EVALUATION OF COLOURED STICKY TRAPS FOR MONITORING BENEFICIAL INSECTS IN APPLE ORCHARDS

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ABSTRACT

Field experiments to evaluate four different coloured sticky traps for monitoring beneficial insects were conducted on 'Braeburn' apple blocks in four commercial orchards situated in the Motueka region. Traps used were white, yellow and blue Corflute® sheets and a clear Mylar® sheet, all coated on one side with adhesive (Tactrap™). The sticky traps were deployed between 27 February and 24 March 2006. Each colour sticky trap was hung vertically from a branch within the tree and traps were replaced and re-randomised two times during the trapping period. Beneficial insects monitored included *Aphelinus mali*, *Platygaster demades*, *Anagrus* sp., *Stethorus bifidus* and *Encarsia* spp. Results indicated that yellow was the best trap colour for catching *A. mali*, *Stethorus* and *Encarsia*, and a clear trap was best for *Anagrus* sp. Trap colour did not have a significant impact on the catch of *P. demades*.

Keywords: colour sticky traps**,** beneficial insects, monitoring, apple orchards.

INTRODUCTION

New Zealand Integrated Fruit Production (IFP) is a way of producing pipfruit in which broad-spectrum chemicals are reduced or eliminated and replaced with new, more selective chemicals. Natural enemies of pests are used in conjunction with these more benign chemical insecticides. Pest and disease monitoring, the use of action thresholds, and alternative methods of control are key components of the NZ IFP, which is defined as "The production of market quality fruit, giving priority to methods that are the safest possible to the environment and human health. It is a programme based on continuous improvement" (Percy 1996; Batchelor et al. 1997).

An important part of this continuous improvement is the monitoring of beneficial insects in IFP orchard blocks to gauge their seasonal abundance and impact in containing insect pest numbers. Sticky traps provide a useful tool for monitoring the presence of beneficial insects and their numbers can reflect the densities of their host pests in orchards.

Previous insect monitoring techniques have included using white sticky traps, beating tray samples of insects from trees and inspection of fruit at harvest. Coloured sticky bases have recently become available and this research was initiated to determine if they were any better than the standard white traps. Trap colour, measurable as spectral reflectance, is known to affect the attraction of diurnally-active insects (Vernon & Gillespie 1990; Childers & Brecht 1996). In particular, yellow was reported as effective in trapping Hymenoptera (Thomson et al. 2004). A field experiment was conducted to evaluate different coloured sticky traps for capturing beneficial insects. The beneficial insects that were monitored are some of the key natural enemies of common insect pests found in pipfruit orchards.

MATERIALS AND METHODS

Trapping was conducted on four commercial pipfruit orchards situated in the Motueka region. Sites were of the 'Braeburn' apple cultivar and run under IFP standards, with the exception of one property that grew fruit organically.

Single-sided sticky traps of four different colours were assessed for trapping the beneficial insects. Trap colours tested were white, yellow and blue Corflute® sheets and a clear Mylar® sheet, all coated on one side with adhesive (Tactrap™). Each trap was 18 cm wide x 19 cm high with a total area of 342 cm^2. The sticky traps were deployed between 27 February and 24 March 2006; each trap was hung vertically from a branch within the apple tree at a height of 1.8 – 2 m. A set of the four different coloured sticky traps was distributed along a tree row at a spacing of approximately 15 m in random order. This was repeated for three rows on each of the four orchards. These traps were replaced and re-randomised during the trapping period on 7 and 15 March, with the final set being collected on 24 March. Traps collected on each of these dates were examined with a binocular microscope and the number and identity of trapped beneficial insects were recorded. The following is a list of the insects monitored and their main hosts:

- *Anagrus* sp. – an important parasitoid of leafhopper (e.g. Froggat's apple leafhopper) eggs.
- *Aphelinus mali* – a parasitoid of woolly apple aphid (*Eriosoma lanigerum)*
- *Encarsia* spp. – a parasitoid of San Jose scale (*Quadraspidiotus perniciosus)*. Two species were caught on the traps, *Encarsia perniciosi* and *Encarsia citrina,* but for the purpose of this trial no differentiation was made between the two species.
- *Platygaster demades* – an egg parasitoid of the apple leaf-curling midge (*Dasineura mali)*.
- *Stethorus bifidus* – a ladybird predator of European red mite (*Panonychus ulmi*).

Sejanus albisignata, Trichogramma spp.*, Aphytis chilensis, Micromus tasmaniae* and hover flies were also monitored in the experiment, but too few were caught to produce any significant results.

Examination of the data suggested that, for the insects of interest, there were either few zero catches, or the zero catches were mostly restricted to particular sites (2 and 3 for *S. bifidus* and *Encarsia* spp.) or dates (first date for *Anagrus* sp. and *P. demades*). Mixed linear modelling on square-root transformed data (restricted appropriately to avoid most of the zero catches) was used. The mixed model fitted had trap colour as the fixed effect, and date plus site and replicate as random effects. The analyses were undertaken in Genstat Release 9.02 [(PC/Windows XP) Copyright 2006, Lawes Agricultural Trust (Rothamsted Experimental Station)].

RESULTS AND DISCUSSION

A total of 15,154 insects were identified and counted for this experiment, with just over 80% of them being *A. mali,* 5% *Anagrus* sp.*,* 2.8% *P. demades* and 1.5% *S. bifidus*.

Best linear unbiased estimates for the trap catches (square-root transformed) indicated that yellow was the most effective trap colour for catching *A. mali*, *S. bifidus* and *Encarsia* spp., but that a clear trap was better for *Anagrus* sp. (Table 1, Fig. 1). Trap colour did not have a significant impact on the catch of *P. demades*. When an attempt was made to analyse counts of *Trichogramma* spp., the residual plots were unsatisfactory. However, the data showed that counts were similar for the different trap colours (total counts ranged from 27 for yellow and white to 37 for clear) and the variability was high (e.g. white traps caught the most insects at two sites and the least at the other two).

The trap colour experiment has been useful, as white sticky traps had previously been used for all beneficial insect monitoring. Yellow sticky traps are now used for monitoring the woolly apple aphid parasitoid *A. mali* in particular. This biocontrol agent is relied upon to provide control of woolly apple aphid (WAA), as effective aphicide options that result in nil residues at harvest are currently lacking in the IFP programme.

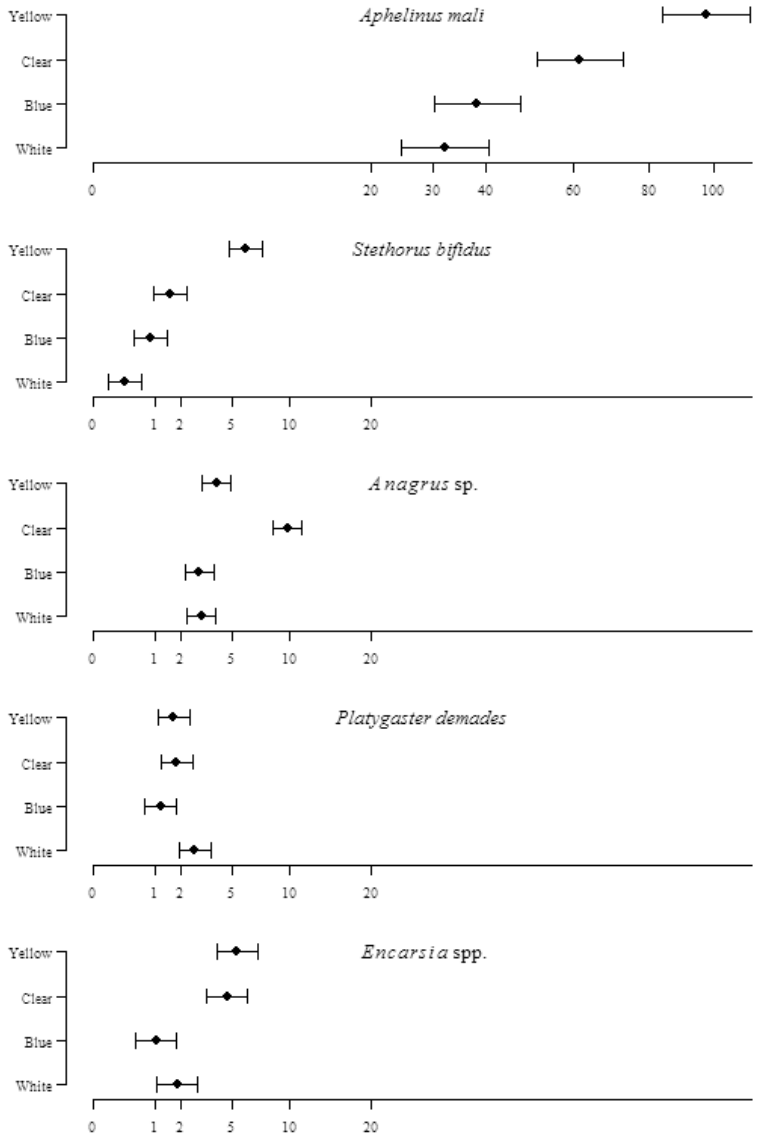

FIGURE 1: Best linear unbiased estimates (square-root transformed values) for trap catches for the five major insects according to colour of the trap. The horizontal error bars indicate one standard error of the difference each way.

TABLE 1: Best linear unbiased estimates for the square-root transformed trap catches for the five major insects. The standard error of the differences and the Wald P value are also shown.

Trap colour	*Aphelinus mali*	*Stethorus bifidus*	*Anagrus* sp.	*Platygaster demades*	*Encarsia* spp.
Yellow	9.89	2.47	1.99	1.31	2.33
Clear	7.85	1.25	3.14	1.36	2.16
Blue	6.19	0.92	1.72	1.09	1.02
White	5.67	0.53	1.75	1.65	1.36
SED	0.701	0.268	0.237	0.253	0.324
P-value	<0.001	<0.001	<0.001	0.184	<0.001

The present results show that yellow sticky traps are effective for monitoring *A. mali* and *Encarsia* spp. and are consistent with studies by Krysan & Horton (1991), Romeis et al. (1998) and Thomson et al. (2004), who all reported that yellow sticky traps are the most effective colour for trapping Hymenoptera. However, exceptions are likely at the species level (Kirk 1984), which may explain the finding that trap colour did not have any significant impact on the catch of *P. demades* and that significantly more *Anagrus* sp. were caught in clear traps. Prischmann et al. (2007) reported using yellow sticky traps to monitor densities of adult *Anagrus* at blackberry, grape and wild rose sites.

Dowell & Cherry (1981) reported that yellow sticky traps caught significantly more parasitoids and coccinellids in their field tests and that yellow was the most attractive colour for five of the six coccinellid species tested. These results support the present findings that yellow is an effective colour for trapping the ladybird predator *S. bifidus*.

No clear result was achieved for *Trichogramma* sp., but it has been reported that the proportion of male and female parasitoids caught on colour traps was significantly different, with females preferring white sticky traps and males yellow or green (Romeis et al. 1998).

In conclusion, the results of this experiment and literature searches have shown that yellow sticky traps are an effective option for trapping Hymenoptera and Coccinellids in general, and especially effective for *A. mali*, *S. bifidus* and *Encarsia* spp.

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