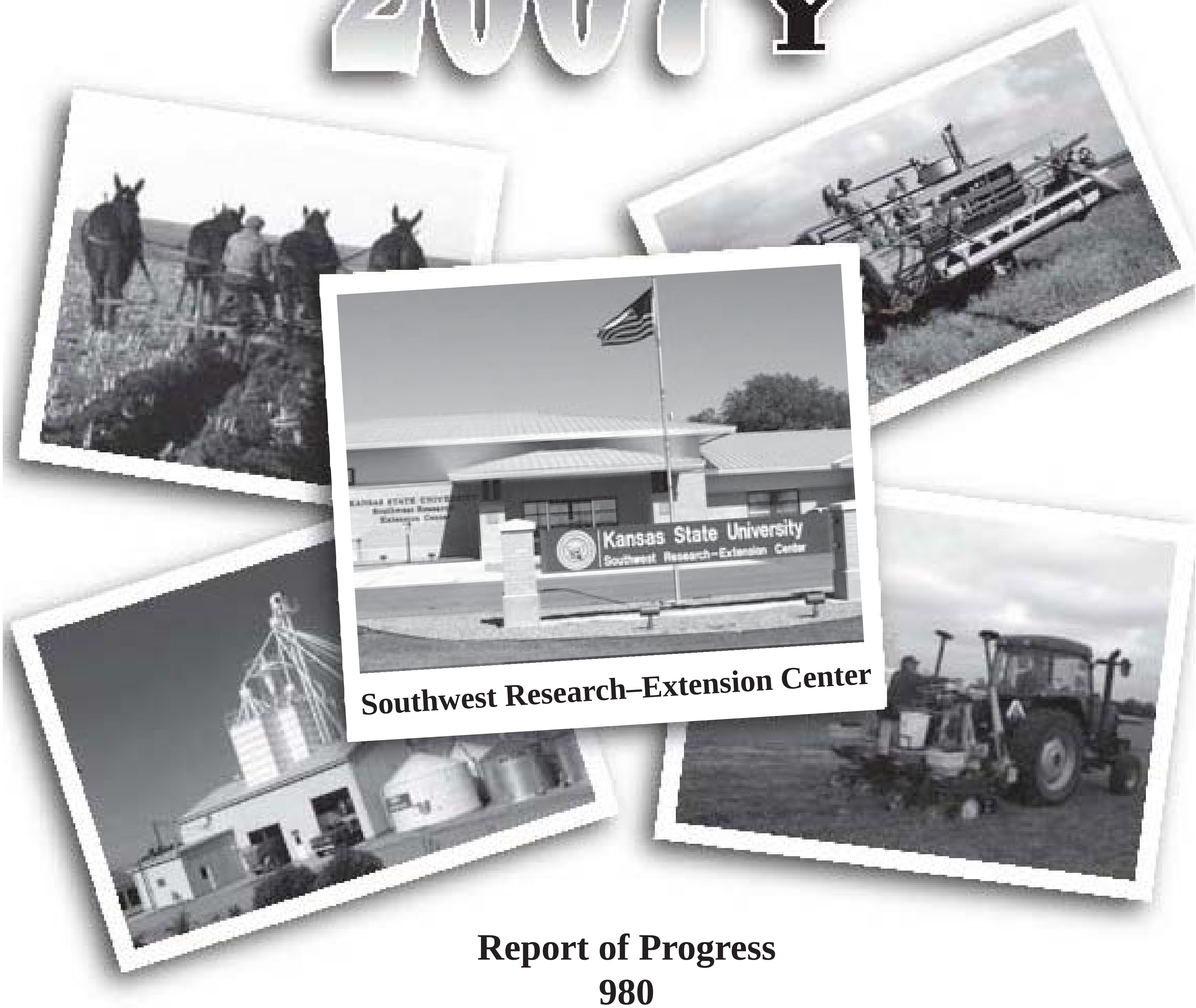
FIELD DAY 2007



Southwest Research–Extension Center

Report of Progress
980

Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service

EFFICACY OF FIPRONIL APPLIED AS A FOLIAR TREATMENT ON SIX COMMERCIAL SOYBEAN VARIETIES TO CONTROL DECTES STEM BORERS IN SOYBEAN, SCANDIA, KS, 2006

by

Larry Buschman, Teru taka Niide[1], William Schapaugh[2], and Barney Gorden[3]

SUMMARY

We tested a foliar fipronil insecticide treatment applied to six soybean varieties to determine effectiveness in reducing Dectes stem borers (Dectes texanus) in soybean. The foliar application of fipronil significantly reduced Dectes stem borer infestations between 76% and 88%. However, these treatments increased yield only 2.9%, and this was not statistically significant. Dectes stem borer infestation averaged 55% infested plants.

PROCEDURES

Seed of six commercial soybean varieties in maturity groups II through to IV was machine-planted at 16 seed per row-foot on May 17, 2005, at the irrigation experiment field near Scandia,. The plots were four rows wide and 20 feet long. There was a 3-foot-wide alley at each end of the plot. The design was a randomized block experiment with three replications. There was a treated and untreated plot of each variety in each replication. The foliar treatment of fipronil was applied July 18 during the beetle flight. This treatment targeted the first two instars developing inside the plants. The foliar treatment was applied with a backpack sprayer, using a hand-held boom with two nozzles (Conejet TXVS 6) directed at a single row. The nozzles were held 6-8 inches from the plants to maximize coverage of the upper canopy. The sprayer was calibrated to deliver 20 gal/acre (8.0 sec per 20 ft row at 30 psi). A chronometer was used to measure the time spent on each row to help maintain appropriate speed. The experiment was analyzed as a two-factor experiment with six levels of variety and two levels of treatment.

Dectes stem borer infestations were recorded at the end of the season (September 22) by dissecting five consecutive plants from each of the four rows in each plot for a total of 20 plants. The plants were dissected to record entry nodes, upper stem tunneling, tunneling that reached the base of the plant, and presence of live Dectes larvae. Grain yield data was collected by machine harvesting the plots October 12 and converted to bushels per acre based on 12% moisture.

RESULTS AND DISCUSSION

Dectes stem borer infested 55% of plants in 2006. This was similar to the infestation of 2004, when we were able to show yield responses with fipronil treatment. In this 2006 trial, the fipronil treatment significantly reduced Dectes stem borer infestations (81%, 78%, 82% and 88% for entry nodes, stem tunneling, base tunneling and live larvae, respectively; Table 1). However, the fipronil treatment only increased grain yield 2.9%, and this was not a significant increase. There were some significant differences in Dectes infestation across the different varieties, but there was no significant yield difference across the varieties. This was surprising because there was such a wide difference in maturity across the varieties. The 2006 results suggest there was no physiological yield loss associated with Dectes stem borer infestations. We were not able to show differences in tolerance of the different varieties to Dectes stem borer infestations.

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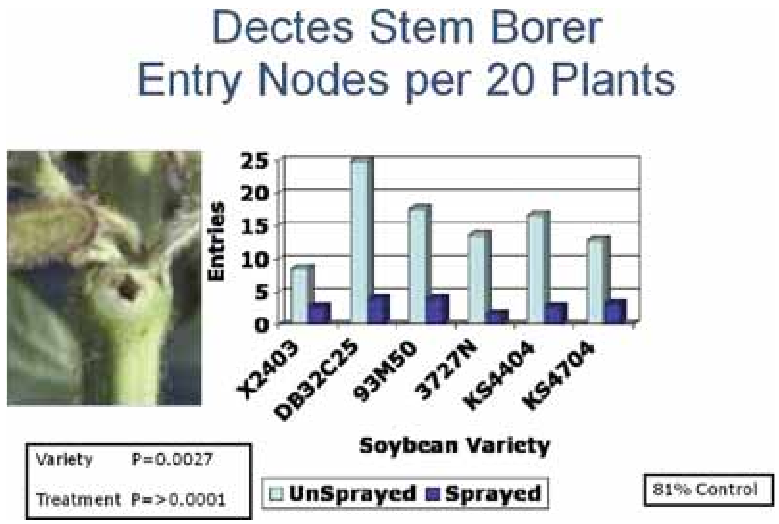
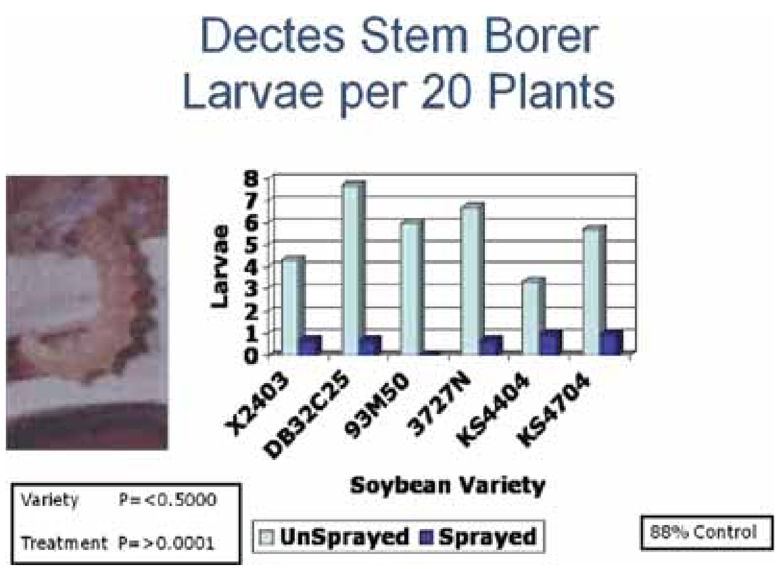

Dectes Stem Borer
Entry Nodes per 20 Plants
Entries
25
20
15
10
5
0
X2403
DB32C25
93M50
3727N
KS4404
KS4704
Soybean Variety
Variety P=0.0027
Treatment P=>0.0001
UnSprayed Sprayed
81% Control


Dectes Stem Borer
Larvae per 20 Plants
Larvae
8
7
6
5
4
3
2
1
0
X2403
DB32C25
93M50
3727N
KS4404
KS4704
Soybean Variety
Variety P=<0.5000
Treatment P=>0.0001
UnSprayed Sprayed
88% Control

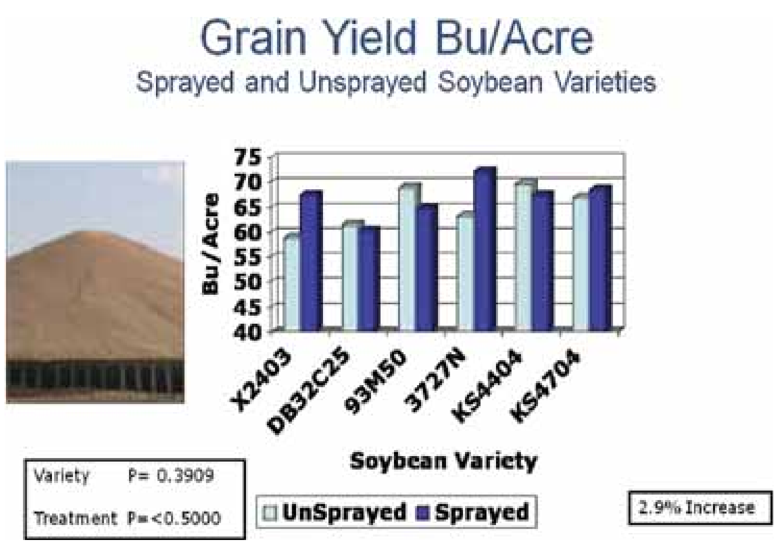

Grain Yield Bu/Acre
Sprayed and Unsprayed Soybean Varieties
Bu/Acre
75
70
65
60
55
50
45
40
X2403
DB32C25
93M50
3727N
KS4404
KS4704
Soybean Variety
Variety P= 0.3909
Treatment P=<0.5000
UnSprayed Sprayed
2.9% Increase

Table 1. F-test Probability values for the ANOVA tests of the two main effects, variety and insecticide treatment. Fipronil treatments were applied as foliar treatments. Irrigation Experiment Field, Scandia, Kansas, 2006.

	Soybean Maturity Group	Entry Nodes /20 plants	Stem Tunneling /20 plants	Base Tunneling /20 plants	Live Larvae /20 plants	Grain Yield Bu/Acre
ANOVA F-Test Probability						
Replication		**0.001**	**0.0191**	0.0669	0.0566	**0.0383**
Variety		**0.0027**	0.3505	**0.0087**	<0.5000	0.3909
Insecticide		**>0.0001**	**>0.0001**	**>0.0001**	**>0.0001**	<0.5000
V x I Interaction		**0.0175**	<0.5000	**0.0465**	<0.5000	<0.5000
Variety Means—Untreated						
Nex2403K2RR	Mid II	8.7	7.3	4.7	4.3	58.9
Dyna-GroDB32C25	Early III	25.0	12.7	2.3	7.7	61.4
Pioneer 93M50	Mid III	17.7	13.3	2.0	6.0	69.0
Ohlde 3727NRS	Late III	13.7	10.3	8.0	6.7	63.2
KS4404RR	Early IV	16.7	12.0	6.0	3.3	69.7
KS4704RR	Mid IV	13.0	9.7	5.3	5.7	66.9
Mean		15.8	10.9	4.7	5.6	64.85
Variety Means—Fipronil—Treated						
Nex2403K2RR	Mid II	2.7	2.7	1.0	0.7	67.5
Dyna-GroDB32C25	Early III	4.0	3.0	1.0	0.7	61.4
Pioneer 93M50	Mid III	4.0	3.0	0.0	0.0	69.0
Ohlde 3727NRS	Late III	1.7	1.0	1.0	0.7	63.2
KS4404RR	Early IV	2.7	2.7	1.0	1.0	69.7
KS4704RR	Mid IV	3.3	2.3	1.0	1.0	66.9
Mean		3.06	2.5	0.8	0.7	66.76

EFFICACY OF SYSTEMIC INSECTICIDES APPLIED AS FOLIAR OR SEED TREATMENTS TO CONTROL DECTES STEM BORERS IN SOYBEAN AT GARDEN CITY, KS, 2006

by
Larry Buschman, Larry Buschman, Holly Davis[1], Randal Currie and Phil Sloderbeck

SUMMARY

We tested systemic insecticides applied as seed treatments for their effectiveness in reducing Dectes stem borers (Dectes texanus) in soybean. Fipronil was applied to the foliage later in the season as a positive check based on previous studies. Of the seed treatments tested, only fipronil significantly reduced Dectes stem borer infestations, but it gave 100% control. The foliar application of fipronil also significantly reduced Dectes stem borer infestations, but it gave 85% control. Dectes stem borer infestation averaged 34% infested plants.

PROCEDURES

Soybean seed (Pioneer 93B85, maturity group 3.8) was machine-planted at 10 seeds per row-foot on May 27, 2006, in a half circle of irrigated soybeans of the same variety on the Ramsey Brothers Farm four miles north of Garden City, Kansas. A quantity of seed was sent to be treated with the seed treatments. Other seed without seed treatments was saved and planted in plots designated to receive foliar treatments later in the season or to serve as check plots. The plots were four rows wide and 20 feet long. There was a 3-foot-wide alley at each end of the plot. The original design was compromised when some plots were over-sprayed with insecticides later in the season, so the experiment was analyzed as a completely randomized experiment. We analyzed only those treatments with three or four surviving plots together with 14 check plots and 14 plots receiving the foliar fipronil treatment. The foliar treatment of fipronil was applied August 3, after the plants had recovered from hail damage. This treatment targeted the first two instars of the insect developing inside the plants. The foliar treatment was applied with a backpack sprayer, a hand-held boom, and two nozzles (Conejet TXVS 6) directed at a single row. The nozzles were held 6-8 inches from the plants to maximize coverage of the upper canopy. The sprayer was calibrated to deliver 20 gal/acre (8.0 sec per 20 ft row at 30 psi). A chronometer was used to measure the time spent on each row to help maintain appropriate speed. For statictical analysis, we used multiple t-test comparisons of the least square means (LSMeans) produced with the SAS-GLM procedure. LSMeans were compared with the check LSMean.

Dectes stem borer beetle populations were estimated by making 100 sweeps across the plants in single rows. Sweep samples were made at irregular intervals during the flight and the numbers were plotted to determine the relationship between the treatment timing and the beetle flight. Dectes larval infestations were recorded at the end of the season (September 18-20) by dissecting 20 plants in each plot. Five consecutive plants were taken from each of the four rows in each plot. The plants were dissected to record entry nodes, upper stem tunneling, tunneling that reached the base of the plant, and presence of live Dectes larvae. When dissected, plants showed very few larvae had tunneled to the base of the plant, so that variable is not reported. Grain yield data was not collected because infestations were low and the plants had been heavily damaged by a hail storm.

RESULTS AND DISCUSSION

Dectes stem borer populations were lower in 2006 than in 2005. On July 11, a hail storm seriously defoliated the soybeans. This defoliation not only damaged plants, but also knocked off many leaf petioles in which the Dectes beetles had oviposited, thus reducing the potential infestation. The hail also broke or bruised the stems, making it difficult for the larvae to tunnel to the base of the plants. Although the plants recovered, the resulting plants were smaller, later maturing, and more branched than normal. The plants were almost a month late in developing the larger petioles that are attractive to the Dectes beetles. This meant most of the plants escaped Dectes infestation. The Dectes infested an average of 34% of the plants. The delayed development of

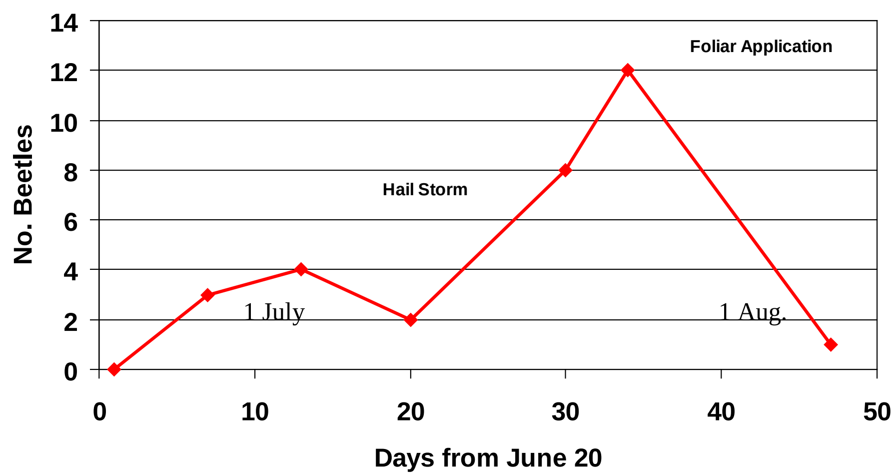
[1] Department of Entomology, Kansas State University, Manhattan

the Dectes infestation also made it difficult to time the foliar treatment.

Of the seed treatments tested, only fipronil appeared to suppress the Dectes stem borer. It gave 100% control, significantly reducing Dectes stem borer infestations (Table 1). The foliar treatment of fipronil also gave a significant (69-85%) control of the Dectes stem borer. It was clear that the timing of the foliar application was late, because many of the larvae had begun tunneling in the main stem, but were killed there. The fipronil treatment was able to kill larvae tunneling in the main stem and thus prevent them from girdling the plants later in the season. It is hoped the fipronil seed treatments can be registered for use in soybean production, because it appears to be an extremely effective treatment option for the Dectes stem borer.

In 2004, we were able to show a significant difference in yield (4.6 to 6.6 bu/acre) for the fipronil treatments. However, we were not able to take yield data in this trial due to the heavy hail damage and resulting low infestation rate.

Fig 1. Dectes Stem Beetles in 100 sweeps in soybeans 2006



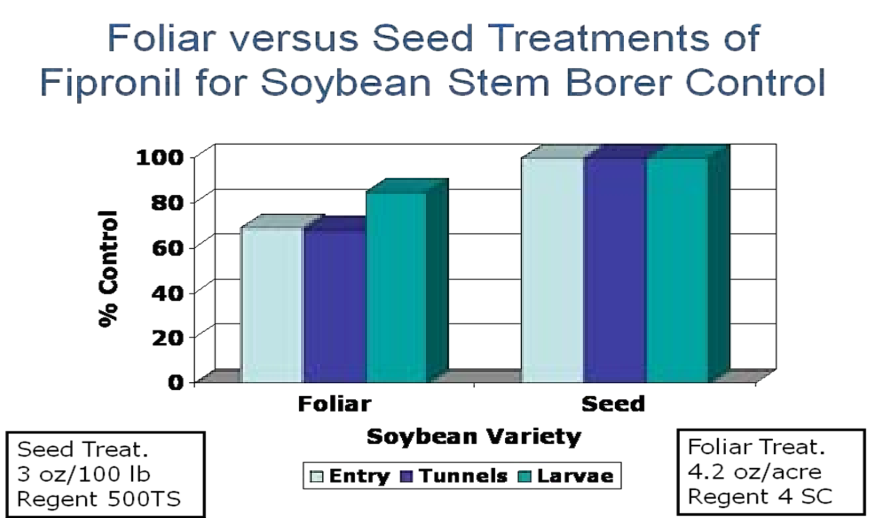


Table 1. F-test Probability values for the ANOVA tests of the two main effects, variety and insecticide treatment. Fipronil treatments were applied as foliar treatments. Irrigation Experiment Field, Scandia, Kansas, 2006.

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KS4404RR	Early IV	2.7	2.7	1.0	1.0	69.7
KS4704RR	Mid IV	3.3	2.3	1.0	1.0	66.9
Mean		3.06	2.5	0.8	0.7	66.76

CROP YIELD IMPROVEMENTS OVER THE PAST 50 YEARS AS MEASURED BY SWREC CROP PERFORMANCE RESULTS

by
Curtis Thompson and John Holman

SUMMARY

The greatest crop improvements over the past 50 years clearly have occurred in irrigated corn hybrid development. In addition to hybrid improvement, increasing plant populations and improving weed and insect control have been contributors to the increased yields. Irrigated and dryland wheat improvements have trended upward, but year-to-year yield variability continues to plague wheat. Hot temperatures during grain fill, spring freezes, rust, and hail contribute to the variability. In addition, seasonal precipitation variation contributes to variability in dryland wheat varieties. These environmental challenges likely mask yield improvements made in wheat varieties. Irrigated grain sorghum has consistently yielded 100 to 140 bu/a and has a flat yield trend since 1956. Standability and yield potential have been improved, allowing irrigated sorghum growers to harvest standing grain sorghum. Dryland grain sorghum has had a slight upward trend. Hybrid development and improved farming practices contribute to this yield increase. Irrigated soybeans also have a slight upward yield trend. Variety/hybrid performance tests have and will continue to assist the producer making decisions of what varieties or hybrids should be planted. It is always most important to plant more than one variety or hybrid, as well as more than one crop, to minimize production risk due to environmental and economic conditions.

PROCEDURES

Crop variety/hybrid performance tests, irrigated corn, irrigated wheat, dryland wheat, irrigated grain sorghum, dryland grain sorghum, and irrigated soybeans have been conducted at the SWREC annually over the past 50 years. For each crop, the varieties/hybrids yields were averaged for each year from 1956 through 2006. These trial averages were regressed against year to measure the level of crop yield improvement throughout the 50-year period.

RESULTS AND DISCUSSION

Advancements in irrigated corn yields since 1956 have exceeded all other crops evaluated during the same period of time at the SWREC. Regression analysis of the irrigated corn performance test averages predicts that irrigated corn yields have increased 2.2 bu/a/year (Figure 1). The development of corn hybrids, as well as fertility, plant population increases, improved weed control practices, and genetically modified organism GMO corn borer resistance have all contributed to the increased corn yields. Annual average yields are shown on Figure 1. The lowest average yields were less than 100 bu/a in 1956 and 1957, while the two highest average yields occurred in 2002 and 2003 (both exceeding 250 bu/a).

Irrigated wheat has had a slight upward trend over the 50-year period (Figure 2). The regression predicts wheat yield improvements of 0.28 bu/a/year from 1956 through 2006. Although huge improvements have been made on wheat standability, earlier maturity, disease resistance, and variety yield potential, environmental conditions continue to control wheat yields, resulting in significant year-to-year variation. High temperatures during grain fill, freeze damage, rust, and hail contribute to low-yielding years. Omitting the zero yielding years, two years had average yields of less than 30 bu/a and two years have had average yields exceeding 80 bu/a.

Dryland wheat, like irrigated, has had a similar upward trend of 0.25 bu/a/yr (Figure 3). Growing-season precipitation variability, along with spring freezes, high temperatures during grain fill, rust, and hail contribute to large variability in dryland wheat yields masking the true increase in wheat variety yield potential improvement. The long term yields indicate that we raise wheat in a harsh environment. In only 17 years since 1956 has the dryland wheat variety trial averaged more than 40 bu/a. In fact, 12 years have had average yields of 20 bu/a or less. This includes 1967, 1979, 1987, and 1996, when the dryland wheat variety trial was abandoned.

Irrigated grain sorghum yield does not trend upward but remained flat from 1956 through 2006 (Figure 4). The excellent yields in the 1950s and '60s perhaps were higher than farmer yields because plots were primarily hand harvested. Varieties and hybrids at that time were prone to lodging, which significantly reduced the amount of crop a producer could machine harvest. Improvements have been made in sorghum standability and hybrids have been shortened in height. They also possess improved stalkrot resistance, which has allowed producers to harvest standing irrigated grain sorghum, resulting in increased harvested yields. Greater variation in sorghum yield has occurred since 1983. Four years of the irrigated sorghum hybrid trials have been abandoned, including three years to hail (1967, 1979, and 1992) and one to freeze (1983) . It is amazing that the irrigated hybrid sorghum yield averages have equaled or exceeded 100 bu/a in all but four years that yield data has been collected; yet, in only three years did the average irrigated sorghum yield exceed 140 bu/a. From 1957 through 2006, irrigated sorghum has consistently yielded 100 to 140 bu/a.

Dryland grain sorghum (conventional tilled sorghum/fallow) yield has trended upward 0.67 bu/a/year (Figure 5). The trend is a result of hybrid improvements for dryland, as well as improved farming practices for fertility and weed control. Since 1990, the occurrence of average yields exceeding 80 bu/a has increased. Like dryland wheat, year-to-year variation is high due to variability in precipitation and other environmental challenges, such as hail.

Irrigated soybean yields have had a slight upward trend of 0.22 bu/a/year (Figure 6). In 1984, the soybean variety trail was split into Group II & III or Group IV bean experiments and remained in that format until 2002. Data in Figure 6 from the periods prior to 1984 and after 2001 include all groups of soybean varieties. The Group IV bean variety averages remained flat from 1984 through 2001 (Figure 7).

Variety/hybrid performance tests have and will continue to assist the producer making decisions about what varieties or hybrids should be planted. It is always most important to plant more than one variety or hybrid, as well as more than one crop, to minimize production risk to environmental and economic conditions.

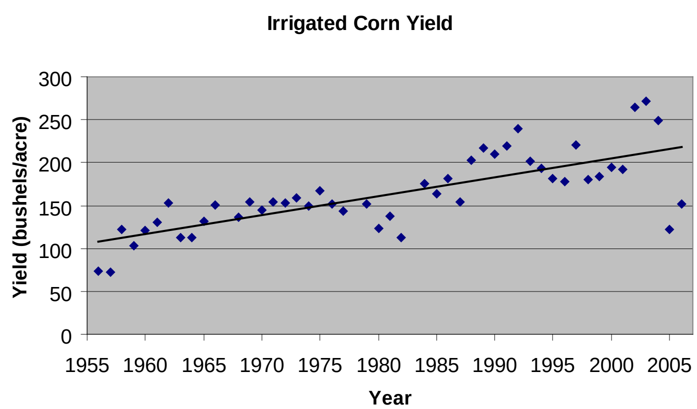

Figure 1. Irrigated Corn Yield. Yield increased 2.2 bu/year (P<0.0001)

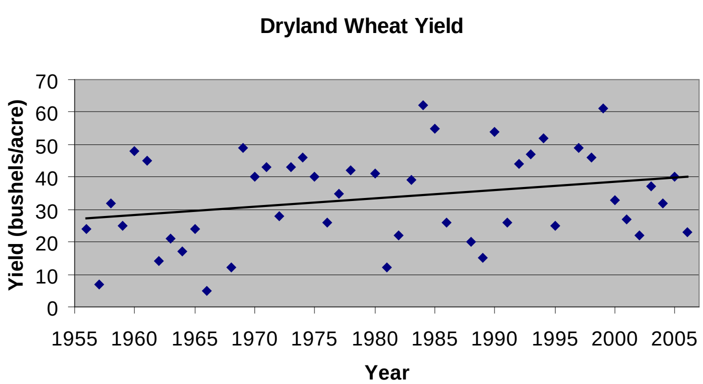

Figure 3. Dryland Wheat Yield. Yield increased 0.25 bu/year (P<0.07).

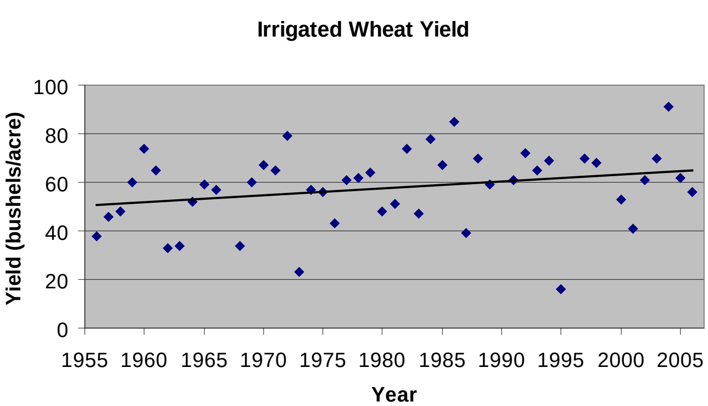

Figure 1. Irrigated Wheat Yield. Yield increased 0.28 bu/year (P<0.07)

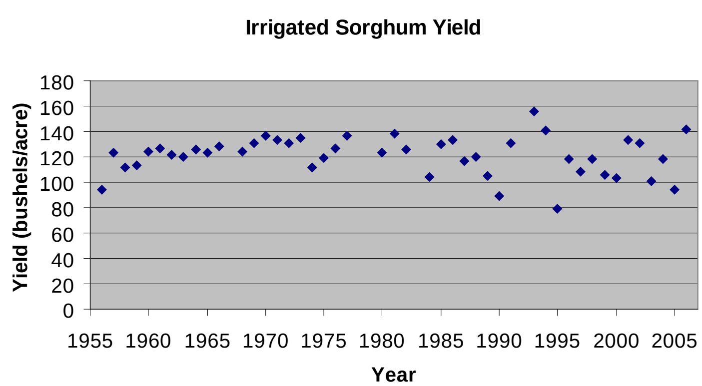

Figure 4. Irrigated Sorghum Yield. Irrigated sorghum yield averaged 121 bu/year.

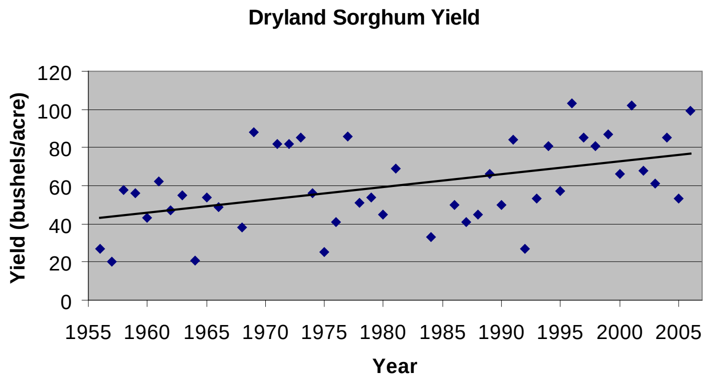

Figure 5. Dryland Sorghum Yield. Yield increased 0.67 bu/year (P < 0.001).

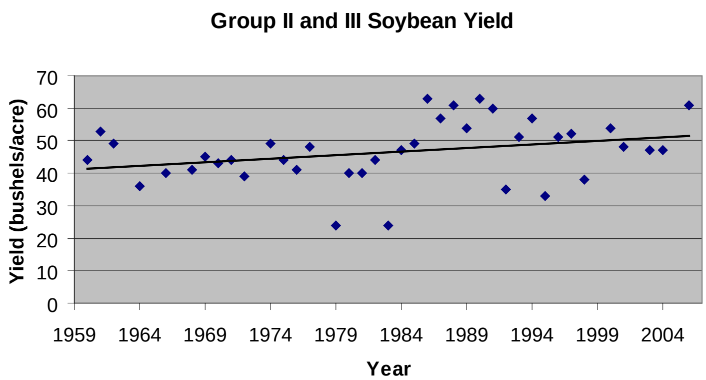

Figure 6. Group II and III Irrigated Soybean Yield. Yield increased 0.22 bu/year (P < 0.06).

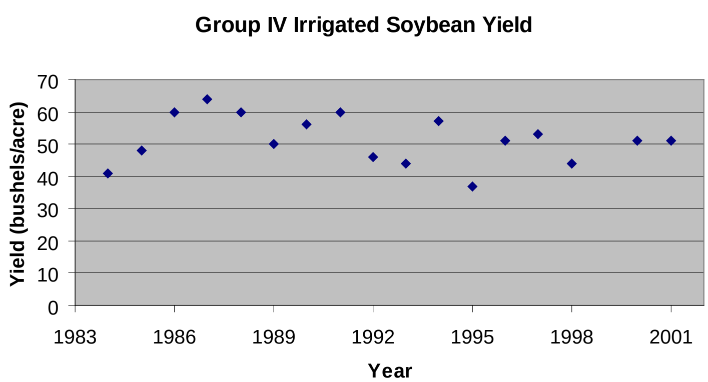

Figure 7. Group IV Irrigated Soybean Yield. No change in Group IV irrigated soybean yield, yield averaged 51.4 bu/acre.

ACKNOWLEDGMENTS

The staff of the Southwest Research-Extension Center and Kansas State University appreciate and acknowledge the following companies, foundations, and individuals for their support of the research that has been conducted during the past year.

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DeKalb Genetics Corp.

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Evans Enterprises

Fluid Fertilizer Foundation

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Kansas Dept. of Wildlife & Parks

Kansas Fertilizer Research Fund

Kansas Grain Sorghum Commission

Kansas Livestock Association

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W-L Research

Z-Public

Notes

Jeff Elliott—Research Farm Manager. Jeff received his B.S. from the University of Nebraska. In 1984, Jeff began work as an Animal Caretaker III and was promoted to Research Farm Manager in 1989.

John Holman—Cropping Systems Agronomist. John received his B.S. and M.S. from Montana State University and his Ph.D. from the University of Idaho. He joined the staff in 2006. His research involves crop rotations, forages, and integrated weed management.

Norman Klocke—Water resources engineer. Norm received B.S. from the University of Illinois, his M.S. from the University of Kansas, and his Ph.D. from Colorado State University. He joined the staff in 2001. His research emphasis includes limited irrigation, water conservation, and leaching.

Alan Schlegel—Agronomist-in-Charge, Tribune. Alan received his M.S. and Ph.D. degrees at Purdue University. He joined the staff in 1986. His research involves fertilizer and water management in reduced tillage systems.

Phil Sloderbeck—Extension Entomologist. Phil received his M.S. from Purdue University and his Ph.D. from the University of Kentucky. He joined the staff in 1981. His extension emphasis is on insect pests of field crops.

Curtis Thompson—Extension Agronomist. Curtis received his M.S. from North Dakota State University and his Ph.D. from the University of Idaho. He joined the staff in 1993. His extension responsibilities include all aspects of soils and field crop production.

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan 66506

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