampton Hass_clonal 2008!Row.cor	0.433	0.099
ExptTime_Hampton Hass_clonal 2009!Row.cor	0.352	0.100
ExptTime_Hampton Hass_clonal 2010!Row.cor	0.422	0.112
ExptTime_Hampton Hass_clonal 2011!Row.cor	-0.150	0.125
ExptTime_Hampton Hass_clonal 2012!Row.cor	0.134	0.155
ExptTime_Hampton Hass_seedling 2007!Row.cor	-0.040	0.137
ExptTime_Hampton Hass_seedling 2008!Row.cor	0.107	0.117
ExptTime_Hampton Hass_seedling 2009!Row.cor	-0.084	0.112
ExptTime_Hampton Hass_seedling 2010!Row.cor	0.102	0.130
ExptTime_Hampton Hass_seedling 2011!Row.cor	-0.187	0.121
ExptTime_Hampton Hass_seedling 2012!Row.cor	-0.093	0.142
ExptTime_WA Hass_clonal 2008!Row.cor	-0.117	0.191
ExptTime_WA Hass_clonal 2009!Row.cor	0.168	0.146
ExptTime_WA Hass_clonal 2010!Row.cor	0.215	0.218
ExptTime_WA Hass_clonal 2011!Row.cor	-0.048	0.235
ExptTime_WA Hass_clonal 2012!Row.cor	0.295	0.181
ExptTime_WA Hass_seedling 2008!Row.cor	0.041	0.133
ExptTime_WA Hass_seedling 2009!Row.cor	0.070	0.155
ExptTime_WA Hass_seedling 2010!Row.cor	0.228	0.181
ExptTime_WA Hass_seedling 2011!Row.cor	0.423	0.113
ExptTime_WA Hass_seedling 2012!Row.cor	0.065	0.179
ExptTime_Walkamin Hass_clonal 2007!Row.cor	0.124	0.132
ExptTime_Walkamin Hass_clonal 2008!Row.cor	0.053	0.159
ExptTime_Walkamin Hass_clonal 2009!Row.cor	0.356	0.129

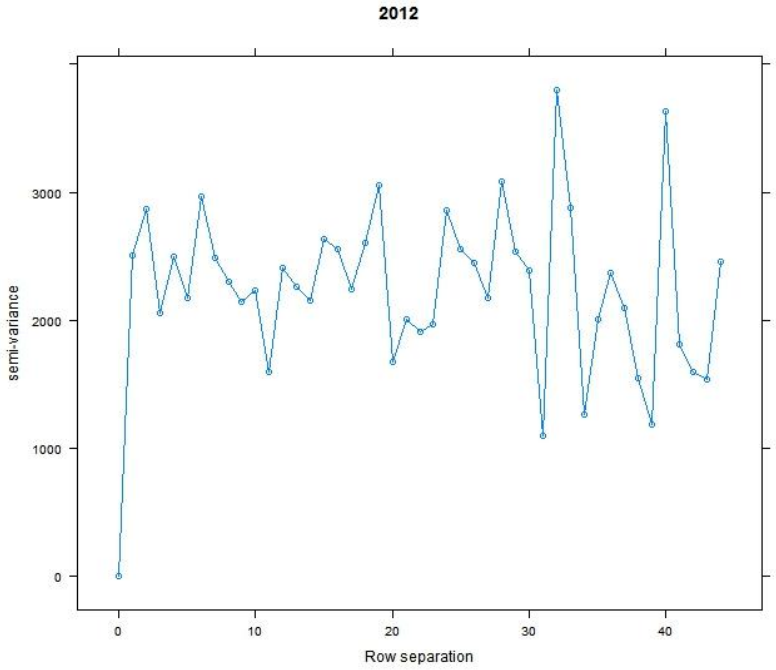
ExptTime_Walkamin Hass_clonal 2010!Row.cor	-0.099	0.181
ExptTime_Walkamin Hass_clonal 2011!Row.cor	0.185	0.174
ExptTime_Walkamin Hass_clonal 2012!Row.cor	-0.026	0.183
ExptTime_Walkamin Hass_seedling 2007!Row.cor	0.022	0.143
ExptTime_Walkamin Hass_seedling 2008!Row.cor	0.245	0.131
ExptTime_Walkamin Hass_seedling 2009!Row.cor	0.385	0.130
ExptTime_Walkamin Hass_seedling 2010!Row.cor	0.119	0.123
ExptTime_Walkamin Hass_seedling 2011!Row.cor	0.191	0.139
ExptTime_Walkamin Hass_seedling 2012!Row.cor	0.149	0.132
ExptTime_Walkamin Shepard_clonal 2007!Row.cor	0.104	0.118
ExptTime_Walkamin Shepard_clonal 2008!Row.cor	0.139	0.113
ExptTime_Walkamin Shepard_clonal 2009!Row.cor	0.239	0.121
ExptTime_Walkamin Shepard_clonal 2010!Row.cor	0.388	0.112
ExptTime_Walkamin Shepard_clonal 2011!Row.cor	0.107	0.148
ExptTime_Walkamin Shepard_clonal 2012!Row.cor	0.279	0.160
ExptTime_Walkamin Shepard_seedling 2007!Row.cor	0.272	0.129
ExptTime_Walkamin Shepard_seedling 2008!Row.cor	0.040	0.114
ExptTime_Walkamin Shepard_seedling 2009!Row.cor	0.263	0.134
ExptTime_Walkamin Shepard_seedling 2010!Row.cor	0.033	0.149
ExptTime_Walkamin Shepard_seedling 2011!Row.cor	0.116	0.153
ExptTime_Walkamin Shepard_seedling 2012!Row.cor	-0.033	0.125

The plots below (variogram slice) are for Childers Hass clonal 2009-2012. They mostly showing a spike at lag1. This is usually indicative of competition effects. It is seen at 2009-2011 but strangely not 2012. I would have expected that the trees would have been more effected by competition effects as they got older but perhaps they were pruned or something in 2012? Anyway it is just a point of interest. It would seem that neighbouring trees may be having an impact on each other (negatively correlated with neighbouring trees).

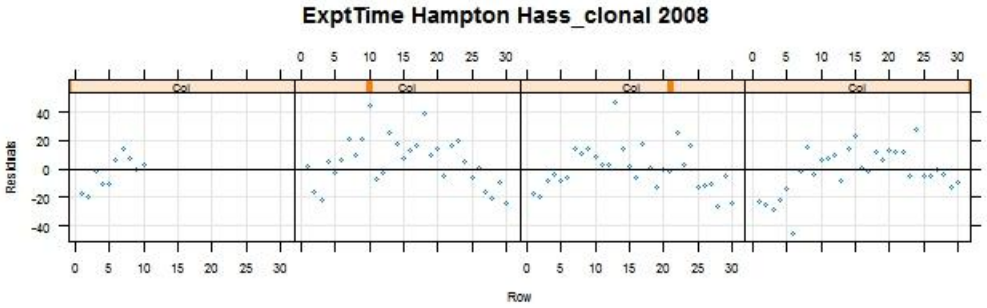

2009
semi-variance
0
100
200
300
0
10
20
30
40
Row separation

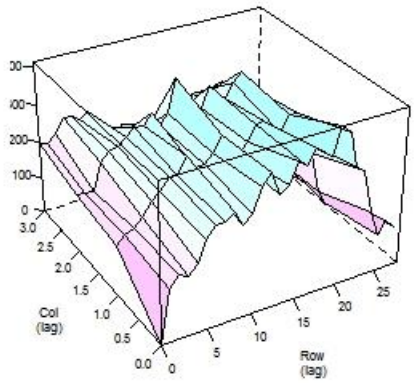

2010
semi-variance
0
200
400
600
800
1000
1200
0
10
20
30
40
Row separation


2011
semi-variance
Row separation
0
1000
2000
3000
4000
0
10
20
30
40


2012
semi-variance
Row separation
0
1000
2000
3000
0
10
20
30
40

Another interesting observation with regards to spatial correlation and trends is at Hampton Hass Clonal Year 2008.
The residual plots & variogram for this trial are given below. The residual plots show a trend along the rows within each Column where the trees on the end of each row have low yield and then the yield increases as you move along the row until it starts decreasing agaian when getting to the end of the row. This effect was not observed at the other years at this trial.





References:

Bevington & Cullis (1990) Evaluation of rootstocks for Marsh & Davis grapefruit AJEA 30(3) 405-411

Campbell, Nicol & Cullis (1996) Effect of 4 different canopy shapes on apple yields AJEA 36, 489-499

De Faveri, Verbyla, Pitchford, Venkatanagappa & Cullis (2015) Statistical methods for analysis of multi-harvest data from perennial
pasture variety selection trials. Crop Science 66 Issue 9

Durand et al (2013) New insights for estimating the genetic value of segregating apple progenies for irregular bearing during the first years of tree production Journal of Experimental Botany

Hobyln, Grubb, Painter, Wates (1936) J Pomology 14:39-76

Huff (2001) A significance test for biennial bearing using data resampling Journal of Horticultural Science and biotechnology 76, 534-535

Smith et al (2004) Long term performance of Ellendale mandarin on seven commercial rootstocks in subtropical Australia. Scientia Horticulturae 102, 75-89

Smith AB, Stringer JK, Wei X, Cullis BR (2007) Varietal selection for perennial crops where data relate to multiple harvests from a series of field trials. Euphytica **157**, 253-266.

Verbyla & Cullis (1992) The analysis of multi-stratum and spatially correlated repeated measures data. Biometrics 48, 1015 -1032

Appendix 3. MET Multi-harvest Analysis of Avocado Rootstock data (all Hass Scion data) November 2015

Clonal and seedling trials

A multi-environment (MET) multi-harvest analysis across both Hass Scion clonal and seedling trials has been performed using the data from all individual years (not combining consecutive years as was done previously). This analysis across sites and propagation types for Hass Scion trees aimed to investigate rootstock (RS) genotype by environment interaction (GxE) whilst also allowing an insight into biennial bearing. A form of this model has also been used to provide a rough test between overall mean level for the two propagation types (clonal vs seedling) using Sites as replicates.

The clonal trials involved 10 replicate trees (considered genetically identical) of each RS (Trt). Interest lies in predicting the RS (Trt) means over trials and times and investigating whether the RS perform differently over the different locations and years. It is desirable to model the genetic correlation between sites and also times. For this reason we have fitted Trt by Trial/Time effects as random effects in the model.

With the seedling trials there is the added complication that there is within rootstock genetic variance (as the 10 "Reps" are RS seedlings with the same RS Mother but which are not genetically identical (as the clones are)). To really assess the individual progeny we would need to include a pedigree linking the seedlings and their parents. However even for the seedling trials we are most interested in predicting means for each RS (Trt) (RS Mother variety of seedlings) rather than the individual progeny (which may be genetically different within each Trt or family) – so we have fitted a "family" genetic model for the seedling trials (which is essentially the same as the genetic model fitted for the clonal trials) with Trt by Trial/Time effects as random effects.

Our analysis has correlated the RS (Trt) effects across Sites & Propagation types & years (using a factor ExptTime with 46 levels) allowing us to investigate the genetic correlations between these 46 "experiment times", and thereby predicting RS means for each Trial by Time and also cumulative yield predictions across all times.

Method:

<u>Statistical Model</u>

Each trait (yield, Fruit wt and yield efficiency) was analysed in a MET multi-harvest analysis over the 8 Hass Scion "trials" (4 sites by 2 propagation types) by 5-6 times (depending on site). The analyses modelled the spatial and temporal correlation present and modelled the genetic effects over trials and times. The analysis (of each trait) was based on a linear mixed model with estimation using residual maximum likelihood (REML). The analyses were performed in ASReml-R (Butler et al 2009).

The following paragraphs define the notation for the linear mixed model used for analysis. Suppose we have t trials in which m rootstock (RS) varieties are grown (not all RS varieties are grown in all trials). The j^{th} trial consists of n_j plots in a rectangular array consisting of c_j columns by r_j rows ($n_j=c_jr_j$). Let h_j denote the number of harvests for the j^{th} trial and let $h+$ be the total number of trial by harvest

combinations ($h+=\sum_{j=1}^{t} h_j$) . Let y_j be the $h_j n_j$ x1 vector of observations (eg yield) for trial *j*, ordered as rows within columns within harvests. The data combined across trials is denoted by $=(y_1^T, y_2^T, \ldots, y_t^T)^T$; this is an Nx1 vector with $N = \sum_{j=1}^{t} h_j n_j$.

A linear mixed model for the data ***y*** may be written as:

$$y = X\tau + Z_g u_g + Z_o u_o + e$$

where τ is a vector of fixed effects with design matrix *X*, u_g is a vector of random variety (or genetic) effects for individual trial by harvest combinations, with design matrix Z_g, u_o is a vector of other non-genetic random effects (e.g. replicate effects) at each time with design matrix Z_o, and ***e*** is the vector of random residual effects.

The random effects from the linear mixed model are assumed to follow a Normal distribution with zero mean vector and variance–covariance matrix :

$$var\left(\begin{bmatrix} u_g \\ u_o \\ e \end{bmatrix}\right) = \begin{bmatrix} G_g & 0 & 0 \\ 0 & G_o & 0 \\ 0 & 0 & R \end{bmatrix}$$

The variance model for the random non-genetic effects is given by $G_o = \mathrm{var}(u_o) = \sigma_o^2 I$.

At the genetic level in MET multi-harvest trials the aim is to model the interaction between trial, harvest within trial and variety. This is variety x environment (or gxe) interaction where environment not only includes location but also harvest or time effects.

In general form the variance matrix $\mathbf{G_g}$ for the genetic effects (u_g), across harvests and trials may be represented by

$$G_g = G_{th} \otimes I_m$$

Where G_{th} is a h+ x h+ genetic variance matrix indexed by all the trial by harvest combinations and I_m is the assumed structure for the RS varieties.

In the following analyses we need to find suitable models for the genetic variance matrix G_{th} (which consists of genetic variances for each trial by harvest and genetic covariances (or correlations) between trial by harvest combinations. As the number of trial by harvest combinations may be large (in our case 46 combinations for yield) the genetic variance matrix is too large to be modelled using a fully unstructured matrix. An alternative is to use factor analytic models (Smith et al 2001) which provide a good approximation to the unstructured form but use a much smaller number of parameters. In the analyses of avocado rootstock data we have used factor analytic models of order 2 or 3 depending on the trait (based on REMLRT tests). To interpret the results from fitting the factor analytic model the clustering techniques of Cullis et al 2010 have been implemented**.**

In MET trials the full residual covariance matrix R is typically given by a block diagonal matrix

$$R = diag(R_j)$$

Where R_j is the residual variance matrix for the j^{th} trial. Therefore each trial has it's own residual covariance structure and residuals are assumed independent between trials.

Within each trial it is important to suitably model the spatial correlation and temporal correlation between repeated measurements. In the following analyses we have assumed a three-way separable spatio-temporal process for the residual variance structure for a trial (Smith et al 2007, De Faveri et al 2015). Therefore the structure for each R_j is assumed to be :

$$R_j = R_{hj} \otimes \sum_{cj} \otimes \sum_{rj}$$

Where R_{hj} is a h_j x h_j covariance matrix for trial j that incorporates temporal correlation (between harvests) and possibly heterogeneous variance across harvests, and Σ_{cj} and Σ_{rj} are the c_j x c_j and r_j x r_j column and row spatial correlation matrices.

In the analyses the temporal covariance component (R_{hj}) has been modelled using antedependence models. An antedependence model of order *s* assumes that the *jth* observation (*j > s*), given the *s* proceeding observations, is independent of all other proceeding observations (Gabriel, 1962). The model is more flexible than the exponential or autoregressive models in that it allows the variances for each harvest time to differ and allows for different antedependence coefficients for each harvest.

Results:

Yield

1. Model to test effect of Propagation type (Clonal or Seedling)

   As there were 4 sites (Childers, Hampton, WA, Walkamin) each with 2 separately planted propagation type "trials" (clonal and seedling) we are able to form a rough test on overall propagation type effect and also Propagation by Year effects by using Site as a replicate.

   There was no significant Propagation by Year interaction so this was removed and a test made on the overall Propagation type. This was also not significant (P=0.4241). So the Propagation type was not significant on Yield (no sig difference in overall mean level for Yield between clonal and seedling rootstocks). This is a very rough overall test as we are using Sites as our replicates and there were only 4 sites.

   ```
   HCF2.asr<-asreml(Yld~Yrf+Prop,
            random=~fa(ExptTime,2):Trtn+at(Yrf):Site/Wplot/Rep,
            rcov=~at(SiteScion):ante(Yrf):id(Col):ar1(Row),
            workspace=2e7,data=H.long,na.method.X='include',maxiter=30,
            R.param=HCF1.asr$R.param, G.param=HCF1.asr$G.param)
   ```

```
               Df Sum of Sq Wald statistic Pr(Chisq)
(Intercept)     1    24.619         24.619 6.986e-07 ***
Yrf             5    46.073         46.073 8.776e-09 ***
Prop            1     0.639          0.639    0.4241
residual (MS)         1.000
```

2. Model to look at GxE and best RS varieties across all Hass clonal and seedling trials

The MET multiharvest linear mixed model analysis outlined above in the Statistical Model Section was fitted to the combined yield data from all Hass Scion trials (4 sites by 2 Propagation types) by 5-6 years. The asreml-R model call is given below.

```
HCF4.asr<-asreml(Yld~ExptTime,
        random=~fa(ExptTime,3):Trtn+at(ExptTime):Rep,
        rcov=~at(SiteScion):ante(Yrf):id(Col):ar1(Row),
        workspace=2e7,data=H.long,na.method.X='include',maxiter=30,
        R.param=HCF3.asr$R.param, G.param=HCF3.asr$G.param)
```

The RS by trial by time genetic variance structure was modelled using a factor analytic model of order 3 (FA3). This model was chosen based on REML likelihood ratio tests (REMLRT) as shown in Table 1. The FA3 model explained 98% of the variance and including further factors (FA4) was shown not to be a significant improvement.

Table 1.

G Model	Loglikelihood	Remlrt	Pr	%VAF	
FA1	-13403			61%	
FA2	-13349	109.2 45df	<0.001	95%	
FA3	-13310	76.6 44df	0.002	98%	
FA4	-13286	47.8 43df	0.28 n.s	100%	

The genetic correlations between Trials and Times are presented below in a heatmap (Fig1).

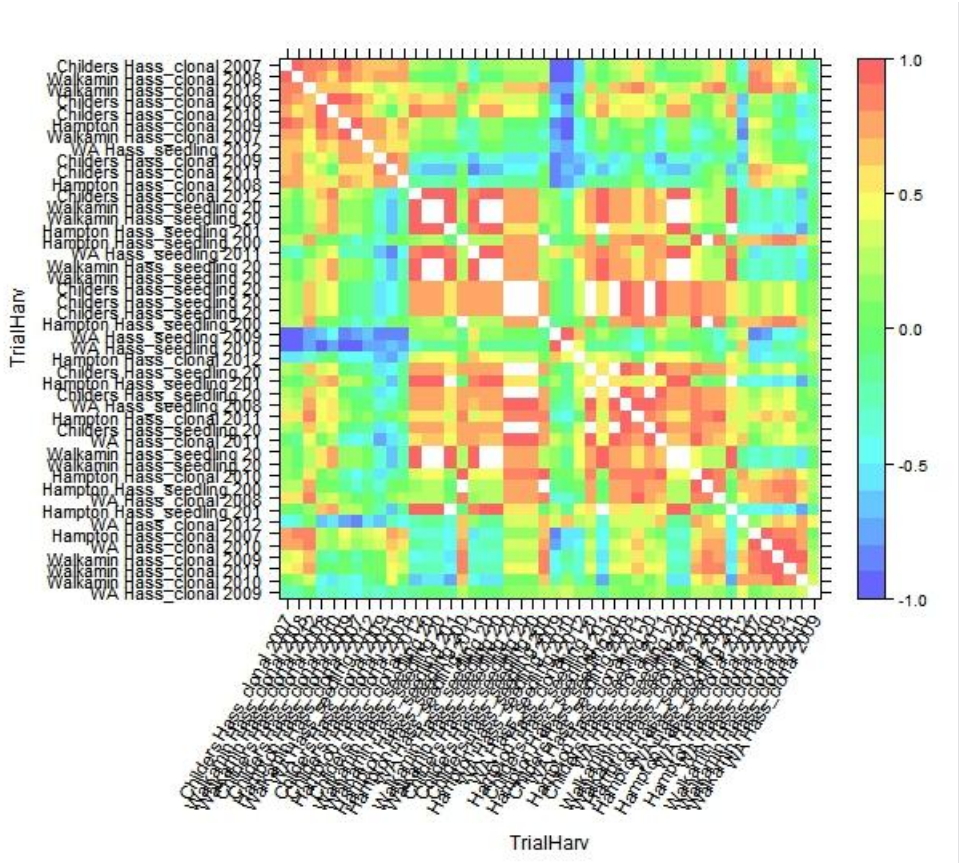


Fig1. Heatmap representation of the genetic correlations between the Trials by harvests.

The predictions for each RS over time at each Site by Propagation type “Trial” are presented in the plots below. The plots show the environment (both Site and year) have a large effect on the RS performance.

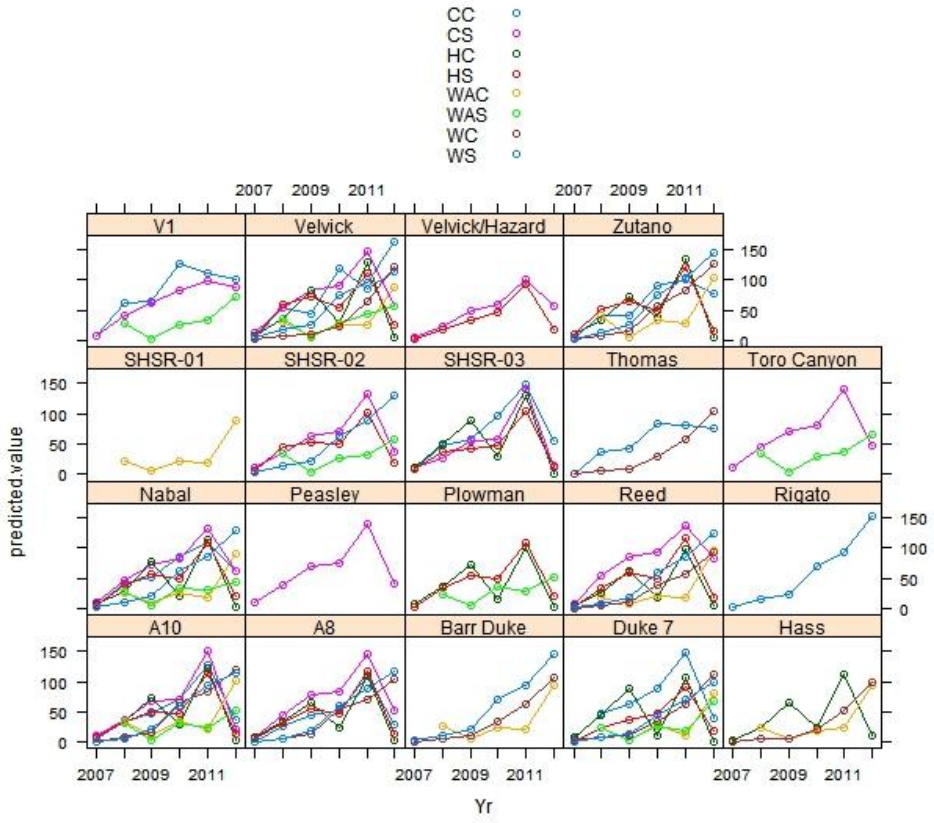


Fig 2. Plot showing predicted Yield for each Rootstock over time with each line representing the different Site by Clonal/Seedling trials.

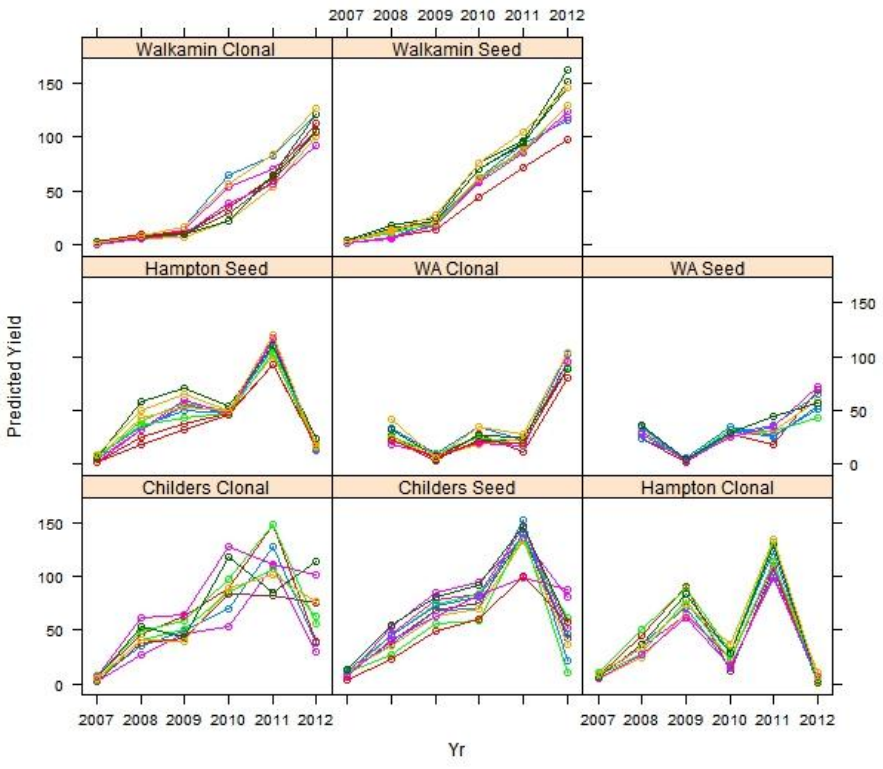


Fig 3. Plot showing predicted yield for each Rootstock over time at each of the 8 Trials.

Cumulative Yield

The cumulative yield has been predicted for each year and is presented in the plots below. The predictions are given in the attached Excel spreadsheet (HassSCpred_MET.xlsx).

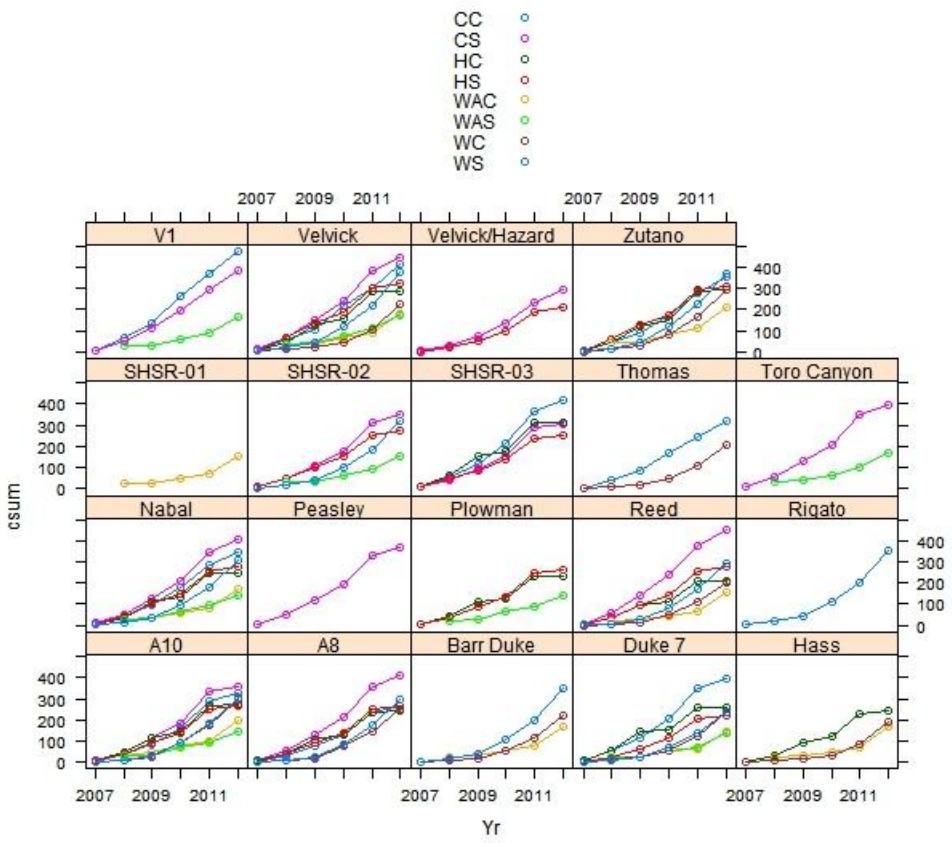


Fig4. Cumulative yield across years for each RS at each Trial. Each panel shows RS performance for a particular RS variety.

The plot above (Fig4) shows the cumulative yield of each RS variety at each of the Site by Clonal/seedling trials (eg CC = Childers clonal, CS = Childers Seedling etc).

The plot below(Fig5) shows the same cumulative predictions over time but this time showing each of the Site by Clonal/Seedling trials as a separate panel and the RS varieties within each. The rootstocks in each trial follow a similar pattern and the differences between RS are more apparent at some sites than others. For example at the WA trials the differences between varieties are small whereas at the Childers trials the varieties differ more. It is difficult to identify the varieties within this plot. Figure 6 shows the cumulative yield over all years for each RS variety – so the best performing RS can be seen at each Site by Seedling/Clonal trial.

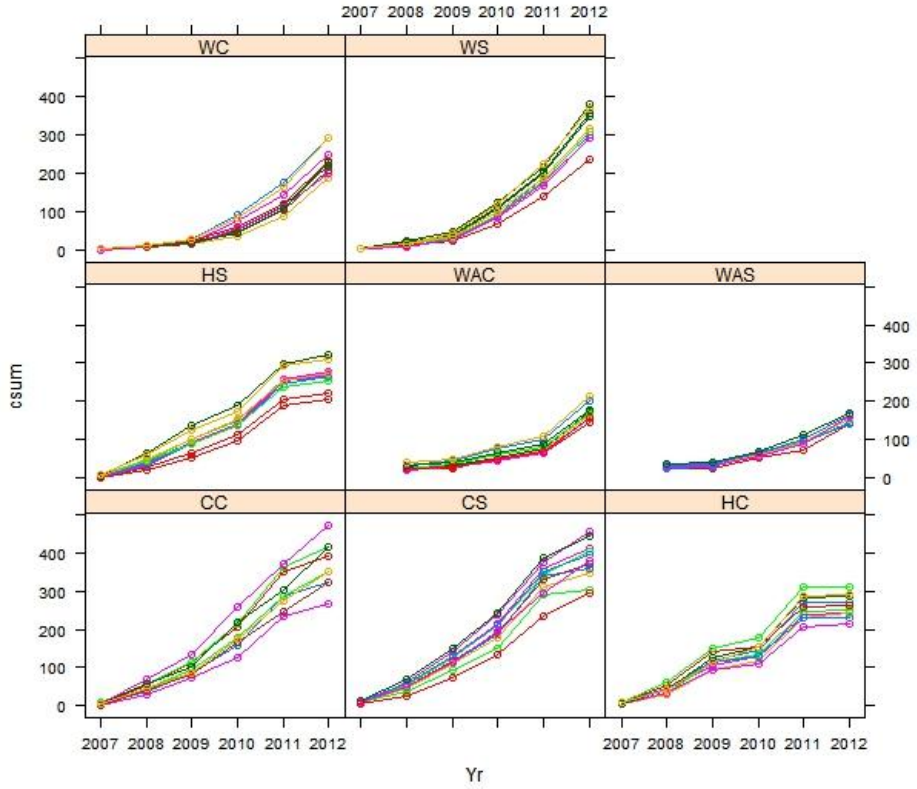


Fig 5. Cumulative yield across years for each RS at each Trial. Each panel shows RS performance at a particular trial.

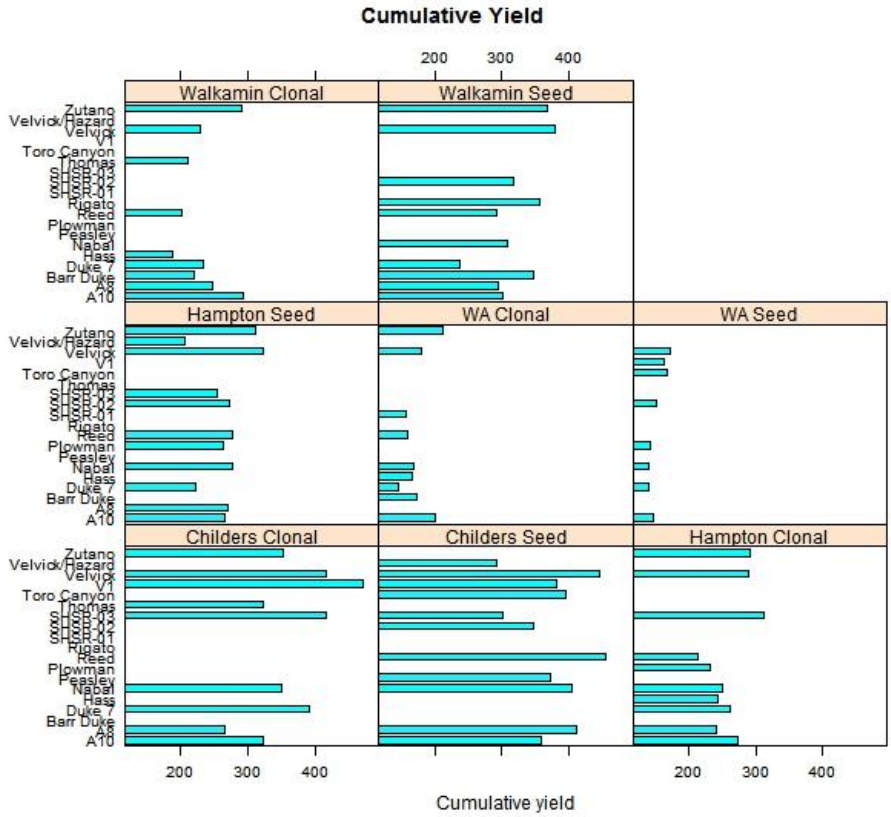


Fig 6. Total cumulative yield for each RS variety at each Trial.

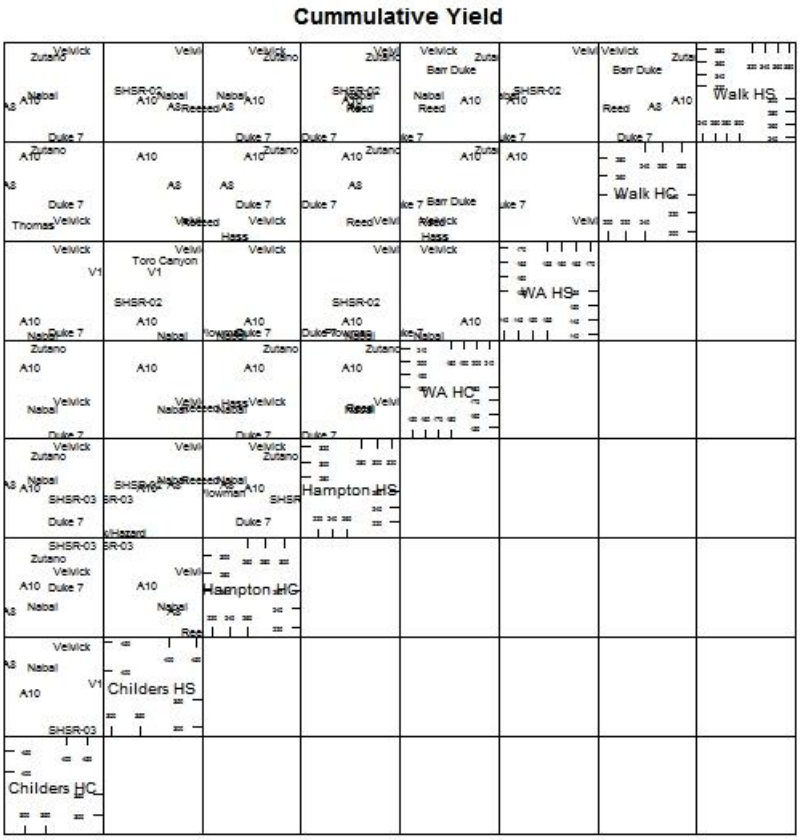


Fig 7. Paiwise plot showing RS performance across Trials.

Figure 7 shows the variety rankings for cumulative yield differ between pairs of sites so there is evidence of gxe. RS variety Velvick is the highest ranked performer at all Seedling trials but is not the highest in the clonal trials. Zutano is the top ranked RS variety at WA and Walkamin Clonal trials while V1 is top at Childers clonal and SHSR-03 is top ranked at Hampton Clonal.

Biennial bearing.

There is evidence of biennial bearing at an overall site level. In Fig3 we can see that there is a strong biennial bearing pattern for all RS varieties at Hampton (especially the clonal trial but also the seedling trial). Childers also shows a similar pattern but it can be seen that some RS varieties may not follow this overall trend so closely. To a lesser extent the pattern can be also seen at WA trials. At Walkamin there is no clear overall biennial pattern in either the seedling & clonal trials.

A plot of overall site by Year means is given below to see the overall site biennial patterns. It can be seen that the overall biennial pattern starts earlier at Hampton (first decline after 2009) than Childers (first decline after 2011). At WA the biennial pattern is not so dramatic however it does seem that there may be a consistent up down pattern from the initial year (2008).

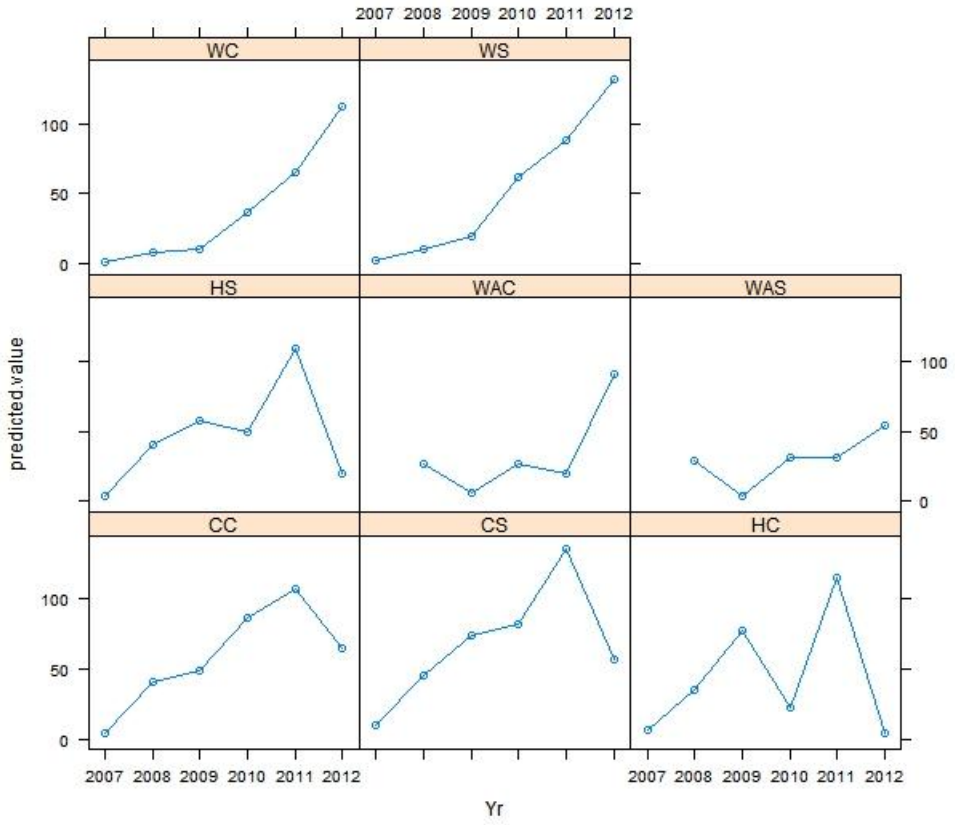


Fig 8. Overall Yield means for each Trial by Year

In the analysis of yield described previously we have modelled the variety deviations from these overall site by year means. (We have fitted a fixed effect term ExptTime which fits a mean level for each of the 46 trial by year combinations).

In the analysis we have modelled the genetic correlation between years and so can see if there is any clear re-ranking of varieties over the years (as indicated by negative correlations between successive years). This change in rankings (after removing the overall trial mean levels) could indicate biennial bearing at the genetic level (so that some RS varieties may show more or less tendency for biennial bearing than others). If the genetic correlations are positive & high between successive years it would indicate that the varieties are following a similar pattern over time (which may or may not be alternating depending on the site).

The analysis also models the residual correlation between years at the individual tree level so negative correlations between successive years at the residual tree level may indicate a biennial bearing pattern for individual trees that differs from any overall environment level pattern or overall variety level pattern.

A complication with this investigation is that some trees appear out of phase (having an on year when others have an off year) with other trees within that variety (and or environment) so while the pattern might be identified to be at the individual tree level rather than variety level – it could just be that some trees of a particular variety are out of phase with the others of that variety and so may have started the biennial bearing pattern a year earlier.

While these investigations into biennial bearing may not be conclusive they may provide insight into the biennial bearing tendency of the trees in these trials and whether it is attributable to sites / varieties or individual trees. To investigate the issue of biennial bearing further and to possibly identify varieties that are more consistent across years will require further analyses which may need to take into account the phase of individual trees. This is the subject of further work.

The Genetic correlations between years at each trial are as follows:

CC

1	0.82	0.66	0.71	0.66	0.23
0.82	1	0.48	0.97	0.21	0.67
0.66	0.48	1	0.28	0.82	-0.27
0.71	0.97	0.28	1	0	0.82
0.66	0.21	0.82	0	1	-0.57
0.23	0.67	-0.27	0.82	-0.57	1

CS

1	0.43	0.44	0.29	0.75	-0.39
0.43	1	0.98	0.98	0.55	0.54
0.44	0.98	1	0.95	0.66	0.42
0.29	0.98	0.95	1	0.4	0.67
0.75	0.55	0.66	0.4	1	-0.39
-0.39	0.54	0.42	0.67	-0.39	1

HC

1	0.62	0.43	0.36	0.56	-0.57
0.62	1	0.73	-0.18	0.2	-0.56
0.43	0.73	1	-0.24	0.29	-0.46
0.36	-0.18	-0.24	1	0.86	0.23
0.56	0.2	0.29	0.86	1	0
-0.57	-0.56	-0.46	0.23	0	1

HS

1	0.34	0.18	-0.05	0.49	-0.47
0.34	1	0.87	0.89	0.39	0.63
0.18	0.87	1	0.72	0.69	0.52
-0.05	0.89	0.72	1	0.01	0.9
0.49	0.39	0.69	0.01	1	-0.25
-0.47	0.63	0.52	0.9	-0.25	1

WAC

1	0.16	0.79	0.66	0.44
0.16	1	0.1	0.25	0.44
0.79	0.1	1	0.21	0.31
0.66	0.25	0.21	1	0.62
0.44	0.44	0.31	0.62	1

WAS

1	-0.11	-0.28	0.66	0
-0.11	1	0.9	0.55	-0.66
-0.28	0.9	1	0.2	-0.71
0.66	0.55	0.2	1	-0.27
0	-0.66	-0.71	-0.27	1

WC

1	0.75	-0.26	-0.5	-0.17	0.41
0.75	1	0.44	0.16	0.52	0.84
-0.26	0.44	1	0.94	0.98	0.62
-0.5	0.16	0.94	1	0.87	0.32
-0.17	0.52	0.98	0.87	1	0.75
0.41	0.84	0.62	0.32	0.75	1

WS

1	0.99	0.65	0.8	0.52	0.92
0.99	1	0.54	0.71	0.4	0.87
0.65	0.54	1	0.93	0.98	0.74
0.8	0.71	0.93	1	0.92	0.92
0.52	0.4	0.98	0.92	1	0.69
0.92	0.87	0.74	0.92	0.69	1

At Walkamin both trials show positive genetic correlations between all pairs of consecutive years so there is no evidence of different varieties having different biennial bearing tendencies.

At the WA seedling trial there is a negative genetic correlation between years 2011 & 2012 while the correlations are all positive for WA clonal.

At Hampton there is a negative genetic correlation between years 2011 & 2012 for the seedling trial and a negative correlation between years 2009&2010 at the clonal trial.

At Childers there is a negative correlation between years 2011 and 2012 for both trials.

These negative genetic correlations (in the times when there was an overall biennial bearing pattern identified) may indicate a variety basis to genetic bearing with some varieties performing differently to the overall environment biennial bearing pattern.

At the residual or individual tree level the correlations between years from each trial are as follows:

```
s1CC
       2007   2008   2009   2010   2011   2012
2007  1.000  0.229  0.077 -0.016  0.007 -0.004
2008  0.229  1.000  0.334 -0.069  0.029 -0.019
2009  0.077  0.334  1.000 -0.208  0.086 -0.057
2010 -0.016 -0.069 -0.208  1.000 -0.414  0.274
2011  0.007  0.029  0.086 -0.414  1.000 -0.662
2012 -0.004 -0.019 -0.057  0.274 -0.662  1.000
```

```
> s1CS
       2007   2008   2009   2010   2011   2012
2007  1.000  0.105  0.032 -0.004  0.001 -0.001
2008  0.105  1.000  0.300 -0.034  0.011 -0.006
2009  0.032  0.300  1.000 -0.112  0.036 -0.021
2010 -0.004 -0.034 -0.112  1.000 -0.320  0.189
2011  0.001  0.011  0.036 -0.320  1.000 -0.590
2012 -0.001 -0.006 -0.021  0.189 -0.590  1.000

>
> s1HC
       2007   2008   2009   2010   2011   2012
2007  1.000  0.094  0.035 -0.015 -0.005  0.000
2008  0.094  1.000  0.375 -0.162 -0.052  0.000
2009  0.035  0.375  1.000 -0.433 -0.138 -0.001
2010 -0.015 -0.162 -0.433  1.000  0.318  0.003
2011 -0.005 -0.052 -0.138  0.318  1.000  0.009
2012  0.000  0.000 -0.001  0.003  0.009  1.000
```

S1HS

```
       2007   2008   2009   2010   2011   2012
2007  1.000  0.019  0.007 -0.003  0.000  0.000
2008  0.019  1.000  0.401 -0.138 -0.010  0.002
2009  0.007  0.401  1.000 -0.345 -0.024  0.006
2010 -0.003 -0.138 -0.345  1.000  0.071 -0.018
2011  0.000 -0.010 -0.024  0.071  1.000 -0.254
2012  0.000  0.002  0.006 -0.018 -0.254  1.000
```

S1WAC

```
      2008  2009  2010  2011  2012
2008 1.000 0.498 0.173 0.125 0.020
2009 0.498 1.000 0.348 0.251 0.041
2010 0.173 0.348 1.000 0.722 0.117
2011 0.125 0.251 0.722 1.000 0.162
2012 0.020 0.041 0.117 0.162 1.000
```

```
> s1WAS
      2008  2009  2010  2011  2012
2008 1.000 0.521 0.157 0.095 0.009
2009 0.521 1.000 0.302 0.183 0.017
2010 0.157 0.302 1.000 0.608 0.056
2011 0.095 0.183 0.608 1.000 0.093
2012 0.009 0.017 0.056 0.093 1.000

>
```

```
> s1WC
      2007  2008  2009  2010  2011  2012
2007 1.000 0.449 0.205 0.143 0.082 0.052
2008 0.449 1.000 0.457 0.319 0.182 0.116
2009 0.205 0.457 1.000 0.698 0.398 0.254
2010 0.143 0.319 0.698 1.000 0.570 0.363
2011 0.082 0.182 0.398 0.570 1.000 0.637
2012 0.052 0.116 0.254 0.363 0.637 1.000
> s1WS
      2007  2008  2009  2010  2011  2012
2007 1.000 0.601 0.346 0.227 0.118 0.066
2008 0.601 1.000 0.575 0.378 0.197 0.109
2009 0.346 0.575 1.000 0.657 0.342 0.190
2010 0.227 0.378 0.657 1.000 0.521 0.289
2011 0.118 0.197 0.342 0.521 1.000 0.554
2012 0.066 0.109 0.190 0.289 0.554 1.000
```

The residual correlations between years at Walkamin and WA are all positive and so do not indicate any (additional) biennial bearing at an individual tree level.

At the two Childers sites the correlations between consecutive years from 2009 onwards (2009&2010, 2010 &2011, 2011&2012) are all negative. This indicates that there may be additional biennial bearing at the individual tree level.

At Hampton there are negative correlations between consecutive years 2009 & 2010 at both clonal and seedling trials and also between 2011 & 2012 at the seedling trial.

Fruit Size

A similar analysis to that above has been performed on the fruit size data.

1. Model to test effect of Propagation type (Clonal or Seedling)

The Interaction Yrf :Prop was not significant so it was removed and a test made on the main effect of Propagation Type.

Prop effect significant (P<0.001).

There is an overall effect of Propagation type on Fruit size with the Clonal trials having higher mean Fruit Size than the seedling trials. [This needs to be interpreted with caution remembering different varieties were grown in Clonal & Seedling trials].

```
              Df Sum of Sq Wald statistic Pr(Chisq)
(Intercept)    1   2475.49        2475.49 < 2.2e-16 ***
Yrf            5      2.14           2.14     0.829
Prop           1     31.02          31.02 2.552e-08 ***
residual (MS)          1.00
```

```
      Prop predicted.value standard.error est.status
1   Clonal        236.0272        8.25226  Estimable
2 Seedling        227.0241        8.23782  Estimable

$avsed
 overall
1.617762
```

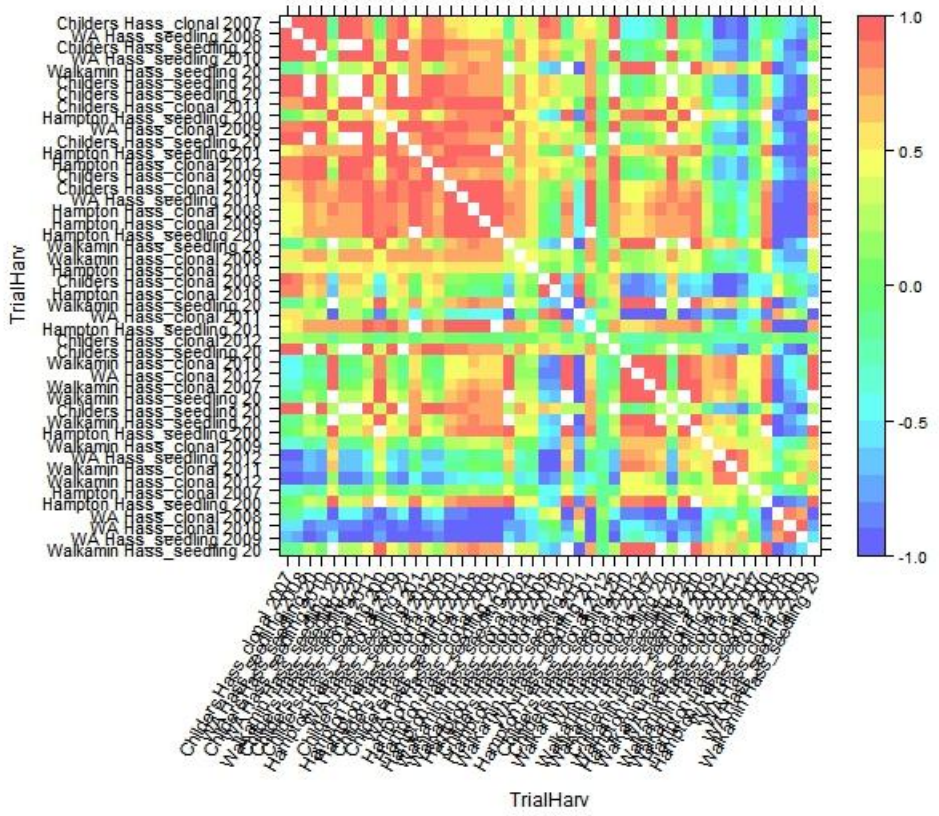
2. Model to look at GxE and best RS varieties across all Hass clonal and seedling trials

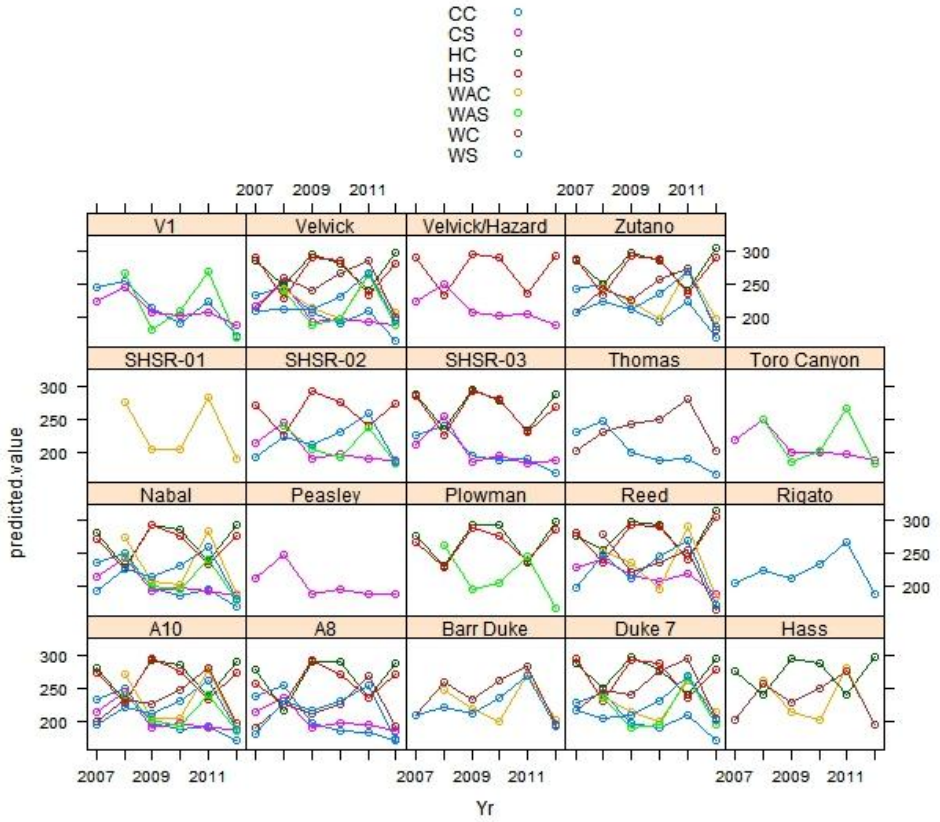
A MET multi-harvest analysis was performed on the fruit size data.

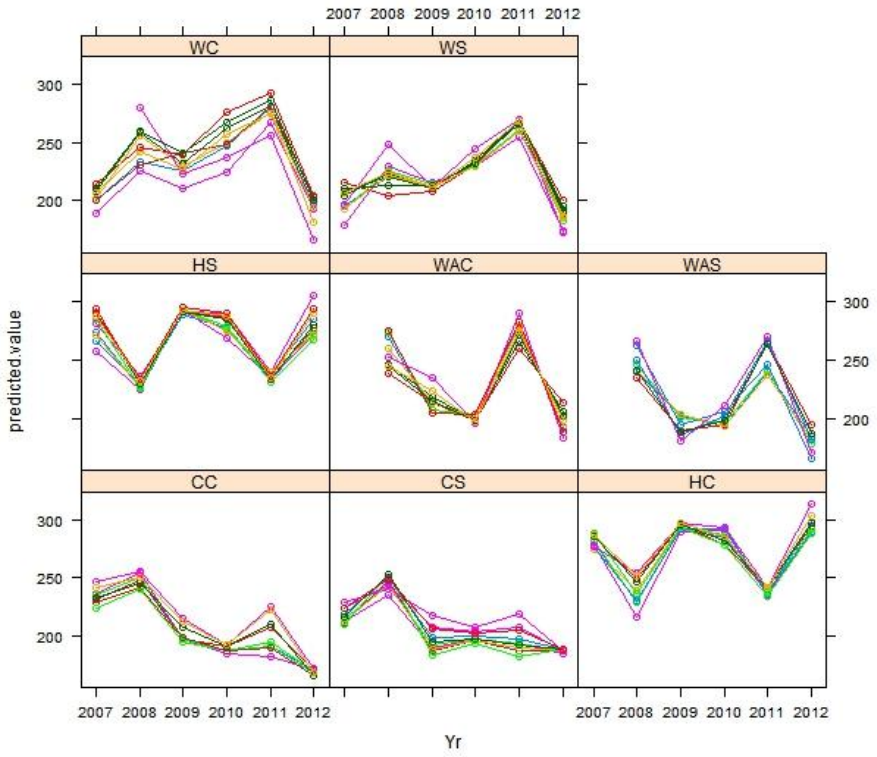
The RS genetic effects over trials and times were modelled using a factor analytic model of order2 (FA2). The table below shows the different models fitted and the percent variance accounted for by each model. The FA2 model was chosen as the final model as it was significantly better than the FA1 and the FA3 model was not a significant improvement.

G Model	Loglikelihood	Pr	%VAF	
FA1	-14674		60.8%	
FA2	-14643	0.05	91.1%	
FA3	-14617	0.12 ns	99.7%	

The genetic correlations between trials and years are presented below in a heatmap.


TrialHarv
TrialHarv
1.0
0.5
0.0
-0.5
-1.0


CC
CS
HC
HS
WAC
WAS
WC
WS
V1
Velvick
Velvick/Hazard
Zutano
SHSR-01
SHSR-02
SHSR-03
Thomas
Toro Canyon
Nabal
Peasley
Plowman
Reed
Rigato
A10
A8
Barr Duke
Duke 7
Hass
predicted.value
Yr
2007
2009
2011
200
250
300



The plot above shows the biennial bearing pattern of large fruit size with low yield (small number of large fruit) and lower fruit size with high yield (large number of smaller fruit).

The predictions for Fruit Size are given in the Excel spreadsheet Fruitsize_predfinal.xlsx.

Based on these predictions above the average Fruit Size across all years for each RS at each site x Propagation type is given below. It can be seen that Reed is the top ranked RS at a number of sites (CS,HC,HS,WAC). At CC and WAS V1 is the highest ranked and at WC Duke 7 is highest ranked while at WS Zutano is the highest ranked.

	CC	CS	HC	HS	WAC	WAS	WC	WS
A10	204.485	203.497	268.851	262.554	229.884	211.901	230.678	217.473
A8	204.479	202.421	266.109	258.4	NA	NA	218.235	213.747
Barr Duke	NA	NA	NA	NA	227.166	NA	239.559	222.206
Duke 7	206.14	NA	274.532	268.945	224.69	215.548	245.877	221.365
Hass	NA	NA	271.95	NA	229.446	NA	234.567	NA
Nabal	206.137	204.748	270.144	263.137	230.899	212.592	NA	217.919
Peasley	NA	202.912	NA	NA	NA	NA	NA	NA
Plowman	NA	NA	271.277	264.018	NA	214.947	NA	NA
Reed	NA	216.929	279.664	274.161	231.499	NA	NA	223.9
Rigato	NA	NA	NA	NA	NA	NA	NA	221.347
SHSR-01	NA	NA	NA	NA	230.81	NA	NA	NA
SHSR-02	NA	203.24	NA	262.806	NA	211.277	NA	216.804
SHSR-03	201.059	202.154	269.671	263.738	NA	NA	NA	NA
Thomas	203.418	NA	NA	NA	NA	NA	234.256	NA
Toro Canyon	NA	209.082	NA	NA	NA	217.29	NA	NA
V1	217.442	212.383	NA	NA	NA	219.647	NA	NA

Velvick	208.46	207.284	274.663	268.63	226.255	215.885	244.359	222.008
Velvick/Hazard	NA	212.899	NA	273.696	NA	NA	NA	NA
Zutano	215.046	NA	277.723	271.308	228.013	NA	231.405	222.749

Yield efficiency

A similar analysis to that performed on Yield and Fruit size has been performed on the Yield efficiency data.

1. Model to test effect of Propagation type (Clonal or Seedling)

The Interaction Yrf :Prop was not significant so it was removed and a test made on the main effect of Propagation Type.

Prop effect significant (P<0.001).

There is an overall effect of Propagation type on Yield efficiency with the Seedling trials having higher mean Yield efficiency than the clonal trials. [This needs to be interpreted with caution remembering different varieties were grown in Clonal & Seedling trials].

```
              Df Sum of Sq Wald statistic Pr(Chisq)
(Intercept)    1   115.377        115.377 < 2.2e-16 ***
Yrf            5    15.579         15.579  0.008156 **
Prop           1    26.661         26.661 2.425e-07 ***
residual (MS)         1.000
```

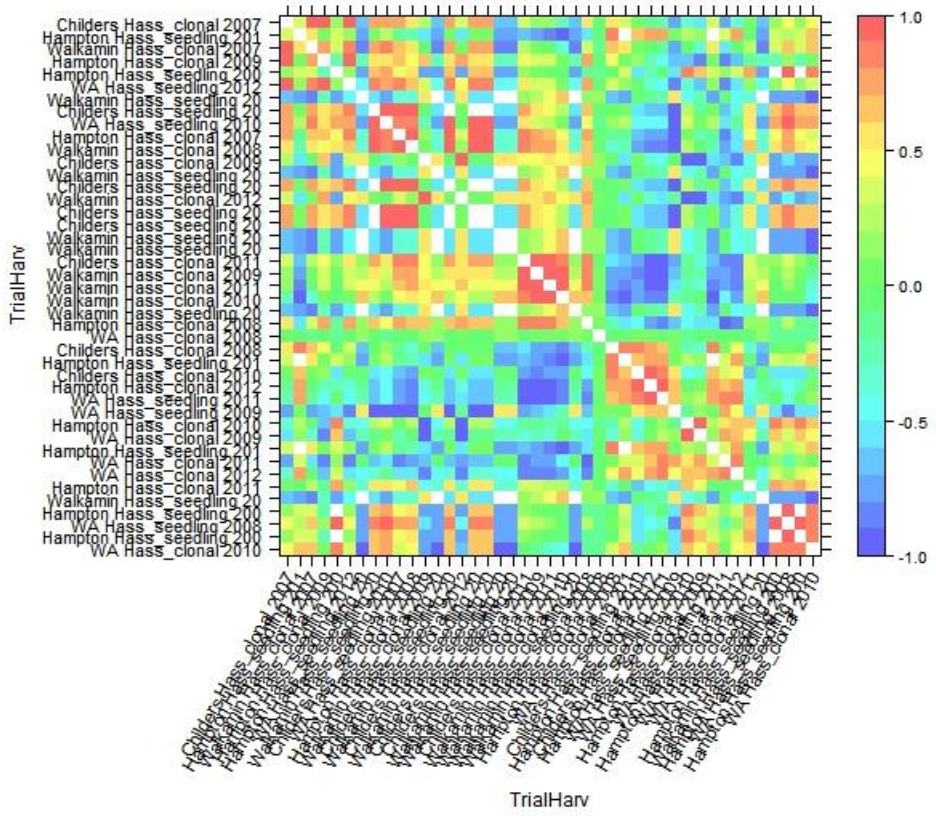
```
      Prop predicted.value standard.error est.status
1   Clonal        1.433110      0.1664280  Estimable
2 Seedling        1.560344      0.1665089  Estimable

$avsed
   overall
0.02464468
```

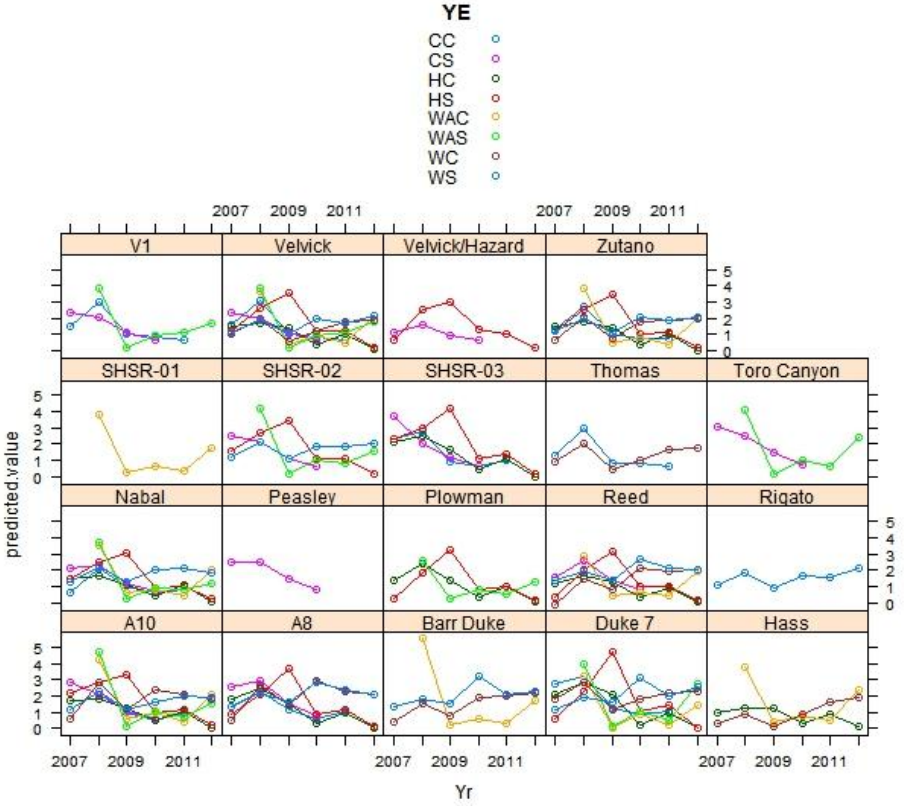
2. Model to look at GxE and best RS varieties across all Hass clonal and seedling trials

A MET multi-harvest analysis was performed on the Yield efficiency data.

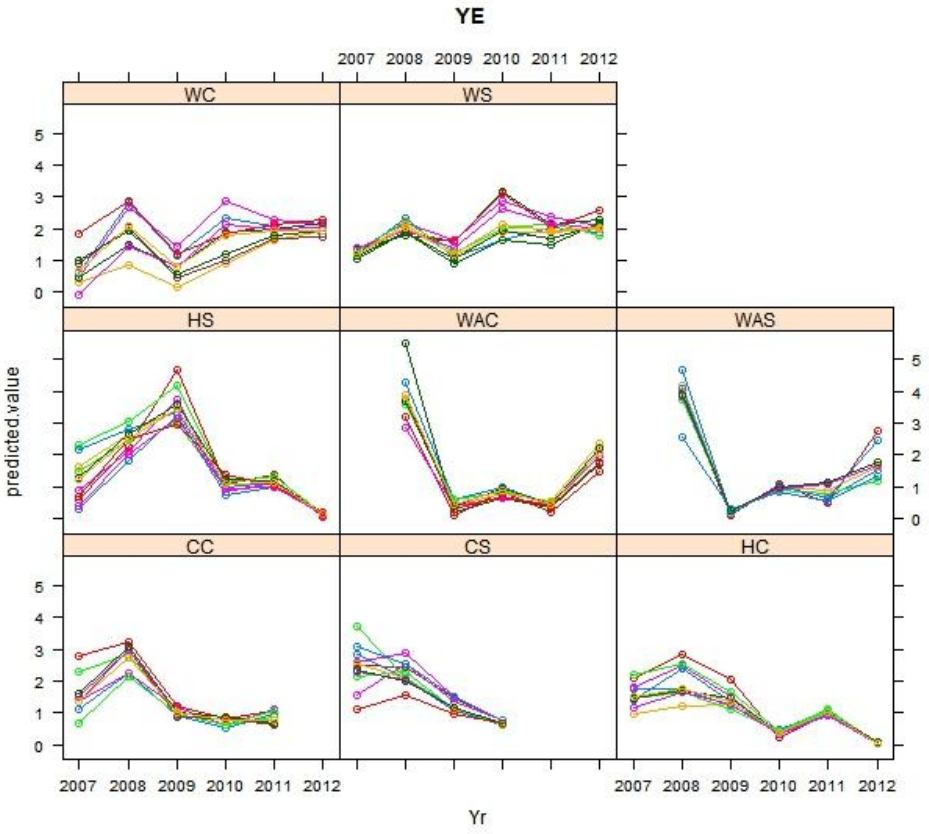
The RS genetic effects over trials and times were modelled using a factor analytic model of order3 (FA3) which explained 88.3% of the variation (%VAF).

The genetic correlations between trials and years are presented below in a heatmap.





Predictions of Yield efficiency (YE) over time for each RS at each Site x Propagation type.



The RS predictions for Yield efficiency are given in the Excel spreadsheet “YE_predfinal.xlsx”.

The average Yield efficiency across all years for each RS at each site x Propagataion type is given below. It can be seen that Duke 7 is the top ranked RS at a number of sites (CC,HC,WAS,WC) but lowest at WAC. At CS Toro Canyon is the highest ranked and at HS SHSR-03 is the highest ranked.

RS	CC	CS	HC	HS	WAC	WAS	WC	WS
A10	1.157	1.657	1.045	1.762	1.666	1.608	1.796	1.687
A8	1.289	1.946	1.187	1.461	NA	NA	1.97	2.075
Barr Duke	NA	NA	NA	NA	1.678	NA	1.473	2.041
Duke 7	1.821	NA	1.363	1.675	1.144	1.675	2.024	2.053
Hass	NA	NA	0.794	NA	1.558	NA	0.963	NA
Nabal	1.04	1.569	0.955	1.512	1.493	1.36	NA	1.781
Peasley	NA	1.777	NA	NA	NA	NA	NA	NA
Plowman	NA	NA	1.073	1.199	NA	1.102	NA	NA
Reed	NA	1.56	0.897	1.272	1.258	NA	1.382	1.911
Rigato	NA	NA	NA	NA	NA	NA	NA	1.513
SHSR-01	NA	NA	NA	NA	1.387	NA	NA	NA
SHSR-02	NA	1.612	NA	1.681	NA	1.563	NA	1.695
SHSR-03	1.547	1.896	1.318	2.025	NA	NA	NA	NA
Thomas	1.31	NA	NA	NA	NA	NA	1.308	NA
Toro Canyon	NA	1.96	NA	NA	NA	1.667	NA	NA
V1	1.404	1.545	NA	NA	NA	1.552	NA	NA
Velvick	1.446	1.544	1.014	1.672	1.528	1.586	1.405	1.64
Velvick/Hazard	NA	1.085	NA	1.454	NA	NA	NA	NA

Zutano	1.322	NA	1.009	1.589	1.53	NA	1.525	1.743