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Hort Innovation R&D project number: VG12017

Project VG12017 examined the two important issues affecting lettuce growers of blindness and transplant shock.

- **Pre-harvest practices that will increase the shelf-life and freshness of vegetables**

Hort Innovation R&D project number: VG14025

This comprehensive review aimed to compile current knowledge on the effects of pre-harvest factors on shelf-life and quality of vegetables.

Controlling multiple heading and transplant shock in lettuce

Facilitators:

Project VG12017 was completed by Applied Horticultural Research (AHR).

Introduction

Multiple heading, or "blindness", is a physiological disorder which can affect up to 20 per cent of lettuce crops in Australia.

Highly prevalent in New South Wales and Queensland during the summer months, blindness occurs when the main apical shoot or growing tip of the lettuce is lost during the seedling's early growth.

Lettuces seldom recover from blindness, developing into a distorted, unmarketable plant.

Another issue facing seedling producers is transplant shock – a check in growth that can occur when seedlings are transplanted from the seedling tray into the field.

Stresses due to root damage, changed environment or water stress can all contribute to transplant shock, resulting in poor plant stands and a lower percentage cut of good-quality lettuce.

About the project

Project VG12017 examined blindness and the resulting problem of multiple heading, as well as transplant shock and its effect on harvestable lettuce yield.

It was developed in consultation with industry, particularly seedling producers in New South Wales and Queensland.

Adam Goldwater, of AHR, said the project tried to determine whether the incidence of blindness was correlated with factors such as temperature, humidity, water stress and crop nutrition.

"The disorder is likely the result of a number of different stresses on the plant during a critical phase of early growth, especially during the warmer months," he said.

To create a clearer picture of how blindness develops, the project tried to identify factors that could either induce or prevent blindness in susceptible lettuce varieties.

Separate trials were conducted in the field to evaluate methods for reducing transplant shock in lettuce seedlings.

Major findings

Growers were surveyed on factors they considered likely to increase blindness, and mitigation strategies.

"The incidence of blindness was monitored in seedling nurseries in New South Wales and Queensland between November and March 2013-14 and outbreaks were found to be correlated with high temperatures and humidity," Mr Goldwater said.

"Despite some certainty that high temperatures and humidity were key factors, the trials demonstrated that the incidence of blindness was extremely variable.

"The incidence increased after some hot spells, but not after others, so factors other than just high temperature and humidity must be involved."

A series of glasshouse trials were then conducted to examine some of the suggested stress factors contributing to blindness.

"Attempts to induce blindness by irrigating with saline water, chlorinated water, as well as spraying with an insecticide known to cause burning, all induced blindness under hot, humid conditions," Mr Goldwater said.

Interestingly, four different forms of blindness were identified which can all look superficially similar, but the causes are different. The following can reduce the risk of blindness in lettuce:

- Germinate lettuce seed at less than 20 degrees Celsius.
- Avoid growing seedlings over 35 degrees Celsius, and if unavoidable, use misting to reduce leaf temperature.
- Use good-quality irrigation water with an EC below 900 µs/cm (including nutrients) and avoid excessive chlorine.
- Grow non-susceptible lettuce varieties.
- Avoid burning seedlings. Do not spray when plants are stressed under extremely hot conditions. Promote fast drying of spray residues.
- Apply a foliar spray of chelated calcium twice-weekly during early development.

Implications for the vegetable industry

Two field trials tested the effect of pre-transplant potassium nitrate drenches (80 grams per 1,000 seedlings in five litres of water) on the growth and final yield of iceberg and cos lettuces.

Drenching with potassium nitrate increased leaf growth, particularly early in growth. The increase in early growth resulted in larger lettuces at harvest in the first trial, although in a second trial, the effect was reduced at harvest maturity.

Overall, the team concluded that drenching lettuce seedlings with potassium nitrate was "good insurance" to reduce transplant shock in lettuce.

Conclusions

There are a number of things seedling producers can do to reduce risk of blindness in lettuce.

Germinating seed at lower temperatures (below 20 degrees Celsius), avoid growing seedlings at temperatures above 35 degrees Celsius and use misting to reduce leaf temperature in hot conditions.

Use good-quality, non-saline irrigation water, grow varieties less susceptible to blindness and don't spray when plants are stressed to avoid burning seedlings.

When it comes to reducing transplant shock of lettuce seedlings, Mr Goldwater suggests drenching with potassium nitrate, which can also increase early growth.

Fact sheets on *Reducing transplant shock in lettuce* and *Management of blindness in lettuce seedlings* can be downloaded online at soilwealth.com.au.

Acknowledgements

This project has been funded by Horticulture Innovation Australia Limited using the National Vegetable Industry Levy and funds from the Australian Government.

THE BOTTOM LINE: VG12017

- Blindness and transplant shock are two important issues affecting lettuce growers.
- Key practices for reducing blindness in lettuce are to mist seedlings at temperatures over 35 degrees Celsius, use good-quality irrigation water without excessive chorine, don't spray when plants are stressed and apply foliar calcium twice-weekly.
- Applying nitrogen and potassium to seedlings as a potassium nitrate drench just before transplanting can help plants overcome transplant shock.

Pre-harvest practices that will increase the shelf-life and freshness of vegetables

Facilitators:
Project VG14025 was completed by Project Leader Dr Jose Roberto Marques, from the NSW Department of Primary Industries (DPI), in collaboration with Applied Horticultural Research (AHR).

Introduction

Quality, including freshness and shelf-life – the length of time produce remains fresh, saleable and edible – is a critical issue for vegetables, which typically withstand the stresses of the farm-to-fork supply chain operations.

Pre-harvest production practices play a decisive role in establishing and maintaining optimal yield and quality of vegetable crops, which often depend on the interaction of agronomic, environmental and genetic factors.

Since the quality of vegetables cannot be improved post-harvest, identifying the best combination of these pre-harvest factors is a key strategy to maximise vegetable quality to meet consumer satisfaction.

About the project

Although considerable research on pre-harvest factors and their interactions has been conducted over the years, the information is scattered across many documents such as industry reports, scientific journals and conference proceedings.

A joint project between the NSW DPI and AHR, VG14025 consulted a number of information sources to identify, collate, analyse and review current knowledge on the pre-harvest factors influencing vegetable quality and shelf-life.

The information collected by NSW DPI was then used to develop an information package, that contained fact sheets and articles produced by AHR.

Dr Roberto Marques, a research horticulturist in postharvest and sensory science at NSW DPI, said the opportunity for this data to be reviewed and organised for each crop – in a format that was easy to understand and interpret – was significant for the Australian vegetable industry.

"This information has the potential to increase grower awareness and foster adoption of practices that can enhance quality across the industry, adding value to Australian vegetables and increasing consumption," he said.

Reviewed commodities were grouped into the following six categories: leafy vegetables, brassica vegetables, cucurbit vegetables, fruiting and legume vegetables, ear and stalk vegetables, and root and tuber vegetables.

Key issues

Overall, the review highlighted that international research on pre-harvest factors that focus not only on yield, but also on the impact on product shelf-life and quality, has been generally limited for most vegetables.

"Leafy and brassica vegetables were the groups with the most research in the topic of review," Dr Marques said.

"The key findings from these groups show that understanding pre-harvest interactions and developing crop schedules that can match best combinations of cultivar, growing area, plant growth rate and time of year can have major benefits in terms of balancing yield and quality/shelf-life.

"But this can only be achieved by targeted research for each production area, which has been done in Australia to a degree for lettuce, spinach and broccoli; however, there are considerable gaps for other vegetables."

Dr Marques said the research suggested that targeted crop nutrition research under local conditions and current cultivars, rather than a 'one-size-fits-all' approach, seemed vital for leafy vegetables, such as lettuce.

The shelf-life, external quality and composition of broccoli also appeared to be strongly influenced by an interaction between cultivars and growing conditions, especially field temperatures.

However, further targeted research is needed to identify the best options in terms of achieving optimum yields of high-quality produce for each key production area and current cultivars.

Next steps

The research team has recommended a number of priority areas that highlight R&D opportunities for potential quality improvement, including extended shelf-life, enhanced produce appearance and composition, and higher resistance to postharvest diseases.

"One of these opportunities includes the development of crop planting schedules to match current cultivars with growing regions and time of year," Dr Marques said.

"These schedules would enable growers to strike an optimum balance between yield and quality/shelf-life for other key commodities such as Asian vegetables, cauliflower, cabbage, kale, capsicum, zucchini, cucumber, green beans and sweet corn."

Dr Marques said the use of silicon and other fertiliser salts during production of leafy vegetables, cucumber, zucchini and capsicum would also be worth examining in future trials, along with the different growing conditions that can increase the content of bio-actives.

"There is also some merit in looking at the use of deficit irrigation to improve quality and shelf-life in broccoli and leafy vegetables, and the use of LED light systems during production of greenhouse lettuce, spinach and capsicum," he said.

THE BOTTOM LINE: VG14025

- Consumer satisfaction and value chain development are key priorities for the vegetable industry.
- Better understanding pre-harvest interactions and developing crop schedules to match cultivar, growing area and time of year can have major benefits in terms of balancing yield and quality/shelf life.
- Investigating the use of silicon in leafy vegetables, cucumber, zucchini and capsicum production may result in increased plant resistance to diseases and improved yield and quality.

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Please contact Michelle De'Lisle at AUSVEG on 03 9882 0277 or email michelle.delisle@ausveg.com.au to submit topics for potential inclusion in future editions of **vege**notes*.*

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