Managing aphids in flowering canola in central west NSW

Leigh Jenkins[1], Rohan Brill[2] and Don McCaffery[3]
[1]NSW Department of Primary Industries, PO Box 183, Warren NSW 2824, Australia.
[2]NSW Department of Primary Industries, PO Box 60, Coonamble NSW 2829, Australia.
[3]NSW Department of Primary Industries, Locked Bag 21, Orange NSW 2800, Australia.
Email: leigh.jenkins@industry.nsw.gov.au

ABSTRACT

This paper reports the results of a trial conducted in 2009 at Trangie Agricultural Research Centre in central west NSW. The aim was to investigate the management of aphids in canola crops during the flowering-early podding period under moisture stressed (drought) conditions. During the course of the trial, both aphid species and beneficial insects were identified and assessed for their response to both commercial and currently unregistered insecticide options at various rates. Canola was sown at two times of sowing and analysed for economic yield response against the cost of control. The most noteworthy finding was the benefit of early sowing in this district; however in terms of aphid management it was confirmed that the currently registered pirimicarb products remain the preferred option for controlling aphids in canola, on the basis of residual activity, yield response and rate of marginal return. The trial was repeated in a modified format in 2010 but applied treatments failed to produce an economic response due to low aphid pressure and above-average rainfall conditions.

Key words: canola – aphid – management – insecticide – beneficial

INTRODUCTION

Aphid infestations can occur at two stages of the canola crop cycle; during the autumn/winter establishment phase, and again during spring when crops are flowering and podding. Early infestations can lead to establishment failure or stress and the risk of virus transmission. Spring infestations often have a higher impact in combination with moisture stress, as high aphid populations appear more evident in dry seasons. In the central west region of NSW, aphids have caused crop loss since 2007, with 2008 being one of the worst seasons for aphids over a wide area of NSW.

Three factors complicate the decision making process regarding the economic benefits of controlling aphids in dry springs. Firstly, yield potential is already reduced by the dry season/moisture stress, so it is difficult to determine when control is warranted, and what thresholds apply to ensure spraying is cost-effective. Secondly, many growers and their advisers have experimented with lower rates of both registered and unregistered products, as a consequence of both aiming to reduce costs and limited product supply at critical times. Thirdly, careful selection of insecticides is essential to ensure that damage is not caused to nearby beehives or to beneficial predatory insects within the crop, and the harvest withholding period of the insecticide is not exceeded.

A trial was undertaken to examine some of these factors at Trangie Agricultural Research Centre in central west NSW in 2009. A modified version of the trial was sown in 2010 but high rainfall conditions negated the impact of low aphid pressure.

MATERIALS AND METHODS

Trial objectives

1. Identify and assess species of aphids affecting canola in the local region, and identify and assess impacts of beneficial insects as biological control agents.
2. Evaluate various registered and unregistered insecticide products for the control of aphids in canola, and their impact on beneficial species.
3. Develop recommendations for aphid thresholds in canola and timing of chemical application, based on economic yield response to control.

2009 Trial details

Canola variety:	44C79 (CL)
Seeding rate:	3.75 kg/ha
Fertiliser:	Granulock 12Z @ 100 kg/ha
Sowing dates:	TOS 1 - 21 April 2009
	TOS 2 - 11 May 2009
Herbicides:	Stomp® @ 2.0 L/ha (at sowing);
	Intervix®, Lontrel® + Verdict® (post-sowing).

Treatments

1. Control (untreated)
2. Pirimor® WG (a.i. pirimicarb) @ 0.5 kg/ha (registered label rate in canola)
3. Pirimor® WG (a.i. pirimicarb) @ 0.25 kg/ha (half registered rate)
4. Pirimor® WG (a.i. pirimicarb) @ 0.125 kg/ha (quarter registered rate)
5. Fastac® Duo (a.i. alpha-cypermethrin) @ 300 mL/ha (unregistered for aphids, label rate for heliothis)
6. Rogor® (a.i. dimethoate) @ 500 mL/ha (unregistered; as per Permit PER11140 issued for use in 2008)

Insecticides were applied on 8 September 2009 by hand-boom over the top of each plot (water rate 70 L/ha; Hardi LD01 nozzles @ 5 km/hr).

TOS 1 (21/04/09) @ late pod-fill stage.

TOS 2 (11/05/09) @ 60% flowering – mid pod-fill stage.

Each treatment plot was separated by two untreated buffer plots to minimise the risk of spray-drift confounding the results.

Assessment protocol

Aphid and beneficial species were identified pre and post spraying using a hand lens. Plots were scored both pre-treatment (twice) and post-treatment (twice) at weekly intervals to assess level of infestation and effectiveness of control. A scoring protocol was used to measure both the incidence of aphids in the crop (percentage of heads affected) and the level of infestation (depth of colony in centimetres). The rating system was as follows, with scores averaged as a measure over the whole plot:

0 = nil present
1 = 1.0 cm colony on tip of flower
2 = 2.5 cm colony
3 = 5.0 cm colony
4 = 5.0 - 15 cm colony
5 = > 20 cm colony, or whole flower stalk.

RESULTS

Aphid incidence and species identification

The outside buffer plots (eastern and western ends of trial) were severely impacted by aphids both in incidence (e.g. up to 80% of flowering branches affected), and level of infestation (e.g. colonies in excess of 10-15 cm in depth). Discounting this edge effect, the aphids were fairly uniform throughout the rest of the trial block prior to treatments being applied. At one day pre-spraying (7 September), aphid incidence had reached a level of 30-40% of flowering branches affected, with most of the colonies between 2.5 and 5 cm in depth.

Aphid species were identified as follows:

- 99% cabbage aphid (*Brevicoryne brassica*) – grey waxy colour in colony
- 1% green peach aphid (*Myzus persicae*) – lime-green in colour, found mixed within cabbage aphid colonies (noted to be more mobile than cabbage aphid)
- one single colony of turnip aphid (*Lipaphis erysimi*) was found in the canola trial separate to the cabbage aphid colony; it appeared this species (dark olive green) has a distinct preference for juncea canola (*Brassica juncea* trial adjoining) when available.

Table 1 shows the impact of the six insecticide treatments for aphid control on aphid incidence and density both pre- and post- treatment applications. Tables 2 and 3 show the impact of these six treatments on final canola yield and quality analysis.

Table 1. Effect of six insecticide treatments on aphid incidence (%) and depth of colony (score) in canola pre and post treatment at two times of sowing in 2009.

TOS 1 (sown 21/04/09)	26/08/09 1 week pre-treatment		7/09/09 1 day pre-treatment		15/09/09 7 days post-treatment		22/09/09 14 days post-treatment	
	%	score	%	score	%	score	%	score
buffer - north	11.67	3.33	70.00	3.00	56.67	3.33	10.00	1.67
1 Control (untreated)	1.67	2.33	33.33	3.00	60.00	2.67	5.33	2.33
2..Pirimor® WG (a.i. pirimicarb) @ 0.5 kg/ha	2.67	2.33	30.00	1.67	10.00	1.00	0.00	0.00
3 Pirimor® WG (a.i. pirimicarb) @ 0.25 kg/ha	2.33	3.33	33.33	2.67	6.67	1.33	0.33	0.67
4 Pirimor® WG (a.i. pirimicarb) @ 0.125 kg/ha	1.00	3.33	43.33	2.33	28.33	2.33	5.33	1.67
5 Fastac® Duo (a.i. alpha-cypermethrin) @ 300 mL/ha	1.00	2.33	16.67	2.00	26.67	2.33	5.33	2.67
6 Rogor® (a.i. dimethoate) @ 500 mL/ha	2.67	2.00	33.33	2.67	65.00	3.00	8.33	3.00
buffer - south	3.67	3.00	60.00	2.67	50.00	4.00	5.00	1.67
Mean of TOS 1	2.73	2.57	33.89	2.36	40.12	2.71	6.26	1.98
Growth stage	late flowering, 50% pod fill		late pod fill (<1% flower)		late pod fill (no flowers)		late pod fill (no flowers)	

TOS 2 (sown 11/05/09)	26/08/09 1 week pre-treatment		7/09/09 1 day pre-treatment		15/09/09 7 days post-treatment		22/09/09 14 days post-treatment	
	%	score	%	score	%	score	%	score
buffer - north	1.00	1.67	76.67	2.33	70.00	3.67	20.00	2.00
1 Control (untreated)	0.67	0.67	23.33	2.67	56.67	3.00	20.00	3.33
2..Pirimor® WG (a.i. pirimicarb) @ 0.5 kg/ha	0.03	0.33	26.67	2.00	2.33	1.33	0.33	0.33
3 Pirimor® WG (a.i. pirimicarb) @ 0.25 kg/ha	0.07	0.67	30.00	2.33	2.33	1.33	0.33	0.67
4 Pirimor® WG (a.i. pirimicarb) @ 0.125 kg/ha	0.10	1.00	30.00	2.67	13.67	1.33	5.33	2.00
5 Fastac® Duo (a.i. alpha-cypermethrin) @ 300 mL/ha	0.40	1.00	30.00	3.00	30.00	2.00	16.67	2.67
6 Rogor® (a.i. dimethoate) @ 500 mL/ha	0.07	0.67	23.33	2.33	43.33	3.00	30.00	3.67
buffer - south	1.00	1.00	100.00	3.00	70.00	3.00	8.33	1.33
Mean of TOS 2	0.27	0.83	37.50	2.42	40.36	2.57	16.14	2.50
Growth stage	100% flowering, no pods yet		60% flowering mid pod fill		20% flowering mid-late pod fill		late pod fill (no flowers)	

Table 2. Effect of six insecticide treatments for aphid control on yield of canola at two times of sowing in 2009.

Treatment	TOS 1 21 Apr 09 yield (t/ha)	TOS 2 11 May 09 yield (t/ha)	Treatment means across sow time yield (t/ha)
1 Control (untreated)	0.85	0.39	0.62
2..Pirimor® WG (a.i. pirimicarb) @ 0.5 kg/ha	1.05	1.19	1.12
3 Pirimor® WG (a.i. pirimicarb) @ 0.25 kg/ha	1.19	1.08	1.13
4 Pirimor® WG (a.i. pirimicarb) @ 0.125 kg/ha	0.98	0.86	0.92
5 Fastac® Duo (a.i. alpha-cypermethrin) @ 300 mL/ha	1.06	0.51	0.78
6 Rogor® (a.i. dimethoate) @ 500 mL/ha	0.94	0.81	0.88
Mean yield (t/ha)	1.01	0.81	0.91
l.s.d. of means (5% level)	0.4727	0.2945	
Harvest date	15/10/09	05/11/09	

Table 3. Effect of six insecticide treatments for aphid control on quality of canola at two times of sowing in 2009.

Treatment	Oil content%		Protein content %		Glucosinolates µmoles/g	
	TOS 1 21/04/09	TOS 2 11/05/09	TOS 1 21/04/09	TOS 2 11/05/09	TOS 1 21/04/09	TOS 2 11/05/09
1 Control (untreated)	40.9	37.1	42.1	45.7	8.3	10.3
2..Pirimor® WG (a.i. pirimicarb) @ 0.5 kg/ha	42.5	39.1	43.6	45.4	6.3	8.0
3 Pirimor® WG (a.i. pirimicarb) @ 0.25 kg/ha	43.8	39.5	43.1	44.9	6.3	8.3
4 Pirimor® WG (a.i. pirimicarb) @ 0.125 kg/ha	40.4	37.7	44.3	45.6	6.7	8.7
5 Fastac® Duo (a.i. alpha-cypermethrin) @ 300 mL/ha	40.8	37.5	43.9	43.9	7.3	8.7
6 Rogor® (a.i. dimethoate) @ 500 mL/ha	41.6	38.3	42.7	42.7	7.3	8.3
Mean of TOS treatments	41.7	38.2	43.3	45.5	7.1	8.7
l.s.d. of means (5% level)	2.672	1.811				

Beneficial species incidence and identification

Numbers of beneficial insects were very low prior to treatments being applied. Species observed included hoverflies and lacewing eggs on upper leaves. Aphid colonies included about 1% of mummified aphids, so presumably some predator wasps were present in the crop at some stage but not observed. Bees were active in the cooler weather during early flowering.

Two weeks after spraying there was a large number of ladybeetles observed (1-2 per m^2), mostly at ground level between plants. Large black and orange wasps (unidentified species) were also observed in close proximity to the remaining aphid colonies.

DISCUSSION

In Table 1, buffer results are included purely for interest but show a consistent level of both incidence (% of plot) and colony size (scores reflecting depth of colony). Plot scoring commenced in late August and within one week (early September) all plots had shown a rapid increase in aphid incidence and colony size, with the buffers representing the extremity of the trial and showing the most marked effects. At 7 days post treatment (mid September), both the buffers (as untreated extremes) and the untreated control plot scored consistently high for aphid incidence and density. By 14 days post-treatment, the aphid pressure had begun to show its own natural decline in the buffer extremes and untreated control plots. However the residual value of the pirimicarb product at 14 days (treatments 2, 3, 4) is clearly shown to be effective in reducing aphid pressure compared to the other insecticide products and untreated control.

All treatments appeared to show a yield response against the untreated control plots (Table 2, TOS 1 no significant difference, TOS 2 significant at 5% level). This yield response was greater in the second time of sowing (TOS 2), which was surprising given that at the time of spraying (8 September) the incidence of aphids was about the same for both times of sowing (approx. 35% of plants affected with average incidence score of 2.4). This suggests that the crop's growth stage at time of spraying had a significant effect, since TOS 2 was still at 60% flowering (compared to TOS 1 at late pod fill stage) but had less time to recover and fill pods before moisture stress induced physiological maturity. Hence this trial reinforced the point that canola yields are maximised by earlier sowing under conditions of spring moisture stress.

The full label rate (0.5 kg/ha) and half label rate (0.25 kg/ha) of Pirimor® (a.i. pirimicarb) were equally effective for residual control and yield response, with the one quarter rate (0.125 kg/ha) less effective but still better than the untreated. At 14 days post treatment there were no aphids present in TOS 1 full rate of Pirimor® treatment, whereas the half rate was still at 0.33% incidence and the one quarter rate was at 5%. Similar results were apparent in TOS 2. The pirimicarb appeared to cause an immediate desiccation effect on aphids.

Fastac® Duo (a.i. alpha-cypermethrin) is regularly used at the 300 mL/ha rate in central-west NSW to control heliothis and "clean-up" any aphids that might be present at the time (with timing based on heliothis pressure, i.e. later than that preferred for aphid control). Local experience suggests that Fastac® has an immediate knockdown action but very little residual control. In this trial, aphid incidence at 14 days post treatment was still 5% in TOS 1 (i.e. equal to Pirimor® at the one quarter rate) and over 16% in TOS 2 (equal to untreated control). In terms of yield response, the Fastac® treatment was equal to the mean yield of all Pirimor® treatments for TOS 1, but only half of the same mean in TOS 2. Yield of Fastac® treated plots was the lowest of all treatments except for the untreated control.

Rogor® (a.i. dimethoate) is not registered for aphids in canola but a Permit (PER11140) was issued for use in 2008 due to shortage of supply of pirimicarb products. Dimethoate is known to affect a broad spectrum of both pest species and beneficials (particularly bees). In this trial at 14 days post treatment the dimethoate product had both higher density and incidence of aphids than the untreated control plots in both TOS 1 and TOS 2. In TOS 2 there were still 30% of plants affected by aphids compared to 20% in the control. The yield response of the dimethoate product was equal to the one quarter rate of Pirimor® for both TOS 1 and TOS 2.

The quality analysis of oil and protein contents, and glucosinulate levels, showed a greater response to time of sowing than individual aphid control treatments (Table 3). The later sowing had a sizeable impact on oil content, with TOS 2 showing an average oil penalty of 3.5 percentage points across all treatments. Of the treatments, the full (0.5 kg/ha) and half (0.25

kg/ha) rates of pirimicarb showed the strongest response above the control in both TOS 1 and TOS 2. Protein contents increased by 2.2% on average across all treatments in the later sowing compared to the earlier sowing; however no one treatment stands out above the control within each time of sowing. Glucosinolate levels are required to be less than 30 µmoles/g to meet meal quality standards for canola. In this trial there is a slight response to both time of sowing, and treatments against control, but all glucosinolate levels are still less than 10 µmoles/g.

These results reinforced commercial experience that delayed sowing (by three weeks in this trial) can greatly reduce yield and oil content of canola in the central west region of NSW.

Most Australian populations of green peach aphid are resistant to organophosphate (OP) insecticides such as dimethoate, and synthetic pyrethroids (SP's) such as alpha-cypermethrin. Organophosphate insecticides such as dimethoate should not be used against green peach aphid because they will trigger an esterase resistance mechanism that can provide cross-resistance to carbamate insecticides and SP's. Synthetic pyrethroids may be effective against green peach aphid at the full recommended rate but using SP's in general will select for insects with the 'kdr' gene which confers resistance to pyrethroids. In this trial the general incidence of green peach aphid was 1% (compared to 99% cabbage aphid) pre-treatment, but increased to 5% in both the untreated control and Rogor® plots post treatment. These aphids were not tested for resistance levels pre or post treatment.

Table 4. Marginal return economic analysis.

Treatment	Total cost of treatment application	TOS1 (21/04/09)		TOS2 (11/05/09)	
		Value of yield difference	Marginal return	Value of yield difference	Marginal return
1 Control (untreated)	$0.00	$0.00	$0.00	$0.00	$0.00
2 Pirimor® WG @ 0.5 kg/ha	$45.65	$79.23	$33.58	$302.21	$256.56
3 Pirimor® WG @ 0.25 kg/ha	$31.90	$130.39	$98.49	$259.08	$227.18
4 Pirimor® WG @ 0.125 kg/ha	$25.03	$50.95	$25.92	$176.21	$151.18
5 Fastac® Duo @ 300 mL/ha	$20.96	$80.89	$59.93	$40.79	$19.83
6 Rogor® @ 500 mL/ha	$23.89	$37.50	$13.61	$157.76	$133.87
Mean of all treatments	$29.49	$63.16	$33.68	$156.01	$126.52

Assumptions for marginal return analysis:

- Canola price, Dec 2009, on-farm $380/t
- Aerial application cost $18.15/ha
- Value of yield difference is yield response above control treatment for each TOS
- Marginal return is yield response less cost of treatment application only
- No consideration given to oil bonus payment or penalty rate above/below 42%.

CONCLUSIONS

- Canola should be sown as early as practical within the sowing window to avoid both yield and oil penalties induced by a combination of aphid pressure and spring moisture stress.
- Pirimicarb products remain the preferred option for controlling aphids in canola, on the basis of residual activity, yield response and rate of marginal return. The current registered rate for pirimicarb is 0.5 kg/ha but the half rate of 0.25 kg/ha was equally effective by all three parameters.

- Product choice and timing of application appear more critical in late sown canola, due to increased moisture stress and a shortened crop recovery time.
- Aphid species identification is encouraged to assist with appropriate product selection and reduce the development of resistance.

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