Economics Of Foliar Insecticides For Aphid Control In Soybean On-Farm Strip Trials In 2005

Purpose:

To validate current thresholds and determine the economics of spraying currently registered foliar insecticides for the control of soybean aphids in on-farm grower strip trials.

Methods:

On-farm strip trials were set up and data collected from grower sites across Ontario in 2005. With the exception of the foliar insecticide treatments, fields were treated as a whole when applying other crop inputs (i.e. herbicides, fertilizers etc).

Insecticide treatments were applied by either the farmer or a custom applicator following common sprayer practices and product label rates and guidelines. Foliar insecticide was applied when soybean aphid populations reached the recommended action threshold of 250 aphids per plant or more with an increasing population, with the exception of 4 sites having been sprayed below the action threshold at 200 aphids per plant.

Each site consisted of strips running the length of the field, with plot width varying depending on sprayer boom width and number of passes done with the sprayer. Side by side comparisons were established, comparing a check (untreated) strip to a foliar insecticide strip of either cyhalothrin-lambda (Matador) at 83 ml/ha (34 ml/ac) or dimethoate (Cygon or Lagon) at 1L/ha (400 ml/ac) or both. Replication of treatments within each field was encouraged, though for some, was not possible.

Aphid population counts prior to application were taken at each site, with some sites also having 3-4 days after application (DAA), and 7-10 DAA assessments done. Cropping information including varieties, row width, planting date, harvest date, growth stage at time of application and spray dates were recorded. Trials were harvested using a commercial combine and weighed with a weigh wagon or yield monitor. Seed moisture on treated and untreated samples was also recorded.

All of the data was analyzed using the SAS statistical software program. The yield response for each location and/or rep within location was determined by the actual yield difference, or percent difference, between the untreated (unsprayed) check treatment and the sprayed treatment. The effect of location or rep within location was treated as random variables in the mixed model.

Results:

In total, 54 grower strip trials were established (Table 1). Trial locations were spread out across the province, ranging from southern, mid-western and eastern regions of Ontario.

Cyhalothrin-lambda (Matador) was used as the insecticide treatment at 44 of the 54 sites, while dimethoate (either Cygon or Lagon) was applied at 10 of the 54 sites. At three of the Matador sites, strips of a tankmix combination of Matador and a foliar fungicide were also included. Three sites out of the 54 had side by side comparisons of both dimethoate and

cyhalothrin-lamda within the same field. Though replication of treatments was encouraged, only 18 sites had two or more replications within field.

Aphid populations at the time of application ranged from 200 to 2000+ aphids per plant. Growth stages of the crop ranged from the R3 (beginning pod) to early R6 (full seed) at the time of application.

On average, in fields that exceeded an aphid threshold of 250 aphids per plant, an application of a foliar insecticide increased ($p < 0.0001$) soybean yields by 4.8 bu/ac for Matador and 4.4 bu/ac for Cygon/Lagon when averaged across all strip trial locations; the response was not different between insecticides ($p > 0.05$). No significant difference in yield response in strips sprayed with a tankmix treatment of Matador + foliar fungicide compared to strips with Matador alone was found (advantage was only 0.22 bu/ac), indicating no significant foliar disease pressure was present in those fields.

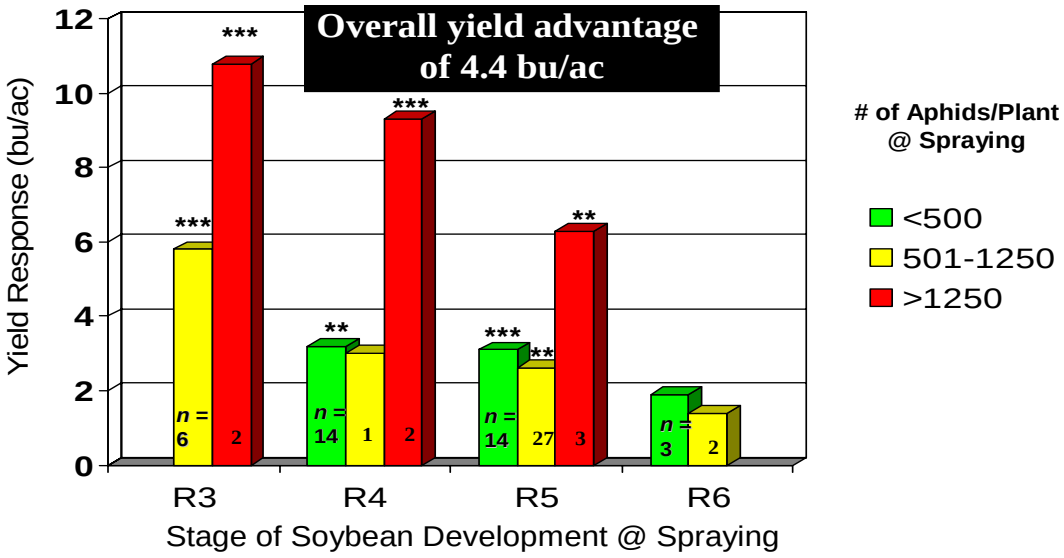
Yield response to aphid populations was significant ($p<0.0001$) when the crop was in the R3 and R4 stages of soybeans, though there was also some response ($p= 0.05$) in the R5 stage. This resulted in a negative correlation ($p < 0.0001$) between soybean development stage and yield response to spraying. Furthermore, yield response to spray increased as the number of aphids per plant at time of application increased ($p=0.50$, 0.05 and <0.0001 at <500, 501-1250 and >1250 aphids/plant, respectively), until the crop reached the R6 stage. This resulted in a positive correlation between yield response and aphid numbers per plant at spraying. Yield response in the R6 stage was not significant, even when aphid populations reached as high as 1000 per plant at the time of application.

Cost of control differs between cyhalothrin-lambda and dimethoate. At the label rate of 83ml/ha (34 ml/ac), Matador costs approximately $5.40 per acre for product, with custom application fees averaging $8.50 per acre. Total cost of application for Matador was approximately $13-14 per acre for growers. Dimethoate costs $280 per 10 L. At the product rate of 1 L/ha (400 ml/ac) dimethoate would cost $11.20 per acre for product alone. The total cost of control using dimethoate was approx $19-20 per acre, including custom application. If the market value for soybeans was $7 per bushel, a grower would need at least 2 bu/ac difference between the treated and untreated strips to see a return on investment if using Matador, while requiring at least 3 bu/ac yield response if spraying with dimethoate (Table 2). At $6 per bushel crop value, a grower would need at least 3 bu/ac yield response to see a return on investment if using Matador, while requiring a 4 bu/ac response if using dimethoate. These costs do not take into considering yield loss due to crop tramping from spray application. Yield loss due to tramping averages one bushel per acre.

Table 1. 2005 Ontario Soybean Aphid On-Farm Strip Tiral Results

							trts	check 1	Mat	check 2	Mat 2	check 3	Mat 3	Check 4	Mat 4	Check 5	Cygon/Magon	Check 6	Mat + Fung	Check 7	Mat + Fung	Check 8	Matador 2xrate								
Cooperator	county/town	Variety	Row spacing	Aphid /Plant	Growth Stage	Spray Date		Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Yield Untreated bu/A	Yield Treated bu/A	Untreated Yield Variability (bu/A)	Treated Yield Variability (bu/A)	Yield Differ. Trt vs untreated	Yield Difference Mat vs untreated	Yield difference Dimeth. Vs. untreated	Yield difference Matador vs Matador+fung	Harvest Date	Planting Date
1	Chatham-Kent	Renwick	15	200	R4	20-Aug		41.25	47																	5.75	5.75			30-Sep	22-May
2	aldimand/Fisherville	kalb 3201	7.5	500-750	R3	26-Jul		45	51.4																	6.4	6.4			06-Oct	28-Apr
3	Lambton/Arkona	RR	20	250	R6	10-Aug		54	58																	4	4			12-Sep	12-May
4	Lambton/thedford	TK89	20	300+	R6	15-Aug		39.2	41.6																	2.4	2.4			13-Sep	13-May
5	Middlesex	RR	14	250	R6	16-Aug		49.2	47.1																	-2.1	-2.1			09-Sep	18-May
6	Middlesex	ekalb 30-06R		250	R3-R4	12-Aug		44.1	46.4		48						41.3		43.9		46.2		41.9		6.7	1.06	3.1	-2.8	-2.15	06-Oct	13-May
7	Middlesex	91M51		1000	R5	11-Aug		54.8	56										56.6							1.5	1.2		0.6	28-Sep	19-May
8	Elgin	S26-V6	15	250	R4	06-Aug		47.1	50.4	48.6	53.4													1.5	3	4.05	4.05			06-Oct	19-May
9	Elgin	Renwick	7.5	300-350	R5	23-Aug		48.1									53.1									5		5		10-Oct	21-May
10	Elgin	92B38	15	1000	R4-R5	17-Aug		56.1	58.1																	2	2			10-Oct	07-May
11	Elgin	S25-D3	7.5	350	R4	15-Aug		51.8	53.6																	1.8	1.8			03-Oct	16-May
12	Middlesex	S17-P9	7.5	300	R5-R5.5	15-Aug		39.3	41.2																	1.9	1.9			03-Oct	22-May
13	Middlesex	AG1901	7.5	250	R4-R5	09-Aug		46.2	49.1																	2.9	2.9			01-Oct	16-May
14	Lambton							60	65.8	54.7	70.8	57.2	73.6											5.3	7.8	12.767	12.767				
15	Lambton							47	57.6																	10.6	10.6				
16	Middlesex	91B33		200-300	R5			50.22									49.98									-0.24		-0.24		13-Sep	24-May
17	Middlesex	P90M91		250	R5	17-Aug		51.65	53.25	47.55														4.1		3.65	3.65				
18	Middlesex	Casino		200-250	R5	12-Aug		53	56																	3	3				
19	Middlesex	S03W4		200	R5	15-Aug		52.45	51.62								52.17									-0.555	-0.83	-0.28			
20	Middlesex	S03W4		200	R5	15-Aug		52.73	54.3								53.19									1.015	1.57	0.46			
21	Middlesex							43.33									46.83									3.5		3.5			
22	Middlesex							43.67									43.5									-0.17		-0.17			
23	Ottawa	S03-W4						31.3	39.2		46.3								44.8		45.1				7.1	12.55	11.45		2.2	03-Oct	
24	Glengarry	Kamanchi		600	R3			28.3	34.6																	6.3	6.3				
25	Glengarry	S08-80		1250	R3	31-Jul		15.8	27	15.9	26.3													0.1	0.7	10.8	10.8			13-Sep	17-May
26	E. Ont	NK S08-80		1000	R6	16-Aug		32.3	32.9	28.0	31.2													4.3	1.7	1.9	1.9			13-Sep	17-May
27	E. Ont	Pioneer 9963		700	R3	06-Aug		41.8	43.6	40.3	41.8													1.5	1.8	1.65	1.65			21-Sep	18-May
28	E. Ont	NK S03W4		750	R3	02-Aug		48.6	57.7	48.1	57.4													0.5	0.3	9.2	9.2			21-Sep	16-May
29	E. Ont	NK S03-W4		525	R5	09-Aug		45.8	50.0																	4.2	4.2			01-Oct	17-May
30	E. Ont	Pro 2690R		1000+	R5	10-Aug		44.4									52.7									8.3		8.3		05-Oct	18-May
31	E. Ont	Pro 2795R		1000+	R5	10-Aug		43.4									48.7									5.3		5.3		05-Oct	18-May
32	E. Ont	Sierra		1000+	R5	15-Aug		39.7									45.1									5.4		5.4		05-Oct	18-May
33	E. Ont	2702R		1000	R5	12-Aug		51.5	53.0	49.1	51.8													2.4	1.2	2.1	2.1			24-Sep	16-May
34	E. Ont	PS 46 RR		500	R5	25-Aug		40.3	41.3	43.3	40.9													3.0	0.4	-0.7	-0.7			02-Oct	25-May
35	E. Ont	Heartbeat		300	R4	09-Aug		43.3	48.7	54.4	59.9	52.3	54.3											11.1	11.2	4.28	4.28			15-Sep	22-May
36	E. Ont	S03-W4		500-750	R5	3-Aug		54.5	58.0																	3.5	3.5			22-Sep	18-May
37	E. Ont	S03-W4		500-750	R5	3-Aug		52.9	59.2																	6.3	6.3			23-Sep	18-May
38	E. Ont	S03-W4		250	Late R4	1-Aug		44.6	48.3																	3.7	3.7			4-Oct	17-May
39	E. Ont	S03-W4		400	R5	11-Aug		40.7	43.2																	2.5	2.5			4-Oct	17-May
40	E. Ont	S03-W4		300	Late R4	1-Aug		43.9	52.7																	8.8	8.8			5-Oct	17-May
41	E. Ont	S03-W4		500	Late R4	3-Aug		34.6	37.0																	2.4	2.4			21-Sep	17-May
42	E. Ont	S03-W4		0-1000	R5	13-Aug		27.1	29.2																	2.1	2.1			2-Oct	26-May
43	E. Ont	90B73		400	Early R4	1-Aug		43.8	50.7																	6.9	6.9			4-Oct	25-May
44	E. Ont	S03-W4		2000 +	R4	4-Aug		31.1	39.4																	8.3	8.3			3-Oct	27-May
45	E. Ont	Heartbeats		2000 +	R4	6-Aug		29.6	39.9																	10.3	10.3			3-Oct	20-May
46	E. Ont	PS 56 RR		600	R5	6-Aug		51.1	54.3																	3.2	3.2			1-Oct	9-May
47	E. Ont	Pride PS 73		250	R4	29-Jul		48.1	51.4																	3.3	3.3			31-Oct	21-May
48						08-Aug		42.2									62.2									20		20			
49	Middlesex			800	R4	08-Aug		51.5									54.5									3		3			
50	Middlesex			250	R4	10-Aug		28									30.5									2.5		2.5			
51	Oxford	NKS12-C2		500-750				52	59.7		54.6														5.1	5.15	5.15				
52	Oxford	NKS12-C2		500	R4.5	09-Aug		44.2	49.1	44.2	46.2															3.45	3.45				
53	Oxford	NKS12-C2		300	R4.5	09-Aug		46.8	51.5	46	46															2.35	2.35				
54	Oxford	NKS12-C2		300	R4.5	09-Aug		49.7	53	53.7	54.9	45.9	52.9	43.9	52.3											4.975	4.975				
Averages								**44.3**	**48.7**	**44.1**	**48.6**	**51.8**	**60.3**	**43.9**	**52.3**	**#DIV/0!**	**48.8**	**#DIV/0!**	**48.4**		**45.7**		**41.9**			**4.52**	**4.38**	**3.84**	**0.22**		

Figure 1. 2005 Ontario Soybean Aphid On-Farm Strip Trials Yield Response to Insecticide as Affected by Soybean Growth Stage and Level of Aphid Infestation.



, * = yield response significant at *p* = 0.01 and 0.001, respectively.
n = number of comparisons

Table 2. Return on Investment to Spraying based on Yield Response, Insecticide Costs and the Market Value of Soybeans.*

Return on spraying ($)	Yield Advantage bu/ac			
Matador	1	2	3	4
$6/bu	-7.90	-1.90	4.10	10.10
$7/bu	-6.90	0.10	7.10	14.10
$8/bu	-5.90	2.10	10.10	18.10

Dimethoate	1	2	3	4
$6/bu	-13.70	-7.70	-1.70	4.30
$7/bu	-12.70	-5.70	1.30	8.30
$8/bu	-11.70	-3.70	4.30	12.30

***** Table does not take into considering yield loss due to crop tramping from spray application. Yield loss due to tramping averages one bushel per acre. Therefore, if considering tramping in the control decision, a grower would need to get an additional 1 bu/ac yield advantage to spraying to cover this cost as well.

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Summary:

The results from this study indicate that the recommended threshold of 250 aphids per plant with increasing populations during the R1-R5 growth stages is effective at keeping populations below economically damaging levels. Soybeans entering into the R6 stage of development require more aphids per plant before yield response to spray is achieved.

Next Steps:

Continue to evaluate the threshold under various environments and regions, including various growth stages to determine its effectiveness. Focus on threshold required at R6 growth stage that would ensure economic return. Focus on sprayer technology to ensure good coverage and better efficacy in lower portion of the soybean canopy where aphids reside.

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