Managing insect contaminants in processed leafy vegetables: A best practice guide

Integrated Crop Protection
PROTECTING CROPS

Introduction

Insects are potential contaminants of processed leafy vegetables. Pest and beneficial species, in both the juvenile and adult stages of their life cycles can become unwanted contaminants if they make their way from the field into the final packaged product and to the end consumer.

This best practice guide summarises the key findings of a project conducted by Applied Horticultural Research and Harvest Fresh Cuts. The focus of this project was to find ways to control contaminants and assess their impact in processed leafy vegetable products.

To determine which insect groups were of most relevance, and how to reduce insect contamination of packaged produce, the project started at the customer level and worked back through the supply chain, examining where information was lacking, and where commercial improvements could be made.

Which insects get the most complaints?

Reviews into historical commercial data from customer complaints about manufactured leafy vegetable mixes found that moths and soldier beetles were the most reported insect contaminant. Insects referred to as moths in the data included Diamondback Moth (*Plutella sp*.), Heliothis (*Helicoverpa sp*.), Cabbage White Butterfly (*Pieris rapae*) and Beet Webworm (*Spoladea mimetica*.) Other insect groups were represented in the data at lower levels. Spiders, Rutherglen bugs, red and blue beetles and beneficials such as lady beetles made up only a small proportion of customer complaints.

Different insect species can show up in customer complaints data, and the regularity at which insect pests appear differs widely between species. The moths group (the order Lepidoptera) includes moths and butterflies. Lepidoptera pests—while seasonal—are quite regular. Soldier beetles, (*Chauliognathus sp.)* on the other hand, are a very sporadic contaminant. Rutherglen bugs (*Nysius sp.)* do not create severe contamination issues unless in plague proportions

Figure 1. Soldier beetle

in the field. Large scale commercial washing and processing lines have the capacity to remove the majority of insect contaminants.

Wanted – Dead or alive

In the factory

The project investigated whether the moths in customer complaints were reported as being dead or alive. Most moth complaints were from consumers reporting the presence of live moths, even though factory product inspection reports showed that both live and dead moths were making it to the factory.

The live moths were more likely to result in customer complaints.

Factory trials recorded the overall removal rate of live and dead moths from the wash line and it was confirmed that dead moths are easier to remove from leafy vegetables in the processing line than live moths.

Figure 2 shows the where insects are removed in the wash line, and how the first and second cleaning drums are much more effective at removing dead moths than live moths.

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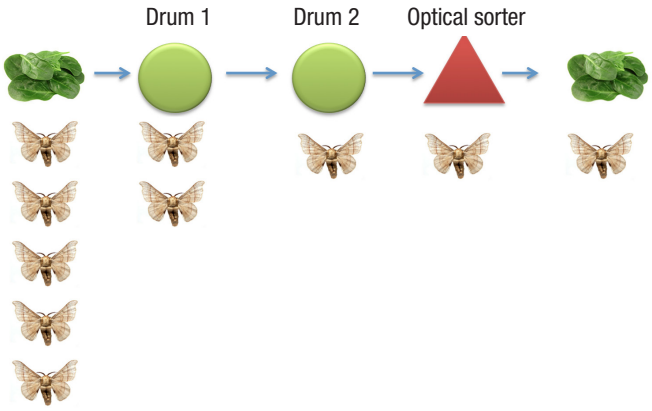


Figure 2: Diagram showing the points in the processing line where insects can be removed.

The first drum removed 42% of the dead moths, but only 15% of the live moths. The second drum removed another 24% of the remaining dead moths but only 13% of the remaining live moths (Figure 3).

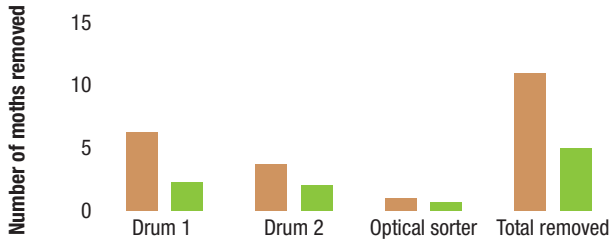
It is clear that a dead insect is much more likely to be removed in the washing process and that live ones are more likely to end up as a customer complaint.

In the field

In Australia the majority of our leafy vegetables are grown in the open field, and it common for pest and beneficial insects to be present in these crops.

There are several ways to reduce the number of insects in a crop:

- Control insects in the crop
- Control insects outside the cropping area
- Make the cropping environment unattractive to insects
- Lure the insect away from the crop



	Drum 1	Drum 2	Optical sorter	Total removed
Dead moths	6.3	3.7	1.0	11.0
Live Moths	2.3	2.0	0.7	5.0

Figure 3. Live and dead moths extracted from baby leaf spinach at various stages of the washing line.

- Exclude insects from the crop using a barrier
- Remove insects at the point of harvest

Remember: Dead insects are easier to remove in the wash line than living insects.

Control insects in the crop

Our single largest group of insect contaminants, the Lepidoptera group, are significant pests in their larval stages of growth in leafy vegetable production. Leafy vegetable producers aim to control these pests in their larval state. However, little consideration is given to the adult moth that lays the egg that becomes the caterpillar that causes the damage. Spray programs target freshly laid eggs and the early larval instar stages.

With the further adoption of more recently developed 'soft' chemistry, fewer broad spectrum insecticides are being used. Investigations examined how effective different groups of chemistry were in controlling adult heliothis moths. Other studies looked at the timing of 'knockdown' sprays in relation to harvest.

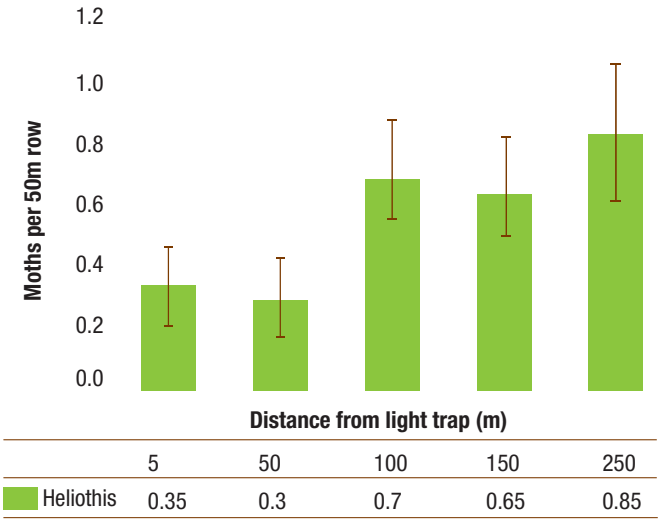
Preliminary trials were conducted on the use of moth attractants mixed with insecticide to lure adult moths to treated parts of the crop or to non-crop areas. The results were encouraging however the appropriate permits or label registrations approvals will need to obtained before these methods can be used.

Make the cropping environment unattractive to insects

Plant based extracts such as chilli were also tested. These products initially appeared to have some impact on target insect species, however in most cases the use of a deterrent such as chilli had little effect. When mixed with natural pyrethroid, the effectiveness of chilli increased slightly. Once overhead irrigation is reapplied almost all effects appear to be lost on species like Rutherglen bug and lady beetles. Overall chilli sprays appear to have little effect on adult Lepidoptera species.

Lure the insect away from the crop

The Vortex insect trapping system was trialled over two seasons with very good results. In a small cropping situation this device was able to greatly reduce moth numbers in baby leaf spinach up to 50m from the trap. Figure 4 show the light trap and its effect on the number of Heliothis moths found in spinach crops. For more information visit http://www.vortexics.com.au/insects.htm



	5	50	100	150	250
Heliothis	0.35	0.3	0.7	0.65	0.85

Figure 4. Vortex light trap and impact of the light trap on moth numbers in a baby leaf spinach crop in SE Qld.

Exclude insects from the crop using a barrier

The project investigated the use of floating row covers to exclude insects. There are many different styles of cover and their effectiveness in excluding most insect species was very high. There are agronomic challenges to consider if row covers are to be used as a control option as floating row covers perform other functions, with insect control an additional benefit.

Figure 5 shows that floating row covers can be very effective in keeping both beet webworm and Rutherglen bugs out of baby leaf spinach crops. They were less effective on lady beetles. It was observed that some beneficial eggs were laid on the row cover itself and the very small juvenile lady beetles may have found a way through the row cover after hatching (Figure 6).

Readers are also directed to a separate study which evaluated the use of floating row covers for the production of babyleaf lettuce[1].

Figure 5. Floating row covers.

1 The production of baby-leaf lettuce under floating crop covers. Horticulture Australia project number VG09188 (2013)

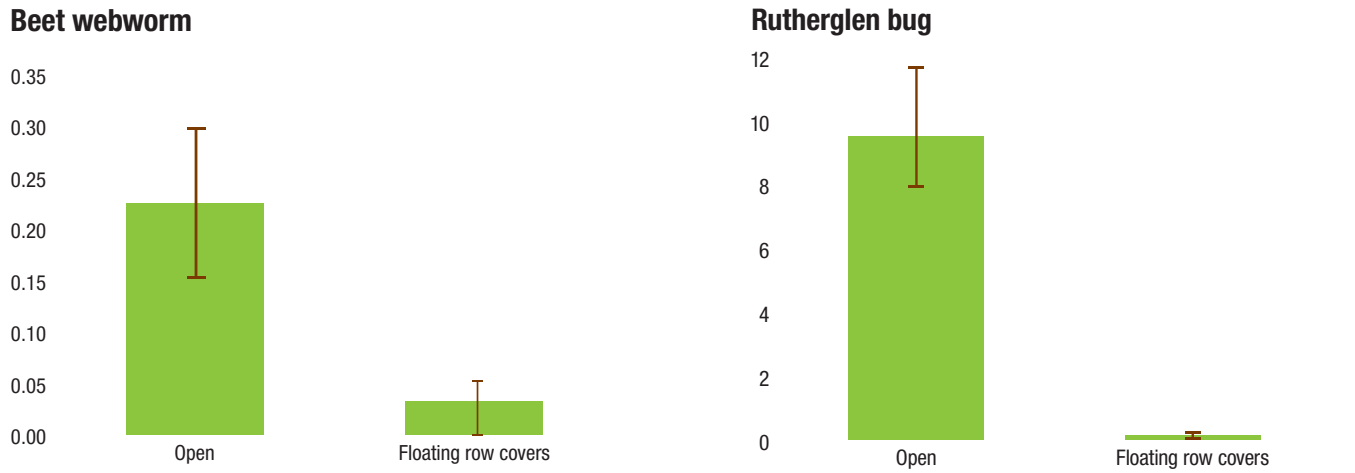


Figure 6. The effect of floating row covers in the numbers of live Rutherglen bug and Beet webworms in Spinach, Stanthorpe, Qld.

Remove insects at the point of harvest

The harvester modifications have shown promising results in field trials carried out as part of this project. The modification evaluated were:

- Fans at the front of the tractor to blow insects out of the crop just before it is harvested.
- Chains attached to the front of the harvester and dragged through the crop to dislodge insects (Figure 7).
- A perforated conveyer belt, which carries the harvested product from the cutters. The perforations allow foreign material such as insects to fall through the holes.

Figure 7. Chains in front of the harvester to dislodge insects

Trials showed that modifications worked best when they were all used together, i.e. fans + chains + the perforated belt. They were especially effective at reducing Rutherglen bug numbers in harvested baby leaf spinach. Used in combination, the modifications were able to reduce overall insect contaminate levels in spinach (Figure 8).

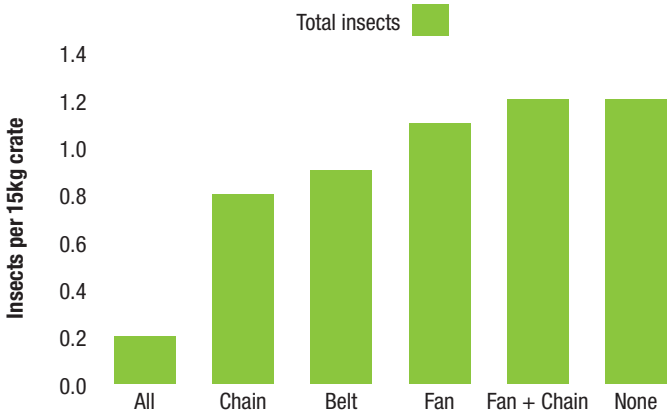


Figure 8. Effect of harvester modification on the level of insect contaminants in spinach, February 2013. The insects reported included Rutherglen Bug, flies and beetles.

For more information, visit the AHR website at www.ahr.com.au or contact Brad Giggins on 0427 014 990

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