Generation of efficacy and residue data for imidacloprid (Confidor) in lettuce to control lettuce aphid

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Peracto Pty Ltd

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FINAL REPORT

Generation of efficacy and residue data for imidacloprid (Confidor® 200 SC) in lettuce to control lettuce aphid (*Nasonovia ribis-nigri*)

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Media Summary

Lettuce aphid (*Nasonovia ribis-nigri*) was first detected in Australia in March 2004. The pest quickly built up to large numbers as traditional management strategies did not control lettuce aphid and lettuce crops with lettuce aphid infestation were un-saleable. Confidor® seedling drench was rapidly adopted as the principal management tool for this pest and an emergency permit was granted for its use. This strategy was a major success and allowed growers, processors and suppliers to continue supply of lettuce which met the strict market specifications.

At the time the permit was granted further testing of Confidor® under Australian conditions was required. This project was established to generate the efficacy, crop safety and residue data to support the continued permitted use and future registration of Confidor® as a seedling drench for the control of lettuce aphid.

A total of 11 efficacy trials and 11 residue trials were conducted, over 3 seasons, in major lettuce production regions throughout Australia. All the data from this project will be used by Bayer CropScience to submit for registration of Confidor® as a seedling drench for the control of lettuce aphid in field grown leafy and head lettuce.

As part of this project, alternative insecticides for the control of lettuce aphid were also evaluated. The most effective of these was CXJ 19441 which is effective as a foliar application if lettuce aphid is present within the crop. Data for CXJ 19441 was generated as part of this project and the product may become registered in the future for control of lettuce aphid.

Other lettuce aphid research being conducted in Australia is looking at developing lettuce varieties with built-in aphid resistance and also the role of predatory insects in the management of this pest (VG05044). As the results from all this work become available it will be necessary for the lettuce industry to integrate these management practices, for lettuce aphid, into the overall management of their lettuce crops. The strategies for the sustainable management of this pest will continue to evolve with commercial growers experience and further research.

Technical Summary

Lettuce aphid (*Nasonovia ribis-nigri*) was first detected in Australia in March 2004. The pest quickly built up to large numbers as traditional management strategies did not control lettuce aphid and lettuce crops with lettuce aphid infestation were un-saleable. Confidor® seedling drench was rapidly adopted as the principal management tool for this pest and an emergency permit was granted for its use. This strategy was a major success and allowed growers, processors and suppliers to continue supply of lettuce which met the strict market specifications.

For Confidor® to be used sustainably into the future for the control of lettuce aphid further testing under Australian conditions was required. This project was established to generate the efficacy, crop safety and residue data to support the continued permitted use and future registration of Confidor® as a seedling drench for the control of lettuce aphid.

A total of 11 efficacy trials and 11 residue trials were conducted, over 3 seasons, in major lettuce production regions throughout Australia. All the data from this project will be used by Bayer CropScience to submit for registration of Confidor® as a seedling drench for the control of lettuce aphid in field grown leafy and head lettuce.

The application of Confidor® as a seedling drench allows effective control of aphids with minimal effects on non target species. Unlike the broadcast application of some insecticides the targeted application of Confidor® to seedlings means that it is ingested by the aphids when they suck the sap from the lettuce plant, but non sap sucking insects do not come into contact with the product.

As part of this project, alternative insecticides for the control of lettuce aphid were evaluated. The most effective of these was CXJ 19441 which is a systemic foliar insecticide with an alternative mode of action to Confidor®, which can be used post plant when lettuce aphid is already present within the crop. A product with an alternative mode of action to Confidor® will be critical for resistance management and the option of a product which can be used post planting will provide more sustainable management options to growers by reducing over-reliance on one chemical group and by allowing a more integrated approach to this pest's management.

11 residue trials were conducted in both leafy and head lettuce and both soil grown and hydroponic crops. The data from these trials will be used for the registration of both Confidor® and CJX 19441 in leafy and head lettuce.

Although there is little information available from Australia on lettuce aphid flights, it has been observed during this project to have similar flight patterns to New Zealand lettuce aphids with peak aphid activity in November-December, with the main peak of activity in March-May. It is during the March-May period that growers will see the greatest numbers of lettuce aphid and insecticide treatments or aphid resistant lettuce varieties will need to be used to manage this pest and produce marketable lettuce. During these peak periods, aphid numbers will build up to several hundred aphids per plant. At other times of the year aphid numbers will be much lower and predatory insects may maintain the population.

As more management options for lettuce aphid are developed integrated crop management strategies in lettuce production will need to be modified to ensure the sustainable management of lettuce aphid in the future. There are a number of management strategies for lettuce aphid now available including, resistant varieties, predatory insects, Confidor® seedling drench and possibly the foliar insecticide CXJ 19441 in the future. Insecticides will form a key part of the management, particularly in the autumn when aphid number reach large numbers and predatory insects cannot reliably control the population of lettuce aphid. Many growers also feel insecticides are the most reliable and cost effective method to protect a high value crop such as lettuce.

Introduction

Lettuce aphid (*Nasonovia ribis-nigri*) was first detected in Australia in March 2004. The pest quickly built up to large numbers as traditional management strategies did not control lettuce aphid. The lettuce aphid colonises the heart of the lettuce and are protected by the outer leaves of the plant. Standard contact insecticides used to control other species of aphid in lettuce did not control the lettuce aphid.

An individual lettuce may contain several hundred lettuce aphid and consequently they were unsaleable. Lettuce aphid is a contamination pest (Figure 1), however it may also transmit some viruses. In response to this new pest Confidor® seedling drench was rapidly adopted as the principal management tool for this pest and a temporary emergency permit (PER7416) was granted for its use. Confidor® was recognised as an effective management tool from the New Zealand lettuce industry. The adoption of Confidor® was a major success and allowed growers, processors and wholesalers to continue the supply of lettuce which met the strict market specifications.

In response to this new pest this project was set up with the following aims;

- To evaluate different rates and application methods of Confidor® for control of lettuce aphid in lettuce.
- To conduct residue trials to ensure the use of Confidor® doesn't exceed MRL's.
- To generate data which can be used to support the permits and ultimately registration of Confidor® as a seedling drench for control of lettuce aphid.
- To evaluate and develop alternative insecticides for control of lettuce aphid in lettuce.

Two separate projects were also conducted to look at lettuce aphid resistant varieties of lettuce and also the role of predatory insects for management of lettuce aphid.

Figure 1 - Lettuce aphid in head lettuce

Materials and Methods

Table 1 - Efficacy Trial Summary

Trial ID	Lettuce Type	Situation	Purpose
HVG04068#1	Head	Soil	Evaluation of Confidor® seedling drenches and in furrow applications.
HVG04068#2	Leafy	Soil	
HVG04068#3	Head	Soil	Evaluation of EXP1 as a planting hole drench and foliar application.
HVG04068#4	Leafy	Soil	
HVG04068#5	Head	Soil	Evaluation of foliar applications of CXJ 19441.
HVG04068#6	Head	Greenhouse Hydroponic	Evaluation of Confidor® seedling drenches.
HVG04068#7	Leafy	Greenhouse Hydroponic	
HVG04068#8	Head	Soil	Evaluation of EXP2 as a seedling drench.
HVG04068#9	Head	Soil	Evaluation of foliar applications of CXJ 19441.
HVG04068#10	Leafy	Greenhouse Hydroponic	Evaluation of foliar applications of CXJ 19441.
HVG04068#11	Head	Soil	Evaluation of Confidor® seedling drenches.

All efficacy trials were conducted as replicated trials with either 3 or 4 replicates of each treatment. All trials were managed to simulate commercial lettuce production.

Treatment Application

Confidor® seedling drenches were applied to the seedling trays 24 hours prior to transplanting using a single fan nozzle. A spray volume of between 213 and 264 mL per tray of 198 seedlings was used. There was no run-off of spray solution from the seedling trays at this volume. Trays were not watered following Confidor® treatment until after transplanting in the field. Treated plants were transplanted into the field using a commercial lettuce transplanter (Figure 2) and watered immediately after planting with solid set sprinklers.

CXJ 19441 treatments were applied as a foliar spray after lettuce aphid was detected in the trials. Treatments were applied with a CO2 pressurised boom sprayer with spray volumes of between 200 and 400 L/ha.

Lettuce Aphid Assessment

Total numbers of lettuce aphid were counted in individual plant on between 6 and 10 plants per plot. Due to the fact that lettuce aphid are distributed throughout the plant each plant had to be dissected leaf by leaf to count the aphids (Figure 3). Trials were assessed weekly up until harvest.

Statistical Analysis

Analysis of Variance (ANOVA) tests and Fischer's Least Significant Difference (LSD) tests were conducted using ARM 7 software. In the results tables means within columns followed by the same letter are not significantly different at the 5% level according to Least Significant Difference (LSD) test.

Materials and Methods (Cont.)

Figure 2 - Transplanting Confidor® treated lettuce in field trials

Figure 3 - Lettuce Aphid Assessment

Materials and Methods (Cont.)

Table 2 - Efficacy trial site details

Site	HVG04068#1	HVG04068#2	HVG04068#3	HVG04068#4	HVG04068#5
Grower	FVRS	FVRS	FVRS	FVRS	FVRS
Location	Forth, Tasmania	Forth, Tasmania	Forth, Tasmania	Forth, Tasmania	Forth, Tasmania
Soil Type	Ferrosol	Ferrosol	Ferrosol	Ferrosol	Ferrosol
Crop	Head lettuce	Leafy lettuce	Head lettuce	Leafy lettuce	Head lettuce
Variety	Toronto	Deltona	Oxley	Deltona	Oxley
Trial Design	Randomised complete block	Randomised complete block	Randomised complete block	Randomised complete block	Randomised complete block
Replicate	4	4	4	4	4
Plot Size	1 bed x 10 m	1 bed x 10 m	1 bed x 10 m	1 bed x 8 m	1 bed x 10 m
Planting Date	20/01/05	17/02/05	18/02/05	18/02/05	17/02/05
Harvest Date	01/04/05	10/04/05	20/04/05	07/04/05	21/04/05

Table 2 (Cont.) - Efficacy trial site details

Site	HVG04068#6	HVG04068#7	HVG04068#8	HVG04068#9	HVG04068#10	HVG04068#11
Grower	Tas Ford	Tas Ford	FVRS	FVRS	Peracto	FVRS
Location	Wesley Vale	Wesley Vale	Forth, Tasmania	Forth, Tasmania	Hydroponic Green house	Forth, Tasmania
Soil Type	NA	NA	Ferrosol	Ferrosol	NA	Ferrosol
Crop	Head lettuce	Leafy lettuce	Head lettuce	Head lettuce	Leafy lettuce	Head lettuce
Variety	Oxley	Deltona	Oxley	Oxley	Virtuose	Target
Trial Design	Randomised complete block	Randomised complete block	Randomised complete block	Randomised complete block	Randomised complete block	Randomised complete block
Replicates	4	4	4	4	3	4
Plot Size	60 plants	60 plants	1 bed x 10 m	1 bed x 9 m	20 plants	1 bed x 9 m
Sowing Date	18/02/05	18/02/05	17/02/05	19/09/06	15/01/07	12/01/07
Harvest Date	NA	NA	21/04/05	22/11/06	15/02/07	16/03/07

Materials and Methods (Cont.)

Table 3 - Residue Trial Summary

Trial ID	Lettuce Type	Situation	State	Purpose
BCS0105-1 Site 1	Head	Soil	Queensland	Residue trial with Confidor® seedling drenches and planting hole applications
BCS0105-1 Site 2	Leafy	Soil	Queensland	
BCS0105-1 Site 3	Head	Soil	Victoria	
BCS0105-1 Site 4	Leafy	Soil	Victoria	
BCS-0105 - 2	Head	Greenhouse Hydroponic	Tasmania	Residue trial with Confidor® seedling drenches
BCS-0105 - 2	Leafy	Greenhouse Hydroponic	Tasmania	
BCS0167 Site 1	Cos	Soil	Queensland	Residue trial with CXJ 19441 as a foliar application and Confidor® as a seedling drench
BCS0167 Site 2	Leafy	Soil	Queensland	
BCS0167 Site 3	Head	Soil	Western Australia	
BCS0207 Site 1	Head	Soil	Victoria	Residue trial with Confidor® seedling drenches
BCS0207 Site 2	Leafy	Soil	Victoria	

A total of 11 trials were conducted to generate residue data to set with holding periods and ensure the use of both Confidor® and CXJ 19441 will comply with MRL's.

The field investigation phase of these studies were conducted using Peracto Pty Ltd's Standard Operating Procedures, which comply with the OECD Principles of Good Laboratory Practice Number 1 (revised 1997), Paris 1998 and Number 13, June 2002. All samples were analysed by Bayer CropScience Analytical laboratories in Brisbane. The results from these trials will be used in the registration submission for both these products for control of lettuce aphid.

Table 4 - Treatment list for residue trials (Field Grown)

Treatment Number	Test Item	Rate Product/ha	Adjuvant
1	Untreated control	N/A	N/A
2	Confidor - seedling drench	55 mL/1000 plants	N/A
3	CXJ 19441 - foliar application	200 mL/ha	Hasten 1 L/ha
4	CXJ 19441 - foliar application	400 mL/ha	Hasten 1 L/ha

Materials and Methods (Cont.)

Table 4 (Cont.) - Sampling information for residue trials (Field Grown)

Treatment Number	Test Item	Specimen Type	Sample Timing	Specimen Quantity
1	Untreated control	Whole heads	3 WAT	12 whole lettuces
2	Confidor – seedling drench	Whole heads	3, 4, 5, 6 & 8 WAT	12 whole lettuces
3	CXJ 19441 - foliar application	Whole heads	-0, 0, 1, 3, 7 & 14 DAT	12 whole lettuces
4	CXJ 19441 - foliar application	Whole heads	-0, 0, 1, 3, 7 & 14 DAT	12 whole lettuces

DAT = Days after Treatment, WAT = Weeks after treatment

Table 5 - Treatment list for residue trials (Hydroponic)

Treatment Number	Test Item	Plant Type	Formulation	Dosage Confidor (mL/1000 plants)	Dosage imidacloprid (g ai/ 1000 plants)
1a	Untreated control	Untreated plant	N/A	Nil	Nil
2a	Confidor 200 SC	Treated plant	200 SC	35	7
2b	Untreated	Untreated plant	N/A	Nil	Nil
3a	Confidor 200 SC	Treated plant	200 SC	55	11
3b	Untreated	Untreated plant	N/A	Nil	Nil
4a	Confidor 200 SC	Treated plant	200 SC	82.5	16.5
4b	Untreated	Untreated plant	N/A	Nil	Nil

The lettuce transplants for each treatment must be grown on separate tables so the solution from one treatment does not mix with the solution from the other treatments or solution from other tables. Approximately 100 seedlings will be needed for each treatment. There will need to be approximately 100 lettuces ranging from mature to 2 weeks before maturity, already growing in the system that each treatment is planted in to. These untreated lettuces need to be sampled prior to the treated lettuces being transplanted and at 1, 3, 7 and 14 days after transplanting. A specimen of the hydroponic solution also needs to be collected prior to transplanting the treated lettuces and at 1, 3, 7 and 14 days after transplanting. The system used must reticulate the solution used rather than allowing it to run to waste.

Materials and Methods (Cont.)

Table 5 (Cont.) - Sampling Information for residue trials (Hydroponic)

Treatment Number	Test Item	Plant Type	Specimen Type	Sample Timing	Specimen Quantity
1	Untreated control	Untreated plant	Whole plants	2 WAT	12
2a	Confidor 200 SC	Treated plant	Whole plants	2, 3, 4 & 8 WAT	12
2b	Confidor 200 SC	Untreated plant	Whole plants	-1, 1, 3, 7 & 14 DAT	12
2b	Confidor 200 SC	N/A	Hydroponic Solution	-1, 1, 3, 7 & 14 DAT	500 mL
3a	Confidor 200 SC	Treated plant	Whole plants	2, 3, 4 & 8 WAT	12
3b	Confidor 200 SC	Untreated plant	Whole plants	-1, 1, 3, 7 & 14 DAT	12
3b	Confidor 200 SC	N/A	Hydroponic Solution	-1, 1, 3, 7 & 14 DAT	500 mL
4a	Confidor 200 SC	Treated plant	Whole plants	2, 3, 4 & 8 WAT	12
4b	Confidor 200 SC	Untreated plant	Whole plants	-1, 1, 3, 7 & 14 DAT	12
4b	Confidor 200 SC	N/A	Hydroponic Solution	-1, 1, 3, 7 & 14 DAT	500 mL

WAT = Weeks after treatment
DAT = Days after treatment

Results

Individual reports have been written for each of the efficacy and residue trials. The following efficacy results are taken from the individual trial reports. Not all assessment data is presented, only the assessments at harvest or sometimes 1 or 2 assessments leading up to the harvest assessments have been presented.

Results (Cont.)

Table 6 (HVG04068#1) - Lettuce aphid count, 22DAP (11/02/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged adults	Adults	Nymphs
1	Untreated control	Nil	5.0 a	17.0 a	78.8 a
4	Confidor® 200 SC 35 mL/1000 seedlings		1.3 ab	0.3 b	0.5 c
5	Confidor® 200 SC 55 mL/1000 seedlings		0.3 b	0.0 b	0.0 c
7	Confidor® 200 SC 35 mL/1000 seedlings		0.3 b	0.0 b	0.0 c
8	Confidor® 200 SC 55 mL/1000 seedlings		0.7 b	0.0 b	0.0 c
9	Confidor® 200 SC 750 mL/ha	In-furrow application prior to planting	5.2 a	3.8 b	34.6 b
10	Confidor® 200 SC 1500 mL/ha		2.3 ab	0.3 b	7.3 bc
p-value			0.0889	0.00000	0.0001
LSD (5%)			3.96	5.77	28.97

DAP = Days after planting

After 22DAP lettuce aphid numbers declined in the trials due to the presence of predatory insects and by commercial harvest there were no lettuce aphid present in the trial.

Table 7 (HVG04068#2) - Lettuce aphid count, 47DAP (05/04/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged adults	Adults	Nymphs
1	Untreated control	Nil	10.0 a	201.3 a	400.8 a
4	Confidor® 200 SC 35 mL/1000 seedlings	Drench prior to planting	1.3 bc	0.0 c	0.0 c
5	Confidor® 200 SC 55 mL/1000 seedlings		0.0 c	0.0 c	0.0 c
6	Confidor® 200 SC 750 mL/ha	In-furrow application prior to planting	4.8 b	95.0 b	180.0 b
7	Confidor® 200 SC 1500 mL/ha		0.5 c	1.0 c	2.5 c
9	Confidor® 200 SC 35 mL/1000 seedlings	Drench prior to planting and pre-plant watering	0.0 c	0.0 c	0.0 c
10	Confidor® 200 SC 55 mL/1000 seedlings		0.8 c	0.0 c	0.0 c
p-value			0.00	0.0008	0.0001
LSD					

Results (Cont.)

Table 8 (HVG04068#3) - Lettuce aphid count at harvest (20/04/05) (61DAP, 40DAFA1, 22DAFA2)

No.	Treatment and Rate	Application Method	Mean number of aphids per 10 lettuce plants		
			Winged adults	Adults	Nymphs
1	Untreated control	Nil	64 cd	180 f	330 e
2	EXP1 75.75 g ai/ha	Planting-hole soil drench immediately prior to transplanting	6 a	66 bcde	140 bcd
3	EXP1 151.5 g ai/ha		5 a	15 a	48 a
4	EXP1 227.25 g ai/ha		7 a	36 abc	73 a
5	EXP1 50 g ai/ha	Two foliar spray applications	30 bc	140 ef	283 de
6	EXP1 100 g ai/ha		13 a	88 de	259 cde
7	EXP1 150 g ai/ha	One foliar spray application	13 ab	87 cde	198 cde
8	Chess 500 WG 100 g ai/ha	Two foliar spray applications	71 d	192 f	383 e
9	Chess 500 WG 200 g ai/ha		54 cd	173 f	322 e
10	EXP1 151.5 g ai/ha fb EXP150 g ai/ha	Planting-hole soil drench immediately prior to transplanting followed by one foliar application	34 bc	25 abcd	88 bc
11	EXP1 151.5 g ai/ha fb EXP1 100 g ai/ha		51 cd	19 ab	74 ab
p-value			0.00	0.00	0.00
LSD (5% level)			*	**	**

DAFA = Days after foliar application
DAP = Days after planting

Results (Cont.)

Table 9 (HVG04068#4) - Lettuce aphid count at harvest (7/04/05) (48DAP, 27DAFA1, 9DAFA2)

No.	Treatment and Rate	Application Method	Mean number of aphids per 10 lettuce plants		
			Winged adults	Adults	Nymphs
1	Untreated control	Nil	5	124 d	94 c
2	EXP1 75.75 g ai/ha	Planting-hole soil drench immediately prior to transplanting	1	2 a	1 a
3	EXP1 151.5 g ai/ha		1	0 a	0 a
4	EXP1 227.25 g ai/ha		1	0 a	0 a
5	EXP1 50 g ai/ha	Two foliar spray applications	1	70 b	38 b
6	EXP1 100 g ai/ha		5	80 bc	66 bc
7	EXP1 150 g ai/ha	One foliar spray application	2	55 b	43 b
8	Chess 500 WG 100 g ai/ha	Two foliar spray applications	6	111 cd	69 bc
9	Chess 500 WG 200 g ai/ha		3	132 d	86 c
10	EXP1 151.5 g ai/ha fb EXP1 50 g ai/ha	Planting-hole soil drench immediately prior to transplanting followed by one foliar application	0	0 a	0 a
11	EXP1 151.5 g ai/ha fb EXP1 100 g ai/ha		0	0 a	1 a
p-value			0.1578	0.00	0.00
LSD (5% level)			-	*	**

DAFA1 = Days after foliar application 1
DAFA2 = Days after foliar application 2
DAP = Days after planting

Results (Cont.)

Table 10 (HVG04068#5) - Lettuce aphid count, 13DAFA (35DAP) (24/03/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged Adults	Adults	Nymphs
1	Untreated	Nil	2.3	14.5 a	17.0 a
2	CJX 19441 200 mL/ha + Hasten 1% v/v	Foliar	0.8	0.0 b	0.0 b
3	CJX 19441 300 mL/ha + Hasten 1% v/v		2.0	0.0 b	0.0 b
4	CJX 19441 400 mL/ha + Hasten 1% v/v		1.8	0.0 b	0.0 b
5	Confidor® 55 mL/1000 seedlings	Seedling drench	0.5	0.0 b	0.0 b
p-value			0.4253	0.0112	0.0021
LSD (5%)			N/A	8.72	8.23

DAFA = Days after foliar application
DAP= Days after planting

Table 11 (HVG04068#5) - Lettuce aphid count, 20DAFA (42DAP) (31/03/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged Adults	Adults	Nymphs
1	Untreated	Nil	7.3	73.3 a	100.5 a
2	CJX 19441 200 mL/ha + Hasten 1% v/v	Foliar	2.8	0.8 b	1.0 b
3	CJX 19441 300 mL/ha + Hasten 1% v/v		5.0	0.0 b	3.0 b
4	CJX 19441 400 mL/ha + Hasten 1% v/v		3.3	0.3 b	0.3 b
5	Confidor® 55 mL/1000 seedlings	Seedling drench	2.0	0.3 b	0.5 b
p-value			0.1330	0.0018	0.0000
LSD (5%)			N/A	34.74	26.41

DAFA = Days after foliar application
DAP= Days after planting

Results (Cont.)

Table 12 HVG04068#5 - Lettuce aphid count, 31DAFA (53DAP) (11/04/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged adults	Adults	Nymphs
1	Untreated	Nil	59.5 a	253.8 a	293.8 a
2	CJX 19441 200 mL/ha + Hasten 1% v/v	Foliar	4.3 b	7.8 b	7.8 b
3	CJX 19441 300 mL/ha + Hasten 1% v/v		2.3 b	3.8 b	11.0 b
4	CJX 19441 400 mL/ha + Hasten 1% v/v		1.5 b	5.8 b	3.3 b
5	Confidor® 55 mL/1000 seedlings	Seedling drench	0.3 b	0.3 b	2.3 b
p-value			0.0113	0.0045	0.0305
LSD (5%)			34.67	132.86	201.72

DAFA = days after foliar application
DAP= days after planting

Table 13 (HVG04068#5) - Lettuce aphid count at harvest, 41DAFA (63DAP) (21/04/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged adults	Adults	Nymphs
1	Untreated	Nil	75.3 a	208.0 a	405.8 a
2	CJX 19441 200 mL/ha + Hasten 1% v/v	Foliar	4.0 b	27.3 b	88.5 b
3	CJX 19441 300 mL/ha + Hasten 1% v/v		1.8 b	24.5 b	97.3 b
4	CJX 19441 400 mL/ha + Hasten 1% v/v		7.0 b	25.5 b	85.3 b
5	Confidor® 55 mL/1000 seedlings	Seedling drench	3.0 b	0.5 b	1.8 b
p-value			0.0000	0.0001	0.0004
LSD (5%)			18.23	63.97	140.02

DAFA = days after foliar application
DAP = days after planting

Results (Cont.)

HVG04068#6 and #7

HVG04068#6 and #7 were conducted in greenhouse hydroponic leafy and head lettuce. The trial was evaluating the effectiveness of Confidor® seedling drenched for control of lettuce aphid. Unfortunately there were no lettuce aphid present in the crop during the trial period so no conclusions could be drawn.

Table 14 (HVG04068#8) - Lettuce aphid count, 42DAP (31/03/05)

No.	Treatment (Rate)	Application Method	Mean number per 5 plants		
			Winged adults	Adults	Nymphs
1	Untreated control	Nil	7.3	9.3	12.3 a
2	Confidor® 35 mL/1000 seedlings	Seedling drench	3.3	0.0	0.0 b
3	EXP2 5.5 mL/1000 seedlings		0.8	0.0	0.0 b
4	EXP2 12.5 mL/1000 seedlings		6.3	0.0	0.0 b
5	EXP2 35 mL/1000 seedlings		3.3	0.0	0.0 b
p-value			0.5358	0.2357	0.0160
LSD (5%)			N/A*	N/A*	7.76

DAP = days after planting

Table 15 (HVG04068#8) - Lettuce aphid count at harvest, 63DAP (21/04/05)

No.	Treatment (Rate)	Application Method	Mean number per 10 plants		
			Winged adults	Adults	Nymphs
1	Untreated control	Nil	55.8 a	171.5 a	411.3 a
2	Confidor® 35 mL/1000 seedlings	Seedling drench	1.3 b	1.3 b	1.8 b
3	EXP2 5.5 mL/1000 seedlings		4.8 b	23.8 b	60.5 b
4	EXP2 12.5 mL/1000 seedlings		3.8 b	11.5 b	28.3 b
5	EXP2 35 mL/1000 seedlings		1.3 b	1.0 b	5.3 b
p-value			0.0022	0.0001	0.0013
LSD (5%)			25.8108	58.4643	178.431

DAP = days after planting

Results (Cont.)

Table 16 (HVG04068#9) - Lettuce aphid counts 7 and 14DAA

No.	Treatment)	Rate (g ai/ha)	Lettuce aphids (mean number per 6 plants)	
			7DAA	14DAA
1	Untreated control	-	91.5 a	65.8 a
2	CJX 19441	24	13.0 b	0.8 b
3	CJX 19441	48	6.5 b	0.5 b
4	CJX 19441	72	7.3 b	1.3 b
5	CJX 19441	96	14.5 b	2.3 b
p value			0.0014	0.0020
LSD (5% level)			N/A	N/A*

Table 17 (HVG04068#10) - Lettuce aphid counts at 7DAA, 15DAA & 21DAA

No.	Treatment	Rate (g ai/ha)	Lettuce aphid (mean number per plant)					
			7DAA		15DAA		21DAA	
1	Untreated control	nil	7.0	b	43.6	b	77.8	b
2	CJX 19441	24	0.0	a	3.5	a	24.5	a
3	CJX 19441	48	0.1	a	1.8	a	17.6	a
4	CJX 19441	72	0.0	a	2.0	a	5.8	a
5	CJX 19441	96	0.0	a	0.1	a	4.6	a
p value			0.0503		0.0058		0.0046	
LSD (5% level)			N/A		17.40		27.24	

Hasten was added to all insecticide treatments at a rate of 0.2 % v/v.
DAA = days after application
N/A = not applicable due to a p-value > 0.05

Results (Cont.)

Table 18 (HVG04068#11) - Lettuce aphid counts at 29, 36, 46, 51, 56 & 64DAA

No	Treatment	Rate (mL/1000 plants)	Non-winged lettuce aphids (mean number per 6 plants)					
			29DAA	36DAA	46DAA	51DAA	56DAA	64DAA
1	Untreated control	nil	256.3 a	125.0 a	3.3 a	28.0 a	18.0 a	251.0 a
4	Confidor®	35	0.0 c	0.0 b	0.0 b	0.0 b	0.0 b	0.0 b
5	Confidor®	55	0.0 c	0.3 b	0.0 b	0.0 b	0.0 b	0.0 b
p value			0.0001	0.0001	0.0028	0.0017	0.0045	0.0003
LSD (5% level)			N/A*	N/A*	N/A*	13.25	9.58	95.92

N/A* = Not applicable due to data being transformed using y=log (x+1) to reflect a normal distribution
DAA = Days after application

Discussion

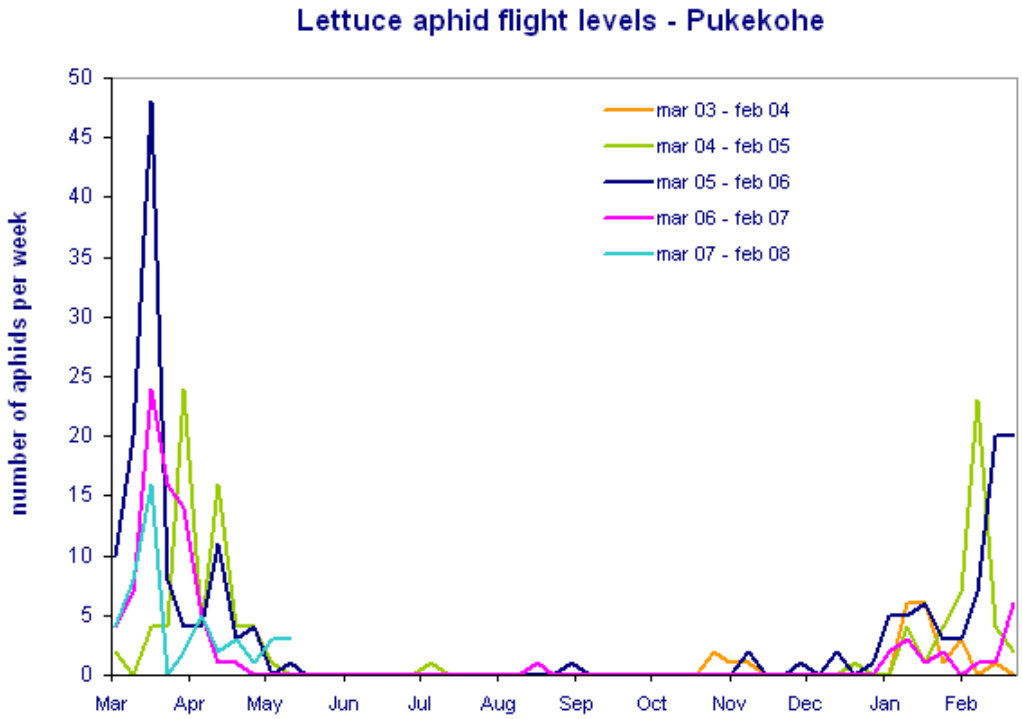
Lettuce Aphid Biology

Figure 4 shows the peak lettuce aphid flight periods from New Zealand. Although there is little information available from Australia on lettuce aphid flights it has been observed during this project to have similar flight patterns with one peak flight in January-February and a major flight in April-May. This is in contrast with the normal aphid flights in Tasmania, which occur during October-November and again in March-April. This will have consequences for growers, as natural predator populations feeding on existing aphid species in surrounding habitats (e.g. cereal crops and pastures) may not be at levels required to control lettuce aphid. This was particularly noticeable during April-May and to a lesser extent in January-February, where aphid numbers built up to several hundred aphids per plant. During there periods growers will need to use insecticide treatments, or lettuce aphid resistant varieties to manage this pest and produce marketable lettuce. At other times of the year aphid numbers will be much lower and predatory insects will often maintain the population.

As more management options for lettuce aphid are developed and become available to growers, integrated crop management strategies in lettuce production will need to be modified to ensure the sustainable management of lettuce aphid in the future.

Although the effect of Confidor® on beneficial insects was not directly assessed in this work, observations were made throughout the project with respect to this point. Unlike the broadcast application of some insecticides the targeted application of Confidor® to seedlings means that it is ingested by the aphids when they suck the sap from the lettuce plant, but non sap sucking insects do not come into contact with the product. In trials, predatory insects such as ladybirds and lace wings were found in Confidor® treated lettuce, however their numbers were notably lower than untreated aphid infested lettuce, due to the lack of aphids as a food source.

Figure 4 – Lettuce aphid flight periods – Pukekohe New Zealand



Discussion (Cont.)

Confidor® Seedling Drenches

In replicated trials Confidor® applied at rates of 35-55 mL/1000 seedlings, has consistently provided control of lettuce aphid up until commercial harvest. Trial HVG04068#1 and #2 suggested that pre-plant watering to the point of run-off from the trays did not reduce the efficacy or longevity of Confidor® on lettuce aphid in either head or leafy lettuce.

The two trials (HVG04068#4 and #5) conducted in hydroponic greenhouse lettuce had no aphids in any treatments including the untreated control, this is possibly due to the uptake of the Confidor® from the hydroponic solution by the untreated seedlings. If the industry requires Confidor® for use in hydroponic lettuce, further work will be required in relation to the movement of Confidor® into the hydroponic solution and how this relates to plant uptake, particularly for lettuce close to commercial harvest. CJX 19441 has been developed for control of lettuce aphid in hydroponically grown lettuce.

Commercial experience has shown that delaying planting beyond 24 hours after treatment (that is, retaining seedlings in trays for more than 1 day after treatment) may result in some unacceptable crop burn. This is thought to occur because the developing young roots of the seedling do not have access to alternative water sources, leading to an excessive uptake of Confidor®. This issue appears to be exacerbated in warmer conditions, and by the use of the higher rate for field grown crops. To help minimise crop damage, it is recommended to transplant seedlings within 24 hours of treatment, and provide irrigation soon after to ensure seedlings have access to an alternative water source.

Residue and efficacy data from this project has been used to support the continued use of Confidor® seedling drenches for control of lettuce aphid and will ultimately be used to support the application for registration with the APVMA.

CJX 19441 Foliar Sprays

As part of this project CJX 19441 has been evaluated and developed as an alternative mode of action to Confidor®. The product also has flexibility in that it is applied post planting once lettuce aphid colonise the crop. The systemic nature of the product allows it to move into the heart of the lettuce where the bulk of the lettuce aphid population are. The product will provide control of lettuce aphid for 7 or more days as it has some persistence in the plant. The product is very target specific with minimal impact on non target species.
‘

Evaluation of other insecticides

EXP1 and EXP2 were also evaluated as either seedling drenches, planting hole drenches or foliar applications. While both these products provided effective control of lettuce aphid they did not offer any advantages over Confidor® seedling drench and were not further evaluated.

Residue Trials

Eleven residue trials were conducted as outlined in Table 2 in both leafy and head lettuce and both soil grown and hydroponic crops. The data from these trials will be used for the registration of both Confidor® and CJX 19441 in leafy and head lettuce.

Technology Transfer

This project commenced soon after the arrival of lettuce aphid in Tasmania and preceding its spread to mainland Australia. As Confidor® was quickly adopted by lettuce growers throughout Australia the information generated from this project was highly sought after by growers, nursery operators and also lettuce processors. Information was disseminated in various forms including phone discussions, meetings and field days (Table 19). Data from this project was also supplied to the APVMA to support the continued permitted use of Confidor®.

Table 19 - Extension activities

Date	Purpose	Attendees
December 2005	Meeting to discuss project	Sumitomo Chemical Australia
January 2005	Meeting to discuss project	Syngenta
February 2005	Discuss Confidor® development and to inspect initial field trials	Bayer CropScience
February 2005	Met with APVMA to discuss Confidor® permit renewal	APVMA
March 2005	Field Day - Tasmania	10 representatives from the Australian lettuce industry including, growers and nursery operators
May 2005	Attendance at the 3rd Australian lettuce conference	Lettuce industry
July 2005	Presentation of project results to meeting	70 representatives from the Australian lettuce industry including growers, processors and nursery operators
July 2005	Presentation of project results at the annual Tasmanian ARAC presentations	Tasmanian lettuce industry representatives
November 2005	Meeting to discuss project results	Representatives from South Australian lettuce industry
May/June 2006	Article published in Vegetables Australia	NA

Due to the continual spread of this new pest throughout Australia there has been continual communication during the project with the following industry sectors.

- APVMA and AgAware Consulting relating to the renewal of the Confidor® permit.
- Bayer CropScience regarding the requirements for registration for Confidor®.
- Nursery operators treating seedlings with Confidor®.
- Growers throughout Australia who are looking to implement management strategies for the control of lettuce aphid.

The major extension activity for this project was the meeting in Melbourne in July 2005, this was well attended by representatives form the Australian lettuce industry. During this meeting detailed results on the project were presented.

Recommendations

- Registration of Confidor® 200 SC as a seedling drench for control of lettuce aphid in field grown leafy and head lettuce should proceed.
- CXJ 19441 should be developed as an alternative insecticide for control of lettuce aphid in field grown leafy and head lettuce.
- CXJ 19441 should be developed for control of hydroponically grown leafy lettuce.
- As more management tools for lettuce aphid are developed, integrated crop management strategies in lettuce production will need to be modified to ensure the sustainable management of lettuce aphid in the future.

Acknowledgements

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- Elizabeth Fields, Peracto
- Ryan Blackney, Peracto
- Lee Peterson, Agricultural Resource Management (ARM)
- Peter DalSanto, AgAware Consulting
- Brad Wells, Horticulture Australia
- Susan Cross, Bayer CropScience
- Anthony De Monte, Bayer CropScience
- Andrew Meurant, formerly with Bayer CropScience
- Stephen and John Hill, Hills Transplants
- Richard Bovill, Lettuce grower
- Lyndon Butler, DPIW Tasmania
- Lionel Hill, DPIW Tasmania

Appendices

Appendix i - Confidor® Permit

PERMIT TO ALLOW EMERGENCY USE
OF A REGISTERED AGVET CHEMICAL PRODUCT

PERMIT NUMBER -PER7416

This permit is issued to the Permit Holder in response to an application granted by the APVMA under section 112 of the Agvet Codes of the jurisdictions set out below. This permit allows a person, as stipulated below, to use the product in the manner specified in this permit in the designated jurisdictions. This permit also allows any person to claim that the product can be used in the manner specified in this permit.

THIS PERMIT IS IN FORCE FROM 24 MARCH 2004 TO 30 JUNE 2007.

Permit Holder:
AUSVEG - C/O AGAWARE CONSULTING PTY LTD
21 Rosella Avenue
STRATHFIELDSAYE VIC 3551

Persons who can use the product under this permit:
Persons generally.

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Appendix i - Confidor® Permit (Cont.)

CONDITIONS OF USE

Product to be used:
CONFIDOR 200 SC INSECTICIDE
Containing: 200 g/L IMIDACLOPRID as its only active constituent.

Directions for Use:

FIELD GROWN CROPS ONLY

Situation/Crop	Pest	Rate
FIELD LETTUCE, CHICORY, ENDIVE & RADICCHIO (PRIOR TO TRANSPLANTING)	LETTUCE APHID (*Nasonovia ribis-nigri*)	Apply as a seedling drench to cell trays at a rate of 35-55mL product per 1000 plants.

HYDROPONICALLY GROWN CROPS ONLY

Situation/Crop	Pest	Rate
HYDROPONIC LETTUCE, CHICORY, ENDIVE & RADICCHIO (PRIOR TO TRANSPLANTING)	LETTUCE APHID (*Nasonovia ribis-nigri*)	Apply as a seedling drench to cell trays at a rate of 12.5-35mL product per 1000 plants.

Withholding Period: DO NOT HARVEST FOR 4 WEEKS AFTER APPLICATION.

Critical Use Comments:

- Apply only one application via a spray or foliar drenching equipment in a sufficient volume of water to ensure complete coverage/drenching of the cell (seedling and soil). Ensure even distribution of the drench across all seedlings by foliar application only.
- The higher rate may be more effective under conditions highly favourable to aphid infestation and may give a longer period of control. Use the lower rate in short season crops.
- To ensure even and accurate application to every seedling treated, Confidor 200 SC should be professionally applied through dedicated nursery spray equipment, such as a calibrated hydraulic boom. The use of water cans and impact sprinklers to apply Confidor 200 SC is discouraged as this frequently results in uneven distribution of the product and potential for undesirable run-off.
- Application should occur close to the time of planting out, as watering of seedling trays following application may wash chemical from the cells. If watering is required between application and planting, care should be taken to avoid or minimise leaching from the cells.
- Users must take care during application to minimise any potential run-off either during or following application. This should include only applying sufficient volumes of prepared solution to fill the cell thereby avoiding excessive application volumes that may result in run-off. If run-off should occur action should be taken to retain and dispose of that run-off in an appropriate manner.
- Delaying planting beyond 24 hours after treatment (that is, retaining seedlings in trays for more than 1 day after treatment) **may** result in some unacceptable crop burn. This is thought to occur because the developing young roots of the seedling do not have access to alternative water sources, leading to an excessive uptake of Confidor. This issue appears to be

Appendix i - Confidor® Permit (Cont.)

exacerbated in warmer conditions, and by the use of the higher rate for field grown crops. To help minimise crop damage, it is recommended to transplant seedlings within 24 hours of treatment, and provide irrigation soon after to ensure seedlings have access to an alternative water source.

- Persons handling treated trays and speedlings following treatment should wear PVC gloves. Persons supplying treated seedlings should advise the purchaser that the seedlings have been treated with imidacloprid and that those persons handling trays and seedlings should wear PVC gloves.
- Only a single application should be made to any one batch of seedlings.
  Lettuce crops treated with Confidor should be monitored for lettuce aphid following transplanting and throughout the life of the crop. If lettuce aphid is observed feeding on the crop, and additional chemical applications are being considered an insecticide with a different mode of action should be used. No other application of Confidor or other Group 4A Insecticides should be made either before or after the drench treatment during the entire life of the crop.

MAXIMUM RESIDUE LIMITS

- The following Maximum Residue Limits (MRLs) apply:
  - Lettuce – head 5 mg/kg
  - Lettuce – leaf 20 mg/kg

ADVISORY INFORMATION

- The use permitted by this permit will not prevent the general movement, spread or colonisation of Lettuce aphid. Therefore it is recommended that growers regularly monitor crops and other host plants for the presence of Lettuce aphid. Monitoring should be undertaken to determine when seedling drench treatments are necessary to provide protection to potentially susceptible crops.

- It is recommended that Integrated Pest Management (IPM) and Insecticide Resistant Management (IRM) strategies for this pest be developed by the lettuce industry as a high priority to complement seedling drench treatments (when required). These strategies should encompass things such as, biological, cultural, mechanical and chemical control options, including the provision of advice as to where, when and how those activities are practised.

Jurisdiction:
ALL STATES (except Victoria).
(Note: Victoria is not included in this permit because their 'control-of-use' legislation means that a permit is not required to legalise this off-label use in VIC).

Additional Conditions:

- THIS PERMIT provides for the use of a product in a manner other than specified on the approved label of the product. Unless otherwise stated in this permit, the use of the product must be in accordance with instructions on its label.

- PERSONS who wish to prepare for use and/or use products for the purposes specified in this permit must read, or have read to them, the details and conditions of this permit.

Issued by

Delegated Officer

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