Insecticidal management of lucerne leafroller, *Merophyas divulsana* (Walker), (Lepidoptera: Tortricidae) on lucerne in Queensland.

R.J. Lloyd, B.A. Franzmann and **P.D. Rossiter,** Department of Primary Industries, PO Box 102, Toowoomba, Qld 4350, Australia.

Summary

Three trials were conducted to find chemical alternatives to carbaryl and methidathion, for the management of lucerne leafroller *Merophyas divulsana* (Walker), on lucerne in Queensland. Chlorpyrifos at 300 g a.i. ha^{-1} gave better control than the recommended treatments of carbaryl at 840 g a.i. ha^{-1} or methidathion at 350 g a.i. ha^{-1}. At the low rate of 100 g a.i. ha^{-1}, chlorpyrifos provided satisfactory control. Its use is discussed in relation to effects on key aphid pests and their natural enemies.

Introduction

The lucerne leafroller, *Merophyas divulsana* (Walker), the spotted alfalfa aphid, *Therioaphis trifolii* (Monell) f. *maculata* and the blue-green aphid, *Acyrthosiphon kondoi* Shinji are major pests of lucerne in Queensland (Turner and Franzmann 1981). Larvae of *M. divulsana* web and roll the leaves at the tip of the shoot and skeletonize the leaves from within the roll. Infestations of *T. trifolii* and *A. kondoi* cause leaf drop, retarded growth and honeydew contamination resulting in reduced yield and quality.

Numerous parasites and predators are capable of causing significant reductions in lucerne aphid populations (Milne and Bishop 1987). Carbaryl and methidathion have been the only insecticides recommended for controlling *M. divulsana* in Queensland (Turner and Franzmann 1981). However, both chemicals are highly toxic to the aphids' natural enemies (Croft and Brown 1975, Franzmann and Rossiter 1981). Also, carbaryl has no effect on aphids and may cause aphid populations to surge after the removal of predators (Bishop and Milne 1986).

This paper reports the results of three trials to evaluate alternative chemicals to carbaryl and methidathion to manage *M. divulsana*.

Materials and methods

Three trials were conducted in south-east Queensland between February 1978 and October 1979. Trials 1 and 2 screened candidate insecticides while various rates of the most promising ones were tested in trial 3. All trials were randomized block designs with plot sizes of 10 × 6 m and three replications. Trials 1 and 2 contained 10 treatments, whereas trial 3 contained eight treatments. Treatments (Table 1) were applied once at 150 L ha^{-1} using a Rega pneumatic sprayer fitted with a 1.5 m boom incorporating four hollow cone nozzles and operated at 240 to 280 kPa.

Larval numbers were assessed in trials 1 and 2 by cutting the lucerne to ground level in random quadrats, placing the lucerne on a wire mesh sieve and smoking with a bee smoker. Larvae dropped through the mesh and were counted in the collecting tray.

Three 0.1 m^2 pre-treatment and three 0.25 m^2 post-treatment (3 d) quadrats were sampled per plot in trial 1. In trial 2, two 0.25 m^2 quadrats per plot were sampled pre-treatment and 2, 5 and 7 days post-treatment. Due to stand variability in trial 3, 20 leaf rolls per plot were randomly sampled pre-treatment and 50 leaf rolls per plot at two and seven days post-treatment. Larvae were extracted as in trials 1 and 2.

Analysis of variance was used to test for treatment effects.

Results and discussion

The results are summarized in Table 1. In trial 1, the larval numbers at three days post-treatment in the endosulfan, diazinon or trichlorphon treatments were not significantly different (P>0.05) to the control. The best control was achieved with carbaryl and chlorpyrifos although larval num-

Table 1. Effect of insecticide treatments on *M. divulsana* larvae

Treatment	Mean number of *M. divulsana* larvae / sample				
		Post-treatment			
(g a.i. ha^{-1})	Pre-Treatment	Day 2	Day 3	Day 5	Day 7
Trial 1					
Control	3.8 a[A]	-	4.7 ab[B]	-	-
Carbaryl (840)	4.6 a	-	0.3 d	-	-
Methidathion (350)	4.8 a	-	1.6 cd	-	-
Chlorpyrifos (500)	4.1 a	-	0.2 d	-	-
Acephate (1000)	3.9 a	-	0.4 cd	-	-
Methamidophos (580)	5.3 a	-	1.0 cd	-	-
Methomyl (300)	4.6 a	-	1.7 cd	-	-
Trichlorphon (840)	4.2 a	-	2.3 bc	-	-
Diazinon (500)	4.2 a	-	4.3 ab	-	-
Endosulfan (735)	6.7 a	-	6.4 a	-	-
Trial 2					
Control	22.1 a[B]	20.4 a[B]	-	14.5 a[B]	13.7 a[B]
Carbaryl (560)	12.1 a	5.3 bc	-	1.4 bcde	1.6 bcde
Carbaryl (840)	19.3 a	6.8 b	-	2.9 bc	1.3 cde
Methidathion (350)	10.8 a	4.6 bc	-	3.2 b	4.7 b
Chlorpyrifos (300)	19.4 a	1.0 d	-	1.1 bcde	0.0 e
Chlorpyrifos (500)	15.7 a	0.8 d	-	0.4 e	0.0 e
Acephate (500)	15.4 a	2.1 cd	-	1.0 cde	0.1 e
Acephate (750)	15.7 a	3.9 bcd	-	0.8 de	1.0 de
Methomyl (300)	15.8 a	2.4 bcd	-	1.4 bcde	3.9 bcd
Trichlorphon (800)	19.5 a	3.9 bcd	-	2.7 bcd	4.1 bc
Trial 3					
Control	14.5 a[C]	12.4 a[C]	-	-	12.9 a[C]
Carbaryl (840)	15.9 a	7.5 bc	-	-	7.6 abc
Chlorpyrifos (100)	16.9 a	9.4 ab	-	-	5.4 bcd
Chlorpyrifos (200)	17.7 a	4.9 c	-	-	3.3 cd
Chlorpyrifos (300)	14.6 a	2.7 d	-	-	2.8 d
Acephate (150)	16.8 a	10.4 ab	-	-	8.4 ab
Acephate (300)	14.2 a	10.1 ab	-	-	7.7 abc
Acephate (450)	15.8 a	9.0 ab	-	-	4.6 cd

[A] In each trial, treatment columns followed by the same letter are not significantly different (P>0.05).

[B] Equivalent means after $(x + 0.5)^{½}$ transformation.

[C] Equivalent means after $(x)^{½}$ transformation.

bers were not significantly different ($P>0.05$) to those in plots treated with methidathion, acephate, meth-amidophos or methomyl. In trial 2, all the insecticides were significantly different to the control ($P<0.05$) at two, five and seven days post-treatment. At two days post-treatment larval numbers were significantly lower ($P<0.05$) in the plots treated with chlorpyrifos than those treated with carbaryl and methidathion. At seven days post-treatment chlorpyrifos gave total control and was significantly different ($P<0.05$) to methidathion, but there were no significant differences ($P>0.05$) between chlorpyrifos, carbaryl and acephate, and for this reason these three chemicals were included in trial 3. At two days post-treatment in trial 3, chlorpyrifos (300 g a.i. ha^{-1}) gave significantly better ($P<0.05$) control than all other treatments.

At seven days post-treatment, carbaryl and the lower rates of acephate were not significantly different ($P>0.05$) to the control while significantly fewer ($P<0.05$) larvae were found in all chlorpyrifos and acephate (450) treatments than in the control.

The results showed that chlorpyrifos at rates as low as 100 g a.i. ha^{-1} was effective in providing control of *M. divulsana* and at 300 g a.i. ha^{-1} was superior to the recommended treatments of carbaryl and methidathion. Chlorpyrifos (250) has been shown to be toxic to the spotted alfalfa aphid parasite *Trioxys complanatus* Quilis (Franzmann and Rossiter 1981). Kay (1979) found chlorpyrifos to be moderately toxic to adults and highly toxic to larvae of the aphid predator *Coccinella repanda* Thunberg. Although chlorpyrifos is a broad spectrum insecticide, at the low rate of 100 g a.i. ha^{-1} it may have only a minor detrimental effect on parasite and predator populations (van den Bosch and Stern 1962). Chlorpyrifos (250) also controls both aphid pests of lucerne (Broadley *et al.* 1980) and is registered for their control in Queensland at 100 g a.i. ha^{-1} (Beavis *et al.* 1991). At this low rate a single cost-effective application of chlorpyrifos may control the three major pests of lucerne in Queensland, with only minor detrimental effect on parasite and predator populations. Further studies are required to examine this aspect.

References

Beavis, C., Simpson, P., Syme, J. and Wright, C. (1991). Infopest: chemicals for the protection of field crops, forage crops and pastures. Queensland Department of Primary Industries information series; QI91006.

Bishop, A.L. and Milne, W.M. (1986). The impact of predators on lucerne aphids and the seasonal production of lucerne in the Hunter Valley, New South Wales. *Journal of the Australian Entomological Society*. 25, 333-7.

Broadley, R.H., Rossiter, P.D., Brier, H., Butler, D.G. and Lloyd, R.J. (1980). Insecticide screening trials against lucerne aphids, *Therioaphis trifolii* (Monell) and *Acyrthosiphon kondoi* Shinji (Hemiptera: Aphididae), in south-east Queensland. *Queensland Journal of Agricultural and Animal Sciences.* 37, 109-20.

Croft, B.A. and Brown, A.W.A. (1975). Responses of arthropod natural enemies to insecticides. *Annual Review of Entomology*. 20, 285-335.

Franzmann, B.A. and Rossiter, P.D. (1981). Toxicity of insecticides to *Trioxys complanatus* Quilis (Hymenoptera: Braconidae) in lucerne. *Journal of the Australian Entomological Society*. 20, 313-5.

Kay, I.R. (1979). Toxicity of insecticides to *Coccinella repanda* Thunberg (Coleoptera: Coccinellidae). *Journal of the Australian Entomological Society*. 18, 233-4.

Milne, W.M. and Bishop, A.L. (1987). The role of predators and parasites in the natural regulation of lucerne aphids in eastern Australia. *Journal of Applied Ecology* 24, 893-905.

Turner, J.W. and Franzmann, B.A. (1981). Lucerne insect pest management. *Queensland Agricultural Journal*. 107, 2-4.

van den Bosch, R. and Stern, V.M. (1962). The integration of chemical and biological control of arthropod pests. *Annual Review of Entomology*. 7, 367-86.