Rosy Apple Aphid Insecticide Efficacy Trial
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Objectives:

To evaluate the efficacy of a new systemic insecticide from Bayer CropScience, BYI02960, applied at multiple rates and compared with the neonicotinoid insecticides Calypso and Admire for control of rosy apple aphid (*Dysaphis plantaginea*) in apple. Green apple aphid, *Aphis pomi*, was also present in the orchard, and so insecticide efficacy against this aphid was also evaluated.

Methods:

Experimental Design

The study was conducted in a 2-acre apple orchard planted in 2006 at the Utah State University research farm in Kaysville, UT (Davis County). Plot design was a randomized complete block with four replicates per treatment. Plots were a single row wide by 3 trees in length (12 ft X 20 ft tree and row spacing, respectively = 20 ft wide X 36 ft long or 0.02 acre per plot). Blocks 1 and 2 were placed in the cultivar 'Gala', and Blocks 3 and 4 were in the cultivar 'Fuji'. Plots had at least one untreated buffer row between them, except where missing trees forced the relocation of some plots (see plot map). Treatments were applied a single time on June 10 with an orchard air blast sprayer at 140 psi and 100 gpa. This spray pressure and rate provided complete coverage of the trees. Treatments were applied to both sides of each row in a plot, but not to the buffer rows. Apple fruit diameter was ¼ - 1/3 inch at the time of treatment application.

Treatments

1. Untreated control (no spray)
2. BYI02960 at 1.8 oz/acre + 0.25% v/v horticulture oil
3. BYI02960 at 3.5 oz/acre + 0.25% v/v horticulture oil
4. BYI02960 at 5.2 oz/acre + 0.25% v/v horticulture oil
5. BYI02960 at 7.0 oz/acre + 0.25% v/v horticulture oil
6. Calypso 480SC at 4.0 oz/acre + 0.25% v/v horticulture oil
7. Admire Pro at 2.8 oz/acre + 0.25% v/v horticulture oil

Aphid Sampling

Aphids were sampled 3-days pre-treatment on June 7; and 4-, 11-, 18-, and 25-days post-treatment on June 14, 21, and 28, and July 5, respectively. Two types of aphid counts were conducted on the center tree of each plot on each sample date: 1) the number of aphid-infested shoots per tree (infested with both rosy apple aphid and green apple aphid) and 2) the number of aphids and predators per shoot for 5 infested shoots per tree. On the pre-treatment sample date, for the center tree in each plot, five aphid-infested shoots were randomly selected and marked with flagging tape. If there was less than five infested shoots, than all that were present were flagged. More infested shoots up to five per tree were

marked on subsequent sample dates. Rosy apple aphid, green apple aphid, and aphid predators were identified and counted. Predators found included syrphid fly eggs and larvae, green lacewing eggs and larvae, ladybeetle larvae and adults, thrips adults, earwig nymphs and adults, and spiders.

Phytotoxicity Assessment

On each sample date and through late August, leaves and fruits of treated trees were visually assessed for symptoms of phytotoxicity, including discoloration, russet, "burn", shriveling, or puckering.

Data Analyses

Because of low densities of predators, counts for all predator species were combined for comparison among treatments. To meet normality assumptions, data were square root-transformed before analysis. Actual means are reported in the table and figures. On each sample date, the number of infested shoots and numbers of aphids and predators per shoot were compared among treatments with analysis of variance (PROC MIXED, SAS version 9.2). When means were significantly different among treatments, they were separated with Tukey's test ($\alpha = 0.05$).

Results:

Shoot Infestation by Aphids

Pre-treatment on Jun 7, the mean number of aphid-infested shoots ranged from approx. 7 to 16 per tree, and were not different among plots (Table 1 and Fig. 1). In untreated plots, shoot infestation peaked on Jun 21 and then declined by the end of the study period to similar levels as at the beginning of the trial. On Jun 14, 21, and 28 (4-, 11-, and 18-days post-treatment, respectively), shoot infestation was significantly greatest in the untreated plots. Shoot infestation was lowest in the highest rate of BYI02960 (7.0 oz per acre) on 4-days post-treatment, and in the three highest rates of BYI02960 (3.5, 5.2, and 7.0 oz per acre) on 11-days post-treatment. By 18-days post-treatment, BYI02960 at 3.5 oz per acre had the fewest aphid-infested shoots; however, it wasn't different from most other rates of BYI02960 or Admire Pro. Calypso, Admire Pro, and the lowest rate of BYI02960 (1.8 oz per acre) were the slowest treatments to reduce shoot infestation post-treatment. Duration of shoot infestation reduction as compared to the untreated plots was shortest for Calypso which rebounded by 18-days post-treatment.

Rosy Apple Aphid

Densities of rosy apple aphids on shoots were similar among plots at pre-treatment, and declined during the trial period for all treatments, including the untreated control (Table 1 and Fig. 2). However, from 4- to 18-days post-treatment, all insecticides significantly reduced densities of rosy apple aphids. The highest rate of BYI02690 reduced rosy apple aphids most quickly by 4-days post-treatment (Fig. 2). Calypso, Admire and the lower rates of BY02690 were the slowest treatments to reduce rosy apple aphid densities after application. By 25-days post-treatment (Jul 5), densities of rosy apple aphid had declined to zero or near zero in all treatments (Table 1).

Green Apple Aphid

In contrast to rosy apple aphid population dynamics, green apple aphids were zero or near zero pre-treatment and increased throughout the trial period in the untreated control plots (Table 1 and Fig. 3). There were differences among treatments on 18- and 25-days post-treatment. All insecticides significantly reduced green apple aphid densities as compared to the untreated plots. Densities were the lowest in Admire on Jun 28 and in the highest rate of BYI02690 on Jul 5 (Table 1).

Predators

Densities of aphid predators were low throughout the trial, and did not exceed 0.4 per shoot. Syrphid fly eggs and larvae were the most abundant predators and life stages observed. Although numbers of all predators combined was numerically lower in most insecticide-treated plots during the latter half of the trial, there were no significant differences among treatments due to the low densities.

Phytotoxicity

There were no symptoms of phytoxicity observed in any plot during or after the trial.

Conclusions:

The higher rates of BY02690 performed well in reducing the number of aphid-infested shoots and aphid densities on shoots. The highest rate, 7.0 oz per acre, generally out-performed the lower rates in reducing rosy apple aphid infestations more quickly and for longer duration. Of the insecticides tested, Calypso (4.0 oz per acre) was the poorest in suppressing rosy apple aphid, but it was effective in reducing green apple aphid, even up to 25-days post-treatment. Predator densities were relatively low during the trial and none of the insecticides significantly reduced their densities as compared to the untreated plots.

There were no effects of block on aphid densities supporting the conclusion that apple cultivar ('Gala' vs. 'Fuji') did not influence performance of the insecticides or aphid population responses. In conclusion, the highest rate of BY02960 performed the best in suppressing both rosy and green apple aphids for up to 25-days post-treatment.

Table 1. Effects of insecticide treatments on mean number of aphid-infested shoots per tree, and on the number of aphids (rosy apple aphid and green apple aphid) and predators per shoot from 3-days pre-treatment through 25-days post-treatment in apple at Kaysville, UT in 2011.

Treatment	Rate per acre	3-days pre-treatment (Jun 7)				4-days post-treatment (Jun 14)			
		Infested shoots	RAA[a]	GAA[b]	Pred[c]	Infested shoots	RAA	GAA	Pred
1. Untreated		8.5	78.1	1.1	0.2	17.8 a	95.2 a	1.9	0.2
2. BYI02960[d]	1.8 oz	13.0	55.6	1.5	0.1	17.3 a	32.5 b	1.1	0.1
3. BYI02960	3.5 oz	12.5	64.6	0.9	0.1	10.5 ab	10.6 bc	0.4	0.2
4. BYI02960	5.2 oz	9.5	125.1	0.0	0.2	10.5 ab	29.5 b	2.1	0.3
5. BYI02690	7.0 oz	15.5	79.9	3.5	0.0	3.0 b	0.7 c	0.0	0.3
6. Calypso	4.0 oz	7.3	45.8	0.0	0.2	15.8 ab	56.8 ab	1.1	0.4
7. Admire	2.8 oz	12.8	94.9	0.0	0.0	13.5 ab	28.7 b	0.1	0.2
P > F		*0.96*	*0.35*	*0.68*	*0.23*	***0.05***	***0.03***	*0.63*	*0.82*

Treatment	Rate per acre	11-days pre-treatment (Jun 21)				18-days post-treatment (Jun 28)			
		Infested shoots	RAA	GAA	Pred	Infested shoots	RAA	GAA	Pred
1. Untreated		25.0 a	38.2 a	5.3	0.3	22.5 a	19.3 a	19.6 a	0.2
2. BYI02960	1.8 oz	10.5 bc	1.6 b	1.0	0.1	6.5 bc	1.0 bc	3.7 bc	0.1
3. BYI02960	3.5 oz	3.3 c	0.0 b	0.3	0.0	4.3 c	0.1 bc	1.1 bc	0.0
4. BYI02960	5.2 oz	4.5 c	0.7 b	0.1	0.0	11.3 b	0.0 c	3.3 bc	0.0
5. BYI02690	7.0 oz	3.0 c	0.8 b	0.1	0.1	8.0 bc	0.0 c	5.3 b	0.0
6. Calypso	4.0 oz	9.3 bc	3.0 b	0.3	0.1	21.5 a	1.4 b	2.3 bc	0.0
7. Admire	2.8 oz	6.5 bc	0.1 b	0.0	0.1	6.5 bc	0.1 bc	0.3 c	0.1
P > F		***0.04***	***0.01***	*0.06*	*0.25*	***0.05***	***0.01***	***0.03***	*0.23*

Treatment	Rate per acre	25-days pre-treatment (Jul 5)			
		Infested shoots	RAA	GAA	Pred
1. Untreated		11.8	0.1	52.2 a	0.3
2. BYI02960	1.8 oz	12.3	0.0	0.9 bc	0.1
3. BYI02960	3.5 oz	8.8	0.0	1.9 bc	0.1
4. BYI02960	5.2 oz	8.5	0.0	4.1 bc	0.1
5. BYI02690	7.0 oz	7.3	0.0	0.4 c	0.0
6. Calypso	4.0 oz	17.8	0.0	5.8 b	0.0
7. Admire	2.8 oz	16.5	0.0	3.5 bc	0.3
P > F		*0.31*	*0.49*	***0.04***	*0.79*

[a]RAA = mean number of rosy apple aphid per shoot, [b]GAA = mean number of green apple aphid per shoot, [c]Pred = mean number of aphid predators per shoot, and [d]0.25% v/v horticultural oil was added to Treatments 2-7.
Data were square root transformed before analysis to meet normality assumptions, compared among treatments with PROC MIXED (SAS ver 9.2), and means separated with Tukey's test ($\alpha = 0.05$).

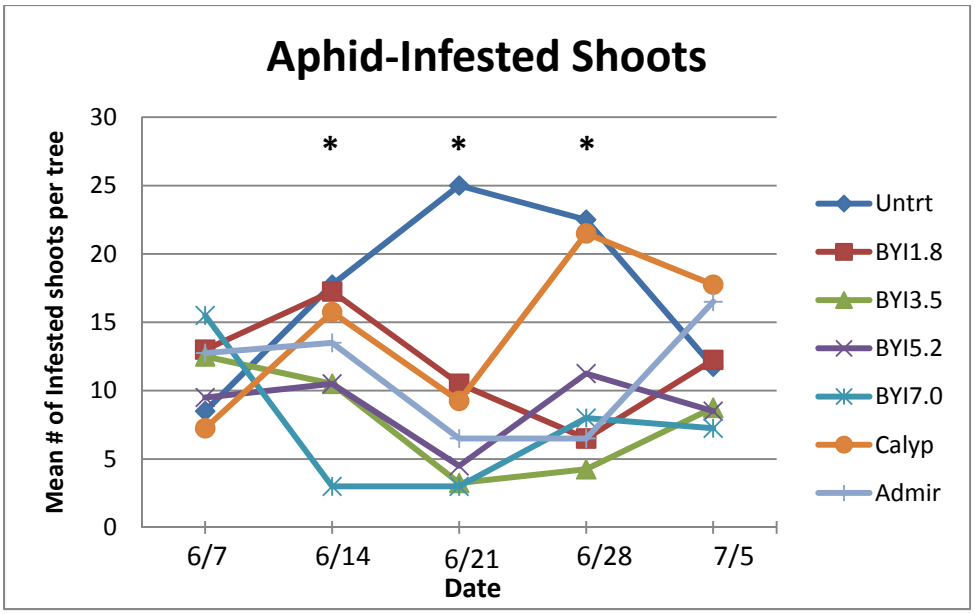

Figure 1. Effects of insecticide treatments on the mean number of aphid-infested shoots per apple tree from 3-days pre-treatment (Jun 7) through 25-days post-treatment (Jul 5). Insecticide treatments were applied on Jun 10. Asterisks indicate dates with significant differences among treatments.

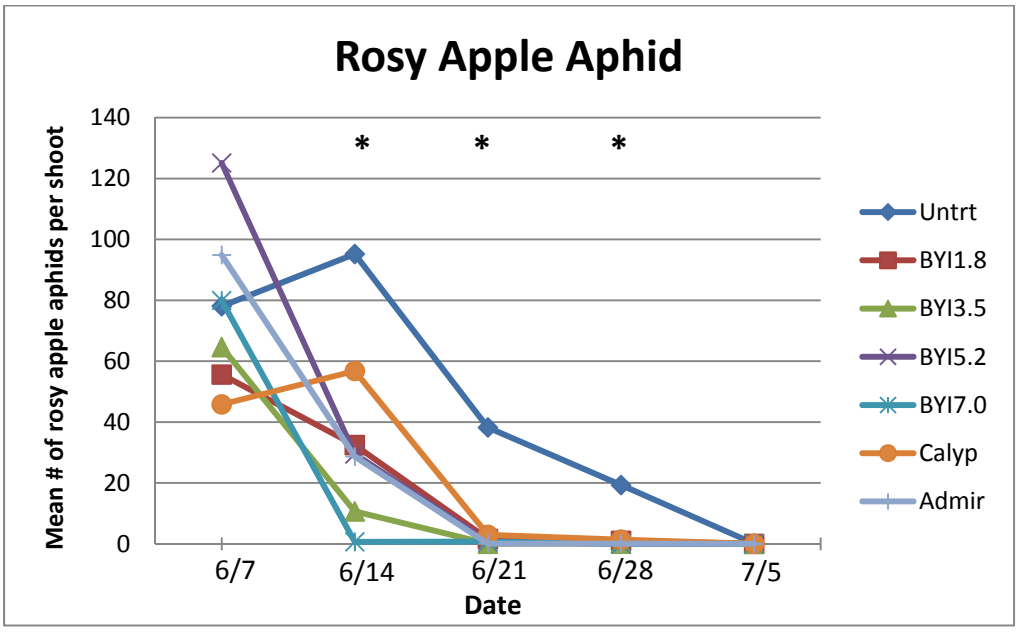

Figure 2. Effects of insecticide treatments on the mean number of rosy apple aphids per shoot.

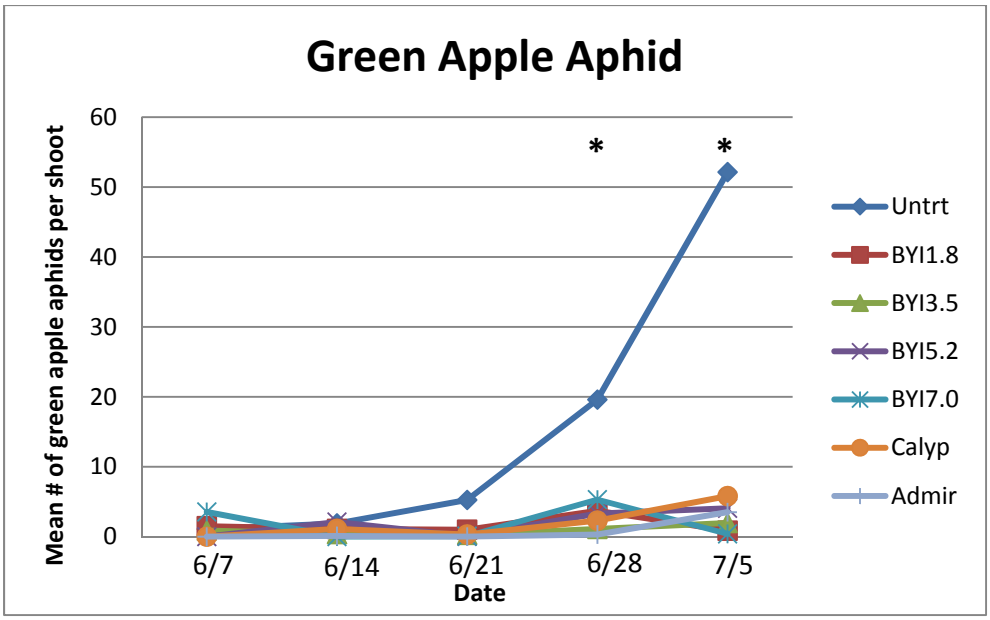

Figure 3. Effects of insecticide treatments on the mean number of green apple aphids per shoot.

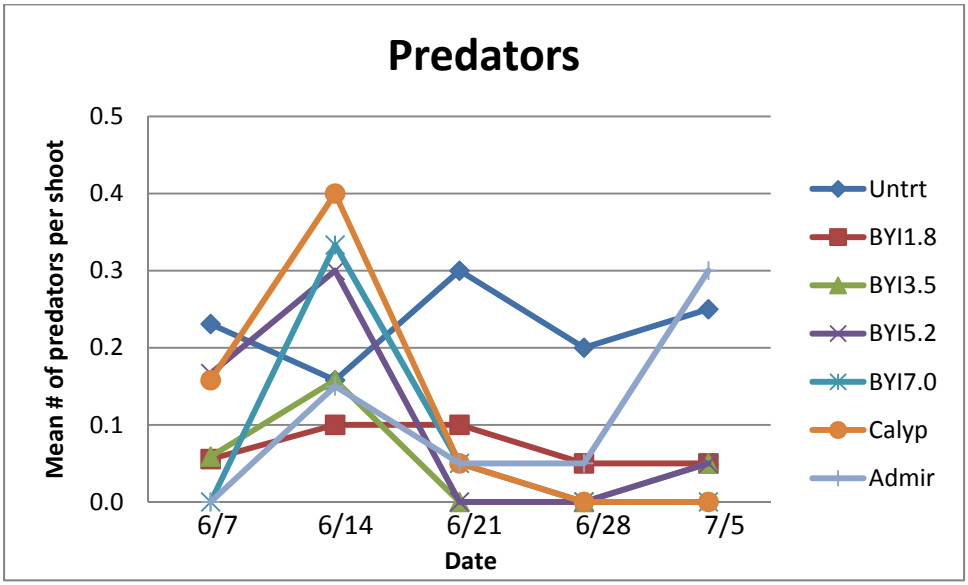

Figure 4. Effects of insecticide treatments on the mean number of predators (combined for all species) per shoot. There were no significant differences among treatments.