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Benchmarking predictive models, nutrients and irrigation for management of downy and powdery mildews and white blister

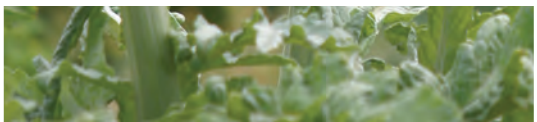
Project no: VG07070

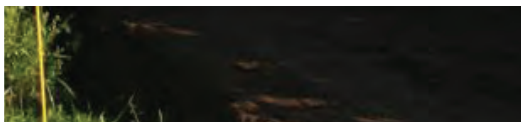
Control of major foliar diseases in brassica, cucurbit and lettuce crops could all come down to timing.

Best-practice IPM strategies for control of major soil borne diseases of vegetable crops throughout Australia

Project no: VG07125

Non-chemical control strategies have dramatically reduced the impact of soil borne diseases in vegetable cropping systems.





Benchmarking predictive models, nutrients and irrigation for management of downy and powdery mildews and white blister

Trial Site.

Introduction

This four-year research program aimed to benchmark methods of economic management for sustainable vegetable production. In addition to reducing pesticide use and improving profitability, it has also incorporated disease predictive modeling with aerial sampling methods, nutritional status, irrigation management, pesticides friendly to beneficial organisms and some fungicide alternatives.

Controlling Fungal Disease

Major fungal diseases in vegetable production can be controlled by a variety of strategies, used alone or in combination. These include:

- Only spraying when necessary based on disease predictive models and in-field spore detection kits
- Timing over-head irrigation to minimize periods of leaf wetness
- Planting resistant varieties
- Maintaining nutritional status
- Using registered pesticides which are friendly to beneficial organisms

The research objective was to compare the efficacy and determine the economic contribution of these various management strategies for control of major foliar diseases in brassica, cucurbit and lettuce crops. Trials have targeted white blister on brassicas, powdery mildew on cucurbits, and downy mildew and anthracnose on lettuce.

Trial sample

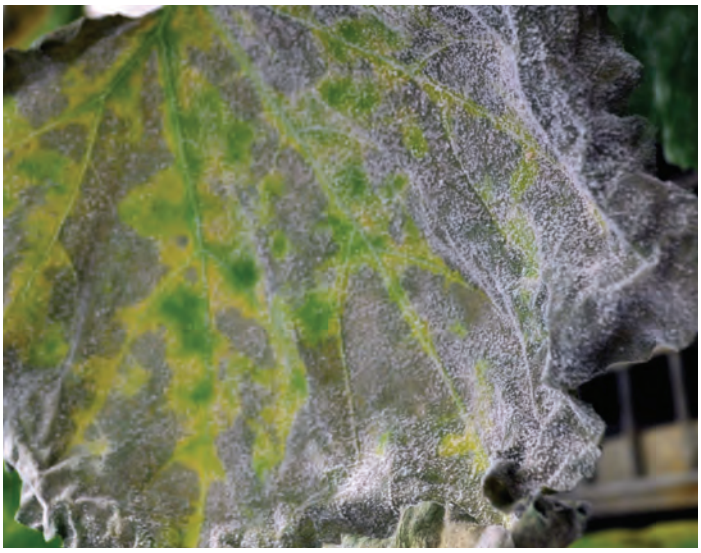
A Werribee field trial on broccoli evaluated three IPM tools; variety, irrigation timing and spraying regimes including the Brassicaspot TM disease risk predictive model, for efficacy in the control of white blister and the economics of this control. The trial showed that growing the more resistant variety, Tyson, reduced the incidence of white blister on broccoli heads by 99 per cent when compared to the susceptible Ironman variety, whilst overhead irrigation at 4am rather than at 8pm resulted in a 58 per cent reduction. Neither version of the Brassicaspot™ differed in its control of white blister nor were they different from the weekly treatment. However, the use of the Brassicaspot™ models considerably reduced the number of spray applications in dry conditions while providing the same level of disease control as weekly sprays.

An economic analysis of this trial showed an 11 per cent increase in farm profits by growing the more resistant variety, a 3 per cent increase by choosing morning irrigation and a 3-4.5 per cent increase in farm profits by using the models because fewer sprays were used.

Research Outcomes

The following major research outcomes will help to maximize the production of broccoli, lettuce and cucurbits and meet the high aesthetic standards of the marketplace:

- The Brassicaspot™ and BREMCAST™ models and the Powdery Mildew Risk Index (PMRI) have proven to be useful decision support tools for timing fungicide applications for control of the targeted foliar diseases. BREMCAST™ reduced spray programs by one to three sprays, maintained disease control and was economically profitable. Brassicaspot™ reduced spray programs by 12-13 sprays in dry conditions. Disease incidence on broccoli heads was reduced by 77 per cent compared with the unsprayed 'Control", yield was increased by 7 per cent. Under wetter conditions, however, either the weekly sprays of protectant fungicide or the grower spray program of systemic and protect fungicides was 75 per cent more economical and reduced white blister incidence by 63-98 per cent, compared with the use of current versions of the Brassicaspot™ model. Further improvements could be made by modifying the spray threshold "Disease Index", using an in-field airborne spore-detection kit currently under development, and/or producing an Australian model to reduce costs and improve access.
- The PMRI reduced fungicide spray programs by one application without affecting zucchini yields.
- Growing a variety of broccoli resistant to white blister reduced disease incidence by 99 per cent and increased yield by 10 per



Powdery Mildew.

cent, however resistant varieties needed to be sprayed. Irrigation of broccoli crops at 4 am instead of 8 pm reduced the incidence of white blister by 58 per cent, and increased yield by three per cent.

- Good control of white blister on the wrap leaves of Chinese cabbage was achieved with a single application of a registered systemic fungicide 14 days before harvest. While producing the same level of control of white blister as the Brassicaspot™ model, this spray regime was 20 per cent more effective in reducing the white blister rating, compared with the grower spray regime. It also had the highest contribution to profit – a 60 per cent increase compared with the grower treatment.
- High rates of calcium nitrate applied to lettuce seedlings reduced susceptibility to downy mildew and anthracnose, but the application of ammonium nitrate increased susceptibility to the disease. Further trial work is required to show efficacy in the field.
- Of the limited alternative fungicide chemistries evaluated in the field, only Bion™ had efficacy and economic advantages for the control of downy mildew on lettuce when applied before the disease appeared in crops, but its response can be variable.

Conclusion

The work undertaken has cut pesticide use by at least a third, whilst maintaining quality and improving profitability. The results have been delivered to many growers at meetings in NSW, VIC and QLD, and plans are underway to format the BREMCAST™ model into user-friendly software and develop a website for access to disease predictive models.

The Bottom Line: VG07070

- Irrigation scheduling and growing resistant varieties are two ways of combating the destructive disease white blister.
- Even resistant varieties should be sprayed as there is a risk that the pathogen can overcome varietal resistance.
- Disease predictive models have their place in disease control but a cautious approach is needed.

Acknowledgements

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Alternating rows of grafted and ungrafted snake beans.

Best-practice IPM strategies for control of major soil borne diseases of vegetable crops throughout Australia

Introduction

This project has produced clear evidence that non-chemical control strategies such as crop rotation and grafting are highly effective weapons in the push to reduce the impact of soil borne diseases in vegetable cropping systems. Crop rotation using Brassica biofumigant crops was found to provide excellent weed suppression, a reduction of root rots in green beans, less lettuce drop and an increase in the fresh weight of spring onions. Results also indicated improvements in soil health due to increases in organic matter, nitrogen and beneficial microbial activity. Researchers have also been able to reduce the incidence of disease in snake beans by up to 98 per cent by grafting onto disease resistant rootstocks.

Project Targets

Researchers have taken a 'systems' approach to the management of soil borne diseases by seeking to develop practical crop strategies and techniques which may be applied broadly in vegetable production systems against soil borne diseases in general, rather than specifically against one pathogen in a single host crop. Laboratory and glasshouse studies identified four Brassica biofumigant crops, Caliente 199™, Mustclean™, Gladiator™ and Nemfix™, with excellent activity against four major soil borne pathogens of vegetables (Sclerotinia minor, Fusarium oxysporum, Pythium dissotocum and Rhizoctonia solani).

Field Trials

Field trials demonstrated that the biofumigation effect of Mustclean™ reduced lettuce drop by 62 per cent and bean root rots by 35 per cent, compared with fallow or grass and cereal rotations. Caliente 199™ increased the fresh weight of spring onions by 16 per cent and had the highest average concentration of shoot GSL (2-propenyl) across all Victorian field sites. Northern Territory field trials using snake beans grafted onto a Fusarium resistant Iron cowpea rootstock have reduced the incidence of Fusarium wilt by as much as 98 per cent. This root stock is also resistant to root knot nematode. There is now potential for grafting to be applied to other candidate crops (eg. cucurbits, capsicums) which are moderately to severely affected with serious soil borne disease problems.

Growers Tips:

A) Crop and Site Selection

Choosing the right green manure or biofumigant crops to include in a rotation strategy for economic feasibility and effective disease management will depend upon the season, cropping system, soil type and condition and known pest and disease pressures. For optimum benefit, growers should avoid winter (as the crops grow too slowly) and summer (due to insect pest pressure) plantings. Sites infested with the clubroot pathogen should also be avoided, as Brassica juncea green manures are highly susceptible to this pathogen. Break crops may need

fertilizer input for maximum biomass production if nutrients in soil from a previous crop are low.

B) Cultivation and Incorporation

Flowering prior to seed formation is the ideal time to incorporate Brassica biofumigant crops as glucosinolate concentration is at its peak. It also prevents these plants from becoming weeds. For the best result, the crop should be pulverised before incorporation into moist soil in order to release the highly volatile ITC compounds which are biocidal to soil borne pathogens. The soil surface should be sealed by rolling or irrigation after incorporation to minimise their escape from the soil. Time to maturity (flowering) varies among cultivars and on the season; in cold weather Mustclean™ matures in 60 days, while Caliente 199™ takes 90-100 days.

Future IPM Tools

A second component of the project has been the evaluation of novel control strategies as future IPM tools. Plant-derived volatile compounds, particularly those based on thyme, clove bud, origanum or mustard (eg. Vigor® and ECO-V) oils and mycofumigation with endophytes that produce volatile antimicrobial compounds have been considered worthy of further development as future IPM tools for field application. Liquid chitin, chitosan, and Bacillus subtilis (biological control) in conjunction with phosphorous acid are worthy of further development for hydroponic applications.

Grafted snake bean plants.

Conclusion

Information from trials including the agronomic characteristics of these crops, their biofumigant potential, effects on key soil health parameters and compatibility with current cropping systems is being used to develop new strategies for managing soil-borne diseases in vegetable production. The data collected in this project has been presented as the four page guide "Managing soil borne diseases in vegetables" which has been distributed to more than 300 growers at field days and national workshops. It is also available online at http://www.vgavic.org.au/pdf/VG07125_Soilborne_Diseases_brochure.pdf

Growers looking at plots.

The Bottom Line: VG07110

- Crop rotation strategies can reduce inoculum of soil borne pathogens by breaking the disease cycle, biofumigation activity (e.g. mustards) and/or improving soil health.
- Biofumigant crops with the highest levels of isothiocyanate (ITC) producing glucosinolate (GSL) compounds are more effective for pathogen control and have reduced lettuce drop and bean root rots by up to 62 and 35 per cent respectively.
- In-field effects include excellent weed suppression, and increased organic matter, nitrogen and soil biological activity.
- Grafting has reduced the incidence of Fusarium wilt by up to 98 per cent in snake bean crops and there is potential for this technique to be used to manage soil borne diseases in other candidate crops.

Acknowledgements

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Please contact Courtney Burger at AUSVEG on 03 9822 0388 or email courtney.burger@ausveg.com.au to submit topics for potential inclusion in future editions of **vege**notes*.*

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