

Trial: 2003-SBASEED

Seed applied insecticide efficacy against the Soybean Aphid (*Aphis glycines*) and Bean leaf beetle (*Certoma trifurcata*)

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Background

The soybean aphid (SBA) is a relatively new pest of Minnesota soybeans. It was first identified during the late summer of 2000 in SE MN. SBA subsequently spread throughout the soybean growing areas of MN during the 2001 growing season with localized yield limiting populations in 2002. Bean leaf beetle and bean pod mottle virus transmitted by the beetle have been a problem in Southwest Minnesota the past couple of years. Management of both insects is problematic. Soybean aphids are unpredictable in timing and location of occurrence. Additionally, the potential for extremely rapid population increase makes timely treatment difficult. In the case of bean leaf beetle, multiple and overlapping generations make timing of scouting and insecticide applications difficult. It is unclear whether seed applied insecticides will be effective in preventing early season bean leaf beetle injury and associated virus transmission. The relationship between aphid populations and soybean yield is not well understood. Quantifying the relationship between aphid population density and yield loss is a necessary first step in the development of workable economic thresholds.

Objective

This trial was designed to examine: 1) soybean aphid control with several seed and foliar applied insecticides 2) yield impacts from varied soybean aphid populations by manipulating product and rates of seed applied insecticide (currently not labeled) and foliar applied insecticides and 3) effect of seed applied insecticides on over-wintering bean leaf beetle populations.

Methods

The trial was planted at the University of Minnesota, Southwest Research and Outreach Center near Lamberton, Redwood County, Minnesota. Site and application details are shown below. Several farm woodlots and the adjacent Cottonwood River area contain buckthorn, *Rhamnus sp*, the winter host for soybean aphids. For the second year, soybean aphids, presumed to be the result of overwintered eggs, were observed in June. These very low initial populations were severely limited by a June 23 hailstorm. Soybeans suffered an average of 43% defoliation at that slowed development, produced callusing and loss of apical meristems or much more rarely mortality. The soybeans, however, had recovered well by mid-July. The 2003 growing season was very dry late in the season with 2.96 inches of rainfall in July and August compared to a 7.07-inch average with below normal growing degree day accumulations.

Beginning on or near July 18th a large immigration of alate (winged) aphids occurred. Alate populations averaged nearly 1/plant with associated nymphs causing a rapid increase of populations (Figure 1).

County: Redwood, MN

Nearest town: Lamberton, MN

Soil type: Normania loam

Fertility: P(bray)- 19 ppm,
K – 173 ppm,
pH 5.8

Previous crop: Corn

Tillage: Disk 2x Fall 2002
Field cultivator 2x 4/23/03

Cultivar: Cropplan CR1976 (roundup ready cyst nematode resistant)

Planting date: May 16, 2003

Seeding rate: 175,000 seeds/acre

Row spacing: 30"

Weed control: Trifluralin @ 1.5 pt./acre PPI 4/23/03

Roundup Weathermax @ 22 oz./acre 6/03/03 and 7/9/03 POST

Design: Randomized complete block with 4 replications

Plot size: 10' x 30'

Application date(s): 1) Seed applied (Rival/Allegiance, Gaucho 480, Poncho 600, Cruiser 5)

2) Foliar July 25

Wind conditions: Calm

Crop stage at foliar application: R3

Gustafson R&D, McKinney, TX, applied insecticide seed treatments to seed supplied by the SWROC. Foliar insecticide treatments were applied with an offset boom sprayer (R&D Sprayers) with 8002XR flat fan nozzles on 18-inch spacing, 15 gallons/acre, 28 PSI.

Soybean aphid populations were estimated by whole plant aphid counts on 5 plants/plot. SBA densities were initially greatest on the upper canopy but by R4 stage lower leaves were also being colonized. Data were

	LOW DENSITY		HIGH DENSITY	
	mimimum	maximum	mimimum	maximum
1	0.0	0.0	0	0
2	0.1	2.5	1	25
3	2.6	5.0	26	50
4	5.1	10.0	51	100
5	10.1	20.0	101	200
6	20.1	40.0	201	400
7	40.1	80.0	401	800
8	80.1	160.0	801	1600
9	160.1	320.0	1601	3200
10 >	320.0		>	3200

transformed to a 1-10 scale to perform an analysis of variance (ANOVA) and means were separated by Duncan's new multiple range test.

Aphid-days or the number of aphids/plant x number of days aphids present were calculated for each plot to provide an estimate of both intensity and duration of soybean aphid pressure. Aphid days = $[(SBA/plant\ sample\ date\ 1 + SBA/plant\ sample\ date\ 2)/2 * days\ between\ samples]$. For example, 25 aphids/plant for 4 day and 50 aphids/plant for 2 days would both equal 100 aphid days.

Seed size was determined by weighing a 200 seed sample from each plot.

This trial was planted late to avoid bean leaf beetle. However, this insect did occur in this trial and injury was noted. Bean leaf beetle damage was estimated based on the percentage of plants expressing bean pod mottle virus symptoms and the percentage of seed showing bean pod mottle symptoms in a 200 seed sample. Protein and oil content will also be determined from each plot.

Results and discussion

All seed insecticide treatments had less overwintering bean leaf beetle injury based on % plants with feeding damage and feeding sites/plant than those with no insecticide. The low (62.5 mg/kg rate of Poncho) had significantly more injury than other insecticide seed treatments. First and second-generation bean leaf beetle populations in this study were low. Bean leaf beetle injury was recorded June 12th on VC stage soybeans as % plants injured and average number of feeding sites/plant. Virus symptomatic plants were 1% or less in all treatments. Differences in bean pod mottle virus transmission, as measured by mottled seed, were not detected between treatments. This may be in part due to low incidence (2.5 % or less seed w/symptoms). Additionally, this method is problematic under high soybean aphid populations as mottled seed could potentially be caused by soybean mosaic or other viruses transmitted by aphids.

Soybean yield and soybean aphid populations are shown in table 2. Aphid assessments were not continued after August 15th due to severe lower leaf loss in untreated plots and declining aphid populations. At this date, the July 25 foliar applications of Baythroid and Warrior had significantly fewer aphids than other treatments. Aphid populations for both Poncho treatments were not significantly different from the untreated. The Cruiser and Gaucho treatments were intermediate in performance (Aphid populations for Cruiser and Gaucho were significantly lower than the untreated, but significantly higher than the foliar applications. Accumulated aphid days and yield differences were similar to late season aphid populations with Cruiser and Gaucho intermediate between foliar insecticides and Poncho treatments. As opposed to early season bean leaf beetle control, the 125-mg/kg rate of Poncho did not perform better than the 62.5

mg/kg rate for SBA control, and the trend was for higher aphid populations later in the season with both treatment levels. The reason for this is unclear but perhaps it may reflect slightly better early infestation growth favoring SBA populations.

Soybean plants in untreated and seed-applied insecticide plots were shorter than those receiving foliar insecticide treatments. Treatments that accumulated the largest number of aphids matured earlier.

Yields related well to estimated aphid – days (Table1) and a regression of aphid –days on percent yield loss was highly significant with an r^2 of $> .95$ (Figure 3). Forcing the line through 0% yield loss yields the equation: % yield loss = $0.0012 * \text{aphid-days}$. If this relationship is consistent over multiple environments and over SBA phenology/crop stage relationships, a relatively precise economic threshold might be determined.

These data suggest that seed applied insecticide treatments (if labeled) can provide control of overwintering bean leaf beetle and early season suppression of soybean aphid. Soybean aphid control with well-timed foliar insecticides is significantly better than seed applications tested. Seed applied insecticides differ in performance against soybean aphid. They probably will not provide adequate stand-alone protection for soybean aphid long enough in the season, especially under conditions where aphids continue migrating into the field. Bean leaf beetle may require a 1st generation treatment in July for best control of bean pod mottle virus.

Acknowledgments:

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Table 1. The effect of seed applied insecticide on bean leaf beetle. University of Minnesota – Southwest Research and Outreach Center, Lamberton, MN. (2003). B. Potter and Wayne Hansen.

Treatment	Applied	Yield Bu/Acre * ¹ 10/2/2003	% mottled seed 10/2/2003	Plants/meter 6/12/2003 VC	% plants w/ BLB feeding 6/12/2003 VC	BLB feeding sites/plant 6/12/2003 VC	BLB/meter 6/12/2003 VC
1 Rival/Allegiance(check)	seed	22.1 cd	2 a	31.4 a	96.75 a	7 a	0.9 a
2 Rival/Allegiance Poncho 600@62.5 g/100kg	seed	22.7 cd	2.13 a	31.4 a	32.9 c	2.4 bc	1.1 a
3 Rival/Allegiance Poncho 600@125 g/100kg	seed	20.1 d	1.88 a	30.4 a	8.33 d	0.6 c	1.4 a
4 untreated		18.4 d	2 a	31.3 a	98.93 a	6.5 a	1.2 a
5 Rival/Allegiance Gaucho 480@125 g/100 kg	seed	27.8 ab	2.5 a	31.1 a	11.38 d	0.3 c	0.3 a
6 Rival/Allegiance Cruiser @ 62.5 g/100kg	seed	25.3 bc	0.75 a	31.2 a	3.36 d	0.1 c	0 a
7 Rival/Allegiance Warrrior @0.025#a/A	seed 7/25/2003	31.3 a	0.75 a	31.1 a	98.27 a	7 a	0.8 a
8 Rival/Allegiance Baythroid @0.44# a/A	seed 7/25/2003	32.1 a	0.88 a	31.3 a	84.43 b	4.5 ab	0.9 a
LSD (P=.05)		4.8	1.32	5.46	10.934t	3.41	0.92
Standard Deviation		3.3	0.897	3.71	7.434t	2.32	0.63
CV		13.1	55.76	11.92	15.06	65.33	77.36
Grand Mean		25.0	1.61	31.13	49.37t	3.55	0.81
Prob(F)		0.0001	0.2943	0.0985	0.0001	0.0002	0.0655

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

t=Mean descriptions are reported in transformed data units, and are not de-transformed.

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

*¹ Adjusted to 13% moisture

Table 2. Relationship of insecticide on soybean aphid populations and on soybean yield. University of Minnesota-Southwest Research and Outreach Center, Lamberton, MN (2003). B. Potter and W. Hansen

Treatment	Applied	Yield Bu/Acre * ₃ 10/2/2003	Estimated SBA/plant 7/18/2003 R2	Estimated SBA/plant 7/24/2003 R3	Estimated SBA/plant 7/31/2003 R3	Estimated SBA/plant 8/8/2003 R4	Estimated SBA/plant 8/15/2003 R4.5	Estimated Aphid days 8/15/2003 R5	Plant height cm 10/1/2003 R8	Weight/200 seeds (grams)
1 Rival/Allegiance(check)	seed	22.1 cd	3.0 a	21.9 a	159.4 a	2514.5 a	3014.8 ab	30757	71.4 d	23.5 a
2 Rival/Allegiance Poncho 600@62.5 g/100 kg	seed	22.7 cd	1.2 a	8.8 a	66.3 a	1485.5 a	2369.4 abc	19992	76.6 bc	23.5 a
3 Rival/Allegiance Poncho 600@125 g/ 100 kg	seed	20.1 d	0.9 a	6.8 a	103.3 a	1643.0 ab	3243.8 ab	24297	73.4 cd	23.1 a
4 untreated		18.4 d	0.9 a	7.8 a	150.6 a	2104.9 a	4306.3 a	32040	71.8 d	22.8 a
5 Rival/Allegiance Gaucho 480@125 g/ 100 kg	seed	27.8 ab	0.5 a	3.7 a	23.3 b	894.5 b	1603.4 c	12521	77.0 bc	23.3 a
6 Rival/Allegiance Cruiser @ 62.5 g/100 kg	seed	25.3 bc	0.9 a	4.5 a	105.4 a	1978.6 ab	2095.0 bc	22994	75.8 bc	23.6 a
7 Rival/Allegiance Warrrior @ 0.025 #a/A	seed 7/25/2003	31.3 a	2.1 a	5.3 a	0.1 c	174.5 c	176.9 d	1970	81.5 a	24.5 a
8 Rival/Allegiance Baythroid @0.044#a/A	seed 7/25/2003	32.1 a	2.5 a	3.0 a	4.9 c	162.9 c	190.4 d	1952	79.8 ab	24.5 a
LSD (P=.05) * ¹		4.8	2.3	7.4	91.2	1089.9	998.5		3.8	1.3
Standard Deviation		3.3	1.6	5.0	62.0	741.0	678.9	7413.2	2.6	0.9
CV		13.1	103.5	64.8	80.9	54.1	32.0	40.4	3.4	3.7
Grand Mean		25.0	1.5	7.7	76.6	1369.8	2125.0	18340.3	75.9	23.6
Prob(F)		0.0001	0.2943	0.0985	0.0001	0.0001	0.0001	0.001 * ²	0.0001	0.1256

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

*¹ Due to non-homozygous variance, aphids/plant counts (presented above) mean transformations performed on a 1-10 aphid abundance scale.

*² non-homozygous variance could not be transformed

*³ Adjusted to 13% moisture

Figure 1.

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Insecticide seed treatments-Effect on aphid populations
U of M SWROC, Lamberton, MN (2003)

B. Potter and W. Hansen

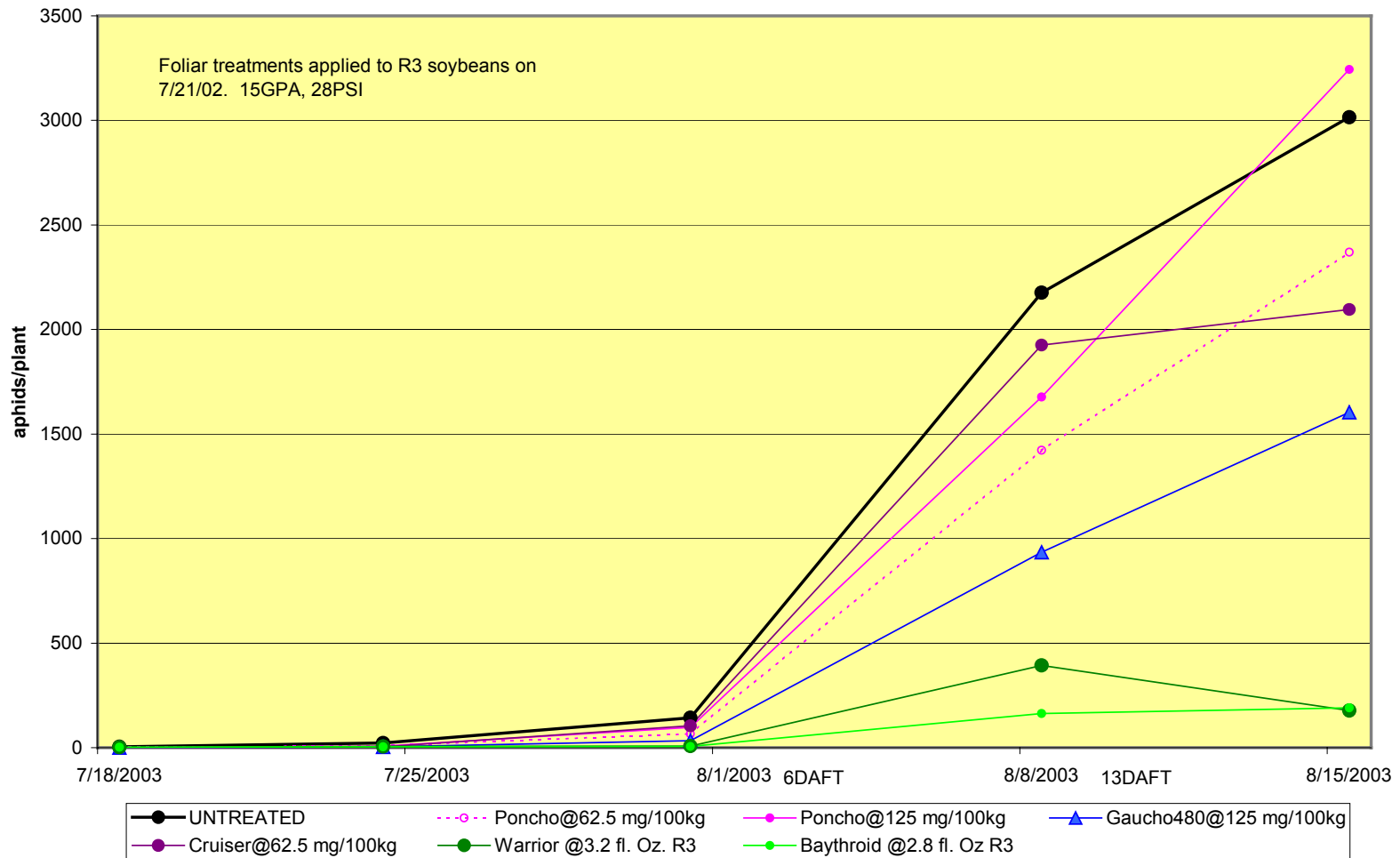


Figure 2.

Aphid population relationship to yield loss (treatment means)
Seed applied insecticide exp.
U of M SWROC, Lamberton MN 2003
Croplan RC1976 5/16/03
B. Potter

