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| IMPROVING SAFETY OF VEGETABLE PRODUCE THROUGH ON-FARM SANITATION, USING ELECTROLYSED OXIDISING (EO) WATER – VG15068 | CHARACTERISATION OF A CARLAVIRUS OF FRENCH BEAN – VG15073 |

VG15068 – IMPROVING SAFETY OF VEGETABLE PRODUCE THROUGH ON-FARM SANITATION, USING ELECTROLYSED OXIDISING (EO) WATER

FACILITATORS

Project VG15068 is being undertaken by a research team from the University of South Australia (UniSA).

INTRODUCTION

While the Australian vegetable industry enjoys a strong global reputation for its clean, green produce, stringent food safety standards command continual research to maintain quality and guarantee consumer confidence.

This three-year project is examining a safe and affordable irrigation method designed to eliminate or reduce exposure to waterborne pathogens using an electricity-charged sanitation process for water supplies. The technique is expected to further improve the quality of leafy crops such as lettuce, spinach and parsley, which carry a greater risk of contamination as they are generally consumed fresh.

ABOUT THE PROJECT

Project VG15068 aims to evaluate the efficacy of pH-neutral electrolysed oxidising (EO) water for on-farm sanitation of irrigation water to add an additional layer of food safety protection pre-harvest. The EO water is formed from the electrolysis of water in a patented 4-chamber electrochemical reactor in the presence of chloride ions (either naturally present or added as salts) to form hypochlorous acid and reactive oxygen species (ozone, hydrogen peroxide) that are toxic to microorganisms. The technology is scalable, with the potential to sanitise thousands of litres of water per hour.

Similar processes are used by some hospitals to prevent the growth of Legionella, and UniSA Chair in Environmental Science and Engineering Professor Enzo Lombi said the EO water could also help to clean biofilms from irrigation pipes on farms.

"It could potentially eliminate biofilm build-up, and it could allow farmers to obtain water from sources not previously deemed safe for irrigation because of high microbial content," he explained.

Current and potential sanitisers for treatment of pre-harvest water are being reviewed to identify their effectiveness, with trials underway to compare the impact on soil microbes and overall efficacy on contaminated produce. Growers are being recruited to trial in-field effectiveness of treating spray irrigation water using EO, and to help develop parameters and protocols for in-field sanitation control under a variety of conditions.

Research is mainly focusing on human pathogens like *Salmonella* and *E. coli*, but it might also be beneficial to control crop diseases in glasshouse environments where spraying options are limited. The project, which is due for completion in 2020, complements ongoing research aimed at keeping vegetables healthy and safe, including the development of new strains and blends of beneficial bacteria to inhibit the growth of harmful bacteria on vegetables.

MAJOR FINDINGS

EO water sanitation pre-harvest has already proven to be gentler on crops than sodium hypochlorite.

"At the concentrations we tested, you don't have the risk of leaf scorching and discolouration, which can diminish value and shelf life," Professor Lombi said.

"In addition, this product doesn't leave any residue on the produce and is certified organic."

Several hypotheses have already been proven during the project:

- The efficacy of EO water for reducing pathogen contamination on pre-harvest vegetable leaves depends on the level of free chlorine and other reactive oxygen species present in the EO irrigation water.
- The production and dosing technology can significantly reduce the microbial load in irrigation water and expand the range of safe source water options for vegetable irrigation.
- The efficacy of EO to reduce the microbial load is driven more by organic matter content than by pH. The efficacy is (at least) comparable to that of chlorine-based sanitisers, efficiently killing bacteria in a remarkably similar manner, but with less risk to the plant.

New booster technology for the production of EO water has several practical advantages for implementation at farm level, and will be tested in the next phase of the project.

CONCLUSION

This project is examining the effectiveness of EO water as an irrigation treatment to benefit growers and ultimately consumers. It is anticipated that the work will offer an additional layer of food safety protection in high-risk fresh vegetable produce such as lettuce, spinach and parsley, with reduced incidence of product recalls. In the future, growers might also be able to irrigate with water previously deemed too poor for use on vegetables, confident in the knowledge that it will be safe for application.

ACKNOWLEDGEMENTS

This project is a strategic levy investment under the Hort Innovation Vegetable Fund.

VG15068 has been funded by Hort Innovation using the vegetable research and development levy and contributions from the Australian Government.

VG15073 – CHARACTERISATION OF A CARLAVIRUS OF FRENCH BEAN

FACILITATORS

Project VG15073 is being undertaken by the Queensland Department of Agriculture and Fisheries (DAF). It is due for completion in May 2019.

INTRODUCTION

Queensland is the major Australian producer of fresh green beans, growing 80 per cent of the national crop with annual production valued at $70 million. In autumn 2016, the carlavirus cowpea mild mottle virus (CPMMV) was identified as the cause of a severe disease in French beans across several properties in the Fassifern Valley in the state's south-east. While the virus has been well documented in Brazil and Argentina, it was the first time CPMMV had been detected in Australia. Silverleaf whitefly (SLW, *Bemisia tabaci*) was identified in laboratory tests as the virus transmitter or vector and is likely the major contributor to virus spread in the field.

Plants affected by CPMMV developed mottled leaves, stunted growth and curled, twisted or discoloured pods. Estimated collective losses of several hundred thousand dollars were recorded over a period of two months. Since the initial reported outbreak, CPMMV has also been detected in the Lockyer Valley, Bowen and Bundaberg growing regions.

ABOUT THE PROJECT

Project VG15073 aims to characterise the new carlavirus, CPMMV, infecting Fabaceae crops in Queensland. The Queensland Department of Agriculture and Fisheries (DAF) has been working to determine the distribution and levels of CPMMV and the SLW vector in green bean production areas, with surveys commencing in late August 2017. In addition to determining the host range of the virus, the project team has also produced seeds from virus-inoculated plants to determine the potential for seed transmission in selected varieties.

"We now know what the virus is and how it is spread, the disease symptoms, and what we can do to minimise further losses," DAF Principal Plant Pathologist Denis Persley explained.

The DAF project team has worked with bean growers to develop a management plan which aims to minimise economic losses from the virus through whitefly monitoring in crops, strategic insecticide application, and the release of biological control agents that attack SLW. Research continues into the identification of tolerant or more resistant bean varieties for use in high-risk situations.

MAJOR FINDINGS

SLW (MEAM1) transmission of CPMMV was confirmed in laboratory tests for both bean and soybean isolates, with aphids, jassids (or leafhoppers) and thrips ruled out as vectors or carriers. Virus transmission occurs in relatively short SLW feeding periods of about 10 minutes, thus in-field spread can occur quite quickly.

"The virus was very severe in crops that were several weeks from harvest, leading to either crop failure or extensive downgrading and culling in the packing shed," Mr Persley said.

Disease and whitefly surveys over three seasons in the Fassifern area have shown that the virus affects French bean crops only during the autumn production period.

"Bean crops grown during other windows over the spring-summer season are less likely to be affected based on data collected thus far."

Most host plants of CPMMV are in the legume family, with French bean, soybean, mung bean, cowpea and several perennial legume species such as Siratro and Glycine identified as natural field hosts in Queensland. Glasshouse inoculation tests have also confirmed that CPMMV has a relatively broad host range within legume species of Phaseolus, Glycine and Macroptilium.

"The virus is known to be seed-borne, so it has almost certainly entered Australia via infected seed of one or more host species," Mr Persley said.

However, extensive testing of bean and soybean seed lots and grow out tests on seed produced during the project from CPMMV inoculated plants has not detected seed transmission of the virus.

"We suspect that the virus has been present in Australia for some years, and there was a trigger in 2016 that caused widespread movement of the virus into bean crops."

In Australia, bean summer death (tobacco yellow dwarf virus) and bean common mosaic virus are well controlled through cultivar resistance. Meanwhile, field trials at the Redlands research centre near Brisbane are now assessing bean varieties for tolerance to CPMMV in terms of symptom severity and marketable pod yields when infected at an early growth stage. Effective virus-tolerant lines will potentially be incorporated into a management program where the virus is a problem at certain times of the season.

CONCLUSION

CPMMV has the potential to wipe out an entire bean crop due to the short seasonal cycle from planting to harvest and the rapid spread of the virus by whitefly. Given this, careful management of crops and SLW populations can help to minimise the risks and prevent further outbreaks.

If the virus is found to be present in an area, growers should try to minimise the amount of disease in the first three weeks of crop growth when the infection will cause the greatest yield losses. This can be achieved by monitoring SLW populations, and applying registered insecticides as required.

ACKNOWLEDGEMENTS

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THE BOTTOM LINE: IMPROVING SAFETY OF VEGETABLE PRODUCE THROUGH ON-FARM SANITATION, USING ELECTROLYSED OXIDISING (EO) WATER (VG15068)

Australia has some of the strictest food safety requirements in the world, with research continually underway to stamp out product recalls and maximise consumer confidence in fresh produce. The University of South Australia is trialling an electricity-charged sanitation process for existing water supplies to eliminate or reduce exposure to waterborne pathogens during in-field production.

The production of electrolysed oxidising (EO) water occurs when chloride ions present in water are charged with an electrical current to shift its molecular structure to create an oxidised, anti-microbial solution. Its use in hospital sanitation is widely documented, but its efficacy as an organically-certified irrigation treatment in the vegetable industry is only now being fully validated. Researchers believe that it has the potential to remove biofilms/build-up in irrigation pipes, and to treat water previously deemed too poor for use on vegetables.

The technique has proven successful for sanitising water applications on produce post-harvest, but project VG15068 is looking at utilising the technology pre-harvest at the critical growth stage. The project is due for completion in 2020.

FURTHER INFORMATION

For more information, please contact Professor Enzo Lombi at the University of South Australia at enzo.lombi@unisa.edu.au.

THE BOTTOM LINE: CHARACTERISATION OF A CARLAVIRUS OF FRENCH BEAN (VG15073)

The carlavirus, cowpea mild mottle virus (CPMMV), has the potential to cause economic losses in Queensland's $70 million green bean industry. The virus is efficiently spread from plant to plant by the silverleaf whitefly (SLW), with early inoculation time found to have a very significant effect on pod yield and quality.

Visible symptoms include mottled leaves, discolouration and deformed pods, with CPMMV found to be most severe in autumn crops that are several weeks from harvest. Surveys in the Fassifern Valley have indicated that bean crops grown during other windows over the spring-summer season are less likely to be affected by CPMMV.

Project VG15073 has provided the bean industry with the essential information to implement management tools specifically targeting CPMMV. Strategic insecticide applications as whitefly populations are detected, release of biological control agents which attack whitefly, and selection of tolerant bean varieties are all expected to prevent or help minimise losses from this virus.

FURTHER INFORMATION

For more information, please contact Denis Persley at the Queensland Department of Agriculture and Fisheries at denis.persley@daf.qld.gov.au.

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

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