Transform™ Insecticide (sulfoxaflor) for control of aphids in canola

Robert Annetts[1], Natalie Elias[2], and Ian Corr[3]

[1] Dow AgroSciences Australia. Email rannetts@dow.com
[2] Dow AgroSciences Australia. Email icorr@dow.com
[3] Dow AgroSciences Australia. Email NElias@dow.com

Abstract
Aphids damage canola crops by direct feeding on sap, by transmitting plant viruses, by injecting toxins and by inducing secondary fungal growth (sooty mould) on honey dew. There are a limited number of insecticides registered for control of aphids in canola, and these often have disadvantages including disruption to beneficial insects and promotion of insecticide resistance. Sulfoxaflor (trade name Transform™ Insecticide 240 SC) is a new insecticide which is effective against a wide range of sap-feeding insects and is being developed for control of aphids in canola in Australia as well as a range of other pests in broadacre and horticultural crops. Data presented here shows that Transform, at rates between 100 -200 mL/ha, is effective on the aphid species which commonly attack canola. Transform is expected to be approved for use in mid 2013 and, once registered, will become a valuable tool for control of aphids in canola.

Key Words
Transform™ Insecticide, sulfoxaflor, aphids, canola

Introduction
The three species of aphids which commonly attack canola are green peach aphid (*Myzus persicae*), grey cabbage aphid (*Brevicoryne brassicae*), and turnip aphid (*Lipaphis erysimi*). Aphids damage canola by direct feeding on growing tips by sucking moisture and nutrients causing wilting, flower abortion and reduced pod set. They may also cover the plants with sticky honeydew, which encourages the growth of black sooty mould, thereby reducing the plants' ability to photosynthesize and generally decreases plant vigour. Aphids also transmit virus diseases in canola such as beet western yellows virus (BWYV).

Currently only pirimicarb is registered for aphid control in canola by foliar application, although synthetic pyrethroids and organophosphates have been used. Imidacloprid is registered for use as a seed treatment; however, it is unlikely that seed treatments would still be controlling aphid effectively through the key period of crop flowering. The use of foliar insecticides can be disruptive to beneficial insects such as parasitoid wasps, ladybirds, lacewings and hoverflies. Pirimicarb has insect resistance recorded against it and is at a high risk of becoming ineffective as resistance is increasing. There are currently a limited number of options for control of aphids in canola.

Sulfoxaflor was discovered by Dow AgroSciences. It is a member of a new class of insecticides called the sulfoximines and is effective against a wide range of sap-feeding insect pests (Zhu *et al.*, 2011). Previous studies have shown sulfoxaflor to be effective against aphids in cereal crops in Australia (Annetts and Welsh, 2012) and cotton (Annetts and Thomas, 2012). Sulfoxaflor is currently being assessed by the APVMA and may be registered in mid 2013 with the trade name Transform Insecticide. Data presented here shows that Transform is effective on aphids in canola at rates between 100 – 200 mL/ha. When registered it will be a valuable tool for canola growers for control of virus-vectoring aphids in canola.

Methods
Experiments were carried out in 2008 to 2010 across the canola growing areas of eastern Australia. All trials were small-scale randomized complete block trials with four replications and included an untreated control treatment. Plot sizes were adequate to allow accurate treatment application and the assessment of pests (for example 3 m x 10 m plots). Products used and trial details are shown below in Tables 1 and 2 respectively. Treatments were applied using a variety of application set-ups using precision small-plot sprayers (pressurized AgMurf or Azo precision small-plot sprayer) in order to closely simulate commercial practice. Applications targeted high infestations of green peach aphid (*M. persicae*), grey cabbage aphid (*B. brassicae*) and turnip aphid (*L. erysimi*) and were applied under good environmental conditions. All trials were assessed for knockdown 3-4 days after application and residual control at 7 day intervals from 7 to 32 days after application. Exact assessment timing varied at each trial. Aphid numbers were assessed by

counting the number of aphids on 10-20 randomly selected leaves or flowers depending on the trial. The maximum manageable numbers of leaves or flowers were counted in order to generate reliable and robust data. All data is presented as aphids per leaf or flower. Data were analyzed using a homogeneity of variance (Bartlett's test) and normalized as necessary using a log (x+1) transformation. Means were separated using Tukey's HSD (P=.05). Where no transformation symbol exists in the table, no transformation was necessary. Untransformed data are presented, while levels of significance and coefficient of variation are displayed on transformed data. Visual assessments of crop injury were made in each trial. The assessment methods used in these trials provides reliable data.

Table 1. Insecticides and formulation used in the trials

Trade Name /Formulation	Active Ingredient	Concentration (g a.i./L or kg)
Transform™ Insecticide	Sulfoxaflor	240 SC
Dimethoate 400	Dimethoate	400 EC
Pirimor® WG	Pirimicarb	500 WG
BS-1000®	nonionic surfactant	
Agral® 600	nonionic surfactant	

Table 2. Trial details (Crop=Canola *Brassica rapa cv. 'Canola'*)

Trial Number	**082044IC**	**104007RA**	**084023RA**	**104003RA**
Year	2008	2010	2008	2009
Author	I. Corr	T. Butler, & D. Kohler	R. Annetts	M. Sumner
Location	Tamworth, NSW	Latrobe, Tasmania	Gatton, Queensland	Badgingarra, Western Australia
Variety	4GC78	K9198	N/R	Rottnest
Crop Stage	Early flowering	Full flowering	Full flowering	Early flowering
Aphid stage assessed	Wingless nymphs	Total aphids	Wingless nymphs	Total aphids
Water rate (L/ha)	100	100	100	100
Pressure (kPa)	200	150	210	200
Nozzle type	Flat fan	Flat fan	Flat fan	Flat fan
Nozzle Tip	110015DG	XR80015VS	110015DG	11002

N/R = not recorded.

Results

This report describes four trials carried out in the field in Australia. Transform Insecticide (240 g/L suspension concentrate) was safe to all crops.

All trials were completed on large populations of aphids. Transform gave very good control of all aphid species in all the trials (see Table 3.). Transform gave quick knock down of aphids 3 days after application and was significantly superior (P<0.05) to the untreated in all trials. Residual control provided by Transform was not observed to "break" in any trial, even when assessed to 32 days after application, with aphid populations tending to decline naturally in the untreated plots during the trials. It is unlikely that Transform is giving residual control for such a length of time, rather it is more likely to be a reflection of lack of reinvasion by aphids; however, previous studies have shown that residual control of aphids could be expected for between 14 and 21 days, which is confirmed in these trials. These data do however show that Transform at 100 to 200 mL/ha gave reliable and robust control of aphids in canola on all species in all trials.

Conclusion

Data from these four field trials demonstrates the excellent activity of Transform on aphids in canola. Transform at 100 to 200 mL/ha will provide robust control of green peach aphid, grey cabbage aphid and turnip aphid in canola. Insecticides should be targeted against low populations of aphids wherever possible; however, this isn't always possible, and the higher rate of Transform will provide improved control in these situations. Extensive field testing globally has demonstrated that all formulations of sulfoxaflor, including Transform Insecticide, are safe to all crops when applied according to label directions.

Table 3. The number of aphids counted per leaf or inflorescent.

Treatment	*Rate mL/ha*	*Mean (±SE)*	*Mean (±SE)*	*Mean (±SE)*	*Mean (±SE)*	*Mean (±SE)*
		Grey cabbage aphid (B. brassicae)				
082044IC		***3 DAA (12/09/2008)†***	***7 DAA (16/09/2008)†***	***15 DAA (24/09/2008)†***	***20 DAA (29/09/2008)***	
Untreated		13.2 ±2.13 a	12.4 ±1.02 a	5.5 ±0.88 a	0.55 ±0.09 a	
Transform*	100	0 ±0.03 b	0 ±0.03 b	0.9 ±0.09 b	0.79 ±0.11 a	
Transform*	200	0 0 b	0 0 b	0.6 ±0.17 b	0.51 ±0.09 a	
Pirimor WG*	1 Kg/ha	0 0 b	0 0 b	0.9 ±0.24 b	0.51 ±0.12 a	
CV		*20.2*	*13.62*	*27.78*	*28.72*	
104007RA		***3 DAA (4/02/2010)†***	***7 DAA (8/02/2010)†***	***14 DAA (15/02/2010)†***		
Untreated		2.80 ±0.07 a	2.70 ±0.07 a	1.03 ±0.04 a		
Transform	100	0.05 ±0.01 b	0.30 ±0.03 b	0.08 ±0.01 a		
Transform	200	0.08 ±0.01 b	0.68 ±0.04 ab	0.03 ±0.01 a		
Pirimor WG	1 Kg/ha	0.08 ±0.01 b	0.50 ±0.04 b	0.05 ±0.01 a		
CV		*75.62*	*58.1*	*153.07*		
		Green peach aphid (*M. persicae*)				
084023RA		***3 DAA (24/10/2008)***	***7 DAA (28/10/2008)***			
Untreated		1.15 ±0.13 a	1.23 ±0.09 a			
Transform	100	0.10 ±0.04 b	0.03 ±0.03 b			
Transform	200	0 0 b	0.05 ±0.03 b			
Dimethoate 400	375	0 0 b	0 0 b			
CV		*45.57*	*28.76*			
		Turnip aphid (*L. erysimi*)				
104003RA		***3 DAA (2/09/2009)†***	***8 DAA (7/09/2009)†***	***15 DAA (14/09/2009)†***	***22 DAA (21/09/2009)†***	***32 DAA (1/10/2009)†***
Untreated		3.76 ±1.06 a	6.28 ±1.01 a	13.96 ±2.56 a	8.89 ±0.95 a	7.73 ±1.38 a
Transform**	100	0.01 ±0 b	0 0 b	0.05 ±0.03 b	0.26 ±0.16 b	0.30 ±0.05 b
Transform**	200	0.15 ±0.14 b	0 0 b	0.08 ±0.06 b	0.19 ±0.11 b	0.79 ±0.48 b
Pirimor WG***	500 g/ha	0.09 ±0.03 b	0.06 ±0.05 b	0.47 ±0.19 b	1.62 ±0.87 b	0.85 ±0.44 b
CV		*54.19*	*30.07*	*25.89*	*39.35*	*42.55*

Means followed by same letter do not significantly differ (P=.05, Tukey's HSD)
† Log (x+1) transformation
DAA= days after application
CV= coefficient of variation
*BS-1000 0.25 %v/v
**BS-1000 100 mL/100 L
***Agral 600 18 mL/100 L

Trial work carried out by Dow AgroSciences (unpublished report: Welsh, 2009) has demonstrated a significant reduction in the transmission of the plant virus barley yellow dwarf virus (BYDV) when Transform was applied for aphid control in a cereal crop. It is likely that Transform will provide protection from certain plant viruses by controlling virus-vectoring aphids, this subject is currently being investigated.

Aphid resistance to the neonicotinoids, carbamates, synthetic pyrethroids and organophosphates is well recorded. Many aphid species are prone to developing resistance as they reproduce asexually. Studies carried out by Dow AgroSciences have demonstrated that sulfoxaflor interacts at the nicotinic acetylcholine receptor (nAchR) site (Watson *et al*., 2011). Extensive testing has demonstrated no cross-resistance between sulfoxaflor and neonicotinoids or other insecticide classes (Zhu *et al*., 2010, Babcock *et al*., 2011). As a result; Transform will be a valuable tool as a new and additional mode of action, as reliance on limited modes of action leads quickly to resistance.

The selectivity of Transform to beneficial insects has been studied extensively in Australia. This unpublished work shows that Transform has a favourable beneficial insect profile. Transform at 100 mL/ha had a very low effect on spiders, a low effect on wasps, predatory beetles, lacewings and ants and a moderate effect on thrips, predatory bugs and Trichogrammatids. Transform had a major effect on apple dimpling bugs, which can be both a beneficial and pest depending on the crop. Integrated pest management (IPM) is gaining momentum in broadacre cropping. The introduction of insecticides such as Transform which are safe to beneficial insects will facilitate the adoption of IPM in Australia and contribute to the sustainability of canola growing.

Transform has an excellent fit in IPM programmes because of its spectrum of activity and low impact on many key beneficial insects. It has low mammalian toxicity, and has minimal effect on non-target organisms such as fish, birds, and aquatic invertebrates. Transform will have a broad label in broadacre and horticulture and will be registered for control of all major species of aphids known to damage canola, cereals and cotton.

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