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Management of vegetable diseases with silicon

A project developed by the Tasmanian Institute of Agricultural Research Vegetable Centre has investigated the impact of silicon applications on reducing disease and increasing yields in field-grown vegetable crops.

The bottom line

- Potassium silicate can be a useful treatment for a variety of vegetable crops.
- It can improve crops directly through suppression of diseases and indirectly through its ability to produce positive physiological responses in plants.
- The improvements to crops could have considerable commercial significance due to increased marketable yields.

Reducing crop loss in greenhouses through preventative disease management

A two-year project developed by Industry & Investment NSW has highlighted cost-effective pest and disease management practices for greenhouses, and has increased their rate of on-farm implementation.

The bottom line

- The profitability and productivity of greenhouses can be significantly improved by minimising the losses caused by pests and diseases.
- Preventative pest and disease management is about planning, cleaning and quarantining.
- Integrating the most suitable strategies from all the available options and establishing a solid prevention program is the key to cost-effective management.

Management of vegetable diseases with silicon

Introduction

The application of silicon can improve plant photosynthesis, prevent lodging, and alleviate the effects of metal toxicity, nutrient imbalance and stress caused by salt, drought and temperature. It can also enhance resistance to pests and disease by strengthening cell walls to provide a physical barrier to infection, stimulating host-resistant responses and serving as a direct fungicide.

These benefits are well established in crops such as rice and sugarcane or those grown hydroponically, however less is known about the effects of silicon application on field-grown vegetable crops which do not accumulate silicon to the same extent. In horticulture, potassium silicate is used overseas as a foliar treatment for control of powdery mildew in greenhouse crops and as a trunk injection for control of Phytophthora in avocado. This project examined the potential for potassium silicate to decrease disease and improve yields in peas, beans, corn, carrots, broccoli, potatoes and pumpkin.

Potassium silicate has fungicidal activity and an ability to promote host plant resistance in some plants, and therefore can play a role in improving the health of vegetable crops.

Premiliminary trials have shown a reduction in storage rots of Pumpkin following foliars application of potassium silicate during the reason.

Test results

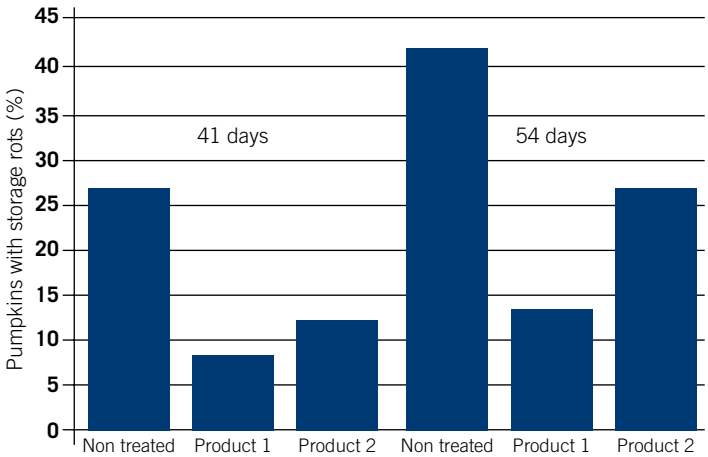
The results of a series of field trials undertaken as part of this project support the conclusion that potassium silicate can be a useful treatment for a variety of vegetable crops both directly as a fungicide and indirectly through its ability to elicit beneficial physiological responses in plants.

Potassium silicate was shown to have direct fungicidal activity, suppressing or eliminating spore germination and growth of several plant fungal pathogens in laboratory tests. Potassium silicate also suppressed bacterial pathogens such as Xanthomonas campestris in vitro, for which there are few control options. In other studies, potassium silicate has also been shown to increase chemicals associated with host plant resistance and reduce disease - even in those crops which are known to be relatively poor accumulators of silicon.

Low disease pressure prevented a full assessment of the ability of potassium silicate to reduce disease in field trials, however foliar application of potassium silicate was observed to significantly increase yields of peas in three of seven trials, with estimated net benefits of $48 to $300/ha. Furthermore, potassium silicate provided a borderline statistical improvement in a further two trials.

Foliar application of potassium silicate significantly increased the yield of marketable pumpkin in one trial. It also had a residual effect for several weeks after harvest in terms of reducing the incidence and severity of rots in cool storage.

The effect of foliar applications of potassium silicate products during the growing season on the percentage of pumpkins with storage rots following 41 or 54 days cool storage.



Foliar application of potassium silicate to a carrot crop in one trial reduced the amount of misshapen and split/cracked carrots, leading to an increase in the percentage of marketable carrots and an estimated net benefit of $132 - $235/ ha. Application of silicon to other plants has been shown to increase the strength of cells around the root cap which might explain the reduced amount of misshapen taproots. Similarly, the ability of silicon to strengthen cell walls may explain the reduction in splitting/cracking observed in this trial.

Potassium silicate had no beneficial effects on yield in two bean trials, two broccoli trials, two potato trials and one corn trial.

In Summary

This project indicated that there are likely to be benefits from the use of potassium silicate in some vegetable crops, even though many vegetables are not considered to be accumulators of silicon.

Project leader Dr Frank Hay says project findings confirm the direct fungicidal and bactericidal nature of potassium silicate.

"Potassium silicate should therefore act in a similar matter to a protectant fungicide when applied to plants, however, it is not known how long this residual activity might last on the plant surface, and it is likely that frequent applications would be required to maintain disease control," he says.

"In some plant species, potassium silicate is known to promote a systemic acquired resistance response which might further improve disease control. Additional research is needed to assess the fungicidal and bactericidal activity of silicon in field trials under moderate to high disease pressure, and identify those vegetable crops which exhibit a significant host plant resistance response following application and would therefore benefit most from application."

The project also indicated that potassium silicate could promote positive physiological responses in some crops, increasing yields of peas and increasing the percentage pack out of carrot crops through a reduction in carrot splitting/ cracking and misshapen carrots. These findings could be of considerable commercial significance and would benefit from further assessment.

Reducing crop loss in greenhouses through preventative disease management

Introduction

The average loss from disease in some greenhouse crops can be as high as 30 per cent, and while preventative and integrated strategies are the key to cost-effective pest and disease management in the Australian greenhouse industry, they have often been inadequate due to limited access to practical information and a lack of time or skill to implement changes.

This project aimed to provide clear, concise information with grower participation, group workshops, individual risk assessments and tailored action plans to assist growers to identify needs, overcome adoption barriers and implement appropriate practices.

Keep it Clean

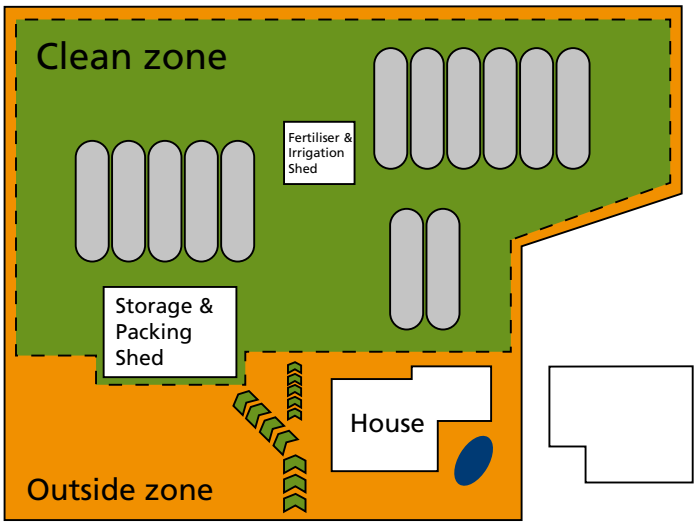
The project team set out to provide greenhouse growers with a manual explaining farm hygiene and preventative pest and disease management. It then wanted to use and present this information with the goal of getting growers to make some real changes on-farm. The resulting 147-page publication Keep it Clean contains information on simple monitoring plans, management protocols, sample record sheets and action plan templates. The comprehensive guide also identifies 77 preventative practices that can be used to cost effectively improve the management of pests and diseases, and reduce the associated losses. The 10 essential management practices have also been presented in a factsheet series.

Thrips on a plant.

The 10 essential practices for every farm:

1. Be able to correctly identify pests and diseases (or have them identified for you) and conduct checks twice-weekly in summer, and once a week in winter, to ensure early detection and correct identification of problems.
2. Determine action points which indicate when chemical, biological, whole-crop and hot-spot treatments should be implemented.
3. Make a 'clean' zone around the greenhouse which is quarantined from the 'outside' zone of the farm (including houses and driveways). Anything entering the clean zone must be cleaned first.
4. Use check and control points such as a gate, signs and washing bays to control movement of people, vehicles, plants and materials into the 'clean' zone.
5. Ensure that employees and visitors who have entered other greenhouses change their clothing and shoes before entering your greenhouse; movement of individuals onto and around the farm is one of the most common ways to spread pests and diseases.
6. Ensure that all seedlings are free from pests and diseases before they are planted out into a clean greenhouse.

7. Maintain a 5 - 10 metre wide clean and clear buffer area around every greenhouse, which will significantly reduce the levels of pests entering from neighbouring paddocks, reduce spray applications and provide farms with all-weather access.
8. Ensure the greenhouse is always cleaned and disinfected before planting a new crop in order to reduce the risk of pests and diseases being carried over from the previous crop. Make sure you have a clear, step-by-step work procedure when cleaning.
9. Keep the greenhouse and farm surrounds weed-free; weeds are one of the most significant sources of pests and diseases.
10. Remove and dispose of crop debris into a trolley or bin outside the 'clean' zone and away from the greenhouse as soon as a crop is finished.



Example of a clean zone.

Example of a clean, well spaced Greenhouse.

Putting it into practice

More than 115 greenhouse growers in three states have participated in workshops and farm review programs designed to guide them through the book, highlight the many resources available and provide skills development where needed. A significant number of resellers and allied trades, as well as industry consultants, have also attended meetings, ensuring strong post-project awareness and ongoing development in the industry.

In Summary

This project has highlighted the importance of small changes in farm management and has enhanced the capacity for many growers to plan, prioritise, resource and implement these changes. It has also provided consultants and other industry stakeholders with a ready-made information resource and program for improving farm practices.

"Eighty-six per cent of project participants have adopted a new preventative pest and disease management practice as a direct result of their participation," explains project leader Jeremy Badgery-Parker. "On a whole of project basis, the return on industry investment has been estimated at $6 for every dollar spent, and broader implementation throughout the industry would offer significant long term gains to individual growers and the industry as a whole."

Further Reading

Keep it clean (normally $33 incl. GST) is available free of charge to all levy paying greenhouse growers. Order at: http://www.dpi.nsw.gov.au/agriculture/horticulture/greenhouse

Preventing pests and diseases - Farm management review is a 19-page booklet that provides a consistent and professional process for farm reviews and individual action plans. It is included in the manual and is also available as stand-alone document for all growers and consultants to use as a planning resource. Download the booklet at: http://www.dpi.nsw.gov.au/__data/assets/

The website www.dpi.nsw.gov.au also has a number of charts designed to make record keeping easier and faster.

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