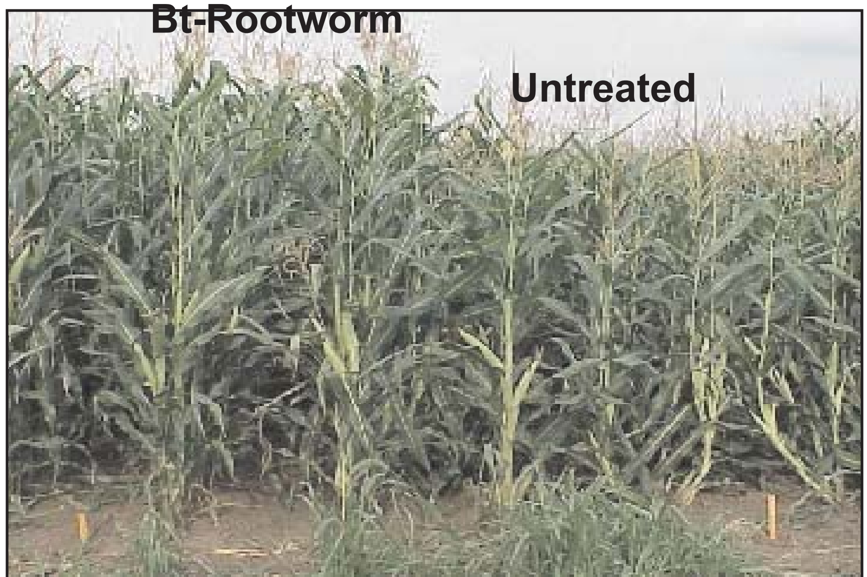
Joliet Junior College
Demonstration & Research Guide
2003

Find out how:

Transgenic Rootworm Corn Protected Roots,



Soybean Aphid Reduced Yield,

Corn Herbicides Performed,

and numerous other cropping practices affected yields.

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Acknowledgments

Numerous people have contributed in many ways to the J.F. Richards Land Laboratory, Demonstration & Research Farm during 2003. Resources donated range from the time donated by drivers for our field day, to equipment, pesticides, cash, and seed, all are listed in the tables below and on the following page. Take some time to look over these folks and their supporting employers and give them a friendly thanks for their support from Joliet Junior College and myself.

A few folks I would like to mention here are; Alan Venters and the following JJC Ag students; Jesse Faber, Brock Flanigan, Bob Mcquillen, and Rob Thomas, for helping put in the corn hybrid demonstration. Rob Thomas and Scott Stine of Monsanto both volunteered to help dig, wash and rate roots in our two corn rootworm studies. Scott Lagar of Hintzsche's spent several hours with a weigh wagon helping to calibrate our combine yield monitor in both corn and soybean. Our field day speakers were: Russel Higgins, Timothy Smith, Kevin Steffey, and David Voegtlin, all associated with the University of Illinois.

Name and company of people who donated equipement to the Joliet Junior College, J.F. Richards Land Laboratory in 2003.

Last	First	Company	Equipment
Dumney	Bill		Field Cultivator
Schafer	John	Grainco FS	Ammonia Applicator
Smerz	Dick		Hayrack
Stine	Scott	Monsanto	Pressure Washer

Name and company of people who donated pesticides and acres of pesticide product to the J.F. Richards Land Laboratory in 2003.

Last	First	Company	Product/Amount
Cowherd	Tommy	Elburn Coop	Degree Xtra/30Ac
Eager	John	Syngenta	Force/30Ac
Roelfs	Duane	Monsanto	Roundup Weather Max/135Ac
Ruhl	Kreg	Bayer Crop Scinece	Aztec and Epic/30Ac

Name and company of people who contributed funds for the pork chop dinner during our 2003 field day.

Last	First	Company
Buhr	Rod	Sieben
Coffman	Lyle	Great Lakes
Fugate	Bill	Burrus
Lagar	Scott	Hintzsche
Ruhl	Kreg	Bayer Crop Science
Skonetski	Bill	Dairyland Seed
Venters	Allan	Hughes

2003 Contributors List

Applied learning in production agriculture at Joliet Junior College continues through the generosity of these contributors. We greatly appreciate their support for research and demonstrations at Joliet Junior College.

Last	First	Company
Brummel	Dan	Golden Harvest
Buhr	Rod	Sieben
Cattron	Carolyn	
Cattron	Dave	Joliet Junior College
Corman	Lyle	Great Lakes
Condit	Todd	LG Seeds
Coshard	Tommy	Elburn Coop
Cronin	John	
Dunmay	Bill	
Eager	John	Syngenta
Engler	Toni	Ag Venture
Frese	Doug	Joliet Junior College
Fugate	William	Burrus
Gick	Ron	Becks
Gillet	Jim	Elburn Coop
Hays	Wesley	Garst
Higgins	Russell	University of Illinois
Huseman	Marty	Grow-Tech-Seeds
Johnson	Les	Cornelius
Kepner	Root	Cornelius
Kwanga	Mike	Dow
Lemmer	Larry	Garst
Luger	Scott	Hintzsche
Laudeman	Craig	FS
Nesbitt	Doug	Adler
Oast	Craig	Dieter
Olson	Trevor	FS
Paul	Lyle	University of Illinois
Perrine	Michael	WKAN
Roolfs	Duane	Heritage FS
Ruhl	Greg	Bayer Crop Science
Scherer	John	Green Co. FS
Schroeder	Dan	LG Seeds
Skonetski	Bill	Dairyland Seed
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Thomas	Robert	Monsanto
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Trost	Mike	Cress
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Vitosh	Ed	Monsanto
Vaughn	David	University of Illinois
Wells	Wayne	Pioneer
Wessel	Bill	
Wendish	Larry	Joliet Junior College
Zeigler	Matt	Fielders Choice

Agriculture and Horticultural Sciences Department Faculty and Staff

The agriculture and horticulture faculty and staff at Joliet Junior College are always willing to answer questions and discuss the information contained within this document. As an institution of higher learning we value the discussion of the contents of our demonstration and research guide, and desire input from the public concerning our farm. Below is a complete list of all faculty and staff in the Agriculture and Horticulture Sciences Department. For more information or additional copies of the JJC Demonstration and Research Guide 2003, contact: Jeff Wessel, Joliet Junior College, 1215 Houbolt Road, Joliet, Illinois 60431. Phone: (815)280-6602 e-mail: jwessel@jjc.edu. To contact faculty and other staff members call (815)280-2320, or fax at (815)280-6650.

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Roxanne Olson - Veterinary Technology
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Lynda Scerine - Department Secretary
Walter Stein - Veterinary Technology
Donna Theimer - Floral Design / Interior Plantscaping
Jeff Wessel - Farm Manager / Agronomy Instructor

Introduction

The Joliet Junior College Demonstration and Research Farm was put into operation in 1983 with the expressed purpose of being an educational resource for agricultural students and their instructors. There are three major objectives of the Demonstration and Research Farm, they are: 1) Provide an instructional setting for crops and soils analysis, this allows students to put into practice skills they have learned in the classroom. 2) Demonstrate crop response to various agronomic practices, this provides an environment for students to observe first hand the impact of various agronomic practices on crop growth and development. 3) Provide unbiased, sound agronomic information to crop producers.

The Demonstration and Research Farm consists of 107 cropped acres with 60 acres of corn and 47 of soybean in 2003. Eighteen agronomic studies and two demonstrations were implemented in 2003, they included the evaluation of corn and soybean herbicides and insecticides, tillage systems, row spacing and seeding rates and planting dates in both corn and soybean. Nitrogen (N) fertilizer rates and application timing in corn were among other replicated studies. Demonstrations (unreplicated) of corn and soybean varieties were also included in our work for 2003.

Our Demonstration and Research Farm is situated in Joliet, Illinois (North Eastern Illinois) a region dominated by soils with low phosphorous (P) supplying power and high cation exchange capacity. Soil fertility levels at the Demonstration and Research Farm are within acceptable ranges for crop production. P soil levels range from 50 to 140 with a median of 69lbs available P per acre, and exchangeable K^+ ranges from 277 to 502 with a median of 360 lbs per acre. Soil pH ranges from 5.6 to 7.4 with an average of 6.7.

Zero tillage is the primary tillage system used, and as such Fall or Spring preplant “burndown” herbicides were applied over the majority of the farm. Areas not receiving burndown herbicides included tilled areas and a few treatments in the corn and soybean herbicide studies. Fall pre-plant burndown included; CanopyXL@2.5 ounces +Express@0.15ounces+2,4-D@1pint+crop oil concentrate@1quart per acre broadcast on 1/3 of the area soybean was planted into. Spring applied pre-plant burndown consisted of Roundup Weather Max (WM)@21ounces+2,4-D@1pint per acre+Ammonium Sulfate@17lbs per 100 gallons of water. For the balance of the document where RoundupWM was applied, Ammonium Sulfate @ 17lbs per 100 gallons of water was always included. In addition to the burndown, weed control in corn was accomplished by pre-emerge applications of Epic+Atrazine or DegreeXtra+Atrazine followed by a post-emerge application of Clarity+2,4-D. All soybean was Roundup Ready so post-emerge applications of RoundupWM were applied at V2 or V4.

Corn was planted in 30 inch rows at a rate of 32,000 seeds per acre and planting dates for most corn ranged from April14th through April 30th. After a fairly wet first two weeks of May (page5, figure1), corn planting was finished up on May 16th and 17th. Soybean was planted in 15 inch rows at a rate of 175,000 seeds per acre. Soybean planting began on May 19th and was completed on May 23rd. Corn was harvested at two periods in the Fall, September 23rd through the 30th, and again on October 27th and 28th. Soybean was harvested on October 30th and 31st.

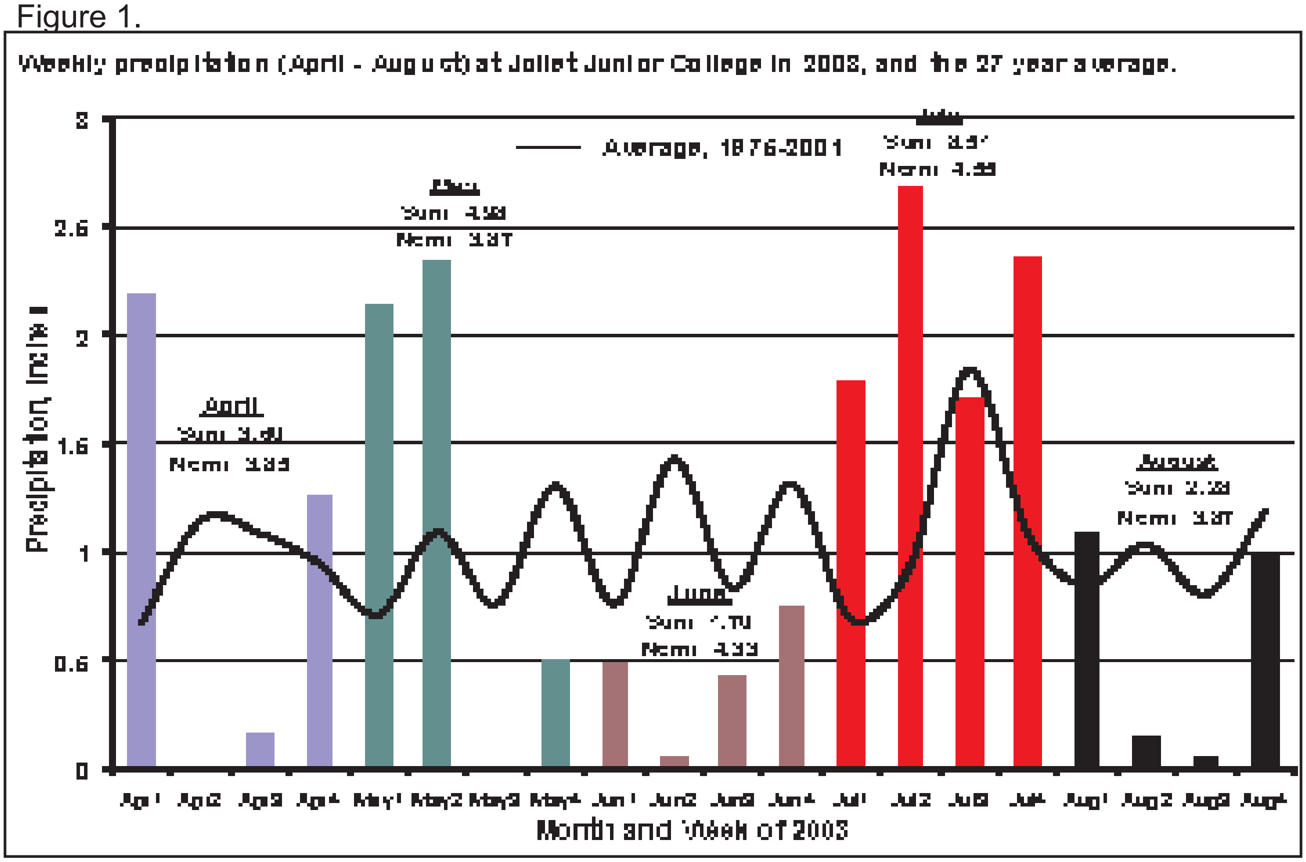
Both crops were harvested with a John Deere 9500 combine equipped with an Ag Leader PF3000 yield monitor to measure grain yields. Before harvesting any studies or demonstrations in either crop, the yield monitor was calibrated with five or six calibration loads harvested at varying speeds to develop a yield curve from the flow sensor of the yield monitor. When corn was harvested for the second period (late October) a weigh wagon was again used to check the accuracy of the yield monitor and appropriate changes made.

The growing season began with a somewhat dry April (page 5, figure 1), all of the precipitation that fell in the fourth week ocurred on April 30th. The first half of May was excessively wet, although the second half of May and June had well below normal rainfall. Corn yield saving precipitation began the first week of July and continued at approximately twice the normal rate throughout most of the month. August brought below normal precipitation with 2.28 inches compared to an average of 3.87, which probably depressed soybean yield. The Fall months were fairly dry and harvest was completed primarily with soil in good shape for wheel traffic.

The average corn yield for the farm was 170 and soybean 50 bushels per acre. The corn and soybean varietal demonstrations averaged 189 and 51 bushels per acre respectively. The corn produced a record high yield by 29 bushels per acre and soybean was the second highest recorded at Joliet Junior College.

Jeffrey R Wessel, Farm Manager/Agronomy Instructor

Figure 1.



Rootworm Larval Insecticides and Transgenic Bt-Rootworm Corn Evaluation

Justification and Objective

Corn rootworm (CRW) is the most damaging insect pest of monocropped corn in the Midwest (Levine and Oloumi-Sadeghi, 1996), and as such has the potential to inflict heavy economic losses (Gray et al., 1993). Recently the development of a variant Western Corn Rootworm (WCR) exhibiting a behavioral shift to oviposition in soybean fields has been identified in Western Indiana and East Central Illinois (Spencer et al., 1997). The spread of this variant WCR in Illinois over the last decade has become fairly extensive (page 6, figure 3), currently WCR adults have been found in soybean fields in 59 Illinois counties with the greatest densities occurring in the east-central portion of the state (Gray and Steffey, 2002). Figure 2 depicts the dramatic increase in rotated corn acres treated with rootworm larval insecticides in the problem area (East-Central portion of Illinois), and underscores the economics associated with this insect pest as treatment costs are approximately $16 per acre (Scott Lager, personal communication). Our objective was to evaluate the efficacy of corn rootworm larval insecticides and transgenic Bt-rootworm corn in an effort to demonstrate root injury and it's effect on yield.

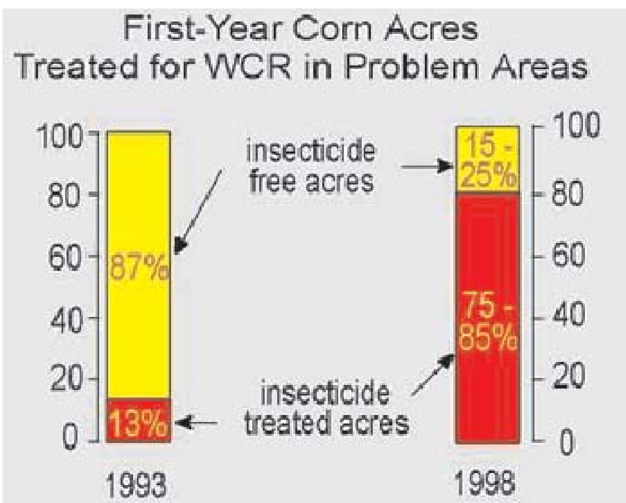
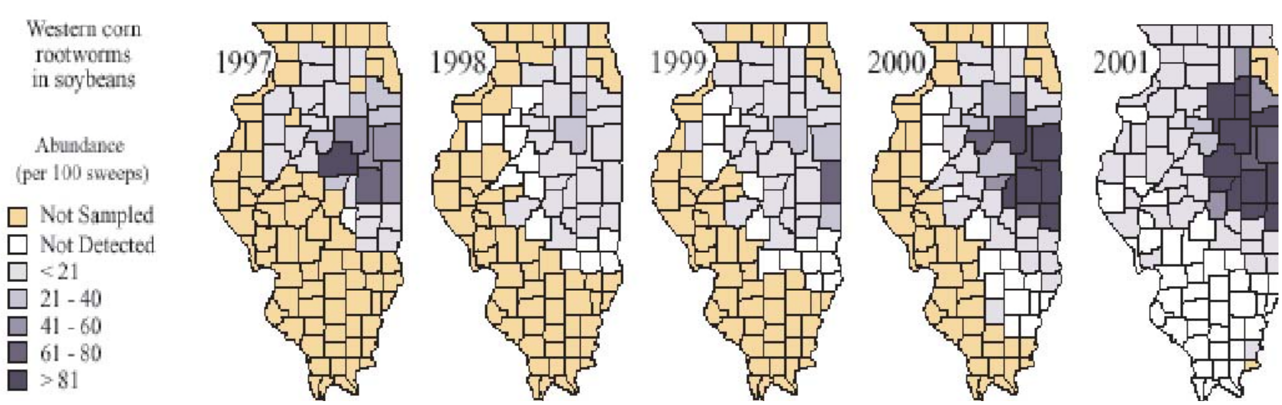


Figure 2. Change in corn rootworm larval insecticide use over five years (1993 to 1998) in the problem area (East Central) of Illinois. Source: http://www.staff.uiuc.edu/~s-isard/Cornrootworm/Insecticide.htm

Figure 3. Western corn rootworm (WCR) adults in Illinois soybean fields. Source: National Soybean Research Laboratory. Factsheet #2.



Rootworm Larval Insecticides and Transgenic Bt-Rootworm Corn Evaluation

Methods

Four planter-box corn rootworm larval insecticides, a transgenic Bacillus thuringiensis for corn rootworm (Bt-RW), and a control with no root protection were evaluated for their effect on root injury and grain yield. Each treatment was replicated three times and planted on the 26th of April with the Dekalb hybrid DK537 and DKC53-29 for the Bt-RW (transgenic) treatment. The previous crop was late planted corn (trap crop) which is predisposed to attract corn rootworm adults, and can increase the number of corn rootworm eggs laid and the potential number of corn rootworm larvae the following growing season. Full width tillage, which included Fall chisel-plowing and Spring discing was performed on the entire experimental area. Corn was planted at a rate of 32,000 seeds per acre and planter-box insecticides were applied "T" band, banded behind the disc openers and in front of the closing wheels, with heavy chains drug directly behind the closing wheels for light soil incorporation of insecticides. Interrow cultivation was performed at V5 for additional weed control and the crop was harvested in late September.

Treatments: 6
Replications: 3
Planting Date: 26 April
Hybrid: Dekalb DK537, and it's Bt-RW isoline (DKC53-29).
Previous Crop: Late planted corn.
Tillage: Mulch
Soil Series: Will silty clay loam
Herbicides:
Degree Xtra@ 3.0qts+Atrazine@1quart per acre applied pre-emerge.
Insecticides: Many

Results and Discussion

Severe (2.4, 0-3 scale) root pruning from corn rootworm larvae occurred in the untreated control (page 8, table 1). Figures 6 and 7 on page 10 show corn grown without root protection adjacent to Bt-rootworm (Bt-RW) and Force treated corn. In both instances untreated corn was considerably shorter and heavily lodged. In addition to the severe root injury the control produced significantly (LSD 0.10) less corn grain than that of any insecticide or transgenic Bt-RW (page 8 table 1). The Lorsban and Counter did not provide any root protection, although their grain yields were significantly higher than the control, with the Counter greater than the Lorsban. The Aztec and Force provided acceptable levels of root protection with significantly less root injury than Lorsban or Counter, however, the Bt-RW resulted in a four fold reduction in root injury compared to Aztec or Force. Although the Bt-RW had superior root protection when compared to any other treatment, grain yields were similar to those of the Aztec and Force. Page 9, figure 5 depicts the relationship between root injury and grain yield, note the high level of root injury (> half of roots) necessary for yield reductions. The environment with which this relationship was developed was one of plentiful July rainfall (~187% of normal) and may not be the same in drier environments.

Corn Rootworm Larval Insecticide and Transgenic (Bt-Rootworm) Corn Evaluation

Figure 4. 0 to 3 node-injury Iowa State root rating scale (Oleson and Tollefson, 2000).

Value	Damage Description
0.00	No feeding damage (lowest rating that can be given)
1.00	One node (circle of roots), or the equivalent of an entire node, eaten back to within approximately two inches of the stalk (soil line on the 7th node)
2.00	Two complete nodes eaten
3.00	Three or more nodes eaten (highest rating that can be given)

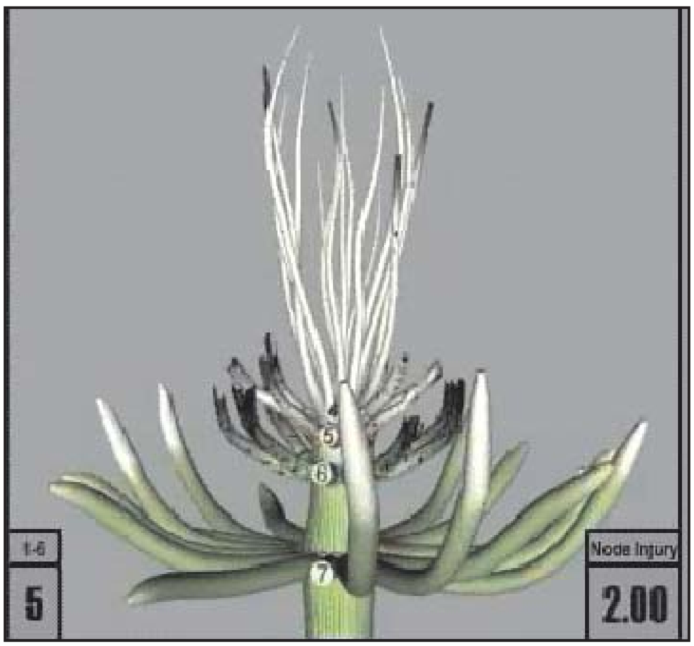


Figure 5. Example of a corn root with two nodes of roots eaten back to within at least 2 inches of the stalk. The root rating on the 0 to 3 scale is 2.

Table 1. Influence of corn rootworm larval insecticides and a transgenic (Bt-rootworm) on the root ratings and grain yield of mono-cropped corn grown at Joliet Junior College in 2003. The previous crop of corn was late planted (trap crop) to enhance the attraction of corn rootworm adults for ovipositioning.

Corn Rootworm Insecticide/Transgenic	Active Ingredient	Application Rate	Root Rating	Grain Yield
		oz/1000 ft row	0 to 3†	Bushels/Acre
Untreated	- - -	- - -	2.4	84
Lorsban 15G	Chlorpyrifos	3	2.4	81
Counter CR	Terbufos	8	2.3	113
Aztec 2.1G	Cyfluthrin/Phosphorothioate	8.7	1.3	166
Force 3G	Tefluthrin	4	1.2	168
Bt-RW. Corn	Insecticidal Protein [illegible]	- - -	0.3	148
LSD(0.10)	- - -	- - -	0.6	14

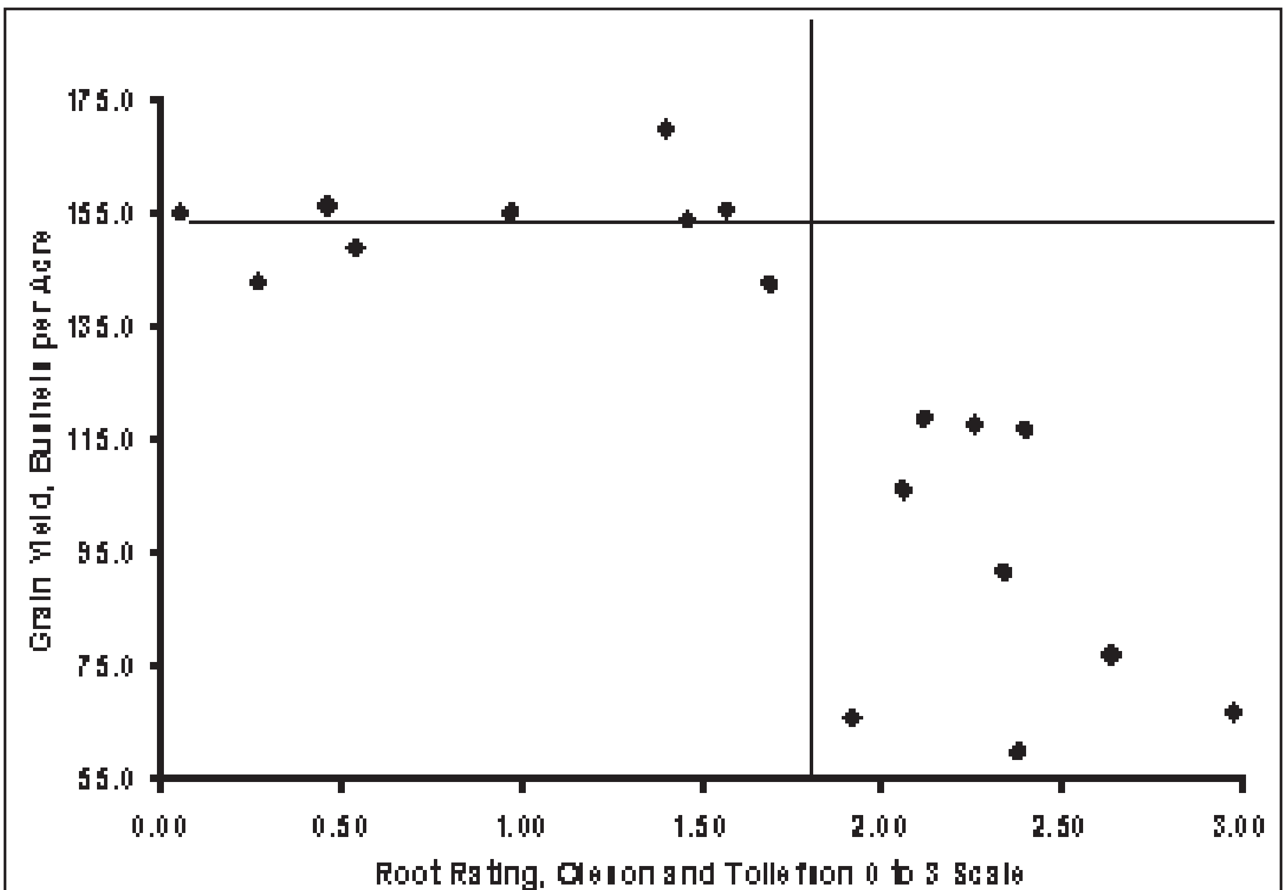
†Roots were rated using the Oleson and Tollefson 0 to 3 node-injury scale.

Corn Rootworm Larval Insecticide and Transgenic (Bt-Rootworm) Corn Evaluation

Table 2. Effect of corn rootworm insecticide and a transgenic Bt-rootworm with Gaucho (imadicloprid) on the harvest population of corn grown at Joliet Junior College in 2003.

Corn Rootworm Insecticide/Transgenic	Harvest Population
	Plants per Acre
Untreated	30,400
Lorsban 15G	30,500
Counter CR	30,100
Aztec 2.1G	30,700
Force 3G	31,100
RW. Corn	29,400
LSD(0.10)	N/S

Figure 5. Influence of root ratings on corn grain yield at Joliet Junior College in 2003.



Corn Rootworm Larval Insecticide and Transgenic (Bt-Rootworm) Evaluation

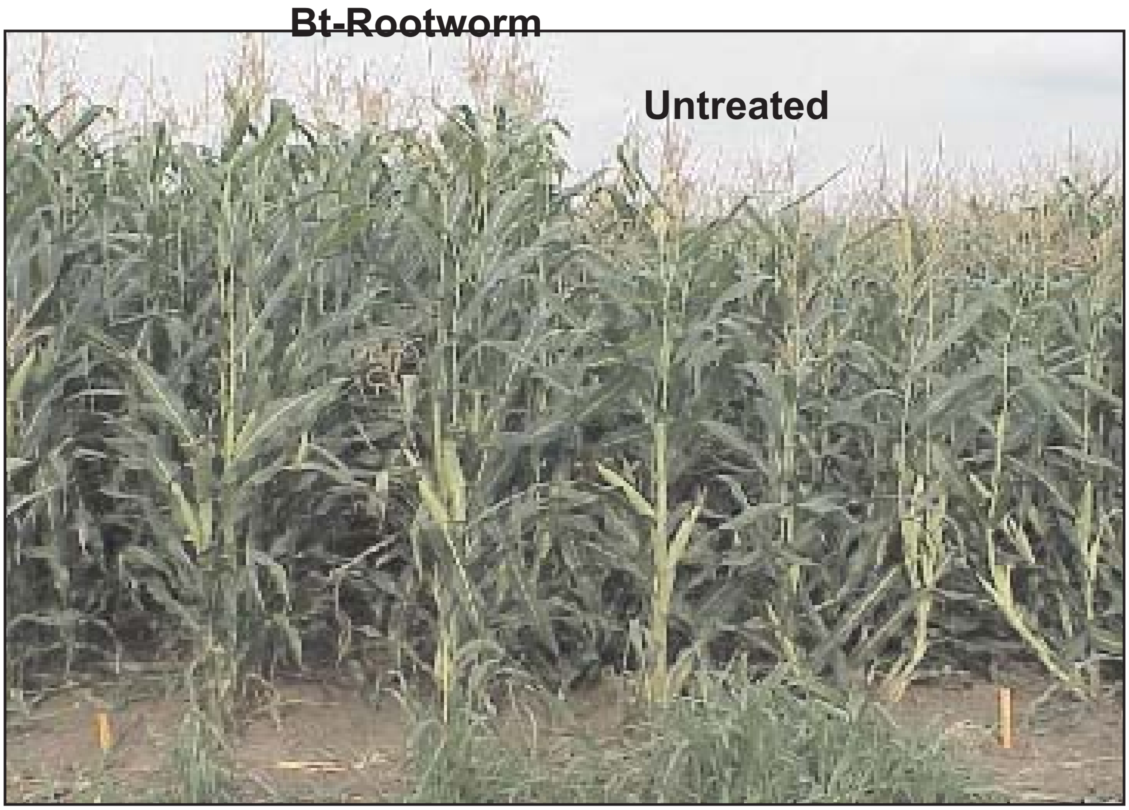


Figure 6. Left, transgenic Bt-RW., right, untreated.

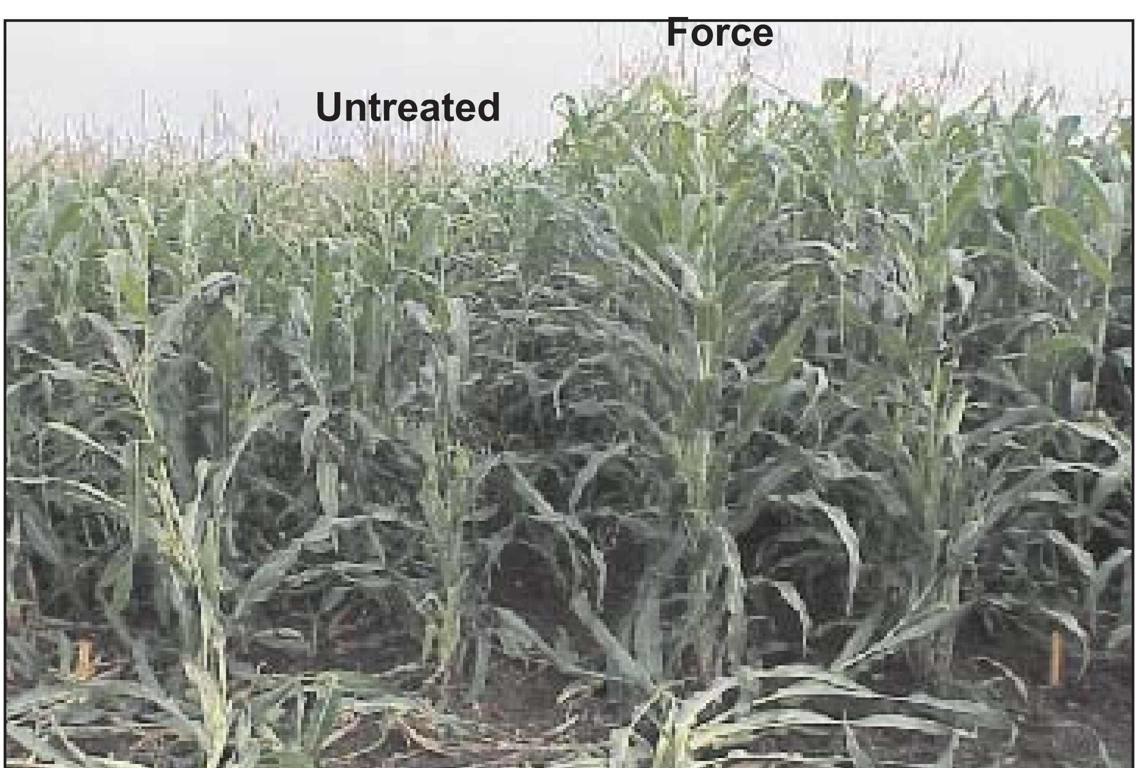


Figure 7. Left, untreated, right, Force treated.

Corn Rootworm Control Methods in Rotated Corn

Justification and Objective

Variant Western Corn Rootworm (WCR) has spread throughout most of the Northern half of Illinois (Page 12, Figure 8), a long way from it's more humble begining near Piper City, Illinois, in 1987 (Levine et al., 2002). The variant went largely unnoticed by Illlinois corn growers until it's explosion in 1995 where heavy root injury was observed in nine East-Central Illinois counties, and 15 North-Western Indiana counties. Entomologists have documented root injury to rotated corn in most of Northern Illinois counties during 2002 and 2003 (Schroeder and Ratcliffe, 2003). Our objective was to evaluate the effectiveness of two rootworm control methods, a corn rootworm insecticide and transgenic Bt-rootworm corn, in rotated corn.

Methods

One planter-box corn rootworm larval insecticide and a transgenic Bacillus thuringiensis for corn rootworm (Bt-RW.), and a control with no root protection were evaluated for their effect on root injury and grain yield. Each treatment was replicated four times and planted on April 28th with the Dekalb hybrid DK537 and DKC53-29 for the Bt-RW (transgenic) treatment. The previous crop was soybean, and full width tillage, which included Fall chisel-plowing and Spring discing, was performed on the entire experimental area. Corn was planted at a rate of 32,000 seeds per acre and the planter-box insecticide was applied "T" band, banded behind the disc openers and in front of the closing wheels, with heavy chains drug directly behind the closing wheels for light soil incorporation. Interrow cultivation was performed at V5 for additional weed control and the crop was harvested in late September.

Treatments: 3
Replications: 4
Planting Date: 28 April
Hybrid: Dekalb DK537, and it's Bt-RW isoline (DKC53-29).
Previous Crop: Soybean
Tillage: Mulch
Soil Series: Symerton silt loam
Herbicides:
Degree Xtra@ 3.0qts+Atrazine@1quart per acre applied pre-emerge.
CRW Insecticides: Force and Transgenic (Bt-RW).

Corn Rootworm Control Methods in Rotated Corn

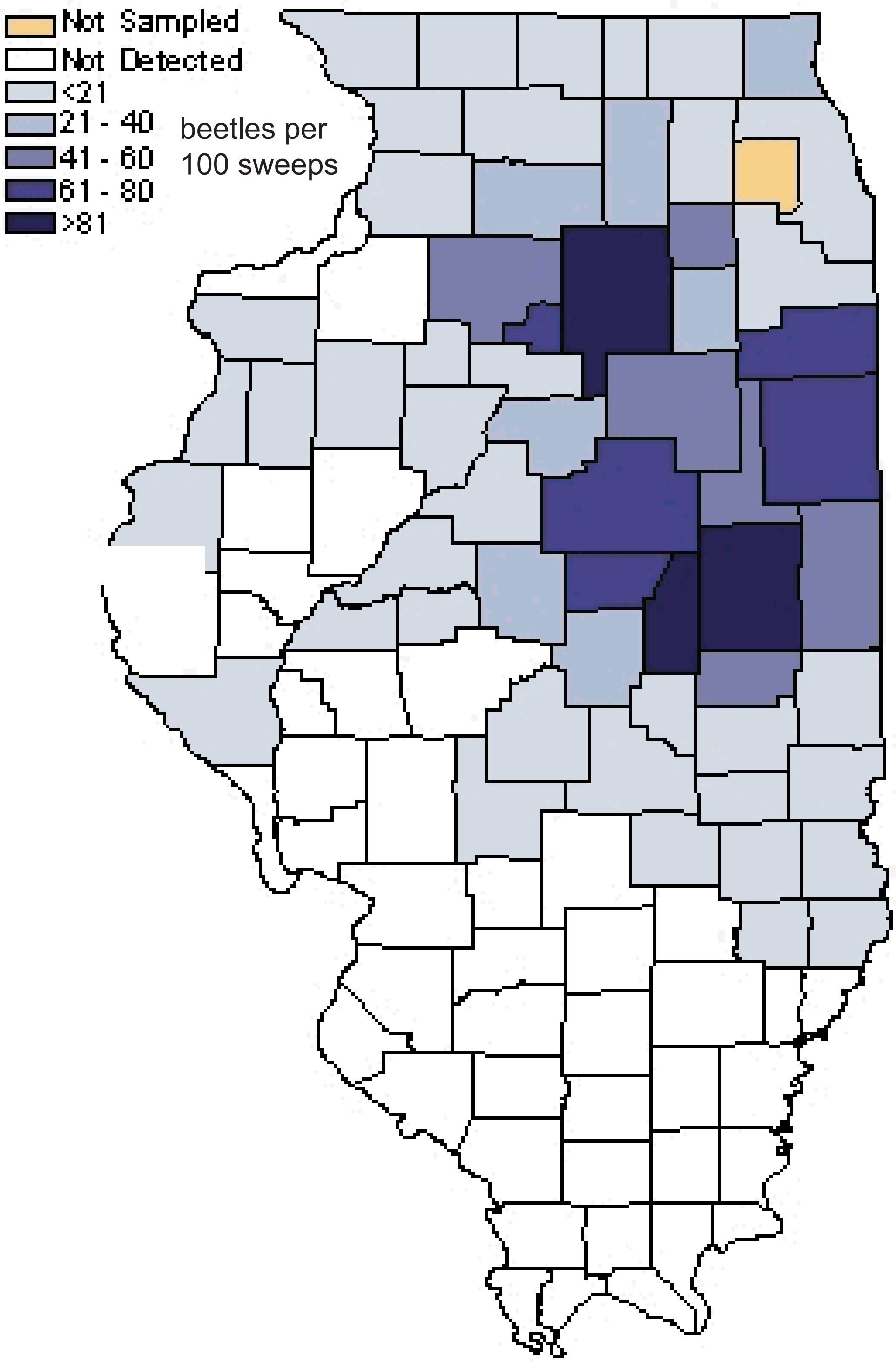


Figure 8. Western Corn Rootworm (WCR) adults captured in soybean fields throughout Illinois in 2002. Source: 2002 WCR distribution map. http://www.staff.uiuc.edu/~s-isard/Beetles/WCR_map02.htm.

Corn Rootworm Control Methods in Rotated Corn

Results and Discussion

Despit the severe corn root pruning in the untreated control plots (2.4, 0-3 node-injury scale), both control methods provided good root protection (page 13, table 3). The corn rootworm insecticide Force3G, and trangenic Bt-rootworm (Bt-RW) significantly (LSD 0.17) reduced root injury. Similarly, both control methods significantly increased grain yield compared to the untreated control. Although the Bt-RW plants tended to have less root injury relative to those treated with Force3G, yields between the two control methods were similar. This finding is the same as that of the rootworm insecticides/transgenic rootworm evaluation on page8 table1. In both studies Bt-RW protected roots better than Force3G, although yields were the same. Page 14 figure 9 shows the two control methods side by side at the R2 growth stage. The transgenic, which was also treated with Gaucho, and Force3G treated corn did not increase harvest populations compared to the untreated control (page 13, table 4).

Table 3. Influence of rootworm larval control methods on the root ratings and grain yield of rotated corn grown at Joliet Junior College in 2003.

Corn Rootworm Control Method	Active Ingredient	Root Rating	Grain Yield
		0 to 3‡	Bushels/Acre
Untreated	- - -	2.4	175
Force 3G†	Tefluthrin	0.6	191
Bt-RW. Corn	Insecticidal Protein Toxin	0.3	194
LSD(0.17)	- - -	0.7	13

† Force 3G was applied at 4 ounces per 1000 feet of row.

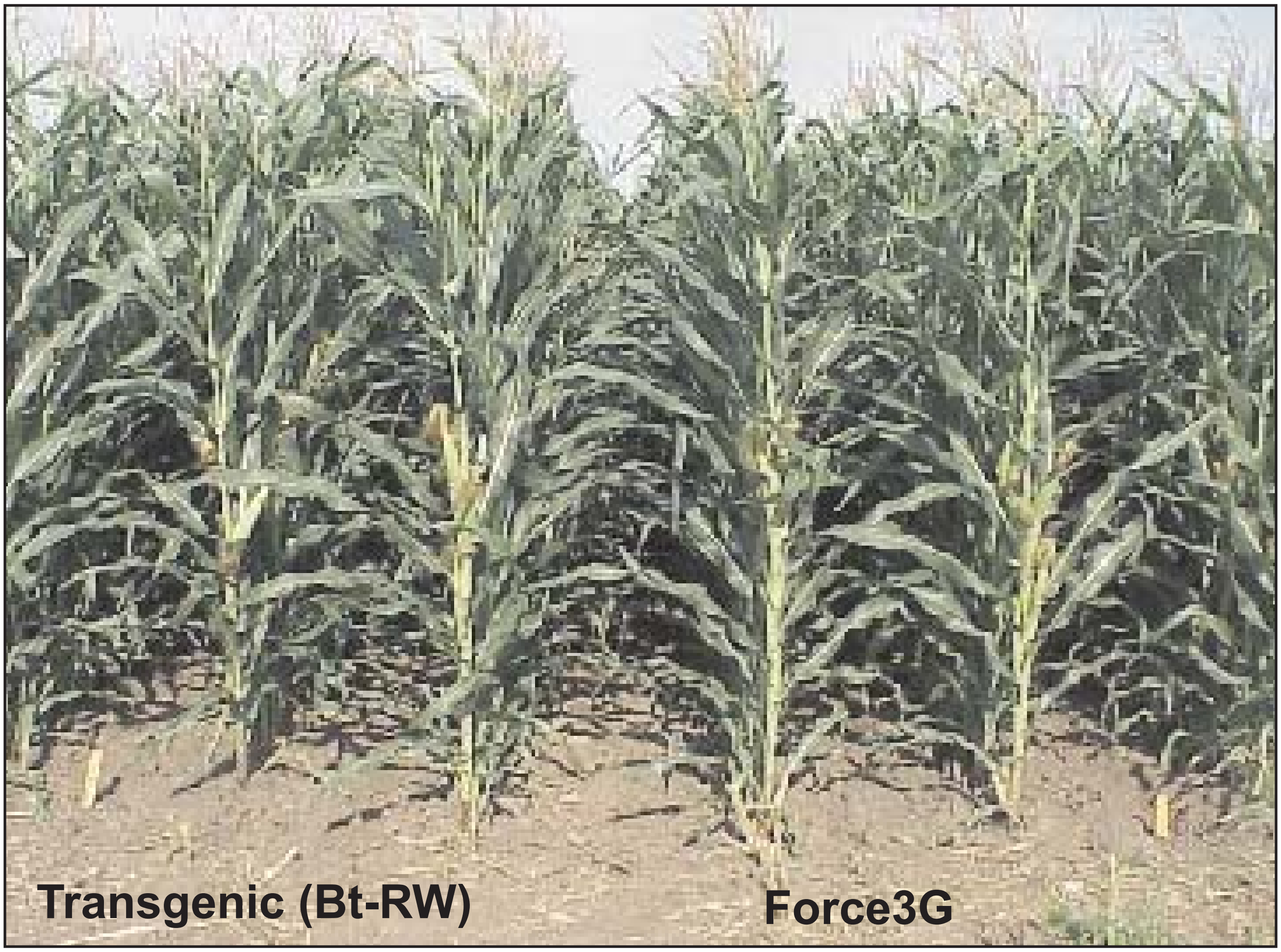
‡ Roots were rated using the Oleson and Tollefson 0 to 3 node-injury scale.

Table 4. Influence of Corn Rootworm Larval control methods on the harvest population of corn grown at Joliet Junior College in 2003.

Corn Rootworm Control Method	Harvest Population
	Plants per Acre
Untreated	30,333
Force 3G	32,000
Bt-RW. Corn	30,600
LSD(0.10)	N/S

Corn Rootworm Control Methods in Rotated Corn

Figure 9. Transgenic Bt-rootworm (left three rows) and Force treated (right three rows) corn at Joliet Junior College in 2003. Despit heavy root injury in the untreated control (2.4, 0-3 node-injury scale), plants with either root protection method did not lodge and produced high yields.



Corn Herbicides

Justification and Objective

Large numbers of herbicidal compounds are available for weed control in corn. The Illinois Agricultural Statistical Service (2000) lists 21 herbicidal compounds for corn. Fourteen of the 21 herbicides listed are used on less than 10% of Illinois corn acres. Seedling shoot and root inhibitors (chemical family Amide) are used extensively in Illinois, as 79% of corn acres receive an application of either s-metolachlor, acetochlor, or dimethenamid. Additionally, a mobile photosynthesis inhibitor (atrazine) is used on 81% of Illinois corn acres. While many compounds are available for weed control in corn, the overwhelming majority of Illinois corn acres receive similar herbicides.

Our objectives were two fold. First, provide a demonstration of the weed efficacy of commonly used corn herbicides in the Midwest to students at Joliet Junior College. Second, demonstrate the combination of the effects of weed efficacy and potential herbicide injury on corn grain yield.

Methods

Eight corn herbicide treatemnts and a no-herbicide control were implemented to determine their effect on weed efficacy and grain yield. Each treatment was replicated three times and planted on April 30th with the Great Lakes hybrid Quad 5. The previous crop was soybean and corn was planted at a rate of 32,000 seeds per acre with the corn rootworm insecticide Aztec. No tillage was performed with the exception of the no-herbicide treatment wich consisted of shallow tillage performed Spring preplant, followed by two post-emerge interrow cultivations. Herbicides were broadcast with flat fan spray nozzles on a Hardy sprayer applying 20 gallons per acre of spray solution and 20 pounds per square inch nozzle tip pressure. The crop was harvested in late September and weed efficacy ratings were taken two weeks before harvest.

Treatments: 9
Replications: 3
Planting Date: 30 April
Hybrid: Great Lakes, Quad 5
Previous Crop: Soybean
Tillage: Zero-Till
Soil Series: Will silty clay loam
Herbicides: Many
Insecticides: Aztec 2.1G @ 6.7ounces/1000 feet of row.

Corn Herbicides

Results and Discussion

Seven of the eight herbicide treatments significantly (LSD 0.10) increased grain yields compared to the No-Herbicide control, and all eight herbicide treatments achieved ≥ 70% control (page 16, table 5). Despite the much improved efficacy of the late-post (V7) applied Marksman+Accent+Atrazine compared to the No-Herbicide treatment, grain yields were similar. Severe early season weed interference (competition+allelopathy) during the critical period (first 4 weeks after crop emergence) resulted in large yield losses from the late-post applied Marksman+Accent+Atrazine which did not have a burndown herbicide applied (page 17, figure 10). Surprisingly, this late post application performed amazingly well given the very large size of broadleaf weeds at application time (page 18, figure 11). However, leaf area and crop growth rate were greatly reduced by application time, and continued to lag behind other treatments through the remainder of vegetative and reproductive growth. Reduced crop growth rates and accumulation of photoassimilate during reproductive growth often results in decreased grain yields. The remaining seven herbicide treatments all produced statistically similar grain yields, however the Degree Xtra+Atrazine treatment yielded 25 bushels per acre less than the same two herbicides with the addition of interrow cultivation. The most efficacious treatment was Degree Xtra+Atrazine followed by a post applied treatment of Clarity+2,4-D. Degree applied without atrazine and followed with a post application of Clarity and 2,4-D provided much improved weed control compared to Degree Xtra+Atrazine applied as a single pre-emerge treatment. Both the Epic+Atrazine and Lumax+Atrazine treatments provided very good weed control and produced similar yields. The post applied (V4) Basis Gold+Clarity also provided good weed control and yields. Pre-emerge and V4 post-emerge applied treatments produced similar yields and good weed control, however, Degree Xtra+Atrazine without a post-emerge weed control tactic and the late post applied treatment were not as efficacious as treatments including both pre-emerge and post-emerge herbicides.

Table 5. Effect of various herbicide treatments on weed efficacy and grain yield of corn grown at Joliet Junior College in 2003. Efficacy ratings were measured at R6. A burndown application of RoundupWM+2,4-D was applied pre-plant in the Spring of the year to the entire experimental area, with the exception of the no-herbicide and late-post applied treatments. Active ingrediants are listed in the same order in table6 as they appear here.

Herbicide Trade Name(Appl.Time)	Application Rate	Weed Efficacy	Grain Yield
	pints(oz)/acre	% Control	bushels/acre
No Herbicide - Interrow Cultivation†	---	0	132
Degree(Pre), Clarity+2,4-D(Post)	4.2, 0.6+0.6	90	138
Degree Xtra+Atrazine(Pre)	8+2	70	188
Degree Xtra+Atrazine(Pre), Interrow Cultivation	8+2	80	181
Degree Xtra+Atrazine(Pre), Clarity+2,4-D(Post)	8+2, 0.6+0.6	100	183
Epic+Atrazine(Pre)	(12)+4	93	186
Lumax+Atrazine(Pre)	8+2.6	93	184
Basis Gold+Clarity(Post)	(14)+0.26	88	182
Marksman+Accent+Atrazine(Late-Post)†	3.6+(0.88)+2.2	70	121
LSD(0.10)	---	---	22

†No burndown herbicide application.

Corn Herbicides

Figure 10. Late post (V7) applied Marksman+Accent+Atrazine treatment before application. No burndown herbicide(s) was applied. Note the heavy infestation of Winter-annuals during the critical weed-free period.

Table 6. Herbicide active ingredient, application rate, and site of action for the eight corn herbicide treatments evaluated at Joliet Junior College in 2003.

Active Ingredient	Application Rate	Site of Action†
	[illegible]	
Acetochlor, Dicamba+2,4-D	[illegible]	S/R, GR+GR
Acetochlor&Atrazine+Atrazine	[illegible]	S/R&PS2+PS2
Acetochlor&Atrazine+Atrazine	[illegible]	S/R&PS2+PS2
Acetochlor&Atrazine+Atrazine, Dicamba+2,4-D	[illegible]	S/R&PS2+PS2, GR+GR
Isoxaflutole&Flufenacet+Atrazine	[illegible]	HPPD&S/R+PS2
s-Metolachlor&Atrazine&Mesotrione+Atrazine	[illegible]	HPPD&S/R&PS2+PS2
Nicosulfuron&Atrazine&Rimsulfuron+Dicamba	[illegible]	ALS&ALS&PS2+GR
Dicamba&Atrazine+Nicosulfuron+Atrazine	[illegible]	GR&PS2+ALS+PS2

†SRI=Shoot and root inhibitor. GR=Growth regulator. PS2=Photosystem two inhibitor. HPPD=HPPD enzyme inhibitor. ALS=Acetolactate synthase inhibitor.

Corn Herbicides

Figure 11. Late post applied Marksman+Accent+Atrazine (left side) 7 days after treatment. Right half was treated with a burndown and a pre-emerge herbicide.

Corn Herbicides

Figure 12. Late post (V7) applied Marksman+Accent+Atrazine 14 days after treatment.

Corn Planting Date and Tillage

Justification and Objective

Optimum corn planting dates are well documented in Illinois, planting within the two week window between April 20th and May 4th usually produces optimum corn grain yields in most of Illinois (Nafziger, 2002). Tillage generally increases corn yields, although interactions with previous crop and soil water holding capacity are not unusual (Hoeft et al., 2000). Corn zero-tilled after soybean and in droughty soils can produces yields similar to tilled soils, however, monocropped corn and corn grown in soils with relatively good water holding capacity often produce higher yields with tillage. The influence planting date has on the response of corn to tillage is not well known. Observations made by researchers at Purdue from long-term tillage comparisons have been that a response to tillage is more likely when planting is done in late April compared to late May (Vyn et al., 2002). In Minnesota Randall and Vetsch (2002) found no interaction between planting date and tillage. Our objective was to determine the effect of planting date on the response of corn grain yield to tillage.

Methods

Two planting dates and tillage systems (four treatments) were replicated three times to determine if planting date influences the tillage system producing the highest corn yields. Tillage systems were zero and mulch, mulch tillage consisted of Fall chisel-plowing followed by two Spring shallow tillage operations. Planting dates were April 2nd and May 8th. The corn hybrid Burrus 628BtRR was seeded at 32,000 seeds per acre and the soil insecticide Aztec was "T" banded to protect roots from corn rootworm larvae. Weed control was achieved by pre-plant tillage for tilled plots and burndown herbicides in zero-till plots. Epic+Atrazine was applied pre-emerge followed by RoundupWM late-post in both tillage systems. The nitrogen source was urea ammonium nitrate (UAN), 40 lbs N per acre applied 2X2 during planting and 80 lbs N per acre soil injected at V5. Corn was harvested October 28th.

Treatments: 4 (2 tillage systems and 2 planting dates).
Replications: 3
Planting Date: 2-April, 8-May.
Hybrid: Burrus 628BtRR
Previous Crop: Soybean
Tillage: Zero and Mulch
Soil Series: Symerton silt loam
Herbicides:
RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied preplant (burndown).
Epic @ 12 ounces and atrazine @ 2 quarts per acre applied pre-emerge.
RoundupWM @ 21 ounces per acre applied late-post (V7).
Insecticides:
Aztec2.1G @ 6.7 ounces per 1000 feet of row.

Corn Planting Date and Tillage

Results and Discussion

No significant (LSD 0.10) interaction occurred between planting date and tillage. Early planted corn (2-April) tended to produce higher yields than planting on 8-May, irrespective of tillage (page 21, table 6). Zero till corn averaged 12 bushels per acre more than corn grown with mulch tillage. This was surprising given that tillage very commonly produces similar or higher yields compared to zero-till (Hoeft et al., 2000) (West et al., 1996) (Hoeft et al., 2002) (SOILS Project, 2003). Although corn yields tended to be very high at the JJC Demonstration and Research Farm in 2003, due primarily to twice the normal rainfall in July, August was relatively dry and zero-tillage may have contributed to soil moisture savings that increased yields. Harvest populations were significantly lower with Mulch compared to zero tillage (page 21, table 7). It is likely that an average reduction of 27,750 to 25,050 plants per acre could account for the yield reduction, as optimal populations are normally near 30,000 plants per acre (Nafziger, 1996). It is unclear why the mulch-till corn had a lower harvest population than the zero-till corn. One possibility is that in an attempt to plant on specific dates, soil conditions at both planting dates were less than ideal and seeding efficiency (harvest population/32,000*100) was low for both tillage systems (87% zero, 78% mulch). The mulch tillage however, tended to form a harder crust at the soil surface and could be the reason for the lower population.

Planting Date	Tillage: Zero	Tillage: Mulch
	Grain Yield	
	bushels per acre	
2-Apr	184	171
8-May	164	153
LSD (0.10)	22	

Table 6. Effect of planting date and tillage on the grain yield of corn grown at Joliet Junior College in 2003.

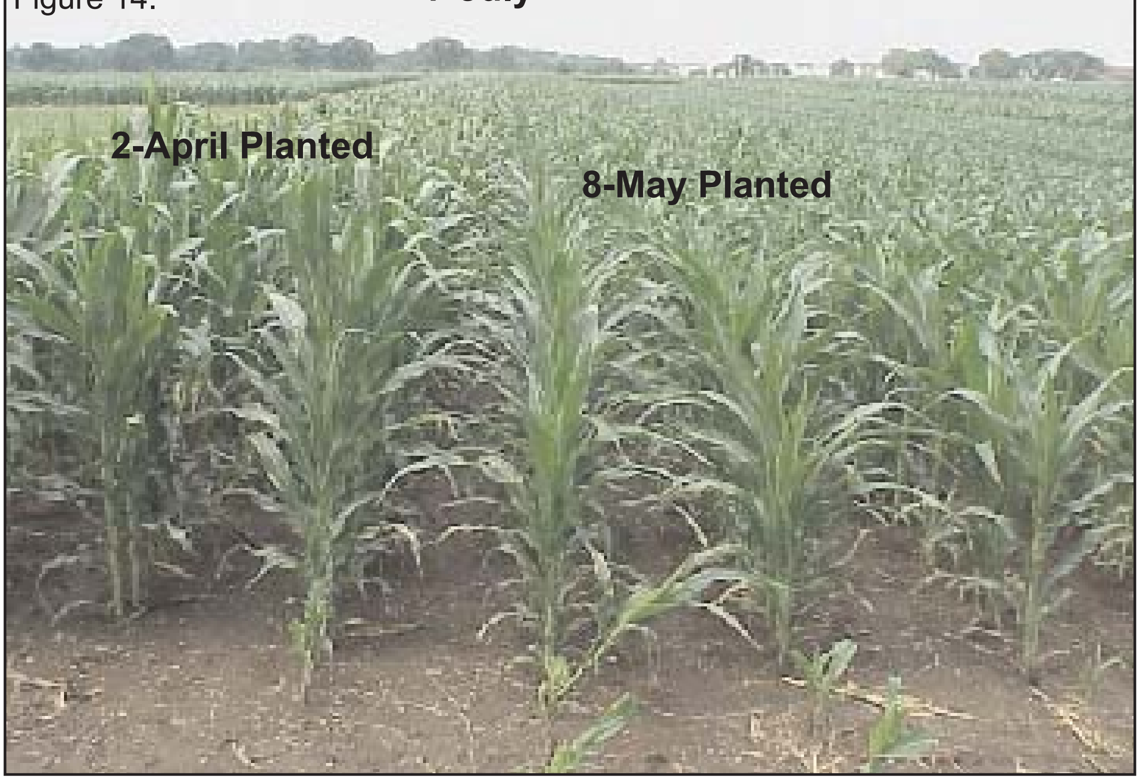
Planting Date	Tillage: Zero	Tillage: Mulch
	Harvest Population	
	plants per acre	
2-Apr	27,900	24,500
8-May	27,600	25,600
LSD (0.10)	377	

Table 7. Effect of planting date and tillage on the harvest population of corn grown at Joliet Junior College in 2003.

Corn Planting Date and Tillage

Figure 13.

Figure 14.



Nitrogen Application Time and Rate

Justification and Objective

Numerous fertilizer nitrogen (N) application times (Fall, Winter, early & late Spring, and Sidedress) are used for fertilizing corn in the Mid-West. Agronomically, agronomists have known for some time that Fall applied N is less effective than Spring or Sidedress N applications (Welch, 1971). Sidedress N is generally more effective than Spring applied, however, the difference between Sidedress and Spring is less than Fall and Spring. During the past decade there has been increasing concern over the efficiency by which N fertilizer is used. The largest zone of oxygen depleted waters in the U.S., Northern Gulf of Mexico, is often the focul point of concerns over N fertilzer use efficiency. This hypoxic area is thought by some to be partially related to or caused by an increase in nitrogen loading in the Gulf due to N fertilizer loss from Mid-Western cropland (Rabalias, 1998). The application of all fertilizer N to a corn crop can be applied sidedress without suffering yield losses (Fox et al., 1986). Scharf et al., (2002) found that sidedress N could be delayed as late as V11 without any yield losses, despite obvious signs of N defficiency. Our objective was to determine the effect of N application time on corn N requirements.

Methods

Two N application times (VE and V7) and five N rates (40 to 200lbs N per acre in 40lb increments) and an unfertilized control were used to determine the effect of N application time on corn yield response to N fertilizer. The eleven treatments were replicated three times and arranged in a randomized complete block design. Corn was planted on April 26th and seeded at 32,000 plants per acre. The corn rootworm insecticide Force3G was applied in a "T" band directly over the row, and weed control was achieved by a pre-plant burndown, and a pre-emerge applicaiton of Epic+Atrazine. Nitrogen fertilizer was urea ammonium nitrate (32% UAN) injected into the soil about 3 inches deep every 60 inches. Corn was harvested in late September.

Treatments: 11
Replications: 3
Planting Date: 26 April
Hybrid: Pioneer 34M95
Previous Crop: Soybean
Tillage: Zero
Soil Series: Symerton silt loam
Herbicides:
  RoundupWM @ 21 ounces+2,4-D @ 1pint per acre applied pre-plant.
  Epic @ 12 ounces+Atrazine @ 2quarts per acre applied pre-emerge.
Insecticides: Force3G @ 4 ounces per 1000 feet of row.

Nitrogen Application Time and Rate

Results and Discussion

Nitrogen (N) fertilizer applications significantly (LSD 0.10) increased corn yields for all N rates and application times except for the 40 pound rate when compared to the unfertilized control (page 24, table 8). Economic optimum N rate (N_{eo}) for VE applied N is 120 lbs N per acre while the 80 pound rate was sufficient to maximize profits for V7 applied N. Assumptions for N_{eo} are $2.40 per bushel corn and $0.225 per lb N fertilizer, a ratio of 10.7:1 (lbs N/bushel of corn) or approximately 4 bushels of corn required to purchase 40 lbs of N. Although not significantly different, N applied at VE tended to produce higher yields which is probably the reason for the higher fertilizer N requirement. Alternatively, N applied sidedress is often more efficiently used by corn (greater plant recovery) indicating that less fertilizer N may be required to maximize profits (Randall et al., 2003). When averaged over N rates N application time did not significantly effect corn yield (page 24, table 9). Pounds of N required per bushel of corn adding the 40 pound soybean credit to the fertilizer N for the two application times is 0.92 and 0.73 for N applied at VE and V7 respectively. In Illinois 1.2lbs N per bushel of historical corn grain yield is the recommended rate of N fertilization (Hoeft and Peck, 2002), although it has been found to be less (Below, 1995).

Table 8. Influence of nitrogen rate and application time on the grain yield of rotated corn grown at Joliet Junior College in 2003.

	N Appl. Time	
	VE	V7
N Rate	Grain Yield	
lbs N / acre	bushels / acre	
0	129	
40	145	144
80	162	165†
120	173†	164
160	174	167
200	179	167
LSD (0.10)	20	

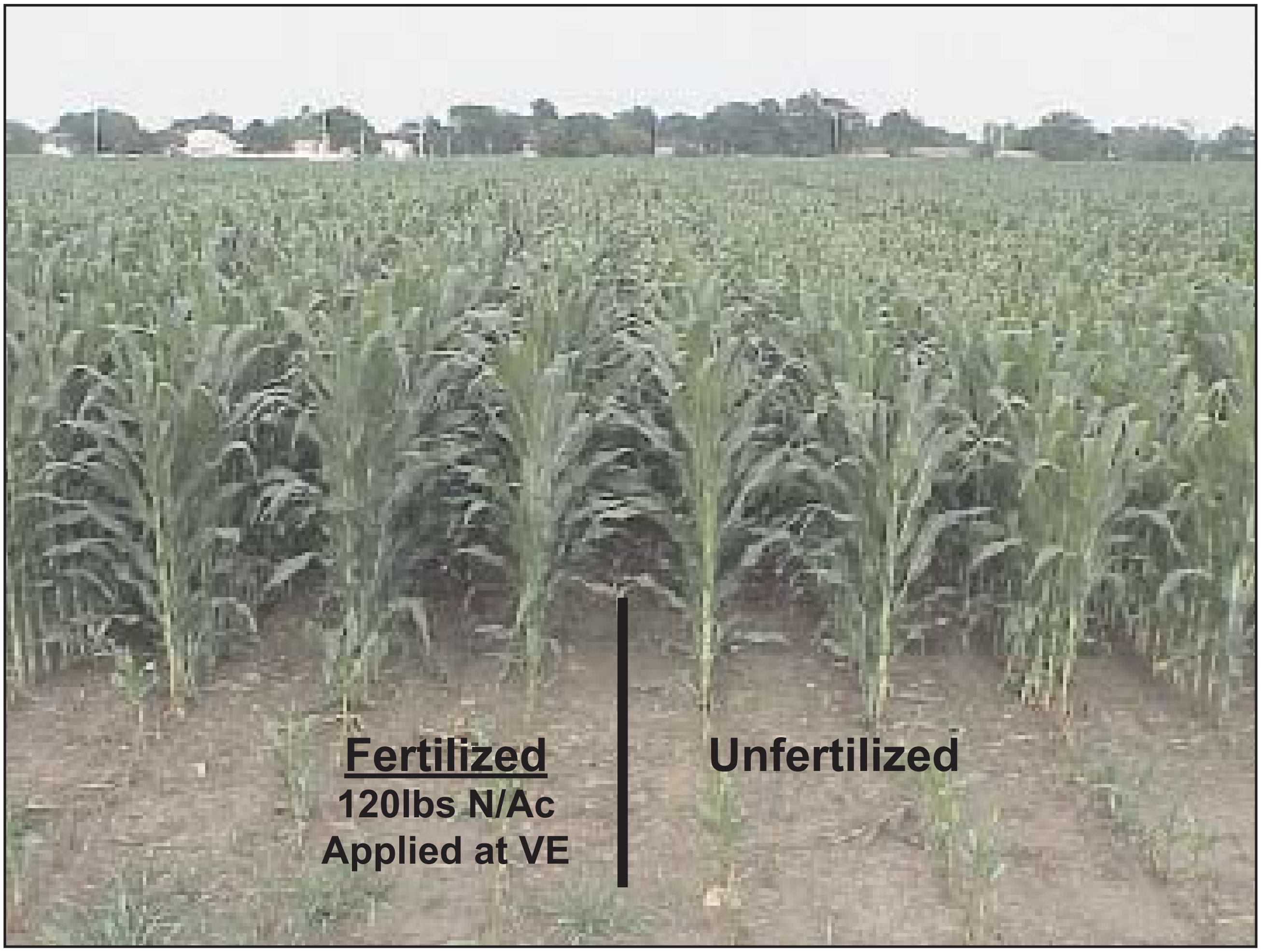
†Economic optimum N rate.

Table 9. Influence of nitrogen rate and application time on the grain yield of rotated corn grown at Joliet Junior College in 2003.

N Appl. Time	Grain Yield
	bushels / acre
No - N	129
VE	166
V7	162
LSD (0.10)	11

Nitrogen Application Time and Rate

Figure 15. V15 corn grown with (left 4 rows) and without (right 4 rows) fertilizer N in the N timing by N rate study at Joliet Junior College in 2003. Note the obvious lack of physical and visible N deficiency symptoms in the unfertilized corn. Despite the healthy appearance of the unfertilized plants, they produced 45 bushels per acre less than fertilized plants.



Variable Rate N Application

Justification and Objective

The advent of the common use of global positioning systems has created a means for producers and commercial applicators of crop production and protection inputs to apply these inputs varied spatially with accuracy unparalleled in the past. Naturally this has generated much excitement among agronomists, as folks involved in the production and protection of crops are continually seeking to improve the efficiency with which inputs are used. In many cases those in the fertilizer industry have not delayed in equipping themselves with the technology to apply fertilizers variably based on any number of soil or crop characteristics. Results from variably applied N fertilizer have been mixed. In Southern Illinois on a Cisne silt loam N was varied using historical corn grain yields, when compared to a constant N application method profitability was not improved (Varsa et al., 2003). However when N was variably applied using modeled corn yields profitability was improved compared to a whole-field application technique (Paz et al., 1999). Using soil NO_3^- - N levels to apply fertilizer N variably has also been used in an attempt to improve profitability, however, corn yields and optimum N rate were similar to N applied at constant rates (Eghball et al., 2003). Our objective was to determine the effect of variably applied N, compared to N applied at a constant rate, on corn yield.

Methods

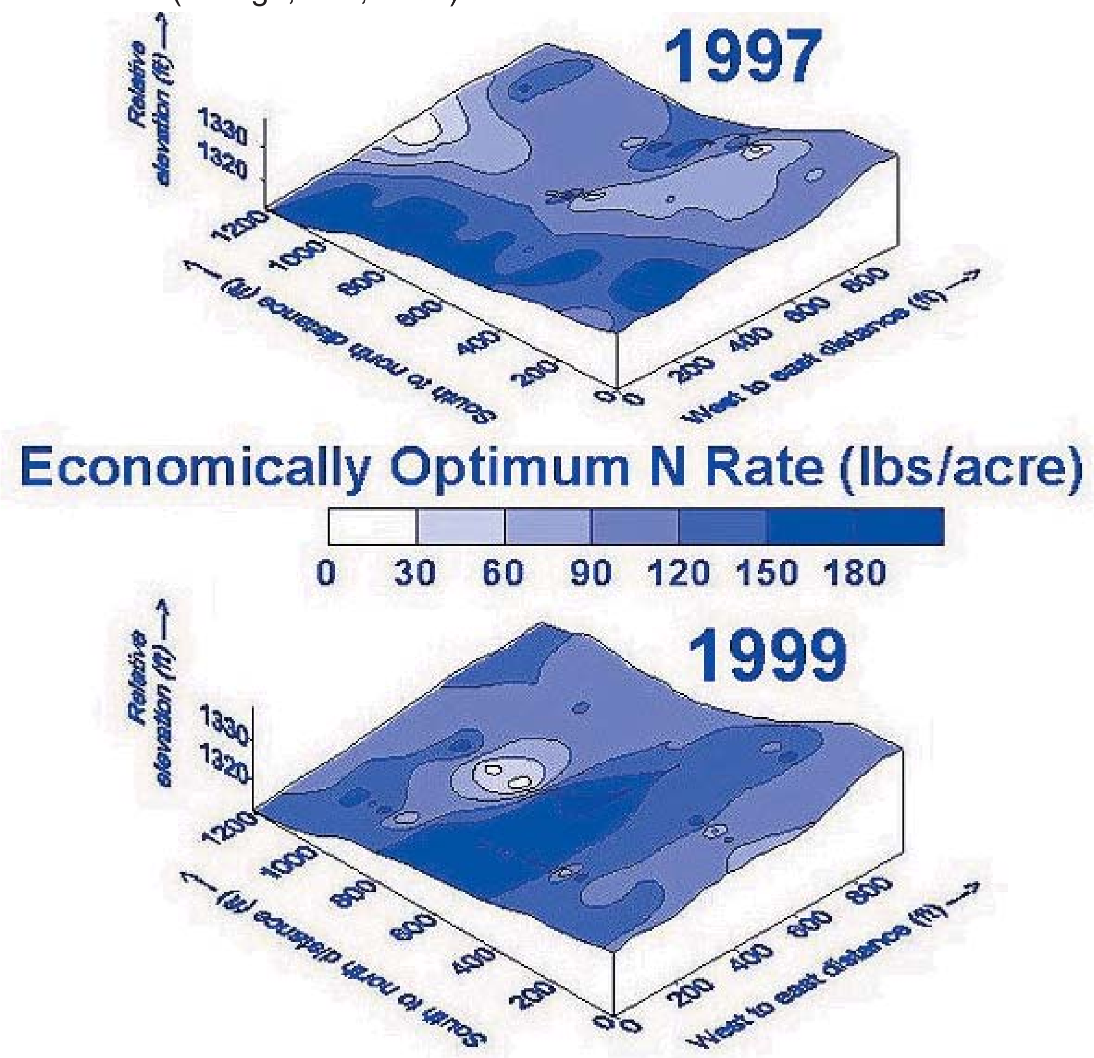
Forty pounds N per acre as urea-ammonium-nitrate (UAN) was applied two inches to the side and two inches below the seed furrow (2X2) to the entire experimental area during planting. The two sidedress treatments, a constant N rate (CNR) and a variable N rate (VNR), consisted of UAN applied in a surface band every 60 inches at V9 (June 23rd). Additionally, a control treatment without sidedress N was used to determine the response of corn to sidedress applied N. The CNR consisted of 80 lbs N per acre applied at a constant rate, while the VNR consisted of N applied variably as determined by soil NO_3^- - N levels. N rates were varied by utilizing the Iowa State University N recommendation system which employs soil NO_3^- - N concentrations (Blackmer et al., 1997). Soil was sampled for NO_3^- - N at V7 by taking one inch diameter cores one foot deep, a sample consisted of 16 cores. The experimental area which was 860 feet in length was split into thirds and each third was sampled once for soil NO_3^- - N. UAN was then applied variably according to soil NO_3^- - N levels in each third of the VNR plots. The VNR treatment averaged 125 lbs N per acre. Each treatment was replicated three times and the Sieben hybrid 6720YGCB was planted on April 28th at a rate of 32,000 seeds per acre. The previous crop was soybean and the experimental area was Fall chisel-plowed and disced once the following Spring.

Variable Rate N Application

Methods

Experimental Unit Dimensions: 10’ X 860’.
Treatments: 3
Replications: 3
Planting Date: 28 April
Hybrid: Sieben 6720YGCB
Previous Crop: Soybean
Tillage: Mulch
Soil Series: Symerton Sil
Herbicides:
Degree Xtra@3quarts+Atrazine@1quart per acre applied pre-emerge.
Insecticides: Force3G @ 4 ounces per 1000 feet of row.

Figure 16. Economically optimum N rates for a 30 acre field in Windom, Minesota in 1997 and 1999. Optimum N rates can vary considerably in a relatively small area, although they may not vary similarly over years. Photo from Gary Malzer, University of Minesota (Doerge, T.A., 2002).



Variable Rate N Application

Results and Discussion

No significant increase (LSD 0.10) in corn grain yield was found for either the constant N rate (CNR) or variable N rate (VNR) treatments compared to the control which had no N sidedressed. Forty pounds N per acre was applied during planting and was apparently enough fertilizer N to maximize yields. Observations throughout the growing season were that the control treatment showed no signs of N deficiency until mid-reproductive growth, and those symptoms were mild. It is interesting to note that lbs of N per bushel, including a 40 lb soybean credit, required to maximize yield is 0.40. Corn response to N fertilizer is highly variable. Page 27 figure 16 depicts large differences in economic optimum N rates over fairly short distances and shows small areas completely unresponsive to N fertilizer.

Figure 17. The Greenseeker™ is an example of new technlogy that utilizes real-time sensors that measure canopy reflectance of red and NIR light to apply N fertilizer variably to corn.

N Application Method	Grain Yield
	bushels/acre
Control†	202
CNR	200
VNR	200
LSD (0.10)	N/S

†The control treatment consisted of 40lbs N/acre applied at planting.

Table 10. Influence of N application method on the grain yield of corn grown at Joliet Junior College in 2003. The entire experimental area was treated with 40 lbs N per acre applied 2X2 during planting. The constant N rate (CNR) application method had 80 lbs N per acre sidedressed, while the variable N rate (VNR) had a variable rate of N sidedressed. N was varied by soil NO_3^- - N levels according to Iowa State Universtiy N recommendation.

Split Versus Single Spring N Applicaitons

Justification and Objective

Corn growers often go to great lengths to “spoon feed” their crop with N fertilizer. Typically producers using sidedress applications of N believe some fraction of the crops total N requirement needs to be applied at or before planting. This thinking of supplying the crop with N before sidedress application revolves around the idea that corn grain yield is largely determined during early vegetative growth. While the potential number of ovules per plant are determined at V5 and V12, cultural practices such as fertilizer N applications have little impact on the potential for ovules to develop. Hybrid genetics, however, are almost entirely responsible for potential ovule development (Below and Brandau, 1992). Additionally, corn N requirements through the first five vegetative growth stages are no more than 5% of the crop total (Ritchie, 1993), usually less than 10 lbs N per acre. When N application time is the subject of experimentation, corn yields are unaffected by a lack of fertilizer N as long as N is applied within six weeks after planting (Reeves et al., 1993). Our objective was to determine the impact of two versus one Spring N application on the grain yield of corn when applied at planting and sidedress compared to a sidedress application.

Methods

Two methods of N application timing were implemented to determine the effect of a single sidedress versus a planting+sidedress (split) application of N on corn yield. The split N application consisted of 40 pounds N per acre applied 2X2 during planting followed by 80 pounds N per acre sidedressed at V4. The sidedress treatment had 120 pounds N per acre applied at V4. An unfertilized control was included to determine the crops response to fertilizer N. Each treatment was replicated three times and corn was planted on May 17th. The hybrid was Dairyland Stealth 1411Bt planted without tillage where the previous crop was soybean. The corn rootworm larval insecticide Force3G was “T” banded during planting.

Treatments: 3
Replications: 3
Planting Date: 17 May
Hybrid: Dairyland Stealth 1411Bt
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
  RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied pre-plant.
  Degree Xtra @ 3 quarts and Atrazine @ 1 quart per acre applied pre-emerge.
  Clarity and 2,4-D @ 0.50 pint per acre each applied post-emerge.
Insecticides: Force3G @ 4ounces per 1000 feet of row.

Split Versus Single Spring N Applicaitons

Results and Discussion

Corn grain yield increased significantly LSD (0.10) for both N treatments compared to the unfertilized (No-N) control (page 30, table 11). Yields were relatively high and although the No-N treatment produced 137 bushels per acre, when N was applied yields increased nearly 50 bushels per acre. Grain yields from the two methods of N application time (sidedress and planting+sidedress) were not significantly different. This indicates that although growers in many instances may go to some length to "spoon feed" their crop with N during seedling and early vegetative growth stages, it may be unnecessary. It is not unusual for delayed N applications to produce yields similar to much earlier applied N. Among the many examples in the literature, a recent Missouri study indicated that N applications can be delayed as late as V11 without suffering yield losses (Scharf et al., 2002).

N Application Time	Grain Yield
	bushels / acre
No - N	137
Sidedress	187
Plant+Side	184
LSD (0.10)	19

Table 11. Influence of nitrogen fertilizer application time on the grain yield of corn grown at Joliet Junior College in 2003. Both of the fertilized treatments received a total of 120 lbs N per acre.

Figure 18. Sidedressing fertilizer nitrogen in corn.

Soil Fertility-Corn

Justification and Objective

Optimum soil phosphorous (P), potassium (K), and acidity levels are critical for corn and soybean production in the Mid-Western United States. Soil P and K, and pH levels for crop production in Illinois have been well established (Hoeft and Peck, 2002). However, many Illinois crop producers maintain soil fertility well above levels considered sufficient. Corn grain yields in Illinois 1998-2002 averaged 144 and soybean 43 bushels per acre (University of Illinois, 2003). Average annual removal of P_2O_5 and K_2O given current yields in a corn soybean rotation is 49 and 48 lbs per acre P_2O_5 and K_2O, however, additions of fertilizer P and K over a similar time period (1998 - 2001) was 76 and 112 lbs per acre P_2O_5 and K_2O (Illinois Agricultural Statistical Service, 2001a). An overapplication of any input to the extent of 55%, as is the case with fertilizer P, represents a serious misallocation of resources, however, that inefficiency pales in comparison relative to fertilizer K which is overapplied by 133%. Our objectives are two fold. First, as an educational tool we will demonstrate production of corn and soybean with fertilizer applications equal to crop removal, and demonstrate corn and soybean production without fertilizer P and K and the accompanying deficiency symptoms to students at Joliet Junior College. Finally we will provide information to crop producers demonstrating crop production with fertilizer applications similar to crop removal.

Methods

Six soil fertility treatments were implemented in the Fall of 2001 with the intention of maintaining them for long-term evaluation. The 2003 crop is the second harvested since the study was implemented. The normal treatment consists of a typical soil fertility program for row crops in Illinois which includes soil pH maintained between 6.0 to 6.5 and annual applications of maintenance fertilizer P and K. Two additional treatments are similar to the normal but are missing either maintenance P or maintenance K, and a fourth treatment has no P or K applications. The fifth and sixth treatments were included with the intention of reducing and increasing soil pH. The acidic treatment receives no liming material while the basic receives three-fold the recomended lime.

Soil samples were taken and analyzed in the Fall of 2001. Soil K levels (363 lbs/acre exchangeable K+), are considered sufficient for row crops in North Eastern Illinois, requiring only maintenance K (Hoeft and Peck, 2002). Soil P levels (44 lbs/acre available P) are slightly below the point at which only maintenance P applications would be necessary. Soil pH ranges from 5.9 to 7.4, somewhat high because of the calcareous nature of the parent material which is a loamy gravel with rock fragments of dolomitic limestone (Wascher et al., 1962). The depth to parent material is fairly shallow (2 to 3.5 feet) and in a few areas may only be covered with 15 inches of solum. The course textured and shallow parent material reduces the soil water holding capacity and makes the crop very susceptible to water stress when less than normal rainfall occurs.

Soil Fertility-Corn

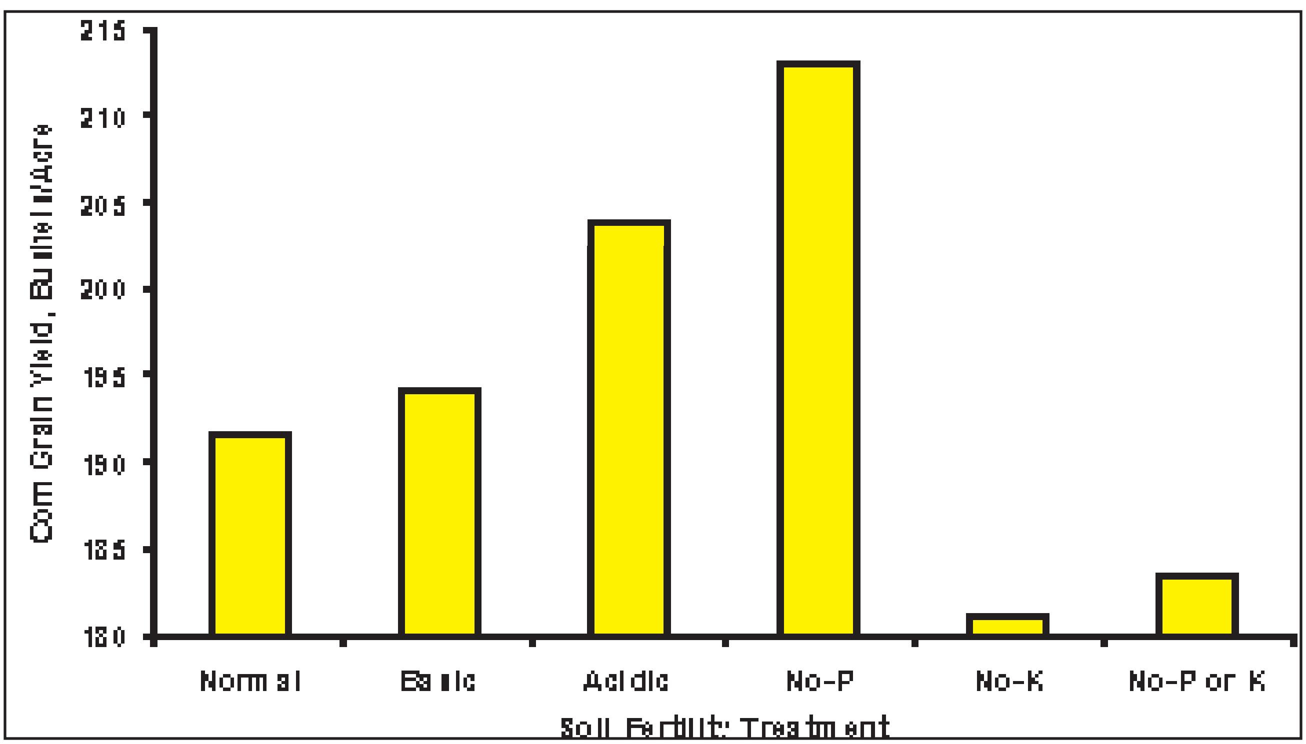
Methods

Treatments: 6
Replications: 2
Planting Date: 27 April
Hybrid: LG 2569G
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied pre-plant.
Degree Xtra @ 3 quarts and Atrazine @ 1 quart per acre applied pre-emerge.
Clarity and 2,4-D @ 0.50 pint per acre each applied post-emerge (V4).
Insecticides: Force3G @ 4ounces per 1000 feet of row.

Results and Discussion

No significant LSD (0.10) differences in grain yield were found among the six soil fertility treatments (page 32, figure 19). The two treatments without fertilizer potassium (K) tended to produce fewer bushels than K fertilized plots. The raw data contains considerable experimental error (variation not explained by treatments or replications) and as such the treatments had much less impact on overall variability than the experimental error (F test=0.62). Treatments of this study were begun in the Fall of 2001, two crops have been produced with the current soil fertility regimes and it is thought that over time differences between treatments will occur.

Figure 19. Effect of soil fertility treatment on the grain yield of corn grown at Joliet Junior College in 2003.



Yield Guard + ™

Justification and Objective

Monsanto made history in early 2003 with the U.S. EPA approval of transgenic Bacillus thuringiensis (Bt) rootworm corn. Genes from the Bt bacteria produce a protein with insecticidal activity on corn rootworm larvae (CRW). The Yield Guard™ technology confers this insecticidal activity to corn plants for insect protection. Yield Guard™ for european corn borer (ECB) has been used extensively for the past several years, now however, with both Bt traits (CRW and ECB) Monsanto has combined these two crop protection technologies together for a novel multiple insect protected plant. The stacking of these two traits should reduce crop losses associated with CRW and ECB. Our objective was to determine the effect of three levels of insect protected corn on grain yield.

Methods

Two insect protected transgenic isolines (Bt-RW and Bt-RW+CB) and the non-transgenic were planted on May 17th to evaluate their effect on corn yield. The Bt-RW+CB hybrid was Monsanto DKC60-14YG+ which employs Monsanto's Yield Guard +™ technology. Each treatment was replicated twice, the previous crop was soybean, and no insecticides for either CRW or ECB were used.

Treatments: 3
Replications: 2
Planting Date: 17 May
Hybrid: Monsanto DKC60-14YG+ and two isolines.
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied pre-plant.
Degree Xtra @ 3 quarts and Atrazine @ 1 quart per acre applied pre-emerge.
Clarity and 2,4-D @ 0.50 pint per acre each applied post-emerge (V4).
Insecticides: None

Results and Discussion

The two transgenics (Bt-RW, Bt-CB+RW) produced 3.4 times more corn grain than the non-transgenic (page 34, table 12). The Bt-RW protects corn roots from corn rootworm (CRW) and the BT-RW+CB protects corn from both CRW and european corn borer (ECB). Yields between the two transgenics were nearly the same, indicating that the large increase in yield over the non-transgenic was the result of root protection from CRW and not ECB. This result is not surprising, as two nearby corn rootworm larval studies had severe root pruning when roots went unprotected. Additionally, field observations during August revealed severe lodging and root pruning of the non-transgenic plots, while damage occuring from ECB appeared to be minimal.

Yield Guard + ™

Table 12. Effect of Monsanto corn hybrid DKC60-14YG+ (Bt-RW+CB) and two isolines on grain yield. The non-transgenic has no insect protection and the Bt-RW has corn rootworm protection, while the Bt-RW+CB has insect protection for both CRW and ECB. The previous crop was soybean and no insecticides were used for either CRW or ECB.

Yield Guard™ Transgenic Technology	Grain Yield
	bushels/acre
Non-Transgenic	56
Bt - RW	196
Bt - RW+CB	189

Figures 20 (left, CRW) & 21(right, ECB). Two important pests of corn in the Mid-West. Both pests are targeted by Yield Guard+™.

Intellicoat ™

Justification and Objective

Corn growers are planting earlier and the increase in conservation tillage acres results in more corn planted into cooler soils every year. A polymer seed coating (Intellicoat™) manufactured by Landec Ag Inc. is available to a number of seed companies. The coated seed is claimed to slow germination by preventing water imbibition during unfavorable environmental conditions (cool soil). The seed coating is supposed to be removed when exposed to warmer temperatures, probably degraded by soil microorganisms, allowing germination to proceed only when soils are relatively warm. Adding a synthetic type of dormancy to corn seed could be helpful for producers planting early into unfavorable environments in an attempt to complete planting by the end of the optimal period. Our objective was to evaluate the effect of intellicoat treated seed on harvest populations and grain yield.

Methods

Seed treated with and without the corn polymer seed coating Intellicoat™ was planted on April 2nd at 32,000 seeds per acre to determine the effect of the seed coating on grain yield and plant population. The corn rootworm insecticide Aztec was applied in a "T" band and 40 lbs N per acre was placed 2X2 during the planting operation. No tillage was performed and weed control was accomplished with a pre-plant burndown followed by pre and post emerge herbicides. Corn was harvested on October 28th and plant population was measured at V5.

Treatments: 2
Replications: 3
Planting Date: 2 April
Hybrid: Ag Venture 696
Previous Crop: Soybean
Tillage: Zero
Soil Series: Symerton silt loam
Herbicides:
RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied preplant (burndown).
Epic @ 12 ounces and atrazine @ 2 quarts per acre applied pre-emerge.
RoundupWM @ 21 ounces per acre applied late-post (V7).

Results and Discussion

No difference in grain yield was found between the untreated and Intellicoat™ treated seed (page 36, table 13). Plant populations however, were increased with the Intellicoat™ seed (page 36, table 14). It is surprising that no increase in yield occurred despite a 4,200 plant per acre population increase with coated seed. Soil conditions were slightly wet at planting and a hard crust formed over the seed furrow after planting. When plants were emerging one month later we received a significant rainfall which softened the crusted soil. It is possible that a greater percentage of plants without the seed coating may have been emerging slightly earlier prior to the crust softening rainfall.

Intellicoat ™

Table 13. Effect of the polymer seedcoating Intellicoat ™ on the grain yield of corn grown at Joliet Junior College in 2003. Corn was planted on April 2nd.

Seed Coating	Grain Yield
	bushels/acre
Untreated	171
Intellicoat	172
LSD (0.10)	N/S

Table 14. Effect of the polymer seedcoating Intellicoat ™ on the plant population of corn grown at Joliet Junior College in 2003. Corn was planted on April 2nd.

Seed Coating	Plant Population
	plants/acre
Untreated	25,800
Intellicoat	30,000
LSD (0.10)	294

Kernal Guard

Justification and Objective

As a means to protect corn seed and seedlings from secondary insect pests (wireworm, seedcorn maggot, seedcorn beetle) growers planting corn in environments where corn rootworm larvae are not likely to injure corn roots, may find seed treatments such as Kernal Guard™ an economical alternative to planter-box insecticides. Additionally, corn planted in environments where seedling diseases routinely reduce seedling vigor or plant populations could benefit from the use of seed treatments with fungicidal activity. Our objective was to determine the effect on yield and harvest population of corn grown with and without Kernal Guard™.

Methods

The Gro-Tech corn hybrid H790 was planted with and without the seed treatment Kernal Guard™ (Active Ingredients: Captan, Diazinon, Lindane). Kernal Guard™ is labeled for seed and seedling protection against some secondary insect pests and seedling diseases. Kernal Guard™ was mixed with seed in the planter box at planting. Corn was planted at 32,000 plants per acre with a Kinze 3000 series planter which uses a finger-type pickup mechanism to secure individual kernels prior to release in the seed tube. Both treatments were replicated three times, the previous crop was soybean and no corn rootworm larval insecticide was used.

Treatments: 2
Replications: 3
Planting Date: 17 May
Hybrid: Gro-Tech-Seed H790
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
  RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied preplant (burndown).
  Degree Xtra @ 3 quarts and Atrazine @ 1 quart per acre applied pre-emerge.
  Clarity and 2,4-D @ 0.50 pint per acre each applied post-emerge (V4).
Insecticides: None

Results and Discussion

Corn yield was significantly increases (LSD 0.10) by the use of Kernal Guard™ treated seed (page 38, table 15). The increase in yield was achieved despite similar harvest populations among the two treatments (page 38, table 16). Yields for both treatments were relatively low as a result of heavy corn rootworm larval root pruning and root lodged plants. A corn rootworm insecticide was not used because it would likely mask the effects of any insect protection provided by Kernal Guard™.

Kernal Guard

Table 15. Effect of the seed treatment Kernal Guard™ (Captan, Diazinon, Lindane) on the grain yield of corn grown at Joliet Junior College in 2003.

Seed Treatment	Grain Yield
	bushels/acre
Untreated	120
Kernal Guard	129
LSD (0.10)	3

Table 16. Effect of the seed treatment Kernal Guard™ (Captan, Diazinon, Lindane) on the harvest population of corn grown at Joliet Junior College in 2003.

Seed Treatment	Harvest Population
	Plants/Acre
Untreated	27,000
Kernal Guard	27,000

Corn Hybrids

Justification and Objective

Numerous corn hybrids are available to corn producers in the Mid-Western United States. In 2002 Illinois corn growers spent an average of $36 dollars per acre acquiring seed from dozens of hybrid seed corn companies (University of Illinois, Dept. of Agriculture and Consumer Economics, 2002). Our objective is to aid corn growers in making hybrid selections most suitable to their operations, and demonstrate to JJC students the large variety of hybrids currently offered in today's market.

Methods

Fifty-one corn hybrids were planted on April 30th at a rate of 32,000 seeds per acre with a model 3000 Kinze planter which uses a finger-type seed pickup mechanism. After each hybrid was planted leftover seeds were vacuumed out of the seed box and finger pickup mechanism. The corn rootworm larval insecticide Aztec2.1G was applied in a "T" band at planting with every hybrid. The check hybrid (Pioneer 34H31) was planted every 100 feet (10 hybrid entries) throughout the entire demonstration area. Each hybrid was evaluated on a relative scale by comparing it to the nearest check, which was never more than 5 entries (50 feet) away. Corn was harvested with a John Deere 9500 combine equiped with an Ag Leader PF3000 yield monitor that was used to measure grain yield. The demonstration area was zero-tilled and weeds were controlled with a pre-plant burndown of RoundupWM+2,4-D, followed by a pre-emerge application of Epic+Atrazine.

Hybrids: 51
Replications: Unreplicated demonstration
Planting Date: 30 April
Hybrid: Many
Previous Crop: Soybean
Tillage: Zero
Soil Series: Symerton silt loam
Herbicides:
RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied pre-plant.
Epic @ 12 ounces+Atrazine @ 2quarts per acre applied pre-emerge.
Insecticides:

Results and Discussion

The 51 corn hybrids had an average grain yield of 189 bushels per acre. Yields ranged 38 bushels per acre from a low of 168 to a high of 206. The check hybrid (Pioneer 34H31) averaged 198 bushels per acre, while all other hybrids averaged 187. Relative yields of the non-check entries averaged 96% and ranged from 85 to 107 percent of the check (page40, table7). Six hybrids (underlined) produced higher grain yields than the check. Twenty-seven hybrids (53%) were transgenic Bt, 24 of the 27 were Bt-CB and 3 were Bt-RW. Bt hybrids averaged 189 while non-Bt hybrids averaged 190 bushels per acre.

Corn Hybrids

Company Name	Hybrid Nomenclature	Transgenic Technology	Grain Yield	Relative Yield Versus Check
			[illegible]	- % -
FS	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
FS	[illegible]	[illegible]	[illegible]	[illegible]
Pioneer	**34H31**		[illegible]	**100**
Dekalb	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
Dekalb	[illegible]		[illegible]	[illegible]
Pioneer	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
Pioneer	**34H31**		[illegible]	**100**
Croplan	[illegible]	[illegible]	[illegible]	[illegible]
Pioneer	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FS	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Beck's	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Wyffels	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
Pioneer	**34H31**		[illegible]	**100**
Cornelius	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
Croplan	[illegible]	[illegible]	[illegible]	[illegible]
Dairyland	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Beck's	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
Pioneer	**34H31**		[illegible]	**100**
Dairyland	[illegible]		[illegible]	[illegible]
LG	[illegible]		[illegible]	[illegible]
Beck's	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
LG	[illegible]		[illegible]	[illegible]
Cornelius	[illegible]	[illegible]	[illegible]	[illegible]
Dairyland	[illegible]		[illegible]	[illegible]
Wyffels	[illegible]	[illegible]	[illegible]	[illegible]
Pioneer	**34H31**		[illegible]	**100**
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FS	[illegible]	[illegible]	[illegible]	[illegible]
Golden Harvest	[illegible]	[illegible]	[illegible]	[illegible]
Golden Harvest	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pioneer	**34H31**		[illegible]	**100**

[illegible]

[illegible]

Table 17. Demonstration of the grain and relative yields of 51corn hybrids grown at Joliet Junior College in 2003. The check hybrid is Pioneer 34H31 (bold font) which averaged 198 bushels per acre, while all other hybrids averaged 187. Note the six hybrids (underlined) with relative yields greater than (>100) the check.

Soybean Row Spacing and Seeding Rates

Justification and Objective

During the mid to late 1990's Illinois soybean planted in row spacings between 10 to 19 inches was increasing while spacings between 29 to 35 inches were declining (Adee and Pepper, 2000). By 1998 soybean acreages in both categories were similar and combined to make up nearly half of the Illinois soybean crop. Soybean row spacing influences canopy light interception which becomes critical in determining seed yield during seed set (R3 - R5) (Andrade et al., 2002). Generally there are small increases in soybean yield as row spacing narrows below that of the traditional 30 inch spacing, and the benefit from reduced row spacing is maximized at row widths of 15 to 20 inches wide (Pepper, 2000). Since light interception during the R3 through R5 growth stages is critical for maximum seed yield, cultural practices that enhance canopy closure before seed set generally increase yield. Practices that enhance canopy closure are; early to normal planting dates, planting late season cultivars, and avoiding double cropping. Soybean plant densities greater than 150,000 plants per acre rarely increase seed yield in Illinois (Nafziger, 2002a). However, practices that delay canopy closure during early reproductive growth are scenarios likely to respond to populations greater than 150,000 plants per acre. Our objectives were to determine the impact of row spacing and harvest populations on the seed yield of soybean, and demonstrate these effects to students at Joliet Junior College.

Methods

Four seeding rates (75, 125, 175, and 225 thousand seeds per acre) and two row spacings (15 and 30 inches) were planted on May 21st to determine the effect of both variables on soybean seed yield. No-tillage was used and weed control was accomplished with a Fall burndown that included herbicides with residual activity, followed by a post-emerge application of RoundupWM. Excellent weed control was accomplished irrespective of row spacing or seeding rate. The crop was harvested on October 31st with a John Deere 9500 combine and a modern grain table.

Treatments: 8
Replications: 3
Planting Date: 21 May
Soybean Cultivar: Pioneer 92M70
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
CanopyXL@2.5ounces+Express@0.15ounces+2,4-D@1pint per acre applied Fall pre-plant.
RoundupWM @21 ounces per acre applied post-emerge (V2).
Insecticides: None

Soybean Row Spacing and Seeding Rates

Results and Discussion

No significant increase (LSD 0.10) in seed yield occured for harvest populations greater than 75,000 plants per acre (page 42, table 18). Seed yield plateaued for both row spacings at 118,000 plants per acre and was significantly reduced at 203,000. At 156,000 plants per acre 15 inch row soybean produced yields similar to 118,000, however, in 30 inch row spacing there was a significant decrease. Overseeding in 30 inch row spacing tended to reduce yield to a greater extent than similar populations in 15 inch rows. Severe lodging at the two highest populations, especially for the 30 inch row spacing, may be partly responsible for the yield loss. One possibility is that greater harvest losses occured when plants were lodged, additionally, the existing canopy may not have been as effective at light interception with lodged plants. When soybean plants lodge they do not necessarily do so in a completely random manner, resulting in “bunches” of lodged plants and sunlight striking the ground instead of being intercepted by the canopy. When row spacing was averaged over the four harvest populations (page 42, table 19), 15 inch row spacing produced significantly (LSD 0.10) higher soybean yield. The three bushel advantage was identical to our findings in 2002 and is similar to the findings of numerous soybean row spacings studies conducted throughout the North-Central U.S. (Dayton and Lowenberg-DeBoer, 2003).

Harvest Population	Row Spacing 15"	30"
	Seed Yield	
Plants/Acre	Bushels/Acre	
75,000	47	47
118,000	50	48
156,000	49	43
203,000	46	40
LSD (0.10)	4	

Table 18. Influence of harvest population and row spacing on the seed yield of soybean grown at Joliet Junior College in 2003.

Row Spacing	Seed Yield
Inches	Bushels/Acre
15	48
30	45
LSD (0.10)	3

Table 19. Influence of row spacing on the seed yield of soybean grown at Joliet Junior College in 2003. Row spacings are the average of the four harvest populations.

Soybean Row Spacing and Seeding Rates

Figure 22. Soybean planted at 175,000 (156,000 harvest population) seeds per acre and grown in 30 (top) and 15 (bottom) inch rows. Photograph was taken on July 14th. Plants had just begun to flower (R1) and had six fully developed trifoliates. Note the incomplete canopy with the 30 inch row spacing, while 15 inch row soybean is maximizing light interception.

Soybean Herbicides

Justification and Objective

Large numbers of herbicides and various combinations of herbicidal compounds are available to Mid-Western soybean growers for control of broadleaf and grassy weeds. Illinois Agricultural Statistical Service (2002a) lists 16 herbicides applied to soybean in Illinois in 2001. These herbicides range from Blazer applied to as little as 3% and roundup applied to 72% of soybean. Our objectives were three fold. First, provide a demonstration of the weed efficacy of commonly used soybean herbicide treatments in the Midwest to students at Joliet Junior College. Second, demonstrate the combination of the effects of weed efficacy and potential herbicide injury to crops. Finally, provide soybean growers with information concerning efficacy and crop injury of commonly used herbicides.

Methods

Six soybean herbicide treatments and a no-herbicide control were implemented. Page44, table 21 lists the site(s) of action for each treatment. Weed efficacy ratings were taken after maturity and before harvest. All herbicide applications were made with flat-fan extended range (XR) type orifices.

Treatments: 7
Replications: 3
Planting Date: 19 May
Soybean Cultivar: Great Lakes GL2709
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides: Many
Insecticides: None

Table 20. Herbicide trade name and application time of six soybean herbicide treatments. The timing of burndown application for each treatment is listed after the dash (-). Herbicides in this table have their active ingredients listed in the same order in table 21 below.

Herbicide Trade Name(Appl.Time)
RoundupWM(post) - No Burndown
RoundupWM(post) - Spring Burndown
RoundupWM(post) - Fall Burndown
RoundupWM(Late-post) - Spring Burndown
Raptor(Late-post) - Spring Burndown
Pursuit(Late-post) - Spring Burndown

Table 21. Active ingredient, application rate, and site of action of six soybean herbicide treatments. Active ingredients listed after the dash (-) refer to the pre-plant burndown applied in either the Spring or Fall as designated in table 20.

Active Ingredient	Application Rate	Site of Action†
	lbs a.i.(a.e.)/acre	
Glyphosate	(0.76)	EPSP
Glyphosate - Glyphosate+2,4-D	(0.76)-(0.76)+(0.48)	EPSP - EPSP+GR
Glyphosate - Chlorimuron, Sulfentrazone+Tribenuron+2,4-D	[illegible]	EPSP - ALS, HPPD+ALS+GR
Glyphosate - Glyphosate+2,4-D	(0.76)-(0.76)+(0.48)	EPSP - EPSP+GR
Imazamox - Glyphosate+2,4-D	(0.039)-(0.76)+(0.48)	ALS - EPSP+GR
Imazethapyr - Glyphosate+2,4-D	(0.063)-(0.76)+(0.48)	ALS - EPSP+GR

†GR = Growth regulator. HPPD = Hydroxyphenylpyruvate dioxygenase inhibitor. ALS = Acetolactate synthase inhibitor.
EPSP = Enolpyruvyl shikimate-3-phosphate Synthase inhibitor.

Soybean Herbicides

Results and Discussion

The experimental area contains heavy weed pressure as can be seen in the top half of page 46, figure 23. Despite the heavy weed pressure some level of weed control was achieved through pre-plant tillage and multiple innterow cultivations (bottom half of figure 23. However, all four treatments with post(V2) or late-post(V4) emerge RoundupWM significantly (LSD (0.20) increased soybean seed yield compared to the no-herbicide treatment (page 45, table 22). Of the three RoundupWM post applied treatments (data in box), the No burndown had the poorest weed control and lowest yield. The Spring applied burndown resulted in both an intermediate control rating and seed yield, while the Fall applied burndown which included herbicides with residual activity produced perfect weed control and the highest yield. Soybean grown without a burndown herbicide (page 47, figure 24) had extremely heavy weed competition from emergence until RoundupWM was applied at V2 (bottom of figure 24). Additionally, the no-burndown treatment had heavy late-season weed competition as the efficacy was only 60% at maturity, table 22. The late season weed infestation of the no-burndown treatment was the result of an early RoundupWM application combined with no residual herbicide activity. Although the post (V2) application may seem relatively early to many, it's importance cannot be overemphasized in this environment. Note the similarity between the yields and the large difference between weed control of the RoundupWM no-burndown and RoundupWM applied late-post with a Spring burndown. The late-post (V4) application killed all emerged weeds and the large canopy at that time prevented any new weed emergence resulting in perfect weed control, but less than optimum yields when compared to earlier (V2) post applications with Spring or Fall burndowns. RoundupWM applied post(V2) with a pre-plant burndown that included herbicides with residual soil activity produced perfect weed control and the highest seed yield. If a burndown does not have residual activity it is more economical to apply RoundupWM post and live with some weeds than to apply late-post and achieve perfect weed control.

Table 22. Effect of six herbicide treatments, thier application time, and type of burndown (after dash) on weed efficacy and seed yield of soybean grown at Joliet Junior College in 2003. Post is defined as V2 and late-post is V4. Weed efficacy ratings were taken after maturity but before harvest. Treatments are listed in the same order as in both tables on page44.

Herbicide Trade Name(Appl.Time)	Appl. Rate	Weed Efficacy	Seed Yield
	ounces/acre	% Control	bushels/acre
No Herbicide, Interrow Cultivation	——	0	42
RoundupWM(post) - No Burndown	21	60	50
RoundupWM(post) - Spring Burndown‡	21	83	55
RoundupWM(post) - Fall Burndown†	21	100	59
RoundupWM(Late-post) - Spring Burndown	21	100	49
Raptor(Late-post) - Spring Burndown	5	92	44
PursuitDG(Late-post) - Spring Burndown	1.44	48	43
LSD(0.20)	——	——	7

†Fall burndown consisted of: CanopyXL@[illegible]oz./acre+Express@[illegible]oz./acre+2,4-D@[illegible] pt./acre. The active ingredients in CanopyXL are Chlorimuron and Sulfentrazone, while Express is Tribenuron.

‡Spring burndown consisted of: RoundupWM@[illegible] oz./acre+2,4-D@[illegible] pt./acre.

Soybean Herbicides

Figure 23. The treatment without herbicide applications, only mechanical weed control was used. Photograph at top was taken on June 23rd before interrow cultivation. The bottom photo was taken on July 7th after one interrow cultivation and considerable rainfall.

Soybean Herbicides

Figure 24. The no-burndown treatment the day before RoundupWM application on June 17th (top), two weeks after application (bottom).

Soybean Planting Date

Justification and Objective

A relatively large window exists for planting soybean in Illinois. The planting window extends from late April to late May and provides a fairly large cushion for timely planting when compared to corn (Pepper, 2000). Generally however, when planting is pushed into early June yields decline rapidly. Our objective was to determine the effect planting date has on soybean seed yield, and to demonstrate the effects of various planting dates on growth and development to Joliet Junior College students.

Methods

Soybean was planted on three dates (9-April, 19-May, 6-June) in 15 inch row spacing at 175,000 seeds per acre with the Seiben cultivar 2900NRR. Each treatment was replicated three times and weed control was achieved with a pre-plant burndown followed by two post-emerge applications of RoundupWM. The crop was harvested on October 31st.

Treatments: 3
Replications: 3
Planting Date: Three; 9-April, 19-May, 6-June.
Soybean Cultivar: Seiben 2900NRR
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
RoundupWM@ 21 ounces+2,4-D@1pint per acre applied pre-plant.
RoundupWM@ 21 ounces per acre applied post-emerge.
RoundupWM@ 21 ounces per acre applied late-post-emerge.
Insecticides: None

Figure 25. Defoliation of soybean caused by bean leaf beetle adult feeding. Bean leaf beetle adults often cause greater injury to soybean planted early, compared to later planting dates.

Soybean Planting Date

Results and Discussion

Soybean planted in early April and mid-May produced similar seed yields, although when planting was delayed until early June yields declined significantly (LSD 0.25) (page 49, table 23). These results are similar to those found by Grau et al. (1994) who noted large yield reductions with mid to late June planted soybean compared to May plantings. No difference was found in harvest populations among the planting dates (table 23), although it is worthwhile to note that all seed was dropped at 175,000 seeds per acre making the seeding efficiency fairly poor regardless of planting date.

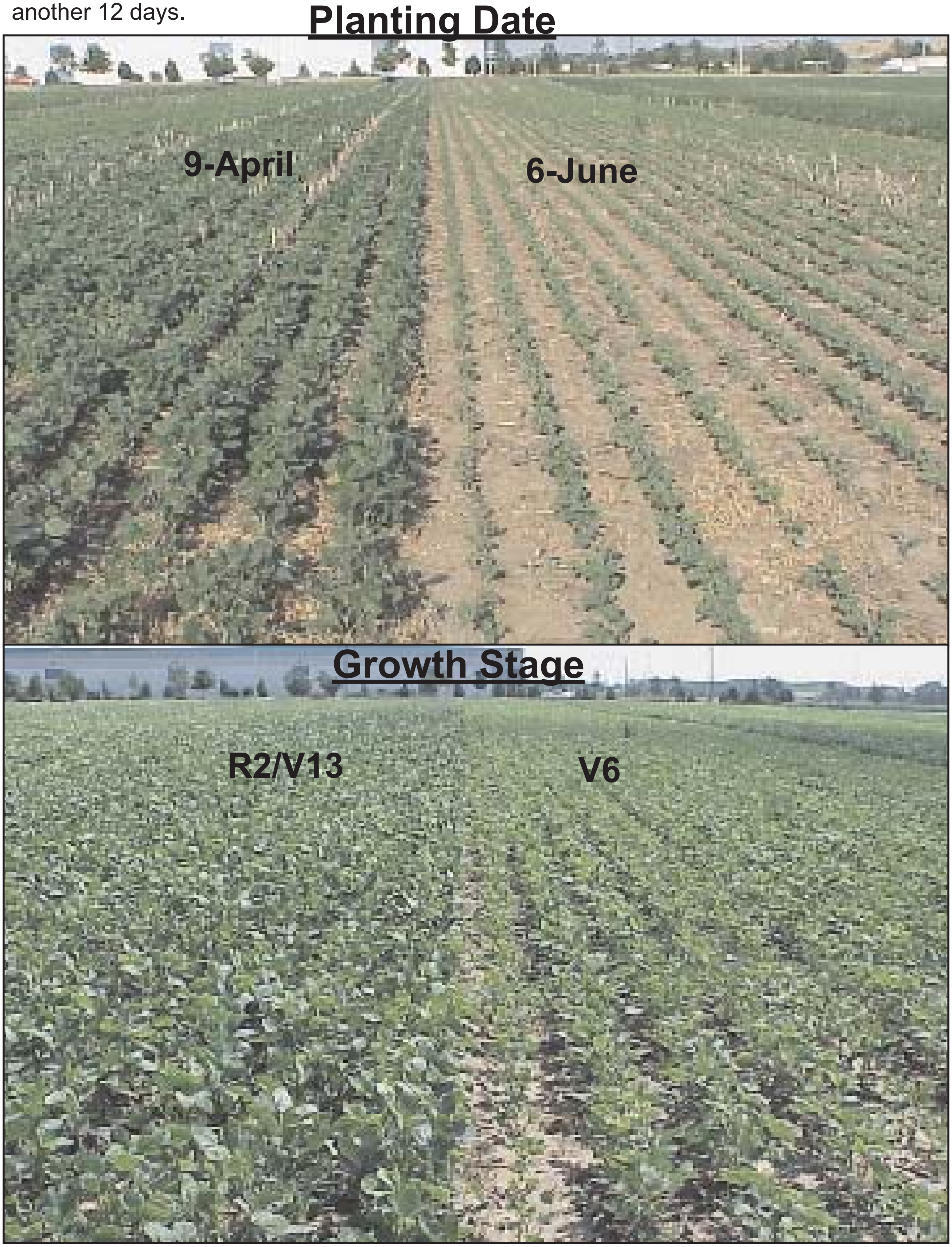
Table 23. Effect of planting date on harvest population and seed yield of soybean grown at Joliet Junior College in 2003. Seeding rate was 175,000 seeds per acre.

Planting Date	Harvest Population	Seed Yield
	Plants/Acre	Bushels/Acre
9-April	113,000	49
19-May	121,000	50
6-June	121,000	43
LSD (0.25)	N/S	6

Figure26. Soybean planted on 9-April in the middle of May. Upon close inspection most of these plants had defoliation from Bean Leaf Beetle adults similar to figure25 on page48.

Soybean Planting Date

Figure 27. Early(left) VS. late(right) planted soybean on June 30th(top) and July 14th (bottom). On July 14th early planted soybean is in full bloom(R2) and has 12 fully developed trifoliates, while late planted has 5 fully developed trifoliates and will not be in full bloom for another 12 days.



Soybean Fungicidal Seed Treatment

Justification and Objective

Nearly half of Illinois soybean is grown using conventional tillage systems (<30% residue coverage at planting), 1/3 using zero tillage, and the balance mulch tillage (>30% residue cover at planting) (Conservation Technology and Information Center, 1996). One reported disadvantage of zero and reduced tillage soybean is the greater necessity for fungicidal seed treatments. It is thought that zero and reduced tillage systems having higher soil water contents, increase the incidence of diseases such as the fungal watermold *Pythium* (Pederson et al., 2001). Currently there are two main combinations of fungicidal seed treatments for soybean growers to choose from, they are; Maxim (fludioxonil) + Apron XL (mefenoxam) and Rival (Captan, TBZ, and PCNB) + Allegiance (metalaxyl). Our objective was to determine the responsiveness of soybean to the fungicidal seed treatments RIVAL™ + ALLEGIANCE™.

Methods

The fungicidal seed treatment RIVAL™ (Captan, TBZ, and PCNB)+ ALLEGIANCE™ (Metalaxyl) and an untreated control were replicated three times to determine the effect of a soybean seed treatment on yield. The cultivar Dairyland Seed 340RR was seeded at 175,000 seeds per acre with and without RIVAL™ + ALLEGIANCE™ on May 19th. The row spacing was 15 inches and RondupWM was used for weed control. The crop was harvested on October 31st.

Treatments: 2
Replications: 3
Planting Date: 19 May
Soybean Cultivar: Dairyland Seed 340RR with and without a seed treatment.
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
  RoundupWM @ 21ounces+2,4-D @ 1pint per acre applied pre-plant.
  RoundupWM @ 21ounces per acre applied post-emerge.
  RoundupWM @ 21ounces per acre applied late post-emerge.
Insecticides: None

Soybean Fungicidal Seed Treatment

Results and Discussion

Seed treated with the fungicidal seed treatment RIVAL™ + ALLEGIANCE™ significantly increased (LSD 0.10) seed yield compared to the untreated control (page 52, table 24). The seed treatment however, did not increase harvest population. It is not surprising in a zero-till environment with twice the normal rainfall in the first half of May (page5, figure1) that an increase in yield occured with the treated seed, as wetter soil environments are likely scenarios for a seed treatment response (Pederson et al., 2001).

Table 24. Effect of the fungicidal seed treatment RIVAL™ + ALLEGIANCE™ on the harvest population and seed yield of soybean grown at Joliet Junior College in 2003.

Seed Treatment	Harvest Population	Seed Yield
	Plants/Acre	Bushels/Acre
Untreated	152,000	47
Treated	148,000	50
LSD (0.10)	N/S	1

Figure 28. Damping off of soybean caused by the water mold fungus *Pythium.* This type of seedling injury can also be caused by *Phytophthora*. Injury from *Pythium* and *Phytophthora* is common when soybean is planted into cool wet environments that reduce seedling growth rates and allow greater infection of fungi.

Soil Compaction

Justification and Objective

As the size of farms increase and the size of equipment required to seed and harvest crops on a timely basis also increases, soil compaction becomes a greater concern for crop producers. Soil compaction is defined as a process of "rearrangement of soil particles to decrease pore space and increase bulk density" (Singer and Munns, 1987). The reduction in soil porosity from compaction is at the expense of larger pores (macropores), creating a soil with a greater proportion of smaller pores (micropores) (Wolkowski, 1990). Macropores are crucial for soil internal drainage (percolation) and when soil is compacted the remaining pore space has a higher percentage of water. The increase in water retention associated with compacted soils results in a more anaerobic environment which increases N losses through denitrification and reduces root growth, as roots require oxygen for respiration. Soil compaction caused by heavy wheel traffic has been found to reduce corn grain yield (Wolkowski and Bundy, 1990). Our objective was to determine the impact of soil compaction caused by excessive wheel traffic on soybean seed yield.

Methods

A compacted and a non-compacted control treatment were established in the Spring of 2002 to determine the effects of soil compaction over several years on corn and soybean yields. The compacted treatment consists of soil compacted twice during April of 2002 and once during April of 2003. Soil was compacted before planting by excessive wheel traffic when relatively wet (too wet for Spring tillage and planting operations) but not saturated. No ruts were created during the soil compaction process. A John Deere 4020 with 200 gallons of water carried primarily on the rear axle was driven slowly over the compacted plots so that the tractor footprint was run over the entire soil surface. The soybean cultivar LG C2982NRR was planted on May 21st at 175,000 seeds per acre. The crop was harvested on October 31st.

Treatments: 2
Replications: 3
Planting Date: 21 May
Cultivar: LG C2982NRR
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
RoundupWM @ 21 ounces + 2,4-D @ 1pint per acre applied pre-plant.
RoundupWM @ 21 ounces per acre applied post-emerge.
Insecticides: None

Soil Compaction

Results & Discussion

Compacted soil had no effect on soybean yield (page 54, table 25). When observations were made throughout the growing season of the compacted and non-compacted plots, no visual effect was noted. This study will be continued in the same location for the foreseeable future in a corn soybean rotation with annual wheel traffic compaction in the same experimental units (plots). It is hoped that this work will provide a good indication of long-term annual soil compaction on crop productivity.

Table 25. Effect of soil compaction on the seed yield of soybean grown at Joliet Junior College in 2003.

Soil Compaction	Seed Yield
	bushels/acre
Control	45
Compacted	44
LSD (0.10)	N/S

Figure 30. Effect of compacted soil on corn root distribution. Note the horizontal and shallow growth of roots in the compacted soil (A) compared to the non-compacted (B).

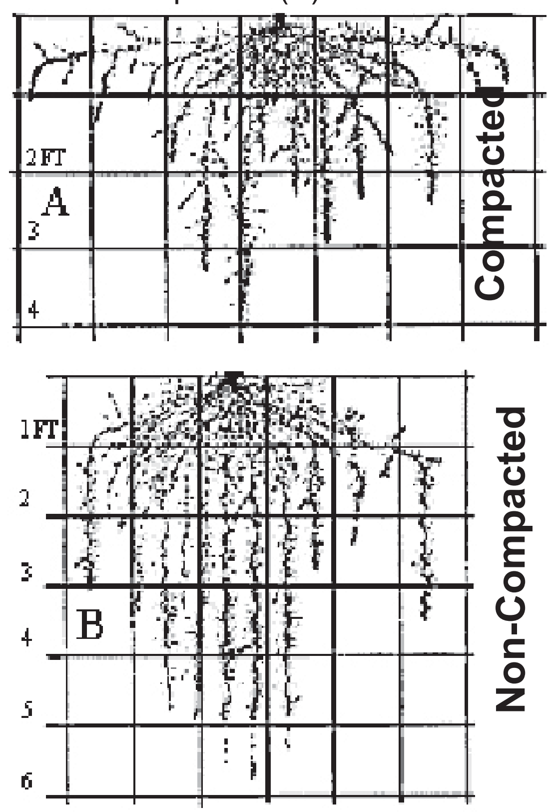
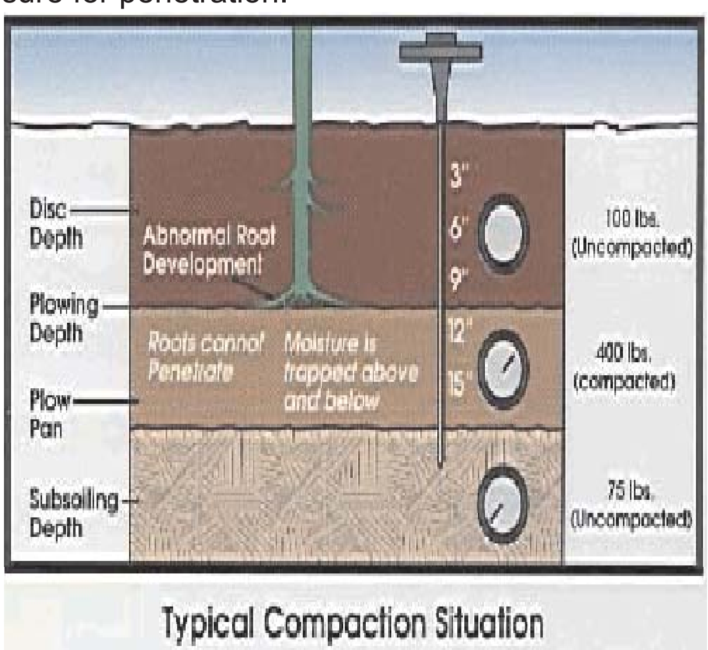


Figure 29. A typical soil compaction situation caused by continuous use of a moldboard plow. Note the center layer requiring very high pressure for penetration.



Soil Fertility-Soybean

Justification and Objective

Optimum soil phosphorous (P), potassium (K), and acidity levels are critical for corn and soybean production in the Mid-Western United States. Soil P and K, and pH levels for crop production in Illinois have been well established (Hoeft and Peck, 2002). However, many Illinois crop producers maintain soil fertility well above levels considered sufficient. Corn grain yields in Illinois over the last five years have averaged 144 and soybean 43 bushels per acre (University of Illinois, 2002). Average annual removal of P_2O_5 and K_2O given current yields in a corn soybean rotation is 49 and 48 lbs per acre P_2O_5 and K_2O, however, additions of fertilizer P and K over a similar time period (1998 - 2000) was 74 and 111 lbs per acre P_2O_5 and K_2O (Illinois Agricultural Statistical Service, 2001a). An overapplication of any input to the extent of 51%, as is the case with fertilizer P, represents a serious misallocation of resources, however, that inefficiency pales in comparison relative to that of fertilizer K which is overapplied by 131%. Our objectives are two fold. First, as an educational tool we will demonstrate production of corn and soybean with fertilizer applications equal to crop removal, and demonstrate corn and soybean production without fertilizer P and K and the accompanying defficiency symptoms to students at Joliet Junior College. Finally we will provide information to crop producers demonstrating crop production with fertilizer applications similar to crop removal.

Methods

Six soil fertility treatments were implemented in the Fall of 2001 with the intention of maintaining them for long-term evaluation. The 2003 crop is the second harvested since the study was implemented. The normal treatment consists of a typical soil fertility program for row crops which includes soil pH maintained between 6.0 to 6.5 and annual applications of maintenance fertilizer P and K. Two additional treatments are similar to the normal but are missing either the maintenance P or maintenance K, and a fourth treatment has no P or K applications. The fifth and sixth treatments were included with the intention of reducing and increasing soil pH. The acidic treatment receives no liming material while the basic receives threefold the recommended lime.

Soil samples were taken and analyzed in the Fall of 2001. Soil K levels (363 lbs/acre exchangeable K+), are considered sufficient for row crops in North Eastern Illinois, requiring only maintenance K (Hoeft and Peck, 2000). Soil P levels (44 lbs/acre available P) are slightly below the point at which only maintenance P would be necessary. Soil pH ranges from 5.9 to 7.4, somewhat high because of the calcareous nature of the parent material which is a loamy gravel with rock fragments of dolomitic limestone (Wascher et al., 1962). The depth to the parent material is fairly shallow (2 to 3.5 feet) and in a few areas may only be covered with 15 inches of solum. The course textured and shallow parent material reduces the soil water holding capacity and makes the crop very susceptible to water stress when less than normal rainfall occurs.

Soil Fertility-Soybean

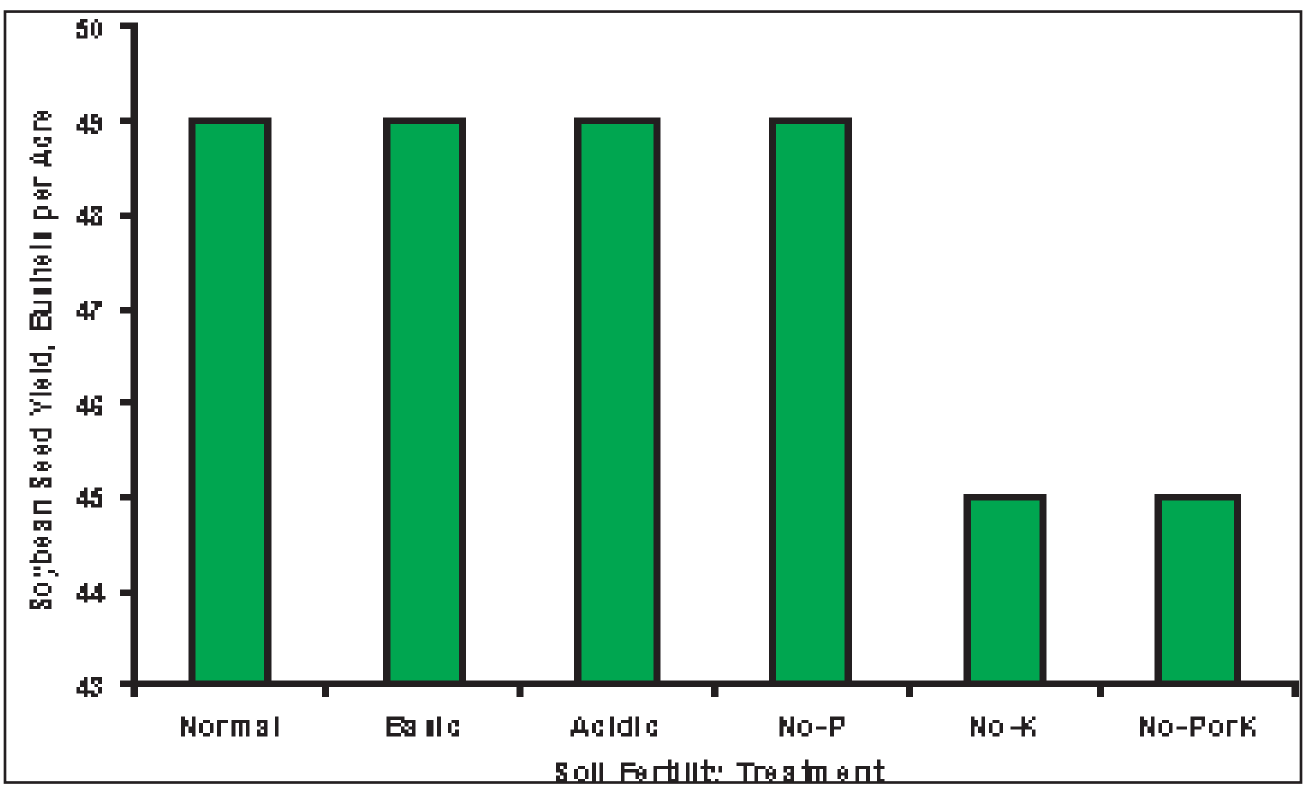
Methods

Treatments: 6
Replications: 2
Planting Date: 19 May
Cultivar: FS HS2826
Previous Crop: Corn
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
  RoundupWM @ 21 ounces and 2,4-D @ 1pint per acre applied pre-plant.
  RoundupWM @ 21 ounces per acre applied post-emerge.
Insecticides: None

Results and Discussion

No significant differences (LSD 0.10) were found among the six soil fertility treatments (page56, figure31). Similar to the corn in 2003 (page 32, figure 19), the two treatments without potassium (K) tended to yield less than the other four treatments. Treatments of this study were begun in the Fall of 2001, two crops have been produced with the current soil fertility regimes and it is thought that over time differences between treatments will occur.

Figure 31. Effect of soil fertility treatment on the seed yield of soybean grown at Joliet Junior College in 2003.



Soybean Aphid

Justification and Objective

Soybean aphid (*Aphis glycines*) is a new pest of soybean in the Mid-West. Originating in Asia it is now found throughout Illinois and nearby States. First detected in the year 2000, and thought to have gone undetected for the preceding few years, soybean aphid was of minor concern during the 2002 growing season (Cook, 2003). In 2003 soybean aphid densities were high throughout Illinois which raised concerns about treating the pest to prevent economic losses. Aphids were first detected in the field in Illinois during the 2003 growing season on May 29th by workers at the J.F. Richards: Demonstration and Research Farm at Joliet Junior College. Aphids could be found at Joliet Junior College throughout the rest of the growing season. Our objective was to determine the impact of treating soybean aphid on soybean seed yield.

Methods

On August 13th the insecticide WarriorT was broadcast at 2.4 ounces per acre for control of soybean aphid. The soybean crop was R4 and although soybean aphid could easily be found, densities were considerably higher 10 days earlier. Four strips were sprayed with a large commercial pesticide applicator owned by the Hintzsche organization at the Minooka plant. Soybean was seeded at 175,000 seeds per acre in 15 inch row spacing. The crop was harvested on October 31st by harvesting the center 25 feet of each 40 foot wide treated swath, and harvesting an adjacent untreated swath.

Treatments: 2
Replications: 4
Planting Date: 21 May
Cultivar:
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
RoundupWM @ 21 ounces + 2,4-D @ 1pint per acre applied pre-plant.
RoundupWM @ 21 ounces per acre applied post-emerge.
Insecticides: None

Soybean Aphid

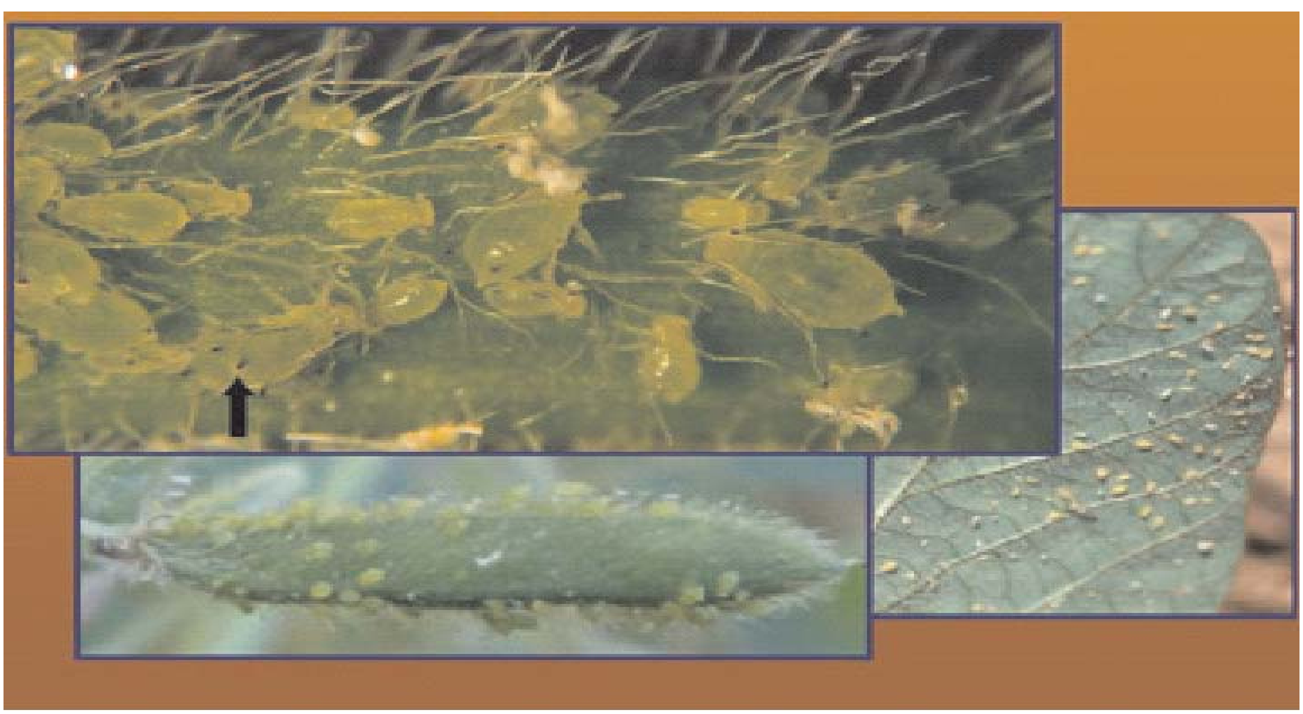
Results and Discussion

Soybean treated with WarriorT significantly (LSD 0.12) increased seed yield compared to the untreated control (page 58, table 26). The two bushel increase may have paid for the application and the insecticide, although little profit was likely gained.

Figure 26. Influence of soybean aphid insecticide treatment (WarriorT applied at 2.4 ounces per acre) during the R4 growth stage on the seed yield of soybean grown at Joliet Junior College in 2003.

Soybean Aphid Treatment	Seed Yield
	bushels/acre
Untreated	44
Treated	46
LSD (0.12)	2

Figure 32. Soybean aphid much magnified with the pubescence on a soybean pod. Below, aphids on a pod much less magnified and on the underside of a leaflet (right).



Soybean Varieties

Justification and Objective

Numerous soybean cultivated varieties (cultivars) are available to Mid-Western soybean producers. In Illinois soybean growers spend $19 per acre acquiring soybean seed from dozens of seed supplying companies (University of Illinois, Dept. of Agriculture and Consumer Economics, 2002). Our objective is to aid Mid-Western soybean growers in choosing cultivars most profitable in their operations, and to demonstrate to students different morphological characteristics of various soybean cultivars.

Methods

Soybean varieties were planted in a timely manner and seeded at 175,000 seeds per acre in 15 inch rows. Thirty one cultivars were entered in this unreplicated varietal demonstration. The check variety (Dairyland Seed, DSR-301RR) was entered five times in the demonstration which was 613 feet wide, and each entry consisted of 14 15 inch rows or 17.5 feet wide and 400 feet in length. The checks were separated by six varieties, as such any given variety was never more than three entries (52.5 feet) from a check. Each variety was evaluated on a relative scale by comparing it to the nearest check. Soybean was harvested with a John Deere 9500 combine equiped with an Ag Leader PF3000 yield monitor that was used to measure seed yield. The demonstration area was zero-tilled and weeds were controlled with a Fall applied pre-plant burndown followed by a post-emerge application of RoundupWM.

Number of entries: 31
Replications: None
Planting Date: 22 May
Soybean Cultivar: Many
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
CanopyXL@2.5ounces+Express@0.15ounces+2,4-D@1pint per acre applied Fall pre-plant.
RoundupWM @ 21 ounces per acre applied post-emerge.
Insecticides: None

Soybean Varieties

Results and Discussion

The 31 soybean varieties had an average seed yield of 51 bushels per acre. Yields ranged 15 bushels per acre from a low of 43 to a high of 59. The check variety (Dairyland DSR-301RR) is emboldened in table 27 and averaged 50.2 bushels per acre. Relative yields averaged 101.7% and ranged from 87 to 113 percent of the check. Entries finishing in the top 25% are underlined.

Table 27. Demonstration of the seed and relative yield of 31 soybean varieties grown at Joliet Junior College in 2003. The eight underlined cultivars had relative yields in the top 25% of entries. All cultivars are transgenic roundup ready.

Company Name	Varietal Nomenclature	Seed Yield	Relative Yield† Nearest Check
		Bushels / Acre	- % -
Steben	2900N RR	54.4	103
Garst	2812RR/N	53.6	102
Becks	323RR	58.8	112
Dairyland	DSR-301RR	62.8	100
LG	C2982NRR	55.9	106
Ag Venture	AV6292N RR	49.3	94
Great Lakes	GL3007 RR	55.9	106
Kruger	K-289 RR	50.2	102
Delner	D3211C R-NGS	45.4	92
Croplan	RT2888	50.3	102
Dairyland	DSR-301RR	48.8	100
Crows	C2615R	55.5	113
Croplan		55.5	113
Golden Harvest	H-3135RR	43.4	88
Hughes	251RR	43.4	88
Steben	SS3003N RR	49.6	100
FS	HS2886	50	100
Dairyland	DSR-301RR	48.8	100
Pioneer	92M70	48.7	98
Garst	2903RR	56.2	113
Crows	C2915R	55.5	112
Dairyland	DSR-340RR	49.6	101
Delner	D2911C R-NGS	50	101
Kruger	K-252-2RR	44	89
Dairyland	DSR-301RR	48.8	100
Becks	335 N RR	49.6	101
Dairyland	DSR-288RR	49.6	101
Ag Venture		49.3	100
Great Lakes	GL2703RR	56.2	112
LG	C3322NRR	50	100
FS	HS3226	50	100
Dairyland	DSR-301RR	60	100
Golden Harvest	H-2557RR	55.9	112
Adler	236RRN	43.7	87
Pioneer	92M80	56.2	112

† Relative yield was calculated by dividing the grain yield of a given cultivar (numerator) with the grain yield of the nearest check (denominator), and multiplying by 100.

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