Appendix 4

KVH/Zespri Psa-V Research & Development programme update

Production figures for the New Zealand kiwifruit industry over the past two years provide a strong indication that growers are not only maintaining orchard productivity in a Psa-V environment, but the industry has entered a production-driven growth phase in spite of the establishment of Psa-V in the key kiwifruit growing regions of the country. Not only is this evident in the increasing volumes of Gold fruit, as Gold3 production areas mature as the replacement for the highly Psa susceptible Hort16A, but interestingly, green production, on what would have been considered a relatively mature productivity platform, has also achieved record volumes this season.

While we can speculate as to main reason for the increase in productivity, the attention to detail by growers as a result of Psa-V management and control approaches, including better male management and use of artificial pollination, have, we believe, significantly contributed to this increase.

Supporting the industries return to growth, research streams within the KVH/Zespri R&D programme over the last year in particular have targeted both optimising disease control strategies aimed at reducing inoculum levels in the orchard environment, as well as optimising Psa-V agrichemical use patterns to mitigate the often perceived negative impact of fighting the disease on vine health and productivity. In particular there has been a strong focus on optimising seasonal spray programmes, particularly with regards to the timing of copper applications and the alternation of alternative product chemistries. A focus has also been on optimising vine spray coverage while at the same time reducing environmental impacts through the use of low-drift technologies.

Some key areas of research undertaken in the programme this season and their outcomes are highlighted below.

Best practice for protectant spray coverage of spring and summer kiwifruit canopies

Optimising copper use for sustainable control of Psa in kiwifruit orchards
This study was undertaken to build on previous work to develop best practice recommendations for Psa-V protective sprays for kiwifruit. In particular, the goal was to determine firstly, for how long low-drift air inclusion (AI) nozzles could efficiently deliver protectant sprays to expanding spring canopies, with a preference for spring Psa-V protectants such as streptomycin to be applied using low drift technology. Secondly, to maximise the efficiency of spray delivery to flowering Hayward and fully expanded Gold3 canopies on wide row spacings. Key findings were:

- AI nozzles performed equally as well as conventional fine droplet ATR nozzles in delivering protectant sprays to pergola canopies, from budburst through to pre-flowering
- AI nozzles visibly reduced off-target drift compared to fine droplet ATR nozzles, in sprays applied to expanding spring canopies.
- AI sprays delivered at 800 L/ha targeted foliage equally as well as, or better than, AI sprays delivered at 1000 L/ha.

Reducing the impact of Psa-V on Green kiwifruit productivity
A correlation between Psa-V and bud-rot in green kiwifruit varieties has been established and projects were undertaken during the season to determine the appropriate control strategies to reduce Psa-V related flower loss.

Two approaches were taken. The first approach targeted identifying the optimal timing for the application of a spring trunk girdle to reduce bud-rot symptom development. Trial results from this project indicated that a girdle applied approximately 30 days pre-flowering was optimal and could result in reductions in flower loss in high-risk orchards of between 20 and 30%. This project also set out to understand the dynamics of the microbial community associated with Psa-V related bud-rot.

Understanding the role of microbial diversity linked to Psa-V presence on the vine and the infection process were highlighted as a key knowledge gap in our understanding of Psa-V epidemiology and

potential disease control by Venturi Vittorio a key note speaker at the Second International Psa Symposium held recently in Bologna.

Discussions with Venturi around the direction of our research programme have opened the way for the development of a collaborative research project targeted at firstly identifying and then blocking the signalling circuits hypothesised to operate between the kiwifruit plant, Psa-V and the associated bacterial communities that may direct or coordinate the Psa-V infection process.

The second approach to controlling bud-rot has been through the evaluation of specific inter seasonal spray programmes targeted at reducing the build-up of post-harvest inoculum pressures and overwintering Psa-V populations through to pre-flowering.

This trial investigated which spray programmes, running from postharvest to spring, would provide the best Psa-V protection. The trial was conducted on three orchards in the Bay of Plenty region (Hayward at Te Puke and Edgecumbe and G14 at Paengaroa) and involved the use of eight different spray programmes, from minimal copper use through to extensive copper, Actigard™ and KeyStrepto™.

Bud-rot was observed in all three sites. Each trial site was different from the others and there was some variance in response to the control programmes. Results for G14 in Paengaroa indicated the autumn period was most important for Psa-V control, whilst the Hayward in Edgecumbe indicated the spring period. Treatments consisting of minimal copper use demonstrated poor control. The level of Psa-V control at all three sites supports the use of a more intensive Psa-V protection programme throughout the autumn, winter and spring period. This involves copper, Actigard™ and KeyStrepto™ applications made at strategic times. These results are a valuable resource for supporting the need for comprehensive spray programmes utilising the various available chemical modes of action.

Psa-V product testing continuation

Potted plant trials have continued to focus on screening new biological and elicitor-based products for activity against Psa-V. In particular, the programme has seen the testing of a number of novel yeast and Trichoderma isolates—both on their own and in combination with other BCA and elicitor based products.

Products showing some degree of efficacy against Psa-V have been targeted for further evaluation, including understanding copper tolerance due to the importance of copper in current spray programmes, efficacy in the field, and identification of potential plant phytotoxicity issues.

Product testing continues to be an integral part of the Psa-V R&D programme and as new products with potential efficacy against Psa are identified, these will be entered into the product testing pipeline.

Biosecurity and emerging pests

A new inclusion in the programme this year has seen the incorporation of projects to identify and understand the risk of emerging pests and diseases to the New Zealand kiwifruit industry.

A project assessing the risk of *Ceratocystis fimbriata* wilt disease is summarised here:

Ceratocystis fimbriata is a complex of soil-borne fungal pathogens which colonise the xylem and is the causal agent of wilt disease in a number of plant species, including kiwifruit. The first reports of a wilt disease in kiwifruit in Brazil appeared in 2010. In the following years, significant vine losses have occurred, with some orchards losing 20–40% of vines. There are no efficacious control options available, and once the soil is contaminated, the replanting or re-grafting of new kiwifruit is not sustainable as the new vine will become infected. Some growers are replacing the kiwifruit vines with alternative crops to grow in infected orchards, which in the long term, will severely impact the volume of kiwifruit production in the area.

In New Zealand, *C. fimbriata* has only been recorded on kumara, and a recent pathology study has shown that the kumara (Ipomoea) strain is not pathogenic to kiwifruit. In this study using potted plants, the kiwifruit vines did not became visibly diseased, growth rates were not restricted, and the lengths of the lesions at the inoculation sites were minimal (Tyson et al., 2015). Hence, KVH have identified the Brazilian kiwifruit strains of *C. fimbriata* as a 'high' biosecurity threat to the New Zealand kiwifruit industry, and a greater understanding of the disease in kiwifruit and the risks to the industry is required.

A pathogenicity study by the Universidade Federal de Viçosa, Brazil is underway. This involves pathogenicity screening of a number of *C. fimbriata* strains against a number of kiwifruit varieties in Brazil. The aim of this research is to understand the degree of pathogenicity that the kiwifruit strains have on kiwifruit, and to identify tolerant / resistant kiwifruit cultivars, which can be used in breeding programmes to produce tolerant kiwifruit which can be grown in infected orchards.

A literature review written by *ceratocystis* expert Professor Tom Harrington was also commissioned, to help generate a greater understanding of *ceratocystis* wilt disease and the potential impact to the New Zealand kiwifruit industry. The review indicated:

- the risk to New Zealand is via the importation of infected plant material from Brazil;
- the sweet potato strain is unlikely to be a risk as this strain is host specific, which has been confirmed; l
- control would be easier in the earlier stages of an incursion through the use of trenching and destruction of infected material;
- orchard hygiene plays a crucial role in minimising the spread of the pathogen, with a need to remove dead material; and
- care to be taken when importing plant material from other orchards, nurseries or from overseas.

The key message is that New Zealand needs strict import measures to prevent the introduction of the pathogenic *C. fimbriata* strains into New Zealand and the means to be able to detect the fungus in non-symptomatic plant material. With this in mind, a proposal to sequence a number of *ceratosystis* strains, including the kiwifruit and sweet potato strains, is being presented to the Biosecurity Steering Group for review, with the aim to develop a number of distinguishing primers that could be used to detect *C. fimbriata* in high risk products at the border.

The Zespri Innovation team remains committed to delivering a world class Psa-V R&D programme that utilises both New Zealand and global Psa-V scientific expertise to deliver to the New Zealand grower tools and management practices to limit the economic impact of Psa-V on the kiwifruit industry.