

Final report – Public Summary

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Novel Topical Vegetable, Cotton Virus and Whitefly Protection

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Public summary

Resistance, lack of pathogen specificity, residues, run-off into waterways and potential harm to human health and the environment are major issues with current crop protection practices. To this end there is an obvious need for a non-GM, environmentally friendly, safe, and sustainable crop protection approach to augment the current strategies.

RNA interference (RNAi) is a powerful strategy to engineer transgenic crops for management of viruses, insect pests, nematodes, and fungi. Topical application or spraying double stranded RNA (dsRNA) without the need for genetic modification presents a novel crop protection platform which is almost like 'nature versus nature' where a gene sequence from the pathogen is used to kill the pathogen itself. However, a major obstacle to commercialisation is the instability of topically applied dsRNA on plants.

We developed patent protected BioClay™ technology to deliver pest targeting RNAi effectors using clay particles as carriers with Nufarm Australia Ltd as the industry partner. RNAi effectors delivered as BioClay are stable, do not get washed off, provide extended window of protection and the clay particles naturally degrade on the leaf surface alleviating any concerns about residues.

The current project focused on developing the BioClay platform targeting Potyviruses, Tospoviruses and Silverleaf whitefly (SLW) and providing a blueprint for Cotton leaf curl virus, a biosecurity threat. The two components of the BioClay platform, dsRNA, and Clay, were designed, modified, engineered, and synthesised to industry relevant parameters. The genes which are critical to viruses (Tomato spotted wilt virus (TSWV), Zucchini yellow mosaic virus (ZYMV), Potato virus Y (PVY) and SLW survival were selected as targets using a software program targeting multiple isolates and addressing issues of off-targets. A dsRNA production system, including high resolution analytics, were optimised for small and medium scale requirements. In partnership with Nufarm clay manufacture was undertaken as a major component with modifications made to better align with cost and regulatory framework. A draft regulatory framework was also developed.

Spray application of BioClay was validated through multiple glasshouse and field trials for ZYMV and TSWV using zucchini and capsicum as hosts respectively. It provided protection against these viruses assessed both in terms of symptoms and virus titre with no adverse effect on plant growth. In the case of SLW, BioClay platform was developed to target all stages of whitefly (eggs, nymphs, and adults). Artificial diet assays were conducted to screen ~100 gene targets. Insectary-based cotton plant assays were optimised for selected targets. BioClay spray resulted in significant egg and nymph mortality. It was shown that dsRNA can enter into leaves of different host plants, moves systemically in both directions and also is taken up by whitefly feeding on the treated plants.

The next steps require validating this platform for viruses and SLW at scale in protected cropping and field locations across Australia and internationally. The Australian owned and invented non-GM, non-toxic, target specific, easy to adopt and environment, grower, and consumer friendly BioClay platform means clean, green produce for domestic consumption and exports and preparedness for biosecurity threats.