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Efficacy of SAR for disease control in rhubarb: A preliminary study

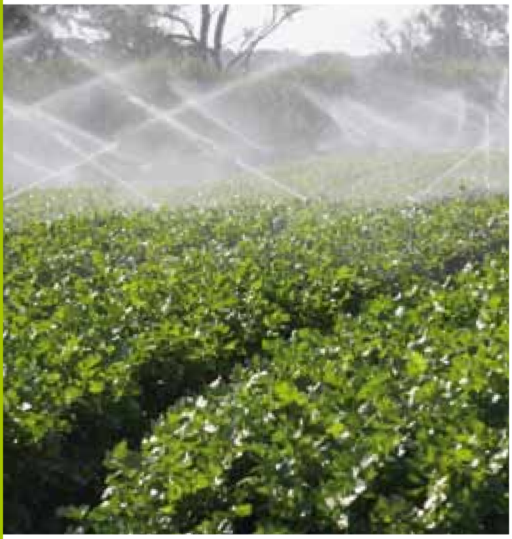
Project no: VG09031

Techniques designed to give nature's disease defence mechanisms a helping hand are now being applied to the vegetable industry.





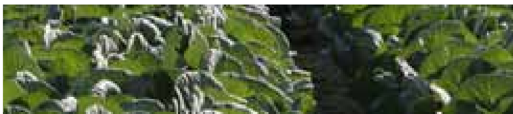




Developing guidelines for environmentally sustainable use of mineral fertilisers

Project no: VG07036

Investigating practical ways for growing leafy vegetable crops that minimise the leaching of fertiliser into the groundwater.

Efficacy of SAR for disease control in rhubarb: A preliminary study

Rhubarb Field View

Introduction

Healthy plants have a range of in-built defence mechanisms designed to combat fungal disease. The 'arsenal' of weapons includes chemical compounds that are toxic to the fungi, physical barriers which prevent hyphal growth and anti-fungal enzymes which attack fungal cells. While the response is naturally triggered in the presence of pathogens, plants can also be 'tricked' into this response so that the defence mechanisms are operating before a pathogen attacks. This novel method of disease control, known as the induction of systemic acquired resistance, is now being marketed for use on agricultural crops such as rhubarb.

Trial Methods

The yield and quality of rhubarb can be affected by a range of viruses, root diseases such as *phythothera sp*, *Rhizoctonia sp* and *Pythium sp*, and foliar pathogens like downy mildew, leaf spot and rust. Few fungicides have been registered for the control of these diseases, but the success of systemic acquired resistance in tomato, strawberry and cauliflower crops suggests that the same results are likely in rhubarb.

Rhubarb plant in a commercial farm infected with leaf spot (caused by the fungus *Ascochyta rhei).*

This preliminary study aimed to screen the use of chemical 'resistance activators' and defence elicitors as methods for controlling leaf spot disease *Ascochyta rhei* in rhubarb by testing to see whether they induced systemic acquired resistance. Trials were carried out in a glasshouse using potted plants sourced from a commercial grower and in the field on a commercial farm. Some plants were treated with BION®, which is a synthetic analogue of salicylic acid that amplifies a wave of signals throughout the plant resulting in a heightened defence level. It is likely that the most effective disease control strategy is to use several chemicals in an integrated control program, so therefore others were treated with the bioprotectant Milsana® which is extracted from the Giant Knotweed (*Reynoutria sachalinensis*), Rezist® or water.

The induction of resistance in the plant was assessed by scoring the leaf spot disease caused by *Ascochyta rhei* (characterised by circular, light-tan spots) and by measuring the activity of the systemic acquired resistance marker enzymes chitinase and ß-glucanse.

Results

The results in the glasshouse were much stronger than in the field; they revealed that plants treated with BION® 50 ppm and Betaine® 50 mM had a significantly lower level of leaf spot disease than the other treatments. The field trial showed no significant differences between the levels of disease severity for any of the treatments and no difference in the levels of enzyme activity. While this suggests that systemic acquired resistance may have been induced in the glasshouse but not in the field trial, the reduced field response could be attributed to possible seasonal variations which had made the plants more susceptible to disease. The systemic acquired resistance response is an active plant response requiring energy and if the plant is under stress as a result of seasonal conditions, there may not be enough energy reserves available to trigger it. It would be worthwhile to repeat the experiments with a young, healthy crop to see if the variability in response is related to plant health at the time of application of the chemicals.

Conclusion

The establishment of systemic acquired resistance results in long-lasting resistance against a broad range of plant pathogens including viruses, bacteria and fungi; systemic acquired resistance exploits the natural defences of the plants against disease and pathogens will not develop resistance to this approach.

Systemic acquired resistance has been shown to be a useful tool in many other crops, however it is important to point out that it is unlikely to control disease to the level the market requires when used alone. The ideal control solution would be an integrated strategy that uses systemic acquired resistance to reduce the plant's susceptibility to disease with chemical controls as required; in situations where the disease severity is high, it will also be necessary to use a fungicidal solution.

The Bottom Line: VG09031

- The development of resistance by pathogens to chemical controls is a big problem for growers.
- Growers are discovering that their arsenal for combating plant diseases is dramatically shrinking.
- The use of systemic acquired resistance could become an additional preventative tool.

Developing guidelines for environmentally sustainable use of mineral fertilisers

Introduction

The low levels of clay and organic matter in the coarse sandy soils of WA's Swan Coastal Plain have made vegetable production highly dependent on frequent irrigation and large amounts of fertiliser, however, this method is facing ongoing scrutiny amid concerns about its contribution to nitrate pollution of groundwater. Research has already shown that mineral fertiliser applied regularly at low doses effectively substitutes for traditional high pre-plant applications of poultry manure. This project demonstrates that the 3Phase method for fertilising leafy vegetable crops is able to reduce nitrate leaching to levels well below the current industry average while increasing yields.

Method

A fertiliser program developed in an earlier project (VG04018) set benchmark rates of nitrogen, phosphorus and potassium for crops according to growth stage and included advice on placement, products and low-cost application methods. This project builds on this research in order to fine-tune blueprints for lettuce and broccoli, and focus on slower growing crops such as cabbage and celery.

Applying simulated fertigation treatments to cabbage crop in Phase 3.

A series of field trials were established at the Department of Agriculture's Medina Research Station south of Perth. Broccoli, cabbage, celery and lettuce were grown in a sequential rotation using commercial row-crop layouts enabling mechanised fertiliser spreading and spraying where appropriate. The trials compared methods and types of fertiliser application at different times of the year.

The fertiliser program was rebadged as 3Phase for easy recognition and adoption by growers:

Phase 1 - The crop establishment phase, lasting two weeks in summer and three to five weeks in winter depending on crop.
Phase 2 - The rapid growth phase leading up to row closure.
Phase 3 - Maturation until harvest.

Sprays and drenches (Phase 1)

A light dressing of granular NPK fertiliser at planting is now fundamental to all crop programs. This is followed by the option of spraying a mixture of potassium nitrate and urea OR broadcasting granular NPK fertiliser once or twice a week in the early establishment stage of crop growth.

Topdressing (Phase 2)

Sufficient root systems are established 14–28 days (depending on crop and time of year) after transplanting, to allow a response to granular fertiliser applications banded between pairs of rows in order to minimise waste and allow the required rate of nitrogen, phosphorous and potassium to be applied in one pass. Both potassium and nitrogen leach readily on poor sandy soils, and both need to be top dressed frequently to ensure steady growth. All Phase 2 fertiliser strategies tested did not require mixing before application, thus saving labour time and simplifying machinery calibration.

Simulated fertigation (Phase 3)

This technique was applied to crops requiring fertiliser applications beyond row closure. It involves spraying the individual plots in the same manner as for Phase 1, but this time, the spray application is washed off immediately afterward to avoid burning. The need for potassium as well as nitrogen during this stage is now thought to be superfluous for celery and cabbage and urea appears a suitable source of nitrogen even over the winter months. Periodic soil testing is still encouraged to assist in checking levels of essential nutrients and for specific crops, additional pre-plant and side dressings of magnesium, manganese or boron may be advisable.

Results

The average nitrate leaching fraction achieved in trials with broccoli, cabbage, celery and iceberg lettuce was in the range of 0.3-0.55 compared to levels frequently around 1.0 or higher among growers on the Swan Coastal Plain. This is because the crop uses fertiliser much more efficiently when supply matches demand, and it represents a true, positive benefit to the environment from the 3Phase method. Rain causes most leaching over winter months while in summer, leaching can be minimised by timing nitrogen application to match crop growth and good irrigation scheduling practice.

Summary

The results show a clear benefit to industry and the environment from implementing the 3Phase method, however, for many growers, the perceived changes in on-farm practices required to implement the program remain a significant stumbling block. On-farm demonstrations and one-on-one support tailoring the technique to individual situations has facilitated the uptake of the 3Phase method by growers. Program participants who grow iceberg lettuce were keen to extend the 3Phase method to their baby leaf crops. The program seems especially suited to these growers but the risks of foliage burning are high and more work is needed to develop a fool-proof program specifically for those crops. There is also value in extending the 3Phase method to other crops such as tomatoes.

The Bottom Line: Project no: VG07036

- The low water-holding capacity and poor nutrition of sandy soils makes it difficult to avoid leaching fertiliser into the underlying aquifers.
- The irrigation and nutrition practices of vegetable growers are continuing to be scrutinised by environmental regulators in all states of Australia as sources of nitrate contamination of groundwater.
- Contamination can be significantly reduced using '3Phase' fertiliser schedules which tailor applications to meet crop demand and increase efficiency and crop quality.

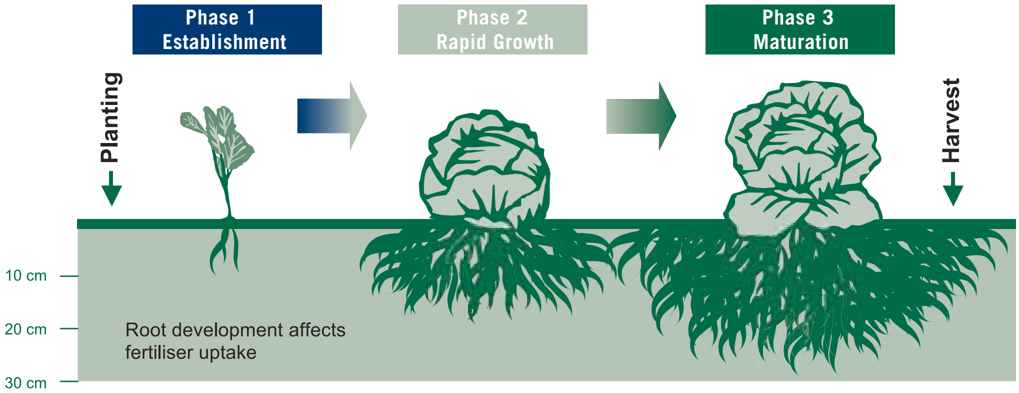


Figure 1 Growth phases from planting to harvest.

Growers at cabbage field day at Medina Research Station.

Pumping lysimeters in an iceberg lettuce trial, a weekly operation.

Acknowledgements

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