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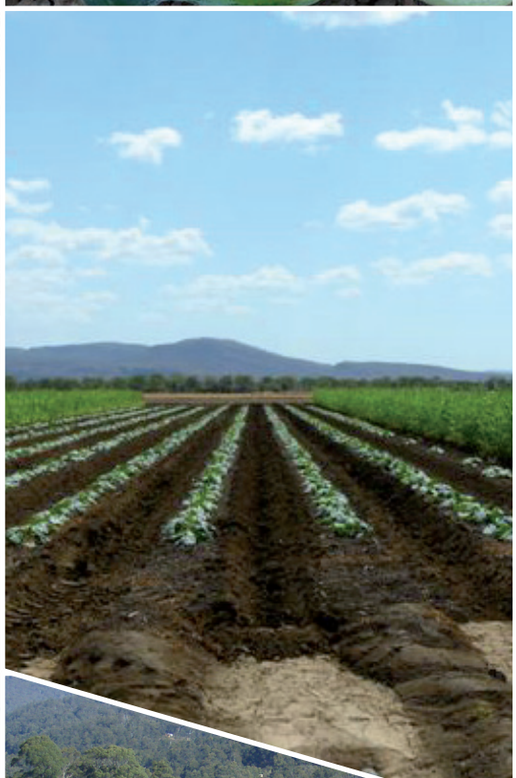
  HAL R&D project number: VG06022

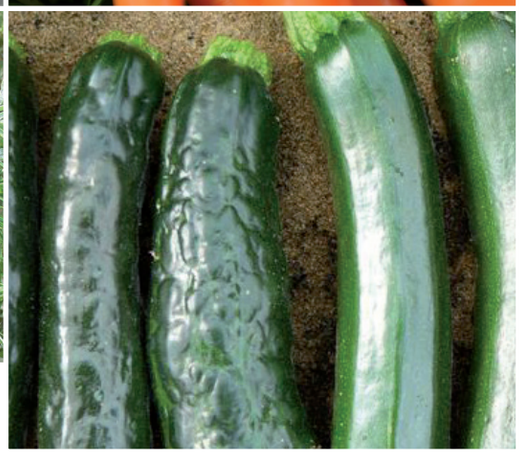
  Project VG06022 sought to increase understanding within the horticulture industry of the epidemiology and control of virus diseases in field grown vegetable cucurbit crops.

- **Investigations and developing integrated management strategies for carrot powdery mildew.**

  HAL R&D project number: VG08044

  Project VG08044 intends to create awareness of the newly identified disease, with research working to identify the impact of Powdery mildew on carrots.





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Developing and communicating strategies for controlling virus diseases in vegetable cucurbit crops.

Pumpkin variety Sampson (left) is more tolerant to disease than pumpkin variety WA grey (right).

Facilitators:

Project VG06022 has been completed by Primary Investigator Brenda Coutts with assistance from Dr Roger Jones and Monica Kehoe from the Department of Agriculture & Food Western Australia (DAFWA), in collaboration with Denis Persley and Lee McMichael of Department of Employment, Economic Development and Innovation (DEEDI), Queensland.

Introduction

Diseases in vegetable cucurbit crops can significantly affect yield, quality and marketability. At present, key viruses of cucurbit crops in Australia are Papaya ringspot virus (PRSV), Squash mosaic virus (SqMV), Watermelon mosaic virus (WMV) and Zucchini yellow mosaic virus (ZYMV). Early infection of cucurbit plants can considerably damage crops, with high levels of infection causing losses of up to 100 per cent of marketable produce.

Project VG06022 sought to increase understanding within the horticulture industry of the epidemiology and control of virus diseases in field grown vegetable cucurbit crops. There were three key components of this research project: firstly, identifying where viruses were instigated between growing seasons; secondly, determining the impact on yield; and thirdly, developing management strategies which could assist growers to reduce the level of crop infection. Field experiments were carried out in: Kununurra, Carnarvon and Medina, Western Australia, to investigate the effectiveness of cultural control measures in limiting ZYMV spread in pumpkin and single-gene resistance in commercial cultivars of pumpkin, zucchini and cucumber.

Aphids on pumpkin flower.

Project findings

Research in the field showed that the spread of ZYMV in pumpkin could be reduced in three ways: by varying planting dates to avoid exposing young plants to peak aphid vector populations; by using tall non-host barrier crops (millet) to protect against aphid vectors; and, by planting upwind of infection sources. Interestingly, seed transmission of ZYMV was found in seedlings grown from ZYMV-infected fruit of zucchini, but not of pumpkin. It was identified that ZYMV, PRSV, WMV and SqMV spread from infected to healthy cucurbit plants by direct leaf contact. ZYMV remained infective on varied surfaces for up to six hours, but was inactivated by some disinfectants.

Primary investigator, Brenda Coutts explained: “It was a new discovery through this research that Zucchini yellow mosaic virus is spread by contact, meaning people and machinery can spread this virus as well as aphids. Some of the work that we have been following up is looking at disinfectants and how they can stop this particular virus, like washing down machinery and looking at those farm hygiene aspects.”

Planting non-host barrier crops as dividers on field was a successful remedy in protecting against infection, with a delay of two weeks in sowing times showing a decrease in the spread of ZYMV. “We found that having a tall non-host barrier, such as sorghum or millets planted around a cucurbit crop, did slow down the rate of infection. Although the crop still became infected, it took a longer time, and therefore, we got a higher yield of that particular crop,” said Ms Coutts. Identifying resistant cucurbit vegetable varieties was also an important aspect of the research, which found some varieties were more susceptible than others.

Management strategies

Existing integrated disease management strategies for virus diseases of vegetable cucurbit crops grown in the field have been improved by the new information gathered. These strategies, which are aimed at minimising extra expenses, labour demands and disruption to normal practices, include the following:

- Avoid spread from nearby crops; plant upwind from potential infection sources.
- Minimise spread from cucurbit weeds or ‘volunteer’ crop plants.
- Sow non-host barrier crops.
- Vary planting dates and monitor aphid populations.
- Use certified seed.
- Use mulches or minimum tillage.

- Use virus-resistant cultivars.
- Maintain good on-farm sanitation practices.
- Plant break crops.

Conclusion

Virus diseases in cucurbit crops infect the plant before flowering or at flowering; it is at this time when yield reductions occur. Project VG06022 identified some of the pathways in which these viruses can infect crops and impact marketable yields and investigated the immense damage on cucurbit crops across the northern areas of Australia in particular. Through multiple field trials and research, a set of more informed management strategies for virus diseases in vegetable cucurbit crops has been developed.

Infected cucurbit produce.

The Bottom Line: VG06022

- The project has developed improved integrated disease management strategies for virus diseases of vegetable cucurbit crops grown in the field through new information.
- Field experiments in Western Australia investigated the effectiveness of cultural control measures in limiting virus spread in pumpkin, and single-gene resistance in commercial cultivars of pumpkin, zucchini and cucumber.
- Key findings included information on non-host barrier crops in slowing down the rate of infection, and determined that Zucchini yellow mosaic virus can be spread by field workers, on equipment and machinery.
- It was identified that ZYMV, PRSV, WMV and SqMV can be spread from infected to healthy cucurbit plants by direct leaf contact and ZYMV may remain infective on varied surfaces for up to six hours.

Acknowledgements

This project has been funded by HAL using the vegetable levy and matched funds from the Australian Government.

Investigations and developing integrated management strategies for carrot powdery mildew.

Carrot powdery mildew.

Facilitators:

Milestone 7 of project VG08044 has been completed by Project Leader Andrew Watson from the New South Wales Department of Primary Industries (NSW DPI), in collaboration with Dr Hoong Pung of Peracto in Tasmania, Barbara Hall of the South Australian Research and Development Institute and Dominic Cavallaro from Cardinal Horticultural Services.

Introduction

First identified in Australia in 2007, Carrot powdery mildew is considered a significant threat to carrot production in Australia. With relatively little known about its development and treatment options, project VG08044 intends to create awareness of the newly identified disease, with research working to identify the impact of Powdery mildew on carrot growth, yield, quality and assess the effectiveness of chemical and non-chemical treatment methods. A fungicide trial was undertaken in a greenhouse at Yanco Agricultural Institute in New South Wales, with carrots grown in greenhouses to examine the effects of previously trialled fungicides in the field. The trials were carried out to produce a higher concentration of disease, without the effects of rainfall. The research identified that once the disease has progressed to a high level it is very difficult to manage and confirms grower experience with the disease. Early detection and application of fungicides was found to be critical in its control. The project also highlights the need for disease monitoring in carrot crops.

Building knowledge for the industry

Powdery mildew in carrots can cause damage to foliage, stems and umbels; often covering leaves with white mycelium and powdery spores. Infected foliage can become brittle, and diseased pedicels may turn brown, causing the florets to die prematurely. The project analysed fungicide usage, water management, varietal differentiation and weather conditions. One of the key findings reported from the research was that the mildew spreads easily from infected to uninfected plants,

particularly through the movement of field workers and field equipment.

"Identifying the disease at an early stage is critical to the management of the disease, as Powdery mildew on carrots is extremely easy to transfer, such as when a person going to a couple of different crops can spread it quite easily," explains Project Leader, Andrew Watson.

"The other aspect with Powdery mildew on carrots is that it is hard to see, as carrots have a fine leaf and early infections are hard to identify. It doesn't show up that much until it is too far gone, and its difficult for fungicides to do anything by that stage," he said.

As the Australian vegetable industry had not yet identified Powdery mildew on carrots prior to 2007, the project sought to address several issues. In order to gain a better understanding of the disease itself, its effects on carrots and to identify fungicide options for its management, the project undertook both field and greenhouse trials.

"Most of the trials we conducted were in the field in New South Wales, Tasmania and South Australia. We planted, developed and fertilised the crops and then introduced the disease in the field and let nature take its course to evaluate its progression," said Mr Watson.

While registered fungicide Amistar Top® showed success in controlling the disease, trials also showed overhead irrigation reduced disease concentration when compared to drip irrigation methods. Mr Watson stressed the importance of monitoring young carrot crops regularly. Though hard to identify in early stages, early detection is critical, once Powdery mildew infects many leaves control methods are not as successful.

Infected and non-infected crop plants.

Project findings

- Temperature trials indicated that Powdery mildew of carrots favours temperate conditions, similar to spring and autumn seasons in much of Australia.
- During trials, Powdery mildew was found to be readily transported on people and infections were easily caused by accidental movement from an infected to a non-infected greenhouse.
- Disease management is most successful with fungicide application showing low disease concentration. Field and greenhouse trials have indicated that the disease is controllable, though not eliminated, by fungicide application.
- Variety trials were valuable in identifying more tolerant carrot varieties and the best options for growers. The carrot variety Stefano was shown to have high resistance to disease incidence and should be considered in periods of high disease pressure.

Conclusion

The project has ascertained that early detection of the disease is critical in efforts towards successful management and minimising loss. Producers should reduce movement of any field workers or machinery between infected and uninfected areas, as it is plausible that a nearby crop could spread the disease through airborne transmission. It has been concluded that early fungicide application is essential and environmental conditions have been shown to affect the incidence of Powdery mildew across all states, with wetter conditions reducing the outbreaks of the virus.

The Bottom Line: VG08044

- Carrot powdery mildew, first identified in Australia in 2007, is extremely contagious and can be spread easily, particularly by movement of field workers and equipment through crops.
- Research identified that overhead irrigation can reduce development of the disease when compared to drip irrigation.
- Weather and temperature conditions were found to effect development of the disease, with humid conditions advancing its development.
- The fungicide *Amistar Top®* was deemed successful at controlling the disease.

Acknowledgements

This project has been funded by HAL using the vegetable levy and matched funds from the Australian Government.

Photo credits:
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VG08044 photos credit Andrew Watson

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