FIELD DAY 2009

Report of Progress 1014

Kansas State University
Agricultural Experiment
Station and Cooperative
Extension Service

SOUTHWEST RESEARCH-EXTENSION CENTER

Yield Losses Associated with *Dectes* Stem Borers in Soybean and Efficacy of Fipronil Seed Treatments, Garden City, 2008[1]

L. Buschman, A. Joshi, P. Sloderbeck and T. Niide[2]

Summary
Fipronil soybean seed treatments were evaluated in large plots (8 rows by 150 ft) at two locations near Garden City (GC), KS. Thrips populations were high on the soybean seedlings, and we found that the fipronil seed treatment was effective in suppressing thrips populations (60%) at both locations. *Dectes* populations were low at GC south (23% of plants infested). At GC north, however, there were substantial *Dectes* populations (84% of plants infested). The fipronil seed treatment was extremely effective in reducing the *Dectes* stem borers, giving 100 and 96 to 98% control at GC south and north, respectively. The fipronil seed treatment did not affect grain yield at GC south, where *Dectes* infestations were low. However, at GC north, the fipronil seed treatment increased grain yield 6.5 bu/a at normal harvest and 9.7 bu/a at late harvest. These results reveal a significant physiological yield loss of 10.2% and a plant lodging loss of 5.0% associated with *Dectes* stem borer infestations. Results from a similar trial at Scandia, KS, reveal a significant physiological yield loss of 8.2% and a plant lodging loss of 2.9%. Fipronil seed treatment could be a useful technology to protect soybean grain yield from *Dectes* stem borer, but it is not yet registered for use on soybean. Timely harvest is also successful in reducing grain yield loss caused by lodging and pod shattering.

Procedures
Soybean seed (Pioneer 93M92, maturity group III) was divided into two lots; one was treated with fipronil (Regent 500TS) at 100 mg a.i./100 kg seed, and the other was left untreated. Plots were machine planted May 21 and 29 at 131,000 and 110,000 seeds per acre at GC south and north, respectively. A 20-ft grain drill with 13-in. rows and a 20-ft row-crop planter with eight rows (30 in.) were used to plant GC south and north, respectively. The treated and untreated main plots were 20 ft (8 rows) wide and 300 ft long. The subplots were 20 ft wide and 150 ft long. To allow plot harvest on two dates, we added 40-ft borders around the main plots that allowed us access to the plots after the borders had been cut. This also allowed the header to overlap the cut border because the combine header was 30 ft wide.

As the soybean germinated, significant numbers of thrips from maturing wheat were found infesting soybean seedlings. Because thrips have been known to cause serious injury to soybean seedlings, we collected 10 soybean seedlings from each plot and placed them in Berlese funnels to force the thrips into jars with 70% methanol. The methanol was then filtered through filter paper, and the trips were counted under a dissecting microscope. During July and August we monitored *Dectes* beetle populations by making 100-sweep samples each week and recording the number of *Dectes* beetles collected. *Dectes* stem borer larval infestations and damage were recorded September 26 by

[1] This research is sponsored by the Kansas Soybean Commission.
[2] K-State Dept. of Entomology, Manhattan, KS

dissecting 20 or 10 plants per subplot at GC south and north, respectively. We collected groups of five consecutive plants from the center of each subplot and recorded entry nodes, upper stem tunneling, tunneling that reached the base of the plant, and the number of live larvae present. At the end of the season, we marked off six 3-ft sections of row at GC north to follow the progression of girdling. The number of standing plants in each section was recorded every 2 days (early October) and once a week (late November and December).

Soybean yields were obtained by using the farmer's field combines to collect grain from the plots. At GC south, the *Dectes* infestations were low and we did not expect to have significant yield reductions, so we harvested both sets of subplots at normal harvest (October 17) with a flex header. The *Dectes* infestations were higher at GC north, so we harvested half of the subplots at normal harvest maturity (October 10) with a flex-header and the other half on October 29 after a period of rainy weather, which allowed the *Dectes*-girdled plants to fall to the ground. Two different headers were available on the second harvest at GC north, so we harvested three replications with the flex header and the other three replications with a row-crop header. At both locations, the harvested grain was transferred to a weigh wagon to be weighed. Grain yield was converted to bushels per acre based on 13% moisture. The experimental plan was a split-plot randomized block design with two factors, seed treatment and harvest time, and six replications. However, some observations were made before harvest, so the design reverted to a simple randomized block design. The SAS-ANOVA procedure was used to analyze the data. Means were compared by LSD.

Results and Discussion

There were substantial thrips populations on soybean seedlings during the seedling stage: 246 and 329 per 10 plants at GC south and north, respectively (Tables 1 and 2). These populations did not lead to damage that required insecticide applications. The fipronil seed treatment was effective in suppressing these populations by 60% at both locations (Figure 1).

Dectes populations were low at GC south. Weekly 100-sweep samples collected only five beetles total throughout July and August with a peak catch of two on July 31. At the end of the season, this field had only 23% of plants infested (Table 1). However, there were substantial *Dectes* populations at GC north. Weekly 100-sweep samples collected 32 beetles total throughout July and August with a peak catch of 12 on August 11. At the end of the season, this field had 84% of the plants infested (Table 2). These beetle populations were substantially lower than in previous years, when up to 50 beetles were collected per 100-sweep sample.

The fipronil seed treatment was extremely effective in reducing the *Dectes* stem borers, giving 100 and 96 to 98% control at GC south and north, respectively (Tables 1 and 2). These data indicate that the residual activity of the fipronil seed treatments remained effective through August when *Dectes* larvae were feeding in the plants (Figures 2 and 3).

Effects of the fipronil seed treatment on grain yield were not significant at GC south (Table 1). This agrees with the adult and larval data that indicated low *Dectes* infestation that was not likely to cause economic damage. At GC north, the effects of fipronil seed treatment and harvest date were highly significant for grain yield, but the interaction was not significant (Table 2). At normal harvest, plots with treated seed had 6.5 bu/a more grain than plots with untreated seed, and at late harvest, plots with treated seed had 9.7 bu/a more grain than plots with untreated seed (Figure 4). These yield losses appear to be from *Dectes* stem borers because there was no yield loss in GC south, where *Dectes* infestations were less than 25% (GC south location). These data also indicate there were no plant growth effects associated with the fipronil seed treatments and that no other factors (even the thrips) were involved in the yield loss (no yield increase in the absence of *Dectes* stem borer pressure). At normal harvest, the grain yield loss between treated and untreated seed can be attributed to insect damage associated with insect tunneling in the plant (physiological yield loss) because there was very little lodging at normal harvest. At the GC north location, there was a 6.5 bu/a yield difference between the treated and untreated plots at normal harvest. At late harvest, the grain yield losses between treated and untreated plots could be due to a combination of physiological yield losses, delay/shattering yield losses, and lodging yield losses. There was a yield loss of 4.1 bu/a for treated seed between normal and late harvest (Figure 4). This loss can be attributed to harvest delay because these plots were protected from *Dectes* damage. There was a 7.3 bu/a yield loss for untreated seed between normal and late harvest (Figure 4). This loss can be attributed to both harvest delay and plant lodging. Therefore, we can subtract the delay losses (from treated seed) from the combined losses (from untreated seed) to determine lodging losses, which turn out to be 3.2 bu/a, or 5.0% (Table 2). These results reveal a significant physiological yield loss of 10.2% and a plant lodging loss of 5.0% associated with *Dectes* stem borer infestations (Table 3, Figure 4). Similar results from Scandia reveal a significant physiological yield loss of 8.2% and a plant lodging loss of 2.9% (Table 3, Figure 2 in the Scandia article; this report, p. 80). For soybean variety 93M92, girdling started in early October, and the percentage of plants girdled increased rapidly during October, reaching 50% by about November 5 (Figure 5). After that, the increase in girdling slowed and reached a maximum of 78.5% by the end of December.

Fipronil seed treatment could be a useful technology to protect soybean grain yield from *Dectes* stem borer, but it is not yet registered for use on soybean. Timely harvest is also successful in reducing grain yield loss caused by lodging and pod shattering.

Table 1. Treatment means, percentage of control, and F-test probability values for ANOVA tests for the two main effects, insecticide treatment and harvest time, Garden City South, 2008

	Thrips	Entry nodes	Stem tunneling	Base tunneling	Live larvae	Grain yield
	per 10 plants	----------------	per 20 plants	----------------		bu/a
ANOVA F-test probability						
Insecticide treatment	0.0010	0.0073	0.0045	0.0104	0.0045	0.1139
Insecticide treatment means						
Untreated	246	5.8a	4.6a	2.2a	3.9a	76.8
Treated	99	0.0a	0.0b	0.0b	0.0b	74.3
% Control/Yield increase	60%	100%	100%	100%	100%	–

Fipronil treatment was applied as a seed treatment.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

Table 2. Treatment means, percentage of control, and F-test probability values for ANOVA tests for the two main effects, insecticide treatment and harvest time, Garden City North, 2008

	Thrips	Entry nodes	Stem tunneling	Base tunneling	Live larvae	Grain yield
	per 10 plants	----------------	per 20 plants	----------------		bu/a
ANOVA F-test probability						
Insecticide treatment	0.0026	0.0001	< 0.0001	< 0.0104	< 0.0001	0.0003
Harvest timing	–	–	–	–	–	< 0.0003
Insecticide × harvest	–	–	–	–	–	0.1692
Insecticide treatment means						
Untreated	329a	19.5a	8.4a	5.8a	6.9a	60.3b
Treated	131b	0.5b	0.3b	0.1b	0.2b	68.4a
% Control/Yield increase	60%	97%	96%	98%	97%	13.4%
Harvest timing treatment means						
Normal	–	–	–	–	–	67.2a
Late	–	–	–	–	–	61.5b
% Control/Yield increase						8.5%

Fipronil treatment was applied as a seed treatment.
Within columns, means followed by the same letter are not significantly different ($P < 0.05$).

Table 3. Dectes stem borer yield damage components at Garden City North, 2008

Yield loss components	Garden City	
	bu/a	% NH UT
Physiological loss		
(TR NH) – (UT NH)	-6.5	-10.2
Delay (D)		
(TR NH) – (TR LH)	4.1	6.4
Delay and lodging (D&L)		
(UT NH – (UT LH)	7.3	11.4
Lodging		
(D&L) - D	3.2	5.0
Total losses		
(TR NH) –UT LH)	13.8	21.6

TR = treated; UT = untreated; NH = normal harvest; LH = late harvest, D = delay losses, D&L = delay and lodging losses.

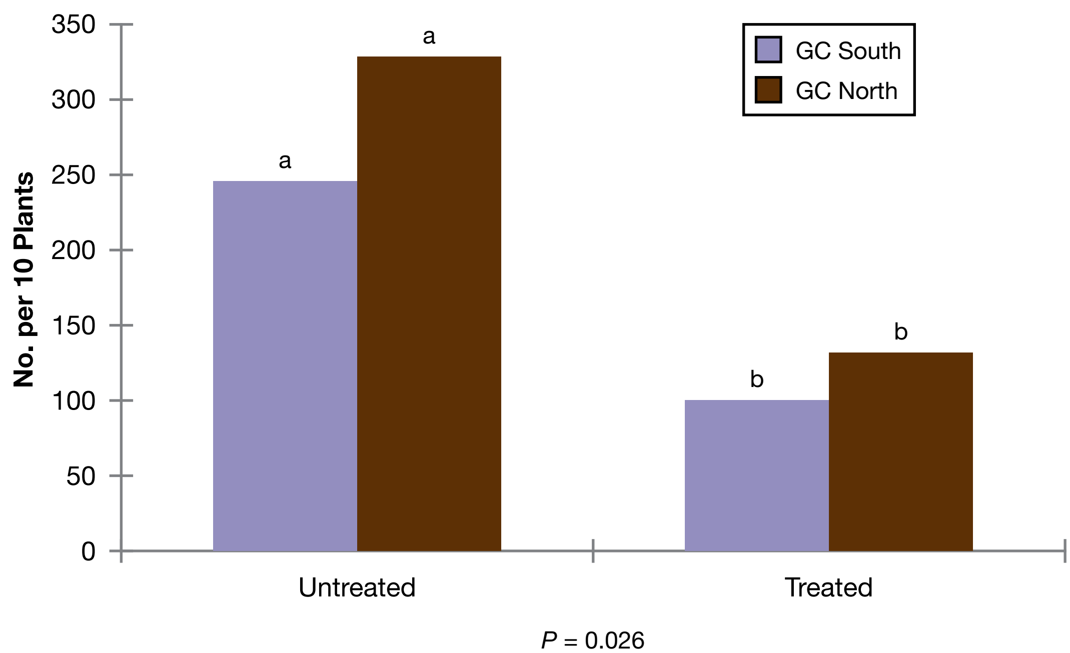
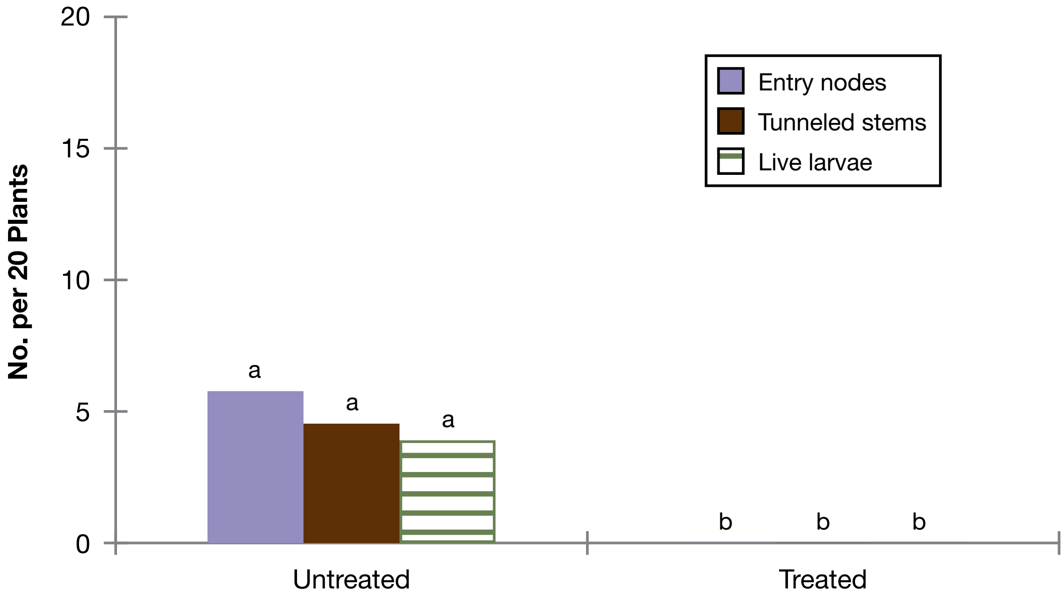
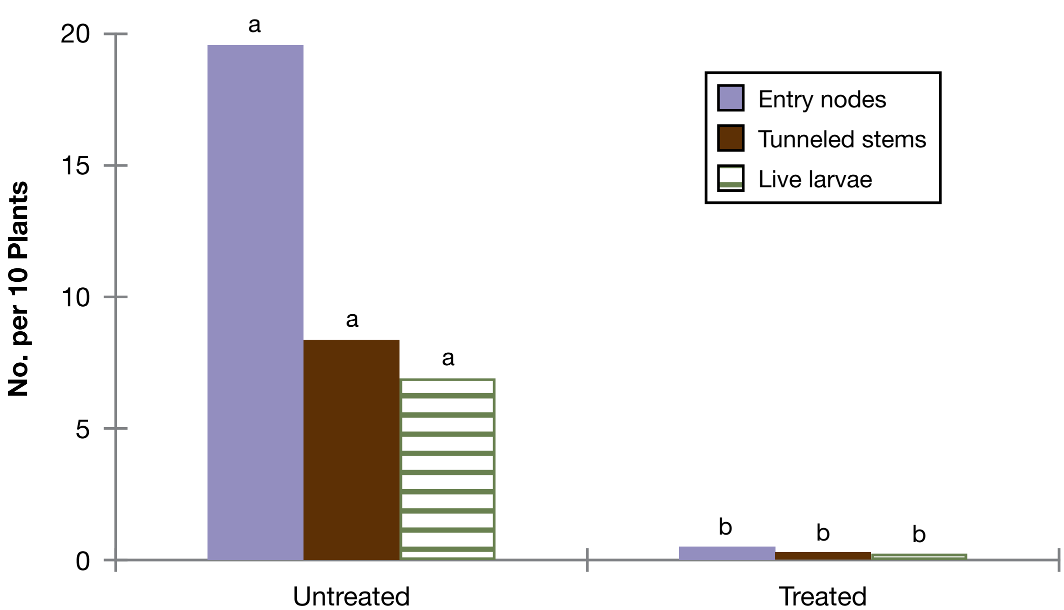


Figure 1. Thrips per 10 plants at Garden City South and Garden City North, 2008.



All observations are significantly different at $P < 0.0001$

Figure 2. Mean numbers for several *Dectes* stem borer observations (entry nodes, tunneled stems, and live larvae) per 20 plants at Garden City South, 2008.



All observations are significantly different at $P < 0.0001$

Figure 3. Mean numbers for several *Dectes* stem borer observations (entry nodes, tunneled stems, and live larvae) per 10 plants at Garden City North, 2008.

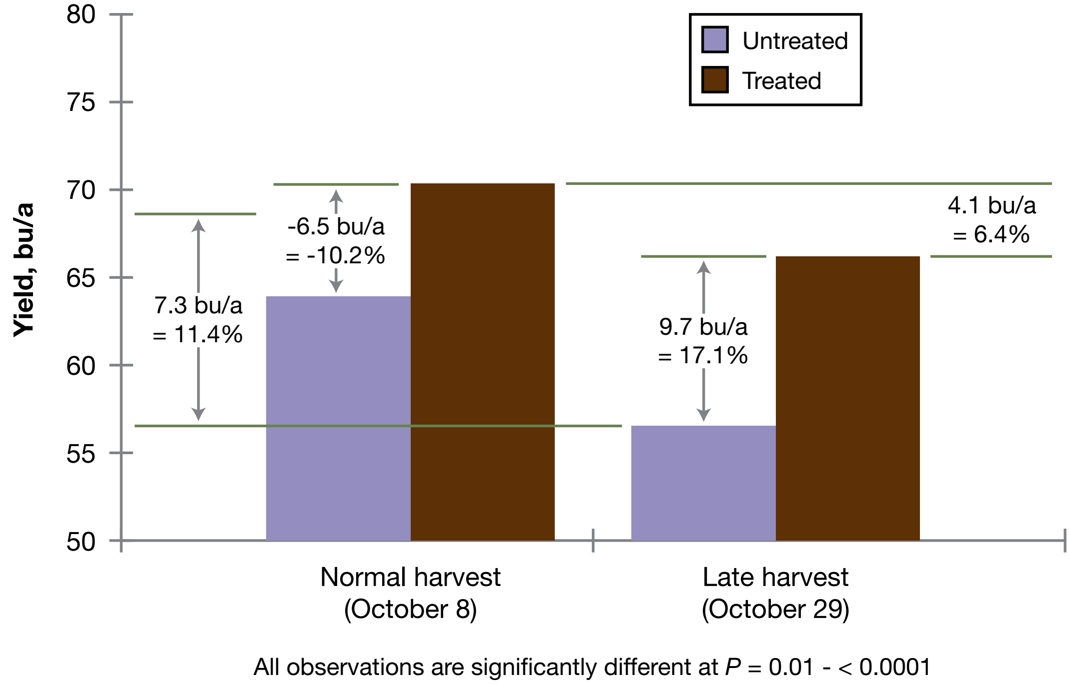


Figure 4. Grain yield at two harvest dates for treated and untreated soybean together with calculated differences used to calculate the *Dectes* stem borer yield damage components at Garden City North, 2008.

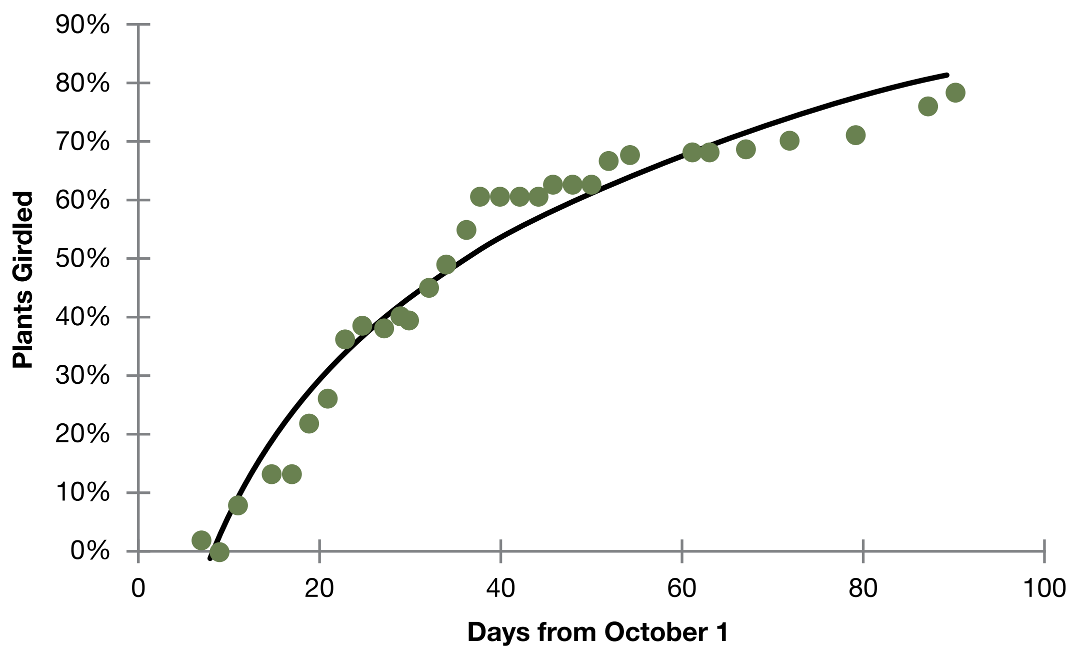


Figure 5. Percentage of plants girdled by the *Dectes* stem borer over time at the end of the season compared with the logarithmic trend line, Garden City North, 2008.

FIELD DAY 2009

Chemical Disclaimer
Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Experiments with pesticides on nonlabeled crops or target species do not imply endorsement or recommendation of nonlabeled use of pesticides by Kansas State University. All pesticides must be used consistent with current label directions. Current information on weed control in Kansas is available in *2009 Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland*, Report of Progress 1007, available from the Distribution Center, Umberger Hall, Kansas State University, or on the World Wide Web at: ***www.ksre.ksu.edu/library*** (type Chemical Weed Control in search box).

Publications from Kansas State University are available on the World Wide Web at: ***www.ksre.ksu.edu***

Some staff photos on inside covers by Dave Dunn, K-State Research and Extension

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

SRP 1014 June 2009