vegenotes 35

2013

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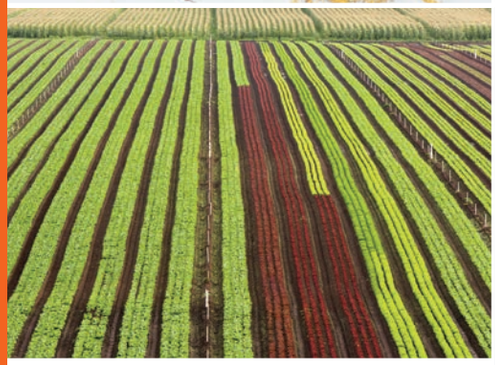
HAL R&D project number: VG09086

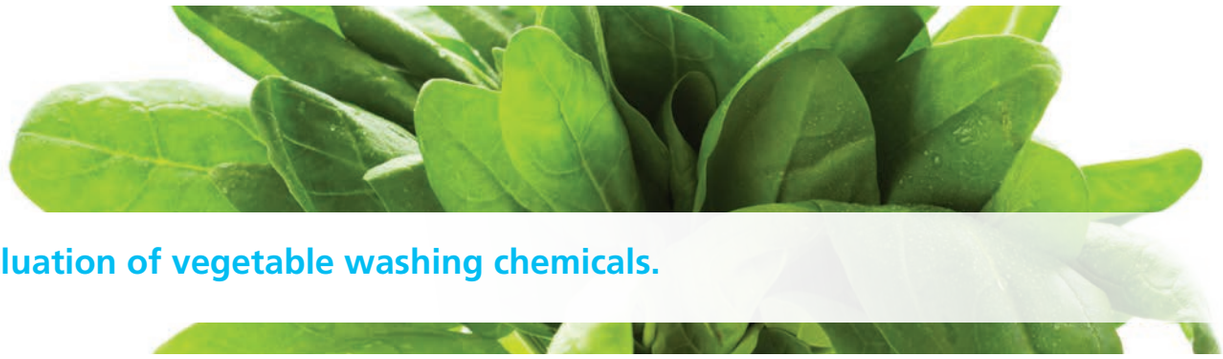
Project VG09086 evaluated a variety of wash water treatments available to commercial vegetable growers to reduce the incidence of food borne illness and post harvest diseases.

- **Development of methods to monitor and control Aphanomyces root rot and black root rot beans.**

HAL R&D project number: VG08043

Project VG08043 examined the occurrence and symptoms of Aphanomyces root rot (ARR) in green beans in different growing conditions and soil types, and trialled methods to reduce the disease.





Evaluation of vegetable washing chemicals.

Facilitators:

Project VG09086 has been recently completed by Project Leader Dr Robert Premier of Global F.S. Pty Ltd and project team.

Introduction

The washing of vegetables on-farm is a practice routinely implemented by vegetable growers in Australia, prior to selling their products to consumers. This step is normally part of a wider food safety plan that growers must maintain on their farms and forms part of the Quality Assurance (QA) system audited by third parties. The sanitary washing of vegetables is required to reduce levels of bacteria, including contaminating human pathogens, and to prevent cross contamination of produce during the washing stage.

Despite a range of chemicals accessible to the Australian vegetable industry, growers have not remained up-to-date with developments in this area. This is mostly due to a lack of independent information available regarding these chemicals. Currently, the most commonly used sanitiser in the industry is chlorine, either in the form of sodium hypochlorite or calcium hypochlorite.

About the project

Project VG09086 compared the efficacy of sanitising chemicals available in Australia, aiming to reduce both spoilage and pathogenic microorganisms on vegetables, particularly leafy vegetables.

The chemicals reported on during the study were peroxyacetic acid sanitisers (including Tsunami® and Summit®); chlorine sanitisers (calcium or sodium hypochlorite and nylate); organic sanitisers (Citrox®, Aussan®, CitroFresh® and acetic acid); and electrified oxidized water. These chemicals were also compared in terms of ease of use, running/set up costs and effects on the post harvest shelf life of leafy vegetables.

Dr Premier said a number of Australian-based projects have attempted to scientifically evaluate the efficacy of several new sanitisers. While some formats of washing chemicals have been developed, he said, most have not been fully scientifically evaluated.

“At the moment, there is a void in the industry relating to independent evidence of the efficacy of commercially available sanitisers, mainly for food safety purposes.

“More importantly, leafy vegetable growers require this information urgently.

“There have been a number of overseas food safety outbreaks related to leafy vegetables in the last few years.”

Sanitisers employed during the trials were measured according to their recommended dosage, with baby spinach selected as the leafy vegetable product for evaluation.

Baths ranged from 1,000 to 2,500-litre wash baths, depending on the testing environment. Two locations were used; both situated on growers’ properties on the eastern side of Melbourne and simulated actual washing steps implemented by growers.

Spinach leaves being washed during trial.

Major project findings

Dr Premier’s research team discovered relatively low levels of total plate counts (TPC) left behind in the wash water when the sanitiser used was chlorine, nylate or peracetic acid sanitisers. In contrast, acetic acid did not effectively reduce bacteria in the wash water.

Findings established that although the peroxyacetic acids displayed acceptable results, there were differences noted in the formulation of these products.

“This difference can have an effect on the efficacy of the sanitisers and the shelf life of the product being sanitised,” Dr Premier said.

“For instance, the level of peroxide is very different in one formula when compared to the other preparations,” he said.

“The level of peroxyacetic acid is also much lower in this commercial preparation meaning that more of the solution needs to be used in order to achieve the desired concentration in the wash baths,” he said.

“Overall, the use of peroxyacetic acid for washing leafy vegetables was shown to be satisfactory in terms of efficacy and shelf life.”

The trials confirmed the organic sanitisers did not perform as well as several of the other sanitisers tested, especially when killing bacteria. Restricted to small-scale batches, they are costly to use and are not particularly suitable for food safety management.

Dr Premier said the chlorine or nylate based sanitisers emerged as the most suitable system available to growers that wash vegetables on-farm.

"Although these work in separate manners, these sanitisers have extremely good efficacy in wash baths and a high shelf life," he said.
"Chlorine specifically has advantages in terms of its cost effectiveness and ease of handling. The chlorine system does need to be monitored though, and should not exceed a pH of 7."
Additional findings highlighted the availability of new washing technology through the use of electrified oxidizing waters. According to Dr Premier, upon further development, the process would fulfil a chemical-free washing claim and also be user-friendly for the grower. It would also be easily adapted to an automatic system with record of efficacy available for review by auditors of on-farm QA systems.

Conclusion

Chlorine used as either calcium hypochlorite or sodium hypochlorite is still the most effective way to sanitise leafy vegetables in Australia. There are however, other sanitisers available that have similar efficacies, including nylate and some of the peroxyacetic acid sanitisers. Although slightly more expensive to use, these alternatives can be monitored in solution, either by hand (with the use of test strips) or automated processes.

THE BOTTOM LINE: VG09086

- Growers who produce leafy vegetables that are sold as pre-washed and ready to eat should consider using peroxyacetic acid based sanitisers. These sanitisers are however, considerably more expensive and may contribute to a lower shelf life of the product.
- Growers who supply the organic market should consider an organic based sanitiser. Although the efficacy of these is not as good as alternate options, they still show some level of efficacy and are better than acetic acid.
- Electrified oxidised water was found to have superior efficacy to any of the other products tested.

Acknowledgements

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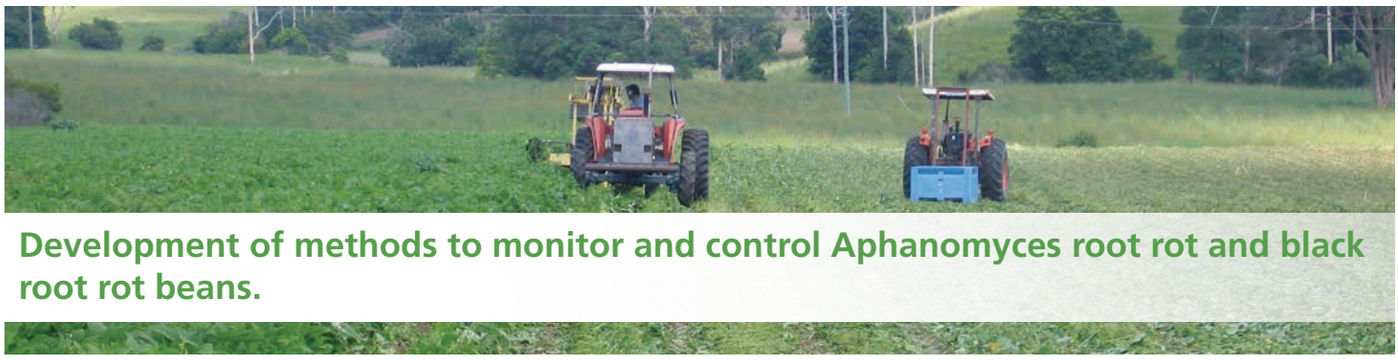

Development of methods to monitor and control Aphanomyces root rot and black root rot beans.

Machine harvesting.

Facilitators:

Milestone 7 of project VG08043 has been recently completed by Primary Investigator Andrew Watson of NSW Department of Primary Industries, with assistance from project collaborators Dr Hoong Pung and Dr Alan McKay (SA).

Introduction

Aphanomyces root rot (ARR) is a soil borne disease causing browning of roots and stems of green beans. In severe cases it can cause the death of plants, often in combination with other pathogens. From a low base level, and given suitable soil conditions, the disease can build up rapidly. Singularly, ARR reduces yield directly, or by delaying flower set, making machine harvesting impossible. Blocks with infected soil should remain free of beans for up to 10 years, to reduce levels of the fungus.
Black root rot (BRR) is another soil borne fungus causing blackening of the stems and roots of beans. Common to many growing regions, but particularly an issue in Tasmania and Victoria, the fungus has a wide host range and appears to infect beans in cooler conditions.

About the project

Project VG08043 examined the prevalence of the ARR fungus and its symptoms in green beans, specifically those growing in regions of high rainfall. A second facet of research focused on identifying control methods to reduce the severity of the disease.
Primary Investigator Andrew Watson, of NSW Department of Primary Industries, led a series of field trials conducted in northern NSW with some work undertaken by collaborators in Devonport, in Tasmania's northwest.
"The initial research concentrated on understanding the complexities of the disease and how common it was in certain environments," Mr Watson said.
"The disease was first identified in Tasmania during project VG03003 which looked at managing bean root and stem diseases. These findings were informed by a preliminary project, which established the presence of the disease in northern NSW," he said.
"From this we could confirm that ARR was certainly growing in areas of high rainfall.
"Tasmania is known for its variable rainfall patterns, providing the ideal environment for cultivating fungicides. The NSW region also has high rainfall, especially during the period when beans are grown."
Over a three-year period, 42 farms in Devonport were tested for the fungus, through a range of identification methods.

Major project findings

"One of the important findings from this project was the number of farms in Tasmania that contained the fungus," Mr Watson said.
"Of the 42 soils examined, 30 were found to have the fungus, and therefore, the potential to cause diseased beans if wet conditions persisted."
Mr Watson said the ARR fungus had the potential to wipe out whole plantings if conditions were favourable toward the disease. He said it was not uncommon for infected plants in the field to be overtaken by secondary fungi, causing total plant death.
"The ARR fungus is an interesting sort. In some cases, even if the disease has not successfully killed off the crop, it is able to weaken it through attacking its roots," he said.
"The disease can build-up throughout the current season and survive for future seasons. This severely affects harvesting and results in the delayed settings of pods.
"Consequently, beans cannot be planted on the same ground regularly, and less so in wetter bean growing areas."
Mr Watson strongly advised growers to implement a soil bioassay, or pre-planting assessment, as one method for detecting the presence of the disease in soils.
"This test provides important information about the level of the disease in before planting," he said.
The project developed a DNA test that gave confirmation on observed symptoms within the bioassay. As part of this strategy, the research team implemented a number of cross infection studies with bean isolates on peas. It was found the isolate from beans (*Aphanomyces euteiches*) was a type specific to beans and was not shown to infect peas.
Brassica biofumigants when incorporated as green manures were shown within the project to reduce disease levels.
In variety screening trials with ARR, bean varieties showed no reduction in disease levels. Trials on beans, without the influence of other pathogens, revealed a direct yield loss due to *A. euteiches* of 70 per cent.
However, bean varieties with better tolerance to BRR were identified and it was recommended that screening for resistance to the disease should be ongoing.

Conclusion

Mr Watson said there were varieties that could be developed that demonstrated particular strength in resisting the disease, but these were unlikely to produce the type of bean desired for the market.
"The main control option for this disease is to have resistant varieties of plants that don't contract the disease," he said.
"Bean varieties are developed overseas for the Australian market and although there have been attempts to develop some resistance to ARR, the end product has not been up to market expectation and are not beneficial for harvesting or consumption."
Seed dressings were also trialled and one was found successful as was another as a soil drench, but the chemicals are not registered for use in Australia.
General options for growers in the industry include avoidance of infected fields, growing alternate crops that are not affected by the disease and fumigation. Additional management tools include improving drainage by planting on beds or hills, carefully monitoring irrigations and removing residual plant matter from fields.

A comparison of ARR affected plants and healthy plants.

THE BOTTOM LINE: VG08043

- There are some control options that can reduce ARR but they may be difficult to consider financially or mechanically.
- Further research is needed on the effects of brassica biofumigants on soil borne diseases. This would include screening varieties in different growing regions and soil types known to have soil borne diseases.
- It would also be useful to conduct cross infection studies with other isolates of Aphanomyces euteiches that are sourced from other hosts and conduct genetic comparisons between isolates.

Acknowledgements

This project has been funded by HAL using the voluntary contributions from industry and matched funds from the Australian Government

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VG08043 photos credit: Andrew Watson

Please contact Hugh Gurney at AUSVEG on 03 9822 0388 or email hugh.gurney@ausveg.com.au to submit topics for potential inclusion in future editions of **vege**notes.

ISSN: 1449 - 1397

vegenotes is produced by AUSVEG Ltd
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T: 03 9822 0388 | F: 03 9822 0688
This project has been funded by HAL using the National Vegetable Levy and matched funds from the Australian Government.

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