SHORT NOTE:

Preliminary trials on trapping Queensland fruit fly (*Bactrocera tryoni*, Froggatt) (Diptera: Tephritidae) with BioTrap CL® and BioTrap-Gel® male-biased and female-biased fruit fly trap and lure systems.

Compiled by Andrew Jessup, NSWDPI, Ourimbah, NSW, Australia. E-mail: andrew.jessup@dpi.nsw.gov.au

ABSTRACT

Preliminary mass-trapping trials in south-eastern Australia were conducted to assess the ability of BioTrap® fruit fly trapping systems to capture male and female fruit flies. These trials were “proof of concept”, carried out prior to setting up large scale field trials to assist in application for regulatory approval to use trapping systems with pesticides. Data from the preliminary trials indicate that male-biased BioTrap® CL and female-biased BioTrap®-Gel trap and lure systems trap as many, or more Queensland fruit fly (*Bactrocera tryoni* Froggatt)
adults than the modified standard Lynfield trap (used by some State governments in Australia) and other commercially available traps (two male-biased and one female-biased). The two BioTrap systems are cheaper than the other traps tested. The conclusion is that both BioTrap systems could be used in mass-trapping programs to control Queensland fruit fly.

INTRODUCTION

Fruit flies impact the production of, and trade in, most Australian grown fresh horticultural commodities, to a greater extent than ever experienced. This has been brought about by:

Restrictions in the use of common pesticides for pre- and post-harvest use against fruit flies – dimethoate and fenthion
Planned restrictions in the use of the post-harvest fumigant, methyl bromide
Incursions and consequent outbreaks of Queensland fruit fly into horticultural production regions that have never before experienced such outbreaks
Reductions in State Government contributions to fruit fly mitigation programs
Changes in State and overseas market requirements for trade in fruit fly host commodities
A lack of alternative pest fruit fly management options approved by national and international authorities
A lack of funds available to address the situation – due to low returns (caused by drought, floods, reduction in available markets, high Australian dollar, oversupply on the domestic market, etc).

The “fruit fly problem” is currently regarded as of national importance due its effect on production (both commercial and backyard), productivity (costs of fruit fly control, reduction in crop volumes, reduction in sales and domestic and international exports) and consumer, grower and environmental health (pesticide use, fruit quality).

We are looking at how Queensland fruit fly (Bactrocera tryoni Froggat) damage to crops and their markets can be minimised using mass-trapping techniques. Mass-trapping involves the placement of a high density of traps per hectare throughout the targeted area, e.g. an orchard. Both female and male fruit flies are targeted and the grower can determine how many fruit flies have been killed, where flies proliferate within the orchard and readily assess the effectiveness of the program without having to wait for fruit to become obviously infested.

The main question is: can mass-trapping techniques, which are being used in overseas countries with a high level of success, operate under Australian conditions and against Australian pest fruit flies?

An attractant that is at least as effective in luring female fruit flies of all species with the additional attribute of attracting males and increased longevity, would be of enormous benefit to home and commercial orchardists as well as border protection officers.

A major problem with female-biased traps that are currently available in Australia (McPhail traps or bottle traps with liquid feed-based lures) is that their effectiveness is quite short-lived, especially during warm weather. Usually it is recommended that these traps are replaced weekly. By the end of each week the bait has deteriorated due to bacterial and fungal degradation and flies in the solution have broken down and are difficult to identify. Also the degraded solution has developed an offensive odour and is no longer attractive to fruit flies. Many non-target flies and other insects are attracted and these add to the labour of
sorting through samples. There is also a high degree of operator resistance to using and servicing these traps.

These problems have been reported by many authors. Caldwell and May (1943) noted that weak concentrations of ammonia were fouled by blow flies. Drew (1978) reported that the McPhail trap was expensive and only attracted small numbers of flies and was of limited value for survey and detection work. Sproule et al. (2001), Dominiak et al. (2003) and Dominiak (2006) reported that wet protein traps attracted non target flies. IAEA (2003) also warned that liquid baits would result in capturing large numbers of non-target insects. Given the increased costs of servicing traps, this contamination with non-target species is an unnecessary cost. Sproule et al. (2001) reported that wet protein traps were cumbersome, the contents were easily spilled when the trap was handled, removal of insects was time consuming and tedious, and trapped flies were often badly decomposed. The lure also attracted non target species such as ferment flies, blow flies, and other insects. Traps based on citrus concentrate seemed equal to protein traps in their attractiveness but did not catch non-target insects (Dominiak et al. 2003) and offer an alternative however they are still relatively ineffective at attracting female B. tryoni.

Male and female fruit flies can be controlled using protein-based baiting technologies. A paste mixture of food lure (e.g. protein autolysate) and toxicant (e.g. maldison) can be applied throughout the targeted area for fruit fly control, often at a rate of 100mL/tree or 20L/ha. This technology is used widely around Australia and internationally and has been found to be effective in fruit fly control. The timing of baiting can be based on standard seasonal orchard time schedules or on the basis of trap capture rates by monitoring traps. Such traps are generally male-biased. Baiting is cheap but it is time-consuming because it needs to be applied once a week or more often after rain or if fruit fly pressure is high. Baiting is not the preferred fruit fly treatment for use in urban areas due to safety concerns. Baits may cause phytotoxic damage to the canopy and fruit of some crops. A trap which captured female fruit flies reliably, for several months and cost-effectively would benefit fruit fly control programs greatly.

Recently BioIberica’s Ceratrap® arrived in Australia. The Ceratrap is used in several countries around the world, such as Spain and Morocco, in mass trapping programs for Mediterranean fruit fly. Testing on the efficacy of Ceratrap in Australia commenced recently. This trap captures large numbers of female and male Qff without rapid putrefaction. It can last for two months or more but that depends on ambient relative humidity and winds as, being a liquid, it desiccates and needs refilling or recharging periodically.

Male-biased traps are widely used around Australia and the rest of the world mainly for monitoring purposes. Such traps are charged with a parapheromone (e.g. cuelure or methyl eugenol) or other sex-specific compound (e.g. spiroketal) and a toxicant (e.g. maldison). These components can also be impregnated into slow release substrates such as fibreboard blocks (caneite blocks, male annihilation pads), fibrous rope (cordellitos) or gel. These devices are used in Male Annihilation Technique (MAT) programs with a high level of success in some areas (for example, refer to Bateman 1973). The advantage of MAT devices over traps is that they are much cheaper to make, deploy and service. Flies are attracted to the lure and are exposed to the toxicant but they die unseen. If traps could be used in place of MAT devices growers would be able to gauge the efficacy of their fruit fly management program in real time benefitting them with more timely additional control options. Such traps would need to be cheap, long lasting and effective.
BioTrap Australia Pty Ltd introduced new fruit fly products to the market recently some of which are innovative. This short note describes some research that has been carried out to scope the need for more extensive trials.

MATERIALS AND METHODS

1. Shepparton, Central Victoria

A one hectare block of ‘Pink Lady’ apples (approximately 500 trees) was chosen and trapped out with 87 BioTrap-Gel traps (BioTrap V1 Fruit Fly Traps with Protein Attractant Gel and DDVP cube). The BioTrap-Gel traps were placed in every 3rd tree in every 2nd row. Rows were 5.5m apart and trees were planted 3m apart along the rows. A similar 1ha block of ‘Pink Lady’ apples, situated 500m from the block trapped out with BioTrap-Gel, was trapped out with 18 commercially available female-biased traps. These traps were placed evenly throughout the block in a grid pattern.

We chose 87 BioTrap-Gel traps and 18 commercial female-biased traps per hectare to equate trap costs. The BioTrap-Gel trap, fully loaded is about one quarter the cost of the commercial female-biased trap. This experimental design favoured the commercial traps over the BioTrap-Gel traps on the basis of the numbers of flies trapped per trap. The design favours the BioTrap-Gel over the commercial trap on the basis of flies trapped per hectare.

Traps were checked weekly from 4 March 2015 to 9 June 2015 (12 weeks over early autumn to early winter). Traps were recharged as per label or, in the case of the BioTrap-Gel traps, every 4 months.
2. Oakdale, Sydney Basin NSW

A trial comparing BioTrap CL (with Farma Tech Mallet CL - wafer impregnated with cuelure and maldison) with standard Government traps (NSW modified Lynfield trap with cuelure plus maldison impregnated perosis rolls) for trapping male Queensland fruit flies was set up on a small commercial pome and stone fruit orchard near Sydney, NSW. Traps were placed on the perimeter of, and throughout, a 2ha block (mixed pome and stone fruit) covered with bird netting. Traps were placed in a grid pattern with the two types alternated as much as possible with the distance between adjacent traps no less than 20m. We deployed 13 BioTraps and 9 Government traps.

The orchardist applied two cover sprays of Talstar (biphenthrin) against *Carpophilus* beetles during the trapping experiment.

Traps were checked weekly from 13 August 2014 to 8 April 2015 (34 weeks over late winter to mid-autumn). Traps were recharged as per label.

3. Trials at Somersby, Central Coast NSW

Somersby Agricultural Research Station was used as a small testing ground for the mass trapping project. Two trials were conducted. One compared BioTrap CL (male-biased) with two commercial male traps. The second compared BioTrap-Gel (female-biased) traps with a commercial female-biased trap. Traps were collected weekly and the contents collected. We recorded fly numbers and maintained the trap to ensure it was full of solution/gel and functioning effectively.

a. Comparisons of male-biased traps.

Ten locations within an orchard of mixed citrus varieties were chosen so that each location was no closer than 75m to the next. Each location consisted of three citrus trees situated in a triangle 20m apart. One trap type (i.e. one each of BioTrap CL, commercial trap 1a and commercial trap 2) was placed in each of these trees and the order around the points of the triangle was randomly allocated.

Traps were checked weekly from 15 April 2014 to 9 October 2014 (about 25 weeks over mid-autumn to mid-spring). Traps were recharged as per label.

The trap labelled commercial 1a is the old trap design (see notes below in 4. Newrybar, North Coast NSW).

b. Comparisons of female-biased traps.

The test orchard block consisted of five rows of ~30 trees (mixed citrus varieties). Six BioTrap-Gel traps and 22 commercial female-biased traps were placed out on a grid pattern throughout the block.

Traps were checked weekly from 20 February 2015 to 25 March 2015 (about 5 weeks over late summer, early autumn). Traps were recharged as per label or, in the case of the BioTrap-Gel traps, every 4 months.
4. Newrybar, North Coast NSW

This site consisted of several hectares of mixed stone fruit under bird netting (top and sides). Traps were placed around the perimeters (inside covered area) in two blocks of fruit 100m apart and also in a windbreak of lilly pilly trees (20m to 50m away from Test Block 2 and 150m away from Test Block 1). The orchardist deployed traps in each location depending on the number of traps he was able to obtain at the time. Test Block 1 had 2 BioTrap CLs, 4 commercial 1a traps and 2 commercial 1b traps. Test Block 2 had 1 BioTrap CL, 6 commercial 1a traps and 8 commercial 1b traps. The lilly pilly hedge had 2 BioTrap CLs, 3 commercial 1a traps and 12 commercial 1b traps.

The traps labelled commercial 1a and commercial 1b are made by the same company but 1a is the old trap design and 1b is a newer trap design.

Traps were checked weekly from 27 July 2014 to 23 December 2014 (about 21 weeks over mid-winter to mid-summer). Traps were recharged as per label.

5. Statistical analyses

The trials described here are preliminary, “proof of concept” experiments to assess the ability of BioTraps, both male-biased and female-biased, to capture and retain Queensland fruit fly adults prior to setting up more comprehensive comparison trials. Within each test orchard the numbers of each trap type deployed were not identical nor were traps positioned in a uniform pattern in all cases so bias could not be discounted. No statistical analyses were carried out.

6. Identification of commercial brands

As these trials were conducted mainly to assess the ability of male-biased and female-biased BioTrap trap/lure systems to trap fruit flies and that these trials were not analysed statistically the brand names of the products with which BioTraps were compared are not presented here.

RESULTS

Results indicate that male-biased BioTrap CL® traps (with Farma Tech Mallet CL - wafer impregnated with cuelure and maldison) (Tables 1, 2 and 3) perform at least as well as the modified standard Lynfield (Government) trap and the three commercial brand traps tested.

Results also indicate that female-biased BioTrap-Gel® traps (Tables 4 and 5) perform as well as the commercially available female-biased trap currently available in Australia.

A. Male-biased traps

<table>
<thead>
<tr>
<th>Trap type</th>
<th>Total no. of traps</th>
<th>Total no. of flies</th>
<th>Average no. of flies per trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>8</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>BioTrap CL</td>
<td>13</td>
<td>51</td>
<td>3.92</td>
</tr>
</tbody>
</table>

Table 1. Oakdale, NSW – 34 weeks from 13 August 2014 to 8 April 2015
Table 2. Somersby, NSW – about 25 weeks from 15 April 2014 to 9 October 2014

<table>
<thead>
<tr>
<th>Trap type</th>
<th>Total no. of traps</th>
<th>Total no. of flies</th>
<th>Average no. of flies per trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial 1a</td>
<td>30</td>
<td>17</td>
<td>0.57</td>
</tr>
<tr>
<td>Commercial 2</td>
<td>30</td>
<td>11</td>
<td>0.37</td>
</tr>
<tr>
<td>BioTrap CL</td>
<td>30</td>
<td>81</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Table 3. Newrybar, NSW – about 21 weeks from 27 July 2014 to 23 December 2014

<table>
<thead>
<tr>
<th>Trap type</th>
<th>Total no. of traps</th>
<th>Total no. of flies</th>
<th>Average no. of flies per trap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial 1a</td>
<td>13</td>
<td>664</td>
<td>51.08</td>
</tr>
<tr>
<td>Commercial 1b</td>
<td>12</td>
<td>201</td>
<td>17.5</td>
</tr>
<tr>
<td>BioTrap CL</td>
<td>5</td>
<td>871</td>
<td>147.2</td>
</tr>
</tbody>
</table>

B. Female-biased traps

Table 4. Shepparton, Victoria – 12 weeks from 4 March 2015 to 9 June 2015

<table>
<thead>
<tr>
<th>Trap type</th>
<th>Total no. of traps</th>
<th>Total no. of flies</th>
<th>Average no. of flies per trap per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioTrap-Gel</td>
<td>87</td>
<td>9,304</td>
<td>7.64</td>
</tr>
<tr>
<td>Commercial female-biased</td>
<td>18</td>
<td>2,094</td>
<td>8.31</td>
</tr>
<tr>
<td>trap</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Somersby, NSW – about 5 weeks from 20 February 2015 to 25 March 2015

<table>
<thead>
<tr>
<th>Trap type</th>
<th>Total no. of traps</th>
<th>Total no. of flies</th>
<th>Average no. of flies per trap per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioTrap-Gel</td>
<td>6</td>
<td>184</td>
<td>30.7</td>
</tr>
<tr>
<td>Commercial female-biased</td>
<td>22</td>
<td>659</td>
<td>30.0</td>
</tr>
<tr>
<td>trap</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

As a result of the scoping trials reported here the indications are that the BioTrap CL male-biased trapping system is several times more effective than the commercially available traps against which we compared them. In addition to this the BioTrap CL trap is also cheaper than the others. The BioTrap CL may be cost-effective when used in mass-trapping programs in both orchard and urban situations.

On studying published literature (IAEA 2003, Sproule et al. 200, Dominiak et al. 2003, Dominiak 2006) there is no doubt that current liquid food-based (protein) lures in McPhail-type traps are not useful for the monitoring or mass-trapping of Queensland fruit fly. These traps foul within a week, trap many non-target species, are difficult and uncomfortable to service and need regular replacement. The commercially available female-biased trap and the BioTrap-Gel trap were found to be superior in that they captured flies for several months without unpleasant aromas and without the need to recharge and/or replace them. The data suggest that the two trapping systems are at least equivalent to each other. The removal of
flies, for counting and identification purposes, from the commercially available traps was more difficult and time-consuming than removing them from the BioTrap-Gel, the latter being drier and of lesser volume to handle. Also the BioTrap-Gel trap is considerably cheaper than the commercially available trap. Like the BioTrap CL the BioTrap-Gel trap has potential in mass-trapping programs.

Further research needs to be carried out on these trapping systems. The current recommendation is that both male- and female-biased trapping systems (BioTraps) are recharged every four months, but as they are new to the market, real trap longevity is unknown. We need to determine the optimum number of traps/ha, the best ways of combining both male-biased and female-biased traps in mass-trapping program, if such a combination is necessary, methods to incorporate these trapping systems into area-wide management programs and assess costs and benefits in a range of climatic locations. We also need to determine what pattern of trap deployment is optimal for both orchard and urban situations. It is recommended, in areas where there is survival of overwintering fruit flies, that bait sprays should be applied in combination with mass-trapping. Future research should compare the costs and efficacy of this BioTrap trapping systems alone, baiting alone and in combination with baiting.

The trap design and the gel base for the female-biased lure are not designed specifically for trapping Queensland fruit fly. It is likely that these systems could manage males and females of other pest fruit fly species.

CONCLUSIONS

Male-biased BioTrap CL® traps and female-biased BioTrap-Gel® traps will capture and retain Queensland fruit fly adults when used in orchards located in various locations around Southeast Australia. The data from the scoping research reported here indicate that these traps are at least as effective as standard Government and currently available commercial traps. The cost of these traps is half that of the commercially available male-biased tested here and one quarter that of the commercially available female-biased trap.

ACKNOWLEDGMENTS

The following people have put in a great deal of time and effort into designing trials; trap procurement, deployment and maintenance; fly collection, identification and recording and phone calls. Their work is very much appreciated.

- Colin Bain, BioTrap Australia
- Lynton Greenwood, Orchardist, Shepparton, Victoria
- Ed Biel, Orchardist, Oakdale, NSW
- Robert Hood, Orchardist, Newrybar, NSW
- Elizabeth Mace, GV Crop Protection, Shepparton, Victoria
- John Archer, David Cruickshank and Christine Cruickshank, NSWDPI

REFERENCES


