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Pre-emptive breeding to combine superior eating quality in tropical super sweet corn with resistance to major diseases.

HAL R&D project number: VG07198

Queensland researchers are leading the push to improve the competitive advantage of the sweet corn industry by using a range of smart solutions designed to overcome environmental limitations and improve disease resilience.

Identification of IPM strategies for Pythium-induced root rots in Apiaceae vegetable crops.

HAL R&D project number: VG08026

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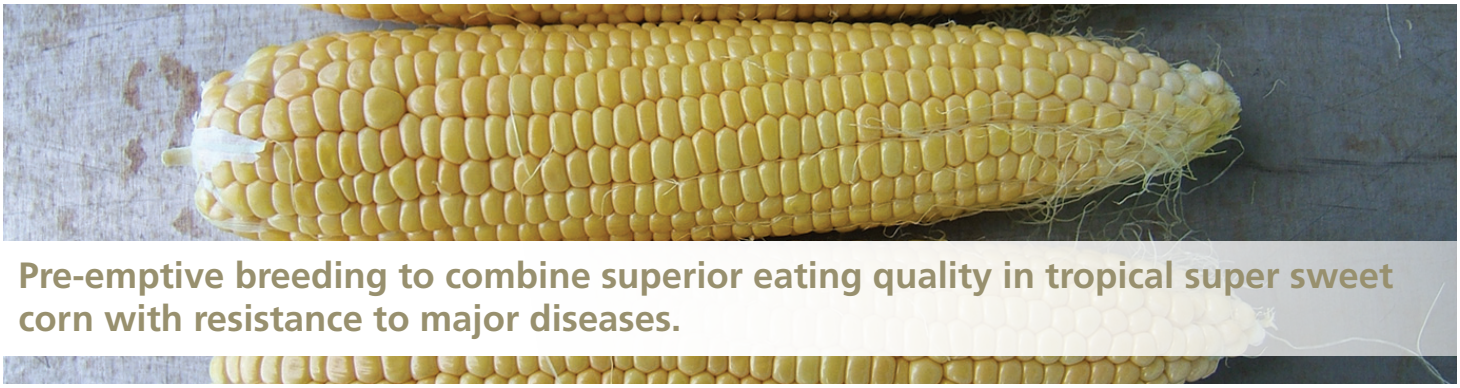

Pre-emptive breeding to combine superior eating quality in tropical super sweet corn with resistance to major diseases.

The cob appearance of one of the candidate hybrids

Facilitators:

Milestone 8 of project VG07198 has recently been completed by Dr Solomon Fekybelu from the Queensland Department of Agriculture, Fisheries and Forestry (DAFF). Dr Solomon is leading a team of three researchers based in North Queensland and Hermitage research station, Warwick, QLD.

Introduction

Most varieties of sweet corn grown in temperate and subtropical parts of Australia may not be adaptable to tropical environments and are quite often susceptible to disease. The identification and development of new hybrid sweet corn germplasms, with adequate resistance to current production constraints, has the potential to not only protect the local industry, but pave the way for possible market expansion. DAFF is examining the potential to lift the profitability of sweet corn by combining genetic resistance with high eating quality and productivity. The sweet corn breeding program is now developing new series of hybrids that enhances the competitive advantages of Australian sweet corn growers.

Sweet Corn Threats

- Polysora rust (*Puccinia polysora*) is an existing tropical disease. Heavy infections may result in stunting, incomplete ear tip fill and pustules on ear husks, which reduce yield and marketability. Incorporation of Polysora rust resistance is vital to expand sweet corn production in tropical Australia.

- Downy mildew (*Peronosclerospora sorghi*) is an exotic threat which causes significant problems in the tropical and subtropical regions of Asia. It is becoming a major threat in most tropical and subtropical sweet corn producing regions around the globe.

Disease resistant new candidate hybrid

- Turcicum leaf blight (*Exserohilum turcicum*) is a significant disease that is increasingly becoming a major problem throughout maize growing environments in Australia and other parts of the world. In India, it has been reported that in susceptible varieties there has been up to 90 per cent yield reduction.

Dr Solomon Fekybelu is heading a team experimenting with pre-emptive breeding strategies using biotechnology and conventional approaches in order to improve resistance against these major foliar diseases threatening the sweet corn industry.

"If an outbreak does occur in Australia, we want growers to be ready, and have hybrids on stand-by which are resistant to the disease," Dr Fekybelu explains.

The pre-emptive breeding work has also been validating marker-assisted back crossing which can then be translated in actual field performance in the presence of downy mildew.

"By using biotechnology, we have been looking to identify such varieties, and then send samples overseas where the disease is present in order to verify whether that resistance is working or not," Dr Fekybelu explains. "Asia is also a significant market for Australian bred hybrids such as Hybrix 5, so it is also important for our hybrids to demonstrate resistance in order to maintain and possibly expand Australia's market share."

About the Project

Since 2009, a range of trials have been undertaken at the Hermitage Research Station, Gatton, Kairi and Bowen. The trials have compared the performance of a new generation of hybrids against commercially available samples. They have been evaluated for a number of agronomic, quality and disease-resistant traits including tillering, stand uniformity, plant architecture, number of marketable cobs, cob weight, flavour and tenderness. Testing has taken place in all seasonal growing environments in order to verify performance consistency.

Major Project Findings

The research currently being undertaken may not only set the scene for increased production of sweet corn in tropical areas of Australia, but also facilitate the expansion of the industry into areas such as the Atherton Tableland and other high rainfall environments.

Selection for tenderness and flavour in tropically-adapted super sweet corn germplasm in the Kairi (North Queensland) breeding program has resulted in improvements in eating quality.

"The newly developed and tested hybrids have demonstrated significantly superior kernel tenderness to Hybrix 5, the first very successful tropical hybrid released from the QDPI Kairi program," said Dr Fekybelu. "The most promising hybrids have been shown to produce twice more marketable cobs compared to Hybrix 5 and are quicker in terms of maturity. The candidate hybrids also showed excellent resistance to the most prevalent diseases of super sweet corn, namely Turcicum leaf blight (*Exserohilum turcicum*)."

Conclusion

Three candidate varieties are currently being grown for demonstration purposes at Gatton. Seeds of these candidate hybrids have also been multiplied for on-farm verification trials with growers during the coming spring. Based on the grower feedback, one of the hybrids is likely to be commercialised.

The Bottom Line: VG07198

- Highly disease-resistant sweet corn hybrids are needed to expand planting windows and supply fresh produce year round.
- Genetic resistance is the most cost-effective means of disease control with the added possibility of production increases.
- A new commercial hybrid is soon expected to be released for use in tropical and subtropical Australia.

Acknowledgements

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

Identification of IPM strategies for Pythium-induced root rots in Apiaceae vegetable crops.

Parsley root close-up

Facilitators:

Milestone 6 for project VG08026 has recently been completed by Dr Elizabeth Minchinton, Plant Pathologist – Vegetables in the Victorian Department of Primary Industries (VIC DPI) Biosciences Research Division, with the assistance of Dr Joanna Petkowski and Dr Dolf de Boer.

Introduction

Apiaceae vegetables – such as parsley, parsnip and carrot – are prone to root rot, canker and cavity spot diseases that can significantly reduce yields. These diseases are associated with a number of microorganisms. *Pythia*, a group of pathogens commonly called 'water moulds', are often present on Apiaceae roots. These pathogens are a major cause of disease when conditions favour their development, such as in soils saturated with water.

Damaged parsnip

Research

The Victorian Department of Primary Industries in Victoria (VIC DPI) conducted a series of field trials between 2009-2011 to evaluate options for the control of *Pythium*-related diseases of Apiaceae vegetable crops, including the use of fungicide, biological and cultural controls, and resistant varieties. Parsley, parsnip and carrot crops were examined either in VIC, QLD, WA or TAS.

Major Project Findings

- *Pythium* and *Itersonilia* are prevalent to damaging the roots and seedling leaves of parsnips in wet conditions. **SOLUTION:** Growers, or their crop consultants, should monitor crops for these diseases, and if observed, apply registered or permitted fungicides.
- One species of *Pythium* was pathogenic over a wide range of temperatures in parsley root. For several years, the appearance of root rot in field grown parsley has been observed about 7 days after heavy rains, especially during cooler months in Victoria. **SOLUTION:** For disease control, monitor 7 day weather forecasts, and if heavy rainfall events are predicted, consider immediately applying a granular formulation of metalaxyl, if it is registered or permitted in your state.
- The fungus *Phoma exiqua* var. exigua and the "water mould" *Pythium tracheiphilum* were identified on parsley and parsnip roots for the first time. **SOLUTION:** As both parsley and parsnip have a broad host range, avoid growing lettuce before these crops.

Biocontrols and cultural controls, such as hilling soil over parsnip crowns, covering plants with fleece or applying mulch to the soil surface, did not control root rots. However, one biocontrol agent *Bacillus*, as well as hilling and mulch, stimulated plant growth in some trials. Unfortunately applications of organic mulch to the soil surface enhanced lateral root development on parsnips, reducing their quality.

Best Practise IPM Guidelines

- **Avoid planting parsnips on poorly drained sites with heavy soils**
  Parsnips are less susceptible to root rots in sandy or sandy loam soils.

- **Plant parsnip varieties which are less susceptible to canker (root rot) and *Itersonilia***
  Select varieties that are most suitable for your soil type.

- **During cooler months apply a fungicide when planting parsley**
  Applications of a registered or permitted fungicide will protect seedlings from damping off in cooler months. Additional applications may be required six weeks after emergence and 6-8 weeks before harvest if symptoms appear.

- **Select crops to rotate with Apiaceace and reduce disease**
  Western Australian research indicated that less cavity spot appeared on carrots if crops followed broccoli that has biofumigation properties (DAFWA). Unfortunately, radish has no such biofumigant activity. Victorian research suggests that growers should avoid planting lettuce before Apiaceae crops as a *Phoma* species, which has a broad host range including lettuce, was identified on parsley and parsnip roots.

Parsely root bunches

Conclusion

The project highlighted the activity of *Pythium* species (in field, hydroponic and laboratory studies), identified factors that foster *Pythium* damage (soil moisture, nutrients and temperature in field and growth chamber studies), and determined the efficacy and economics of biological, cultural and chemical options.

Key recommendations for control of these *Pythium* induced root rots include:

- Rotation with biofumigant producing crops (e.g. broccoli).
- Avoiding rotation with crops carrying similar pathogens (e.g. lettuce).
- Selection of fields/beds with relatively good drainage (e.g. avoiding heavier water logged soils).
- Choosing varieties that are less prone to disease.
- Early application of fungicides such as metalaxyl, preferably in granular form to ensure good distribution in soil (if registered or permitted in your state).

Field day

The Bottom Line: VG08026

- *Pythium* pathogens are associated with root rots of Apiaceae vegetable crops.
- Soil applications of the *Pythium* specific fungicide metalaxyl reduced root rots and improved yields of parsley and parsnips, but the effect was variable in parsnips and only observed on sandy soils.
- Some commercial parsnip varieties are less susceptible to canker and their use improved yields three-fold, compared with the grower's standard variety.

Acknowledgements

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