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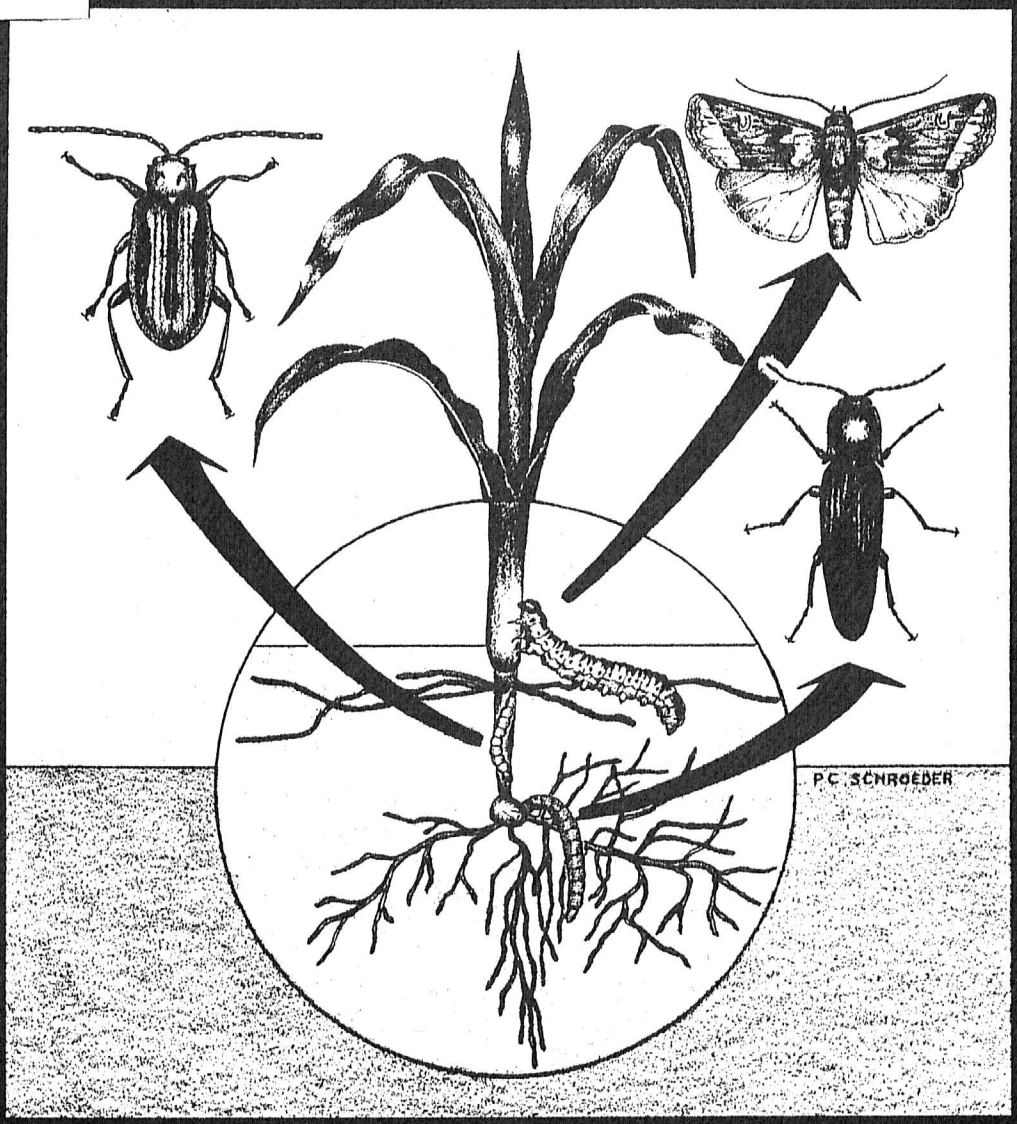
Corn Soil Insects Research

1996 Insecticide Evaluations



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Special Report 499

11/96/400

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ACKNOWLEDGMENT

The authors wish to acknowledge the assistance of Mary Jackson, Merita Nettles, Rita Gerke, and George Laur in the typing and preparation of this report. The authors are indebted to José Cardozo, and Mary Jackson for their assistance in plot preparation, maintenance, and evaluations. We also thank the farmer-cooperators who provided test sites within their production fields and time to prepare sites for planting, and to numerous industry representatives for their cooperation and support. Appreciation is expressed to Peter Schroeder for the cover drawing.

CORN SOIL INSECTS RESEARCH
1996 INSECTICIDE EVALUATIONS

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Soil insecticide evaluations were conducted to compare the relative efficacy of labeled and experimental compounds for control of corn soil insect pests. This report presents data on the efficacy of compounds for control of western and northern corn rootworms (*Diabrotica virgifera virgifera* [LeConte] and *D. barberi* [Say]), black cutworm (*Agrotis ipsilon* [Hufnagel]), and wireworms (*Melanotus spp.*).

This report and the data contained within are presented for purposes of information only to agribusiness industries, University of Missouri extension and research personnel, and to interested university extension and research personnel at other Midwestern institutions. The data do not reflect nor constitute a recommendation of specific compounds. The 10-year comparisons of performance for rootworm compounds do, however, provide a basis for comparison of efficacy for control over a period of time. For additional information and specific recommendation for control of corn soil insects, see the current issue of the Handbook for the Management of Insects and Plant Diseases, MU Agricultural Guides 4150 (Corn Cutworm Control), 4151 (Corn Rootworm Control), 4154 (Control of Wireworms and Other Corn Soil Insects), and 4906 (Soil Insect Control in Reduced Tillage Cropping Systems).

ROOTWORM INSECTICIDE EVALUATIONS

Insecticide evaluations for rootworm control were conducted at two locations - near Glasgow in Howard County and near Maitland in Nodaway County. The plots near Glasgow were part of an 80-acre field that has been in continuous corn for more than 10 years. Plots at Maitland were in a 6-acre continuous corn block located along one side of a corn/soybean production field planted to corn in 1995.

A two-row John Deere model 7100 max-emerge planter with a mounted V-belt seeder was used for 7-inch band (7"B) and in-furrow (IF) granular applications. Preweighed insecticide granules were placed uniformly along the V-belt seeder and directed through banders or tubes to obtain the desired placement.

The Furadan 4F spray treatments were applied through a tractor-mounted compressed-air system, calibrated to deliver 18 gallons of finished spray at 35 psi. Regent 80WG was also applied through the tractor-mounted compressed air system, calibrated to deliver 1 gallon of finished spray at 35 psi. The Lorsban 4E spray treatments were applied through a tractor-mounted 12-volt pump system calibrated to deliver 9.5 gallons of finished product at 18 psi. Smartbox treatments were applied in a 7-inch band or in-furrow. Insecticides were metered through a computer module calibrated before field application.

Insecticides were applied to two 35-foot rows and replicated according to a randomized complete block design. Test 1 was replicated four times and Test 2 six times at both locations. Test 3 was replicated four times at the Glasgow location and three times at the Maitland location. Seeds at the rate of 22,100 per acre were planted in 30-inch rows at a depth of 1.5 to 2.0 inches at the same time the insecticides were applied. A 15-foot alleyway separated each replication. There were two untreated border rows between each treatment in Test 2 at Maitland. The fields were planted under reduced tillage conditions with approximately 20 to 30 percent residue on the surface.

Efficacy of treatments within Test 1 and 3 was determined by digging 16 plants from each treatment. Test 2 was evaluated by digging 24 plants from each treatment (four per replication). Corn roots were washed free of dirt and evaluated as follows:

A. General Root Rating - The entire root system was taken into consideration when assigning a rating according to the amount of visible rootworm damage. The ratings were assigned as follows: 1) no feeding damage, 2) light feeding damage with pruning, 3) occasional pruning, 4) moderate to severe pruning (one node of roots destroyed), 5) severe pruning (two nodes of roots destroyed), and 6) three nodes of roots destroyed.

B. Damaged Root Rating - The percentage of the roots showing rootworm damage in the second and third nodes below ground level was estimated and assigned to five categories as follows: 1) no injury, 2) 1-25%, 3) 26-50%, 4) 51-75%, and 5) 76-100%.

C. Pruned Root Rating - The same root systems evaluated under A and B were rated where only the percent of the roots pruned in the second and third nodes below ground level were estimated. Ratings were as follows: 1) no pruning, 2) 1-25%, 3)26-50%, 4) 51-75%, and 5) 76-100%.

D. Combined Analysis Rating - The combined analysis rating is the average of the pruned root rating and damaged root rating. Only the general root rating and the combined analysis ratings are reported as indicators of insecticide performance.

Table 1. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 1), Glasgow, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	General Root Rating Means
Furadan 4F	2.40	IF	1.94 a
Lorsban 4E	2.40	IF	2.06 ab
Counter 15G	8.00	IF	2.13 ab
NAF-288 C-FOS 30G EXP#1	4.00	7"B	2.19 abc
Force 3G	3.33	IF	2.25 abcd
EXP61217A-CELLUSORB 3.0	4.00	IF	2.25 abcd
NAF-287 C-FOS 30G EXP#2	4.00	7"B	2.25 abcd
NAF-289 C-FOS 30G EXP#3	4.00	7"B	2.25 abcd
Furadan 4F	2.40	7"B	2.25 abcd
Aztec 2.1G	6.70	IF	2.31 abcd
Force 3G	3.33	7"B	2.38 abcde
Thimet 20G	6.00	7"B	2.38 abcde
AC172093	6.00	IF	2.38 abcde
EXP60655A-CLAY 1.5 GR	8.00	IF	2.38 abcde
EXP61192A-BIODAC 3.0 GR	4.00	IF	2.38 abcde
Aztec 2.1G	6.70	7"B	2.44 abcde
Lorsban 4E	2.40	7"B	2.44 abcde
Thimet 20G	6.00	IF	2.44 abcde
Lorsban 15G	8.00	IF	2.50 abcde
Fortress 2.5G	6.00	IF	2.50 abcde
Counter 20CR	6.00	IF	2.63 bcde
Lorsban 15G	8.00	7"B	2.63 bcde
Check	-	-	2.63 bcde
AC172093	6.00	7"B	2.69 bcde
Fortress 2.5G	6.00	7"B	2.69 bcde
Force 1.5G	8.00	IF	2.69 bcde
EXP61216A-CLAY 3.0 GR	4.00	IF	2.69 bcde
Counter 15G	8.00	7"B	2.81 cde
Counter 20CR	6.00	7"B	2.81 cde
Force 1.5G	8.00	7"B	2.88 de
Regent 80 WG EXP60720A	0.13 lb ai/A	IF	2.88 de
Check	-	-	3.00 e

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 2. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 1), Glasgow, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	Combined Analysis Rating Means
Counter 15G	8.00	IF	1.84 a
Lorsban 4E	2.40	IF	2.00 ab
Furadan 4F	2.40	IF	2.00 ab
Force 3G	3.33	IF	2.09 abc
NAF-287 C-FOS 30G EXP#2	4.00	7"B	2.09 abc
Furadan 4F	2.40	7"B	2.09 abc
Lorsban 15G	8.00	IF	2.09 abc
EXP61192A-BIODAC 3.0 GR	4.00	IF	2.13 abc
Fortress 2.5G	6.00	IF	2.16 abc
Aztec 2.1G	6.70	IF	2.19 abc
Lorsban 4E	2.40	7"B	2.19 abc
EXP61217A-CELLUSORB 3.0	4.00	IF	2.19 abc
NAF-289 C-FOS 30G EXP#3	4.00	7"B	2.19 abc
EXP60655A-CLAY 1.5 GR	8.00	IF	2.22 abc
Force 3G	3.33	7"B	2.25 abc
Thimet 20G	6.00	7"B	2.25 abc
AC172093	6.00	IF	2.25 abc
NAF-288 C-FOS 30G EXP#1	4.00	7"B	2.25 abc
Thimet 20G	6.00	IF	2.25 abc
Lorsban 15G	8.00	7"B	2.28 abcd
AC172093	6.00	7"B	2.31 abcd
Aztec 2.1G	6.70	7"B	2.31 abcd
Check	-	-	2.34 bcd
Counter 15G	8.00	7"B	2.44 bcd
Fortress 2.5G	6.00	7"B	2.44 bcd
Counter 20CR	6.00	7"B	2.47 bcd
EXP61216A-CLAY 3.0 GR	4.00	IF	2.47 bcd
Force 1.5G	8.00	IF	2.50 cd
Force 1.5G	8.00	7"B	2.53 cd
Counter 20CR	6.00	IF	2.56 cd
Regent 80 WG EXP60720A	0.13 lb ai/A	IF	2.56 cd
Check	-	-	2.75 d

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 3. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 2), Glasgow, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	General Root Rating Means
AZTEC 2.1G	6.7	7"B	2.17 a
BWC00504I 0.5G	8.0	7"B	2.25 a
Lorsban 15G	8.0	7"B	2.33 ab
AF426-1-1 2.5G	8.0	7"B	2.38 ab
BWC00506I 1.1G	8.0	7"B	2.42 ab
Lorsban 4E	2.4	7"B	2.42 ab
BWC00103I 2.5G	8.0	7"B	2.46 ab
Counter 15G	8.0	IF	2.50 ab
AF426-2-1 1.0G	8.0	7"B	2.54 ab
BWC00600I 0.0G+Lorsban 15G	8.0 + 1.3	7"B	2.67 ab
Check	-	-	2.75 ab
BWC00600I 0.0G	8.0	7"B	2.92 b

Insecticide	Rate oz/1000 ft.	Placement	Combined Analysis Rating Means
AZTEC 2.1G	6.7	7"B	2.10 a
AF426-1-1 2.5G	8.0	7"B	2.10 a
Lorsban 15G	8.0	7"B	2.19 ab
BWC00504I 0.5G	8.0	7"B	2.25 abc
AF426-2-1 1.0G	8.0	7"B	2.31 abc
BWC00103I 2.5G	8.0	7"B	2.35 abc
BWC00600I 0.0G+Lorsban 15G	8.0 + 1.3	7"B	2.40 abc
BWC00506I 1.1G	8.0	7"B	2.44 abc
Lorsban 4E	2.4	7"B	2.50 abc
BWC00600I 0.0G	8.0	7"B	2.58 bc
Check	-	-	2.60 bc
Counter 15G	8.0	IF	2.67 c

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 4. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 3), Glasgow, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	General Root Rating Means
FORTRESS 5G	3.00	Conventional IF	1.69 a
FORTRESS 2.5G	6.00	Conventional IF	1.94 ab
Counter 15G	8.00	Conventional IF	1.94 ab
Lorsban 15G	8.00	Conventional 7"B	2.06 ab
Aztec 4.67G	4.00	Smartbox IF	2.19 abc
FORTRESS 5G	3.00	Smartbox IF	2.31 abc
FORTRESS 5G	2.25	Smartbox IF	2.44 bc
FORTRESS 2.5G	4.50	Conventional IF	2.50 bc
FORTRESS 5G	3.00	Smartbox 7"B	2.50 bc
Check	-	-	2.50 bc
FORTRESS 5G	3.00	Conventional 7"B	2.75 c

Insecticide	Rate oz/1000 ft.	Placement	Combined Analysis Rating Means
Lorsban 15G	8.00	Conventional 7"B	1.84 a
FORTRESS 5G	3.00	Conventional IF	1.88 ab
FORTRESS 2.5G	6.00	Conventional IF	1.88 ab
Counter 15G	8.00	Conventional IF	1.97 ab
Aztec 4.67G	4.00	Smartbox IF	2.09 abc
FORTRESS 5G	2.25	Smartbox IF	2.25 abc
FORTRESS 2.5G	4.50	Conventional IF	2.38 bc
FORTRESS 5G	3.00	Smartbox IF	2.38 bc
FORTRESS 5G	3.00	Smartbox 7"B	2.38 bc
Check	-	-	2.38 bc
FORTRESS 5G	3.00	Conventional 7"B	2.50 c

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 5. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 1), Maitland, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	General Root Rating Means[1]
AC172093	6.00	IF	3.19 a
Counter 20CR	6.00	IF	3.31 a
Aztec 2.1G	6.70	IF	3.44 ab
Fortress 2.5G	6.00	IF	3.52 ab
Thimet 20G	6.00	7"B	3.63 ab
Lorsban 15G	8.00	IF	3.63 ab
Force 1.5G	8.00	IF	3.63 ab
EXP61192A-BIODAC 3.0 GR	4.00	IF	3.63 ab
Force 3G	3.33	IF	3.69 ab
Counter 15G	8.00	7"B	3.75 ab
Lorsban 15G	8.00	7"B	3.75 ab
Counter 15G	8.00	IF	3.81 abc
EXP61217A-CELLUSORB 3.0	4.00	IF	3.81 abc
Furadan 4F	2.40	IF	3.94 abc
Force 1.5G	8.00	7"B	4.00 abc
EXP61216A-CLAY 3.0 GR	4.00	IF	4.00 abc
Counter 20CR	6.00	7"B	4.06 abc
Aztec 2.1G	6.70	7"B	4.06 abc
NAF-289 C-FOS 30G EXP#3	4.00	7"B	4.13 abc
EXP60655A-CLAY 1.5 GR	8.00	IF	4.19 abc
Force 3G	3.33	7"B	4.25 abc
Lorsban 4E	2.40	7"B	4.25 abc
NAF-287 C-FOS 30G EXP#2	4.00	7"B	4.25 abc
Check	-	-	4.31 abc
AC172093	6.00	7"B	4.44 abc
Lorsban 4E	2.40	IF	4.44 abc
Regent 80 WG EXP60720A	0.13 lb ai/A	IF	4.44 abc
Furadan 4F	2.40	7"B	4.44 abc
Fortress 2.5G	6.00	7"B	4.56 abc
NAF-288 C-FOS 30G EXP#1	4.00	7"B	4.63 abc
Thimet 20G	6.00	IF	5.06 bc
Check	-	-	5.44 c

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 6. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 1), Maitland, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	Combined Analysis Rating Means[1]
EXP60655A-CLAY 1.5 GR	8.00	IF	2.69 a
EXP61192A-BIODAC 3.0 GR	4.00	IF	2.78 ab
Counter 20CR	6.00	IF	2.88 abc
Force 3G	3.33	IF	3.00 abcd
Counter 15G	8.00	7"B	3.03 abcde
Force 1.5G	8.00	IF	3.03 abcde
Force 1.5G	8.00	7"B	3.06 abcde
AC172093	6.00	IF	3.09 abcde
EXP61216A-CLAY 3.0 GR	4.00	IF	3.09 abcde
Force 3G	3.33	7"B	3.13 abcde
Aztec 2.1G	6.70	IF	3.16 abcde
Aztec 2.1G	6.70	7"B	3.16 abcde
EXP61217A-CELLUSORB 3.0	4.00	IF	3.25 abcdef
NAF-289 C-FOS 30G EXP#3	4.00	7"B	3.25 abcdef
Fortress 2.5G	6.00	IF	3.26 abcdef
Counter 15G	8.00	IF	3.28 abcdef
Thimet 20G	6.00	7"B	3.28 abcdef
Lorsban 15G	8.00	7"B	3.28 abcdef
Furadan 4F	2.40	7"B	3.31 abcdef
Lorsban 15G	8.00	IF	3.38 abcdef
Furadan 4F	2.40	IF	3.50 abcdef
Lorsban 4E	2.40	7"B	3.59 abcdef
Counter 20CR	6.00	7"B	3.63 abcdef
AC172093	6.00	7"B	3.63 abcdef
NAF-287 C-FOS 30G EXP#2	4.00	7"B	3.63 abcdef
Regent 80 WG EXP60720A	0.13 lb ai/A	IF	3.69 bcdef
Lorsban 4E	2.40	IF	3.72 bcdef
Fortress 2.5G	6.00	7"B	3.72 bcdef
Check	-		3.75 cdef
NAF-288 C-FOS 30G EXP#1	4.00	7"B	3.94 def
Thimet 20G	6.00	IF	3.97 ef
Check	-		4.13 f

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 7. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 2), Maitland, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	General Root Rating Means[1]
AF426-1-1 2.5G	8.0	7"B	3.29 a
BWC00506I 1.1G	8.0	7"B	3.38 a
AZTEC 2.1G	6.7	7"B	3.46 a
BWC00504I 0.5G	8.0	7"B	3.50 a
BWC00600I 0.0G	8.0	7"B	3.71 a
BWC00600I 0.0G+Lorsban 15G	8.0 + 1.3	7"B	3.75 a
Lorsban 15G	8.0	7"B	3.79 a
Counter 15G	8.0	IF	3.79 a
BWC00103I 2.5G	8.0	7"B	3.83 a
AF426-2-1 1.0G	8.0	7"B	3.83 a
Lorsban 4E	2.4	7"B	3.83 a
Check	-	-	3.83 a

Insecticide	Rate oz/1000 ft.	Placement	Combined Analysis Rating Means[1]
BWC00504I 0.5G	8.0	7"B	2.97 a
AF426-1-1 2.5G	8.0	7"B	3.10 a
Lorsban 15G	8.0	7"B	3.17 a
BWC00506I 1.1G	8.0	7"B	3.23 a
BWC00600I 0.0G	8.0	7"B	3.29 a
Lorsban 4E	2.4	7"B	3.31 a
Counter 15G	8.0	IF	3.35 a
BWC00103I 2.5G	8.0	7"B	3.38 a
AZTEC 2.1G	6.7	7"B	3.38 a
BWC00600I 0.0G+Lorsban 15G	8.0 + 1.3	7"B	3.38 a
AF426-2-1 1.0G	8.0	7"B	3.40 a
Check	-	-	3.52 a

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 8. Comparison of Soil Insecticide Efficacy for Control of Western and Northern Corn Rootworm Larvae in Reduced-Tillage Corn (Test 3), Maitland, Missouri, 1996.

Insecticide	Rate oz/1000 ft.	Placement	General Root Rating Means[1]
Counter 15G	8.00	Conventional IF	2.86 a
Aztec 4.67G	4.00	Smartbox IF	3.00 a
FORTRESS 5G	2.25	Smartbox IF	3.58 a
FORTRESS 5G	3.00	Smartbox IF	3.92 a
FORTRESS 5G	3.00	Smartbox 7"B	4.00 a
FORTRESS 5G	3.00	Conventional 7"B	4.08 a
FORTRESS 2.5G	4.50	Conventional IF	4.08 a
FORTRESS 5G	3.00	Conventional IF	4.25 a
FORTRESS 2.5G	6.00	Conventional IF	4.42 a
Lorsban 15G	8.00	Conventional 7"B	4.42 a
Check	-	-	4.42 a

Insecticide	Rate oz/1000 ft.	Placement	Combined Analysis Rating Means[1]
Aztec 4.67G	4.00	Smartbox IF	2.58 a
Counter 15G	8.00	Conventional IF	2.88 a
FORTRESS 2.5G	4.50	Conventional IF	3.08 a
Lorsban 15G	8.00	Conventional 7"B	3.13 a
Check	-	-	3.13 a
FORTRESS 5G	3.00	Conventional IF	3.42 a
FORTRESS 5G	3.00	Conventional 7"B	3.42 a
FORTRESS 5G	2.25	Smartbox IF	3.42 a
FORTRESS 5G	3.00	Smartbox IF	3.58 a
FORTRESS 5G	3.00	Smartbox 7"B	3.63 a
FORTRESS 2.5G	6.00	Conventional IF	3.67 a

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 9. Ten-Year Comparison of Performance[1] for Recommended Corn Rootworm Insecticides Applied at 1 lb. ai/A in a Seven-inch Band at Planting.

Insecticide	A	C	A	C	A	B	A	B	A	B	B	B	B	B	B	B	B	B
	1987		1988		1989		1990		1991		1992		1993		1994		1995	1996	
chlorpyrifos (Lorsban) 15G	3.00	2.75	3.12	3.75	3.12	3.00	3.37	2.62	3.00	3.12	2.69*	3.00*	3.13	2.00	3.13		3.00	2.63	3.75
fonofos (Dyfonate) 20G	2.81	3.56	2.93	3.56	3.06	4.06	3.62	2.68	3.37	3.43	3.06	2.75	2.88	2.00					
phorate (Thimet) 20G	3.31	3.18	3.00	4.00	3.06	3.56	3.50	2.62	3.25	3.18	3.13	2.88	2.94	1.88			2.88	2.38	3.63
tefluthrin[2] (Force) 1.5G					2.75	3.18	3.25	2.50	2.93	3.12	2.88	3.00	2.75	1.75	2.94		3.13	2.88	4.00
terbufos (Counter) 15G	2.43	2.43	2.75	3.56	2.37	3.25	3.31	2.56	3.00	3.18	2.56	2.50	2.19	1.75	2.57		2.63	2.81	3.75
CONTROL	4.00	5.00	3.87	5.47	3.50	3.67	4.25	2.93	3.59	4.27	4.44	4.75	5.25	2.69	4.43		4.94	3.00	5.44

[1] Based on general root rating (Iowa method 1-6)
[2] Tefluthrin applied at 0.10 lb. ai/A
[A] Data from field with carbamate history
[B] Data from field with no carbamate history
[C] Data from field with organophosphate history
[*] Applied in-furrow

Wireworm Insecticide Evaluations

Wireworm control trials were conducted at a 60-acre site near Kansas City, Missouri (Clay County) where severely stunted plants and a reduction in stand were first noticed in 1989. A significant wireworm population was found and monitored by the UMC Pest Management staff in 1989, and wireworm insecticide evaluations were conducted at this site in 1994 and 1995. The wireworm plots in 1996 were located within a 5-acre plot area.

Insecticide plots were placed in areas of heaviest wireworm concentrations. Individual plots were two 35-foot rows replicated four times according to a randomized complete block design. Performance of treatments was evaluated by counting the total number of emerged plants to assess seed protection; and dead and damaged (wilted or stunted) plants were counted to assess seedling protection. The live plant count represents the mean number of plants remaining in the 35-ft row after subtracting the dead and damaged plants from the total number emerged.

Seven-inch band (7"B) and in-furrow (IF) granular applications were made with a V-belt seeder mounted on a two-row John Deere max-emerge planter. Preweighed insecticide granules were placed uniformly along the V-belt seeder and directed through banders or tubes to obtain the desired placement.

Furadan 4F and Capture 2EC spray treatments were applied through a tractor-mounted compressed-air system, calibrated to deliver 18 gallons of finished spray at 35 psi. Regent 80WG was also applied through the tractor-mounted compressed-air system, calibrated to deliver 1 gallon of finished spray at 35 psi. Lorsban 4E spray treatments were applied through a tractor-mounted 12-volt pump system calibrated to deliver 9.5 gallons of finished spray at 18 psi. Corn was planted in 30-inch rows at a rate of 22,100 seeds per acre. Seeds pre-treated with seed treatments (ST) were planted through a cone seeder to uniformly distribute a pre-counted number of seeds over the 35-foot rows.

Table 10. Comparison of Registered and Experimental Insecticide Efficacy for Control of Wireworms in Corn (Test 1), Kansas City, Missouri, 1996.

Insecticide	Rate oz/1000 ft	Placement	Plant Emergence (Stand Count) Mean No. [1] Emerged Plants/35 row ft.
Furadan 4F	2.4	IF	41.75 a
Regent 80WG	0.13 lb ai/A	IF	40.25 ab
Furadan 4F	1.8	IF	39.88 abc
EXP61216A-CLAY 3.0 GR	4.0	IF	39.50 abc
Fortress 5G	3.0	IF	39.38 abc
Force 1.5G	8.0	7"B	39.00 abc
Counter 15G	8.0	7"B	39.00 abc
Capture 2EC	0.12	IF	38.88 abc
Force 3G	3.0	IF	38.75 abc
Aztec 2.1G	6.7	7"B	38.50 abc
Fortress 2.5G	6.0	IF	38.25 abc
Counter 15G	8.0	IF	38.00 abc
Lorsban 4E	2.4	IF	37.75 bc
AC172093	6.0	7"B	37.63 bc
Aztec 2.1G	6.7	IF	37.50 bc
Control	-	-	37.50 bc
Counter 20CR	6.0	IF	37.38 bc
AC172093	6.0	IF	37.38 bc
Force 1.5G	8.0	IF	37.33 bc
Dyfonate II 20G	6.0	7"B	37.33 bc
Thimet 20G	6.0	IF	37.25 bc
Force 3G	4.0	IF	37.00 bc
Lorsban 15G	8.0	IF	37.00 bc
Thimet 20G	6.0	7"B	37.00 bc
Lorsban 4E	2.4	7"B	37.00 bc
Lorsban 15G	8.0	7"B	36.88 bc
Control	-	-	36.88 bc
Force 3G	3.0	7"B	36.75 bc
Counter 20CR	6.0	7"B	36.75 bc
Fortress 2.5G	6.0	7"B	36.33 bc
Force 3G	4.0	7"B	35.75 c

[1]Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 11. Comparison of Registered and Experimental Insecticide Efficacy for Control of Wireworms in Corn (Test 1), Kansas City, Missouri, 1996.

Insecticide	Rate oz/1000 ft	Placement	Mean % damaged[1] plants/35 row ft.
Furadan 4F	1.8	IF	1.57 a
Counter 15G	8.0	7"B	1.69 ab
Furadan 4F	2.4	IF	2.40 ab
Dyfonate II 20G	6.0	7"B	2.68 abc
Force 1.5G	8.0	IF	2.70 abc
Thimet 20G	6.0	IF	3.34 abcd
Lorsban 15G	8.0	7"B	3.51 abcd
Fortress 2.5G	6.0	IF	3.94 abcde
AC172093	6.0	IF	3.97 abcde
Thimet 20G	6.0	7"B	4.32 abcde
Fortress 5G	3.0	IF	4.38 abcde
Lorsban 15G	8.0	IF	4.39 abcde
Counter 15G	8.0	IF	4.60 abcde
Aztec 2.1G	6.7	IF	4.66 abcde
EXP61216A-CLAY 3.0 GR	4.0	IF	4.97 abcde
Force 1.5G	8.0	7"B	5.22 abcde
Counter 20CR	6.0	IF	5.23 abcde
Aztec 2.1G	6.7	7"B	5.24 abcde
Counter 20CR	6.0	7"B	5.51 abcdef
Lorsban 4E	2.4	IF	5.63 abcdef
Force 3G	4.0	IF	5.75 abcdef
Fortress 2.5G	6.0	7"B	5.98 abcdef
AC172093	6.0	7"B	6.06 abcdef
Force 3G	3.0	7"B	6.37 bcdef
Regent 80WG	0.13 lb ai/A	IF	7.20 cdef
Force 3G	3.0	IF	7.52 def
Force 3G	4.0	7"B	8.00 defg
Capture 2EC	0.12	IF	8.04 defg
Lorsban 4E	2.4	7"B	8.48 efg
Control	-	-	9.90 fg
Control	-	-	11.89 g

[1]Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 12. Comparison of Registered and Experimental Insecticide Efficacy for Control of Wireworms in Corn (Test 1), Kansas City, Missouri, 1996.

Insecticide	Rate oz/1000 ft	Placement	Live Plant Count Mean No. [1] Live Plants/35 row ft.
Furadan 4F	2.4	IF	40.75 a
Furadan 4F	1.8	IF	39.25 ab
Counter 15G	8.0	7"B	38.33 abc
Fortress 5G	3.0	IF	37.63 abcd
EXP61216A-CLAY 3.0 GR	4.0	IF	37.50 abcd
Regent 80WG	0.13 lb ai/A	IF	37.38 abcd
Force 1.5G	8.0	7"B	37.00 abcd
Fortress 2.5G	6.0	IF	36.75 abcd
Aztec 2.1G	6.7	7"B	36.50 abcd
Force 1.5G	8.0	IF	36.33 abcd
Dyfonate II 20G	6.0	7"B	36.33 abcd
Counter 15G	8.0	IF	36.25 abcd
Thimet 20G	6.0	IF	36.00 bcd
Force 3G	3.0	IF	35.88 bcd
AC172093	6.0	IF	35.88 bcd
Aztec 2.1G	6.7	IF	35.75 bcd
Capture 2EC	0.12	IF	35.75 bcd
Lorsban 15G	8.0	7"B	35.63 bcd
Lorsban 4E	2.4	IF	35.63 bcd
Counter 20CR	6.0	IF	35.38 bcd
Lorsban 15G	8.0	IF	35.38 bcd
Thimet 20G	6.0	7"B	35.38 bcd
AC172093	6.0	7"B	35.38 bcd
Force 3G	4.0	IF	34.88 bcd
Counter 20CR	6.0	7"B	34.75 bcd
Force 3G	3.0	7"B	34.50 cd
Fortress 2.5G	6.0	7"B	34.17 cd
Lorsban 4E	2.4	7"B	33.88 cd
Control	-	-	33.38 d
Control	-	-	33.13 d
Force 3G	4.0	7"B	32.88 d

[1]Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 13. Comparison of Registered and Experimental Insecticide Efficacy for Control of Wireworms in Corn (Test 2), Kansas City, Missouri, 1996.

Insecticide	Rate /cwt	Placement	Plant Emergence (Stand Count) Mean No.[1] Emerged Plants/35 row ft.
Fungicide Check + LS015	0.94 fl oz	ST	50.38 a
Fungicide Check + /OT Dry H101:4-5 1D55	1.8 oz	ST	50.25 a
Fungicide Check + /OT Dry H101:4-4 1D54	1.8 oz	ST	50.25 a
Fungicide Check + /OT Dry Germate Plus	1.8 oz	ST	50.13 a
Fungicide Check + LS015	1.25 fl oz	ST	50.00 a
Fungicide Check (Captan 400)	1.76 fl oz	ST	49.88 a
Counter 15G	8 oz/1000ft	IF	48.75 ab
Control	-	-	46.25 b

Insecticide	Rate /cwt	Placement	Mean % damaged[1] plants/35 row ft.
Fungicide Check + /OT Dry Germate Plus	1.8 oz	ST	4.51 a
Fungicide Check + LS015	1.25 fl oz	ST	4.74 a
Fungicide Check + /OT Dry H101:4-4 1D54	1.8 oz	ST	5.22 a
Fungicide Check + LS015	0.94 fl oz	ST	5.68 a
Fungicide Check + /OT Dry H101:4-5 1D55	1.8 oz	ST	6.20 a
Fungicide Check (Captan 400)	1.76 fl oz	ST	6.26 a
Counter 15G	8 oz/1000ft	IF	6.44 a
Control	-	-	9.26 b

Insecticide	Rate /cwt	Placement	Live Plant Count Mean No.[1] Live Plants/35 row ft.
Fungicide Check + /OT Dry Germate Plus	1.8 oz	ST	47.88 a
Fungicide Check + LS015	1.25 fl oz	ST	47.63 a
Fungicide Check + /OT Dry H101:4-4 1D54	1.8 oz	ST	47.63 a
Fungicide Check + LS015	0.94 fl oz	ST	47.50 a
Fungicide Check + /OT Dry H101:4-5 1D55	1.8 oz	ST	47.13 a
Fungicide Check (Captan 400)	1.76 fl oz	ST	46.75 a
Counter 15G	8 oz/1000ft	IF	45.63 a
Control	-	-	42.00 b

[1]Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

CUTWORM INSECTICIDE EVALUATIONS

Planting-time insecticide evaluations for control of black cutworm, *Agrotis ipsilon* (Hufn.), were conducted in barrier plots on the University of Missouri-Columbia South Farms near Columbia, Boone County. Granular row band treatments were applied with a V-belt seeder mounted on a two-row John Deere model 7100 max-emerge planter. Preweighed insecticide granules were placed uniformly along the V-belt seeder and directed for either 7-inch band (7"B) or in-furrow (IF) placement. Corn was planted at a seeding rate of 24,200 seeds per acre in 30-inch rows. Broadcast (BD) and banded (7"B) sprays were applied through a tractor-mounted compressed-air sprayer system calibrated to 18 gallons of finished spray at 30 psi. Rescue treatments were applied with a hand-held CO_2 sprayer calibrated to deliver 46 gpa at 30 psi.

Individual plots were two rows 35 feet in length. Treatments were replicated three times according to a randomized complete block design. Following planting, metal barriers (8 inchs in height) were driven approximately 3 inches into the soil to enclose portions (6 feet by 2 rows) of the 35-foot plots. In Test 1, barriers were infested at seedling emergence with ten 3rd- to 5th-instar laboratory-reared black cutworm larvae. In Test 2, the cutworm infestation rate was increased to 12 because of corn stubble and weed residue in the plots. Rescue treatments were applied within the barriers approximately one hour after release of cutworms. Efficacy of the treatments was evaluated by counting the number of plants cut on five dates following larval infestation.

Table 14. Comparison of Registered and Experimental Insecticide Efficacy for Black Cutworm Planting-Time Treatments in Corn (Test 1), Columbia, Missouri, 1996.

Insecticide	Rate oz/ 1,000 ft	Placement	Mean % Cut Plants Days Post-Infestation 1	2	3	5	12	Total[1]	
AC 173,355	6	7"B	1.75	1.96	1.96	0	0	5.68	a
AC 173,355	6	IF	2.08	6.13	0.00	0	0	8.21	ab
AC 172,093	6	IF	3.92	6.14	0.00	2.22	0	12.29	abc
Counter 20CR	6	7"B	1.96	5.93	5.93	0	0	13.81	abc
AC 172,093	6	7"B	4.14	6.10	5.68	0	0	15.91	abc
Counter 15G	8	7"B	4.17	11.90	1.85	0	0	17.92	abcd
AC 173,353	8	7"B	2.56	8.75	4.44	9.43	0	25.19	abcde
AC 173,353	8	IF	4.42	14.76	9.54	0	0	28.72	abcde
Counter 20CR	6	IF	10.07	17.05	0.00	2.22	0	29.34	abcde
AC 173,354	6	7"B	2.38	11.06	11.43	6.14	0	31.02	bcde
AC 173,354	6	IF	8.37	12.55	12.55	0	0	33.46	cde
Counter 15G	8	IF	13.33	12.22	3.89	4.44	6.67	40.56	de
Control	-	-	9.10	17.37	17.79	1.96	0	46.22	e

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

Table 15. Comparison of Registered and Experimental Insecticide Efficacy for Black Cutworm Planting-Time and Rescue Treatments in Corn (Test 2), Columbia, Missouri, 1996.

Insecticide	Rate oz/ 1,000 ft	Placement	Mean % Cut Plants Days Post-Infestation 1	2	3	6	8	Total[1]
Pounce 3.2EC	0.10 [2]	Rescue	2.08	0.00	0.00	0.00	0	2.08 a
Lorsban 4E	1 pt/A	Rescue	9.17	1.67	0.00	0.00	0	10.83 ab
Pounce 3.2EC	0.10 [2]	Broadcast	7.78	3.89	4.44	1.67	0	17.78 ab
Lorsban 15G	8.0	7"B	11.70	5.40	1.04	0.00	0	18.13 abc
Lorsban 30G NAF-287	4.0	7"B	9.21	7.36	0.00	1.85	0	18.43 abc
Dyfonate II 20G	6.0	7"B	7.85	4.14	7.43	1.75	0	21.17 abc
Lorsban 4E	2.4	7"B	14.22	1.67	3.92	1.67	0	21.47 abc
Lorsban 30G NAF-289	4.0	7"B	13.85	1.96	3.92	1.96	0	21.69 abc
Lorsban 30G NAF-288	4.0	7"B	16.47	3.70	1.85	0.00	0	22.03 abc
Lorsban 4E	1.2	7"B	14.57	6.59	3.24	1.85	0	26.25 abc
Capture 2EC	0.015 [2]	Broadcast	16.46	4.32	6.07	4.32	0	31.17 bc
Control	-	-	16.42	12.53	12.03	2.22	0	43.20 cd
Capture 2EC	0.02 [2]	Broadcast	16.72	14.21	12.77	11.34	1.75	56.80 d

[1] Mean separation by DMRT; means followed by the same letter are not significantly different at P=0.05.

[2] Treatment applied at lb ai/A.

APPENDIX

Agronomic and Entomological Information for Insecticide Efficacy Plots, Missouri, 1996.

	ROOTWORM		CUTWORM		WIREWORM
Location	Maitland	Glasgow	Columbia		Kansas City
	Nodaway County	Howard County	Boone County		Clay County
Planting Date	May 19, 22	May 21	June 4 Test 1	June 21 Test 2	May 23
Corn Hybrid	Pioneer 3377	Pioneer 3377	Pioneer 3377	Pioneer 3162	Pioneer 3377
Evaluation Date	August 6, 7 & 8	August 12 & 15	June 13, 14, 15, 17 & 24	June 26, 27, 28 July 1 & 3	June 13
Insect Population	85% Western 15% Northern	99% Western 1% Northern	Infested with laboratory-reared black cutworm larvae		Presence determined by digging

1996 Soil Test Results for Evaluation Sites

Location	pHs	N.A. meq/ 100 g	O.M. %	P lbs/A	Ca lbs/A	Mg lbs/A	K lbs/A	% Sand	% Silt	% Clay	Texture
Glasgow	5.9	2.5	2.7	30	3925	673	521	10	56	34	Silty Clay Loam
Kansas City	7.0	0.0	1.3	47	2697	455	385	36	46	18	Loam
Maitland	6.0	2.5	3.5	150	5708	538	687	12	52	36	Silty Clay Loam
South Farms	4.5	8.5	2.4	42	2583	555	285	12	54	34	Silty Clay Loam

Daily Rainfall and Temperature Data for **Glasgow, Missouri**, 1996[1]

Date	May Temp (°F) Max	May Temp (°F) Min	May Rainfall (Inches)	June Temp (°F) Max	June Temp (°F) Min	June Rainfall (Inches)	July Temp (°F) Max	July Temp (°F) Min	July Rainfall (Inches)
1	62	33	0.02	73	54	0.40	92	75	
2	67	43		71	56	0.10	92	69	
3	73	47	0.02	80	55	0.08	93	61	
4	67	50	T[2]	64	51		83	61	
5	71	50	0.77	72	51		81	63	T
6	65	50	0.20	81	53	T	85	63	
7	59	51	0.80	76	57	T	89	71	
8	71	56	0.70	72	56	T	89	68	
9	82	62	0.80	64	58	T	86	56	
10	86	67		73	60	0.08	78	52	
11	72	52	0.75	70	57	0.08	79	52	
12	64	44		82	61	0.02	84	53	
13	53	45	0.15	90	63		88	63	
14	60	45		88	66		87	65	0.17
15	59	48	0.75	90	67	0.07	76	60	
16	85	57	T	91	73		88	61	
17	83	69		86	68	0.85	90	70	
18	91	69		84	65	0.48	95	74	
19	90	73		86	66		96	78	
20	89	70		88	67		96	72	0.50
21	81	52	0.07	90	71		79	71	1.68
22	79	52		89	73	0.12	80	68	0.02
23	81	52	0.02	89	71		84	61	0.20
24	88	62	T	93	67	1.50	86	60	
25	71	58	0.52	84	61		84	60	
26	78	58	T	82	64		79	57	
27	70	57	2.60	85	65		79	57	T
28	81	56		88	67		76	62	0.03
29	68	55		90	68		86	66	
30	67	52		91	72		82	66	0.30
31	72	53					79	58	

[1] Weather data was collected at Salisbury, Missouri, approximately 18 miles north of field plots.

[2] T = trace

Daily Rainfall and Temperature Data for **Kansas City, Missouri**, 1996[1]

Date	May Temp (°F) Max	May Temp (°F) Min	May Rainfall (Inches)	June Temp (°F) Max	June Temp (°F) Min	June Rainfall (Inches)
1	65	42		75	59	0.90
2	77	50	0.04	80	55	0.08
3	68	52	0.01	72	55	
4	74	50	0.70	72	45	
5	67	50	0.10	81	53	1.11
6	55	50	1.28	75	59	0.24
7	68	51	0.86	71	56	0.03
8	79	61	0.62	71	54	
9	80	71	T[2]	74	56	
10	74	51	0.30	74	59	T
11	64	51		86	63	T
12	51	45	0.31	89	63	0.13
13	60	45		86	66	0.49
14	60	50	0.01	88	68	
15	85	58	T	86	70	T
16	82	69		86	70	2.18
17	89	72		82	69	0.31
18	88	70		87	64	
19	86	75		89	66	
20	75	57	0.02	91	69	
21	79	54		90	72	
22	83	54		89	71	0.32
23	87	61	0.24	91	66	1.63
24	80	62	0.01	85	67	0.09
25	69	61	T	85	70	
26	76	59	3.35	87	68	
27	73	54		88	70	T
28	62	53		90	74	
29	64	53		91	74	
30	73	52		92	75	
31	64	59	2.44			

[1] Weather data was collected at Kansas City International Airport, approximately five miles northwest of field plots.

[2] T = trace

Daily Rainfall and Temperature Data for **Maitland, Missouri**, 1996[1]

Date	May Temp (°F) Max	May Temp (°F) Min	May Rainfall (Inches)	June Temp (°F) Max	June Temp (°F) Min	June Rainfall (Inches)	July Temp (°F) Max	July Temp (°F) Min	July Rainfall (Inches)
1	64.2	41.2		74.6	58.1	0.63	89.4	69.6	
2	75.0	42.3	0.09	77.7	54.7	0.12	91.5	67.4	
3	69.1	47.9	0.02	61.9	51.8		84.2	60.2	0.04
4	62.1	49.7	0.30	73.2	46.0		76.1	64.4	0.67
5	67.2	46.9		79.8	51.8	0.04	84.4	64.9	
6	67.7	45.8	0.08	74.0	58.0	0.72	88.6	66.6	
7	65.0	50.4	0.22	70.6	57.8	0.37	87.1	69.9	
8	78.9	60.3	1.41	70.3	56.8		80.8	60.4	0.06
9	75.9	63.3	0.27	73.4	56.9		75.6	53.4	
10	68.5	51.9	0.17	77.4	62.0		79.2	49.5	
11	61.1	45.1	0.01	88.4	64.8		82.2	56.0	
12	47.2	42.4	0.14	91.8	62.7		86.1	63.2	
13	57.8	44.1		90.2	63.8		86.1	57.6	0.14
14	58.0	44.7	2.40	89.4	65.7		79.2	62.7	0.81
15	83.2	56.2		89.0	68.3	0.09	87.8	59.3	
16	80.5	68.4		84.2	69.3	1.17	86.7	67.9	
17	88.7	69.1		78.1	69.1	0.01	93.3	75.1	
18	no	observation		85.0	64.2		94.8	77.0	
19	88.3	68.6	0.02	90.0	66.7		93.7	72.0	0.35
20	74.7	55.6	0.48	85.1	69.9		78.1	71.0	2.31
21	78.5	54.2		88.8	73.9		84.1	72.6	
22	81.6	52.7		81.2	68.8	0.05	84.6	64.7	
23	76.5	61.6	2.02	92.8	67.9	1.26	85.1	62.9	
24	63.6	56.3		83.8	67.3		80.1	60.8	0.01
25	63.9	56.3	0.13	83.3	65.4		79.8	57.6	
26	63.8	54.6	1.40	86.5	66.6		74.5	58.2	
27	73.4	56.7		88.3	66.3		78.9	62.2	0.01
28	58.6	53.9		92.0	72.1		85.6	63.5	
29	67.1	52.3		92.3	74.0		85.1	66.3	0.16
30	71.6	48.2		91.7	73.2		76.6	60.8	
31	66.5	55.1	0.29				78.5	56.2	

[1] Weather data was collected at Albany, Missouri, approximately 36 miles east of field plots.
[2] T = trace

Daily Rainfall and Temperature Data
for
South Farms, Columbia, Missouri, 1996[1]

Date	June Temp (°F) Max	June Temp (°F) Min	June Rainfall (Inches)	July Temp (°F) Max	July Temp (°F) Min	July Rainfall (Inches)
1	71.0	59.6	0.21	89.3	70.7	0.79
2	80.4	55.1	0.21	91.1	68.1	0.04
3	67.7	50.9		82.6	62.0	
4	70.9	50.2		80.1	64.4	
5	80.1	53.0	0.01	84.7	62.8	
6	78.9	59.7	0.62	89.3	66.9	
7	72.4	55.2	0.57	90.0	71.5	
8	61.2	52.7	0.01	84.0	63.1	0.14
9	66.9	56.1	0.05	76.9	58.9	
10	68.1	59.7	0.04	80.2	52.5	
11	80.1	55.7	0.07	83.2	59.8	
12	87.9	62.9	0.06	77.9	64.8	
13	88.6	63.9		86.2	64.3	
14	88.5	67.4	0.41	75.7	62.8	0.18
15	88.2	68.5		86.0	61.2	
16	88.1	71.6		88.9	67.0	
17	85.2	67.9	0.45	93.5	72.8	
18	86.6	64.8		95.6	76.5	
19	91.3	68.4		96.8	73.0	0.15
20	91.1	69.9		80.8	70.6	1.18
21	88.6	72.1	0.01	79.9	68.0	1.22
22	90.7	74.1		82.0	66.3	0.05
23	90.5	66.4	0.02	86.5	62.6	
24	83.5	66.3	0.34	86.0	64.9	
25	83.4	63.1		78.9	59.5	
26	84.8	63.7		81.0	56.9	
27	87.1	64.5		75.2	63.9	0.23
28	89.2	64.2		86.4	63.6	
29	90.5	69.9		80.4	67.8	0.41
30	92.0	69.6		79.6	60.7	
31				79.8	57.3	

[1] Weather data was collected at South Farms, Columbia, Missouri.
[2] T = trace

Industry Cooperators

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