A HIGH-PRESSURE WATER JET TREATMENT TO REMOVE QUARANTINE PESTS FROM HARVESTED APPLES

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Over the last 5 years, HortResearch, in partnership with ENZAFRUIT New Zealand (International) and Technology New Zealand, has developed a packhouse high-pressure water jet system to remove surface dwelling quarantine pests from export apples after harvest. Biological trials, to identify treatment configurations effective for insect removal but which do not damage the fruit, have run parallel to engineering improvements to enhance the technology's final commercial manufacture and implementation. We present a summary of the entomological investigations during this development.

Initial trials tested the effectiveness of 4 treatment configurations (varying in water pressure and conveyor speed) of a 2-lane prototype to remove artificial infestations of 2 key quarantine pests, obscure mealybug (*Pseudococcus viburni*) and lightbrown apple moth (*Epiphyas postvittana*), from 'Royal Gala' apples (Whiting et al. 1998). High-pressure water jet treatment significantly reduced the insect load on treated apples relative to apples subjected to normal packhouse processing, without increased fruit damage. In addition, removal rates were relatively uniform across treatments. Mealybug removal by apple location decreased in the following order: calyx cavity outside the sepals > cheek ≈ stem cavity ≥ calyx cavity beneath the sepals. The pattern of removal of early instar lightbrown apple moth larvae was calyx cavity outside the sepals ≈ stem cavity > calyx cavity beneath the sepals ≈ cheek. Insects were very persistent if located deep in the calyx cavity beneath the sepals (especially if the sepals were closed) or burrowed inside the fruit (most tunnels where on the apple cheek).

As the outcome of neither the entomological trials nor the apple quality investigations showed a strong influence of treatment configuration, the removal success of only one treatment was tested the following year. However, the trials were performed with a bigger, 10-lane prototype installed in a commercial packhouse, and in relation to a different export cultivar, 'Fuji'. High-pressure water jet treatment again significantly reduced the insect load on the apples without increase in fruit damage. Removal rates and patterns were similar to those recorded previously with 'Royal Gala' apples despite 'Fuji' apples having more anatomical features that may shelter insects from such treatment.

In 1997, this prototype was redesigned to suit the simplicity and low-cost requirements of commercial manufacture while addressing fruit-handling problems. Trials, focusing on mealybug as a surface indicator pest, found that, although standard packhouse processing tended to remove more insects from small apples than large apples, the addition of the high-pressure water jet treatment largely eliminated removal differences related to fruit size. Removal success was also verified with 'Royal Gala'

apples naturally infested with a range of mealybug life stages. Despite this promising entomological outcome, apple quality evaluations identified damage on some treated fruit. Unfortunately, when the rollers and water jets were modified to prevent this fruit damage, insect removal success declined.

In 1998, further engineering modifications were made to the high-pressure water jet machine to regain the technologies former high performance. These were successful and patented. Removal success of natural infestations of mealybug from 'Royal Gala' apples recovered to previous levels, and high-pressure water jet-treated fruit displayed no increase in damage over fruit exposed to the standard packhouse procedure. Together these results indicate commercial use of the high-pressure water jet technology should be successful.

This developmental process has highlighted both advantages and problems with implementation high-pressure water jet technology:

Advantages:

- Robust, safe, quick, and easy
- No grower or packhouse operator resistance to the treatment type
- Could easily be combined with other compatible disinfestation approaches, eg: heat, adjuvants, 'generally recognised as safe' compounds
- Cleans apples of organic matter, sooty mould and spray residues
- Technology is readily transferable to other export fruit crops

Problems:

- Not a quarantine treatment
- Areas of fruit where treatment is less effective
- High cost of modifications to scale-up to treat commercially realistic fruit volumes
- Economics of commercial implementation

References cited

Whiting, D.C., L.E. Hoy, J.H. Maindonald, P.G. Connolly and R.M. McDonald. 1998. High-pressure washing treatments to remove obscure mealybug (Homoptera: Pseudococcidae) and lightbrown apple moth (Lepidoptera: Tortricidae) from harvested apples. J. Econ. Entomol. 91: 1458—1463.