IMPACT OF PHEROMONE MATING DISRUPTION AND PESTICIDES ON ORIENTAL FRUIT MOTH (*GRAPHOLITA MOLESTA*) ON PEACHES

P.L. LO and L.M. COLE

HortResearch, Private Bag 1401, Havelock North, Hastings 4157, New Zealand

Corresponding author: plo@hortresearch.co.nz

ABSTRACT

Oriental fruit moth (OFM) is an important pest of summerfruit grown for both fresh market and processing in Hawke's Bay, New Zealand. Mating disruption was applied over three consecutive years on the same three cv. Golden Queen peach orchards. At each orchard plots of 0.5-3.5 ha were treated with pheromone dispensers, either alone or supplemented with insecticides. In year one, OFM populations were high and mating disruption or 1-2 insecticide applications did not provide sufficient control, with up to 3% damage at harvest. The following year all trial areas received pheromone dispensers plus one or two insecticide applications and fruit damage was at acceptable level of less than 1%. In year three, blocks with mating disruption alone averaged 0.2% OFM infestation compared with 0.9% where no OFM control was used. OFM mating disruption is now increasingly being adopted by growers, but the cost relative to insecticides is a barrier.

Keywords: *Grapholita molesta*, mating disruption, integrated fruit production, peach.

INTRODUCTION

Oriental fruit moth (*Grapholita molesta*, OFM, Lepidoptera: Tortricidae) is a major pest of summerfruit in Europe, North America and Australia. The eggs are laid on new leaves and the first generation larvae tunnel into shoot tips. Later generations enter the fruit and bore through the flesh to feed around the stone. OFM was accidentally introduced to Auckland about 30 years ago and quickly spread to Hawke's Bay, presumably inadvertently assisted by people (Baker 1982). Adult OFM typically disperse less than 200 m (Yetter & Steiner 1932) and it has been slow to spread within Hawke's Bay. Fifteen years after its arrival in the district it was recorded on 5/19 summerfruit orchards (Murrell & Lo 1998). OFM remains confined to the North Island (Rothschild & Vickers 1991) where it has become an increasing problem in Hawke's Bay. It appears that it was formerly well controlled by organophosphate insecticide-dominated spray schedules, but such programmes were phased out on tree fruit crops during the 1990s.

Implementation of the SummerGreen™ integrated fruit production programme has encouraged growers to reduce insecticide applications and replace broad-spectrum insecticides with more selective products (Lo et al. 2000). Peaches in Hawke's Bay currently average less than two insecticide applications per year (S.J. Gurnsey, unpubl. data), whereas previously cv. Golden Queen peaches received an average of six applications (Lo et al. 1997). Pheromone mating disruption is a non-insecticidal method for controlling lepidopteran pests that is fully compatible with the aims of the SummerGreen programme. Mating disruption is widely used against OFM in for example, Italy (Cravedi et al. 2001), Australia (Il'ichev et al. 2002) and North America (Kovanci et al. 2005). This paper reports on trials testing the effectiveness of pheromone mating disruption against OFM on cv. Golden Queen peach orchards in Hawke's Bay. The bulk of this variety is grown for processing.

METHODS

Pheromone mating disruption was tested on three cv. Golden Queen orchards over 3 years between 1997-98 and 1999-00. The orchards ranged in size from 1.5-9 ha and comprised mature trees over 10 years old, 4-5 m tall and planted at 5 m row and 4 m tree spacings. Twist tie pheromone dispensers (Isomate® OFM, ShinEtsu Chemical Co.) were applied at 1000/ha in year one. New dispensers (Isomate OFM Rosso) subsequently became available and were used at 500/ha in years two and three. They contain 50% more pheromone than the original dispenser, hence the lower application rate per hectare. Dispensers were placed in the top third of the trees between late October and late November each year.

In year one, at each orchard the pheromone treatment was compared with one or two applications of tebufenozide (Mimic®) or azinphos-methyl (Gusathion®). At Orchard A, the 1 ha mating disruption plot was separated by 70 m of open ground from another 1.5 ha of trees, which were divided in half. These plots were sprayed with either one application of tebufenozide or azinphos-methyl. At Orchard B, the eastern half of a 6 ha block received pheromone dispensers while the adjacent trees were treated twice with tebufenozide. Two azinphos-methyl applications were made to a 7.5 ha block 300 m away. Orchard C had the same treatments as Orchard A, with the 1.5 ha divided in thirds and the mating disruption area on the eastern side, downwind of the prevailing winds. There were no untreated control trees at any orchard.

All trial plots received either an oil, or an oil and chlorpyrifos spray in August each year. Thereafter in year one, insecticides were applied according to spray thresholds (Lo et al. 1997), except in pheromone treated areas. Numbers of adult male OFM in insecticide-treated plots were monitored approximately weekly between early November 1997 and late February 1998, using two delta traps per plot. No monitoring was conducted in mating disruption areas.

In year two, pheromone dispensers were supplemented by one or two applications of tebufenozide in early or late December (Orchards A, B and C), or one azinphos-methyl in early December (Orchards A and B). There was no comparative treatment without mating disruption except at Orchard B. At Orchard A, the same trees as year one were treated with pheromone dispensers and half received one tebufenozide spray and the rest two sprays. The azinphos-methyl plot from year one received the same treatment in year two. At Orchard B, mating disruption was applied to the 7.5 ha treated with azinphos-methyl in year one. This area was sprayed once, half with tebufenozide and half with azinphos-methyl. At Orchard B, the 6 ha block that was half treated with pheromone dispensers and half with tebufenozide in year one, was leased by a different grower. The only insecticide this block (redesignated as B1) received in year two was an oil and chlorpyrifos application in August. It was included in the harvest fruit assessment as a comparison with Orchard B. The whole cv. Golden Queen block at Orchard C was treated with pheromone dispensers and half received one tebufenozide spray and the rest two sprays. There was no azinphos-methyl treatment at this orchard. OFM populations were not monitored and instead sprays were applied when the threshold for OFM is typically exceeded (Lo et al. 1997).

Mating disruption without additional insecticide applications was tested again in year three and compared with neighbouring trees where no mating disruption or insecticides were used. Areas of approximately 1, 3 and 0.5 ha at Orchards A, B, and C respectively were treated with pheromone dispensers. These areas were all under mating disruption in year two. Control of OFM on neighbouring trees was left to the grower's discretion and each decided not to apply any post-bloom insecticides. No monitoring of OFM populations was conducted.

Each year samples of 1000 fruit from each plot were assessed for OFM damage during the main harvest in early March. One hundred fruit were inspected from each of 10 randomly selected bins situated throughout each plot. Fruit were scored as either damaged or undamaged by OFM. Differences between treatments in OFM damage each year were analysed by a generalised linear model using a binomial distribution.

OFM damage at block B1 was assessed in the same way as the trial plots, except that 500 fruit were examined from each half (1000 in total), which corresponded with the mating disruption and tebufenozide treatments in year one.

RESULTS

In year one, the OFM spray threshold of 1 moth/trap/day was exceeded at all three orchards in early December. At Orchards A and C, catches peaked at approximately 2/trap/day, and after one tebufenozide or azinphos-methyl application in mid-December catches remained close to or below the threshold for the remainder of the season. Trap catches of OFM were much higher at Orchard B at up to 10/trap/day. They stayed above the threshold after the block was sprayed on 8 December and a second spray was applied on 10 January.

OFM infestations at harvest during the three years are shown in Figure 1. In year one, similar levels of OFM damaged fruit were found in all three treatments (P=0.735), but infestations on average exceeded the 1% threshold at which processing crops are downgraded. OFM damage varied from 0.6-2.1% in the mating disruption areas of the three orchards.

In year two, OFM infestations were 0-0.6% in all mating disruption plots. At Orchard B, these plots had 0% or 0.1% damage (mating disruption plus one azinphos-methyl or one tebufenozide respectively). The same trees had 2.8% damage in year one when they received two azinphos-methyl sprays. This was the only orchard where there was a comparison with trees where there was no mating disruption or post-bloom insecticides (block B1). In year two, block B1 had 0.4% damage on the side treated with dispensers in year one and 1.8% damage where tebufenozide was used in year one.

In year three, OFM infestations at harvest in mating disruption plots were 0-0.5%, compared with 0.2-2.0% where no pheromone or insecticide was applied (P<0.01).

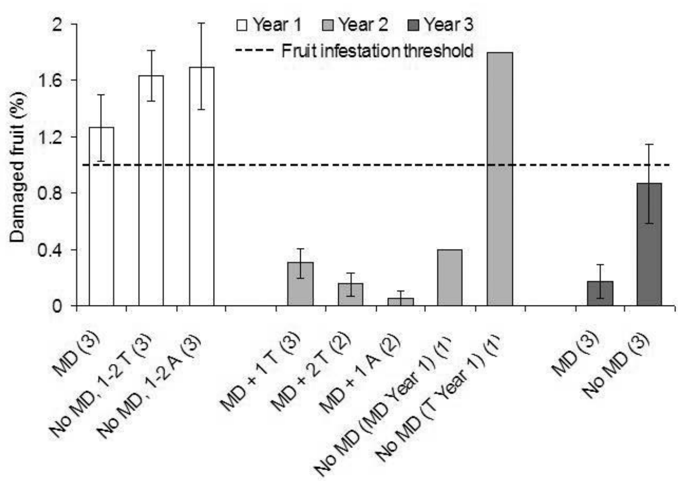

FIGURE 1: Mean percentage of fruit (± SEM) at harvest that were damaged by oriental fruit moth on three cv. Golden Queen peach orchards over 3 years. Treatments were MD=mating disruption, T=tebufenozide or A=azinphos-methyl. Numbers in brackets refer to the number of plots for each treatment. The fruit infestation level set by the processing company is indicated by a dotted line.

DISCUSSION

In year one, mating disruption did not provide adequate control of OFM, i.e. keep damage below 1%. Likewise one or two applications of tebufenozide or azinphos-methyl also failed to reduce damage sufficiently. Trap catches of up to 10 OFM per trap per day recorded in this study were much higher than previously found over several years of monitoring (Lo et al. 1997). This indicated that background populations were unusually high, at least at Orchard B where damage reached 3% despite two applications of azinphos-methyl.

Because mating disruption does not kill pests, the chances of male and female moths meeting randomly rises as the populations within orchards increase. Under these circumstances of high populations, it was perhaps not surprising that the crops sustained damage above the threshold level, especially given the relatively small pheromone-treated areas. These results were consistent with a Canadian study in which peach orchards with low pest pressure (trap catches averaging less than 0.5/trap/day) suffered well below 1% fruit damage (Pree et al. 1994). The same study found that orchards with catches higher than 1.5/trap/day could not use mating disruption alone.

In year two, the strategy was to ensure that OFM populations were adequately controlled. It was considered too risky on commercial orchards to try dispensers alone again, hence insecticides were applied as well. Although OFM damage was reduced to very low levels in mating disruption plots, the only comparison was with block B1. Here there was a relatively high level of damage on the side where tebufenozide had been used the previous year. Interestingly damage appeared to be less in the part of the block where pheromone dispensers had been placed previously. It is possible that mating disruption has a cumulative effect over several years if some pheromone is absorbed onto the trees and lasts until the next growing season.

Having a low incidence of OFM damaged fruit in year two, it was felt that mating disruption could be tried on its own again in the final year of the trial. This position was vindicated by the results where damage in mating disruption blocks was well below the damage threshold set by the processing factory, and less than in adjacent trees that had neither pheromone nor insecticides applied. Other researchers in Italy (Molinari & Cravedi 1992), Australia (Il'ichev et al. 2002) and North America (Kovanci et al. 2005) have also concluded that mating disruption alone can effectively control OFM, as long as populations are not too high. Mating disruption should give better results when used on the same blocks over several years and where larger contiguous areas are treated. This minimises edge effects where mated females can fly in from neighbouring untreated orchards.

Growers switching to mating disruption from insecticides should not rely on pheromone dispensers alone in the first year, unless they know from previous trapping that the OFM population is low (e.g. trap catches of <1.5 moths per day). Otherwise it would be prudent to use a combination of mating disruption with one or two insecticide applications before mid December. Crop damage should be assessed at harvest and if it is minimal, this is a good indication that populations have been reduced. Then in subsequent years pheromone dispensers alone should provide adequate control of OFM, providing there are no uncontrolled sources of re-infestation nearby.

Adoption of mating disruption for OFM has been relatively slow in Hawke's Bay. Dispenser sales have risen from 2 ha worth in 1999-00 to ~100 ha last season (G. Clare, pers. comm.). This slow growth is partly due to the limited distribution of the pest but probably more importantly reflects the price difference with insecticides. Isomate OFM Rosso pheromone dispensers are purchased from Japan, and at current prices the cost per hectare is roughly equivalent to two tebufenozide or three azinphos-methyl applications. The higher cost of pheromone dispensers than either of these insecticides is a barrier to greater adoption of this control method.

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