AMPARO®: A NEW COTTON SEED-DRESSING MIXTURE OF IMIDACLOPRID AND THIODICARB

G.A. Herron[1], G. Gullick[1] and J. Holloway[2]

[1]NSW Agriculture, EMAI, PMB 8, Camden NSW 2570, Australia
[2]Bayer CropScience Pty Ltd, "The Valley" Kaputar Road, Narrabri NSW 2390, Australia
Email: grant.herron@agric.nsw.gov.au

Summary

The new cotton-seed dressing Amparo® is a mixture of two chemical groups (chloronicotinyl and carbamate) that must be accurately positioned within the Australian cotton Integrated Resistance Management Strategy (IRMS). Against cotton aphid, *Aphis gossypii* Glover, the carbamate component of the mixture did not significantly reduce aphid numbers. In contrast, the chloronicotinyl component was significantly better than the control and gave statistically equivalent efficacy at all rates tested. Consequently, the current chloronicotinyl grouping of Amparo® within the cotton IRMS is valid.

Keywords: mixtures, seed-dressing, resistance management, *Aphis gossypii*, cotton aphid

INTRODUCTION

The Integrated Resistance Management Strategy (IRMS) for Australian cotton was originally designed to manage resistance in *Helicoverpa* spp. but increasingly considers a range of insecticide resistant secondary pests (Johnson and Farrell 2003). *Aphis gossypii* Glover is one such pest that has recently risen in status due to increasing resistance and associated control failures (Herron *et al*. 2001). The aphid management strategy in cotton is based on the grouping of like chemicals including foliar sprays and seed treatments with chemical alternation between groups (Rossiter *et al*. 2003).

For the 2003-2004 cotton season, Bayer CropScience Pty. Ltd. will introduce a new seed treatment for aphid control that is a combination of the chloronicotinyl, imidacloprid and the carbamate, thiodicarb. Other seed dressings and in-furrow insecticides currently in use in Australian cotton include the carbamate aldicarb (Temik® 150 G), the organophosphate phorate (Thimet® 200 G), and the chloronicotinyls imidacloprid (Gaucho® 600 FS), acetamiprid (Intruder® Insecticide) and thiamethoxam (Cruiser® 350 FS) (Johnson and Farrell 2003). Due to cross-resistance between organophosphates and carbamates in *A. gossypii*, pesticides belonging to these classes are considered as one group in the IRMS (Rossiter *et al*. 2003).

To accurately position Amparo® within the management strategy we aimed to evaluate its individual components for efficacy against *A. gossypii*.

MATERIALS AND METHODS

Aphids

Insecticide susceptible aphids were collected from an unsprayed Sydney backyard. Their response to a range of chemicals has been previously described (Herron *et al*. 2000).

Chemicals

Bayer CropScience Pty. Ltd. supplied cottonseed variety Sicala V3i previously treated with formulated imidacloprid or thiodicarb at various rates (Table 1).

Seed germination

On the 7th August 2003 five treated seeds were planted evenly into plastic pots (15 cm diam.) filled with Yates Green Earth™ premium potting mix. Pots contained only one treatment and each treatment was replicated three times. Pots were placed onto individual saucers and watered from above and below with 100 mL. The pots were transferred to a plant germination room maintained at 28 ± 2 ^{O}C where they were watered with a further 100 mL on Day 3 and Day 6 and left for a total of 7 d until dicotyledons had emerged.

On the 14th August pots were transferred into one of three aphid proof cages in an insectary maintained at 25 ± 4 ^{O}C. Each cage contained all treatments in a randomised complete block design with pot position randomly assigned. Each plant was challenged with two adult insecticide susceptible *A. gossypii* aptera at weekly intervals until 29-30th September 2003. Four days post-challenge the plants were examined and

those with leaves with 0, <10 or >10 aphids noted. During the interval plants were watered (150-200 mL) twice a week at the base of the plant only. After the final challenge the leaves were removed from each plant and number of aphids counted with the aid of a stereo-microscope.

Statistical analysis

Final aphid numbers per plant were analysed using a generalised linear mixed model with errors assumed to follow a Poisson distribution with a logarithmic link function as follows: Ln (count) = offset + treatment + *block* + *plot* where "offset" is natural logarithmic of Control mean and the "*italicised*" terms are included in the model as random effects. Parameters were estimated using the residual maximum likelihood (REML) technique through ASREML statistical software (Gilmour *et al.* 1999). Predicted values of the ratio of treatment means over the Control mean were used to estimate percentage efficacy.

RESULTS

Treatment effects (ie. % efficacy) were highly significant (P<0.001) with all imidacloprid treatments having similar efficacy that was significantly different from the thiodicarb only treatment (Table 2). Interestingly, thiodicarb (treatment 6) seemed to have an inhibitory effect on aphid numbers during the first week of the trial (Table 3).

Table 1. Seed treatments.

Treatment[1]	Active ingredient
1	fungicide only control[2]
2	imidacloprid 600 g L^{-1} Flowable Concentrate for Seed Treatment (FS) (580 mL 100 kg^{-1}) + thiodicarb 500 g L^{-1} FS (250 mL 100 kg^{-1})
3	imidacloprid 600 g L^{-1} FS (580 mL 100 kg^{-1}) + thiodicarb 500 g L^{-1} FS (500 mL 100 kg^{-1})
4	imidacloprid 600 g L^{-1} FS (580 mL 100 kg^{-1})
5	imidacloprid 600 g L^{-1} FS (875 mL 100 kg^{-1})
6	thiodicarb 500 g L^{-1} FS (500 mL 100kg^{-1})

[1]every treatment included Quintozene, Apron and Peridiam fungicides.
[2] QAP

Table 2. Mean calculated as a ratio to the control count.

Treatment	Ln(mean)	SE	Mean	% Efficacy
2	-7.0788	2.3568	0.0008	99.92a
3	-4.1231	0.681	0.0162	98.38a
4	-5.4845	1.0435	0.0042	99.58a
5	-5.8647	1.2147	0.0028	99.72a
6	-0.0782	0.4862	0.9248	7.52b

Note: Significant differences were determined using Z-value at P<0.001 on Ln(mean)

Table 3. The number of plants in each treatment with leaves infested with 0, <10 or >10 aphids when assessed at six different challenge dates (see Table 1 for key to treatments).

Assessment date (days post cotyledon emergence)	No. of plants (max. 15) with leaves containing	Treatment					
		1	**2**	**3**	**4**	**5**	**6**
18 August	0 aphids	2	11	14	14	14	9
(4)	<10 aphids	10	0	0	0	0	2
	>10 aphids	0	0	0	0	0	0
25 August	0 aphids	1	10	13	14	14	3
(11)	<10 aphids	11	1	1	0	0	8
	>10 aphids	0	0	0	0	0	0
1 September	0 aphids	0	10	13	12	14	0
(18)	<10 aphids	1	1	1	2	0	11
	>10 aphids	11	0	0	0	0	0
8 September	0 aphids	0	3	12	12	12	0
(25)	<10 aphids	0	8	2	2	2	3
	>10 aphids	12	0	0	0	0	8
16 September	0 aphids	0	9	9	10	11	0
(33)	<10 aphids	0	2	5	4	3	0
	>10 aphids	12	0	0	0	0	11
22 September	0 aphids	0	9	5	8	10	0
(39)	<10 aphids	0	2	8	4	4	0
	>10 aphids	12	0	0	2	0	11
29-30 September (46)	Total aphids	6864	6	160	38	26	6479

DISCUSSION

The seed treatments Gaucho® 600 FS and Amparo® contain different amounts of the active ingredient imidacloprid. The Gaucho® 600 formulation has a higher application rate of 525 g ai (875 mL product) while Amparo® is applied at 348 g ai (580 mL product) 100 kg^{-1} seed. However, by the end of the current study both rates provided statistically equivalent control of aphids. In contrast, the carbamate component of the Amparo® mixture did not significantly reduce aphid numbers. Consequently, in terms of the cotton IRMS, Amparo® should be included in a chloronicotinyl grouping with Cruiser® 350 FS, Intruder® Insecticide and Gaucho® 600 FS.

Interestingly, our results suggest that the thiodicarb component of the Amparo® mixture when applied at 250 g ai (500 mL product 100 kg^{-1} seed) had a short-lived inhibitory effect on aphid numbers. The phenomenon may be worthy of further study to ascertain if the effect is statistically significant.

ACKNOWLEDGMENTS

Ms Brie Collier provided technical assistance. Dr Idris Barchia is thanked for the statistical analysis.

REFERENCES

Gilmour, A.R., Cullis, B.R., Welham, S.J. and Thompson, R. (1999). *ASREML Reference Manual, NSW Agriculture Biometric Bulletin* No. 3. NSW Agriculture, Orange. pp. 210.

Herron, G., Powis, K. and Rophail, J. (2000). Baseline studies and preliminary resistance survey of Australian populations of cotton aphid *Aphis gossypii* Glover (Hemiptera: Aphididae). *Australian Journal of Entomology* **39**: 33-38.

Herron, G.A., Powis, K. and Rophail, J. (2001). Insecticide resistance in *Aphis gossypii* Glover (Hemiptera: Aphididae), a serious threat to Australian cotton. *Australian Journal of Entomology* **40**: 85-89.

Johnson, A. and Farrell, T. (2003). *Cotton Pest Management Guide* 2003-04. NSW Agriculture, Orange. pp. 67.

Rossiter, L., Wilson, L., Larsen, L., Pyke, B., Gunning, R., Herron, G. and Kelly, D. (2003). *Insecticide Resistance Where Are We Now*? Dec. 2003. Cotton Information Sheet TRC 43 12/03. Australian Cotton Cooperative Research Centre, Narrabri. pp. 4.