Joliet Junior College
Demonstration & Research Guide
2005

Explore Cropping Management at JJC

Prepared by: Jeff Wessel

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Acknowledgments

Numerous people have contributed in many ways to the J.F. Richards Land Laboratory, Demonstration & Research Farm during 2005. Resources donated range from the time donated by drivers for our field day, to equipment, pesticides, cash, and seed, all are listed in the paragraphs and tables below including 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 Jerry Berg for assisting in the planting of our corn hybrid demonstration, Matt Meyer for summer help, and Andy Rousonelos for his invaluable assistance during harvest. Matt Foes and Rob Thomas of Monsanto, Mark Chastain of AMVAC, and Alan Venters of Hughes Hybrids all volunteered to help dig, wash, and rate roots in our two corn rootworm studies. The owner of our rented combine, Bill Dumney, also hauled all of the farms grain, and kept the combine in good operating condition. Our field day speakers were; Fred Below, Russel Higgins, and David Voegtlin, all associated with the University of Illinois, and Don Rhoads of Burrus Power Hybrids.

Table 1.

List of people and companies they represent that donated various products for crop protection at Joliet Junior College in 2005.

Last	First	Organization	Product
Chastain	Mark	AMVAC	Fortress
Foes	Matt	Monsanto	Harness Xtra
Foes	Matt	Monsanto	RoundupWM
Hopkins	Alan	Dupont	Basis
Hopkins	Alan	Dupont	AsanaXL
Hopkins	Alan	Dupont	SteadfastATZ

Contributors

Table 2.

List of people and companies they represent that donated seed to Joliet Junior College in 2005.

Last	First	Organization
Berg	Jerry	Stone Seed Co.
Brummel	Don	Golden Harvest
Coffman	Lyle	Great Lakes
Doty	Daryl	Dekalb
Engler	Tom	Ag Venture
Fugate	Bill	Burrus
Gick	Ron	Beck's
Horner	Jeff	Garst
Kultgen	John	Golden Harvest
Lagar	Scott	Wyfells
Laudeman	Craig	Grainco FS, Minooka
Nesbitt	Doug	Adler
Schneider	Dan	LG
Skonetski	Bill	Dairyland Seed
Stork	Harold	Kruger
Thumma	Todd	Garst
Twait	Mike	Crows
Venters	Allan	Hughes
Wals	Wayne	Pioneer
Zeigler	Matt	Fielders Choice

Table 3.

People who helped with the field day, harvest, and other miscellaneous activities.

Last	First	Organization
Cronin	John	
Dumney	Bill	
Smerz	Dick	
Thomas	Rob	Monsanto
Venters	Allan	Hughes
Wessel	Bill	

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 2004, 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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Eileen McKee - Veterinary Technology
Fredric Miller - Nursery Management
Tammy Miller - Soils / Fertilizers
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Lisa Perkins - Turf Management
Lynda Scerine - Department Secretary
Walter Stein - Veterinary Technology
Donna Theimer - Floral Design / Interior Plantscaping
Jeff Wessel - Farm Manager / Crop Protection 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 109 cropped acres with 61 acres of corn and 48 of soybean in 2004. Eighteen agronomic studies and two demonstrations were implemented, they included the evaluation of corn and soybean herbicides and insecticides, tillage systems, row spacing and plant populations, 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 during 2005.

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 row 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. Given these soil fertility levels, maintenance fertilizer P and K are applied annually at a rate of 50lbs P_2O_5 and K_2O per acre. The five year moving average yield for corn and soybean is 138 and 38 bushels per acre respectively, these yields include the severe drought year of 2002. Annual removal of P and K given recent yields is 46lbs P_2O_5 and 43lbs K_2O per acre.

Zero tillage is the primary tillage system used, and as such Fall, Spring preplant, or Spring preemerge "burndown" herbicides are used to kill existing vegetation. Areas not receiving burndown herbicides included tilled areas and a few treatments in the corn and soybean herbicide studies. Fall preplant burndown herbicides were applied in November of 2003 where soybean was to be planted in 2004 and included; CanopyXL @ 2.5 ounces + Express @ 0.10ounces + 2,4-D @ 1pint + crop oil concentrate @ 1% by volume. For corn, Spring applied preplant or preemerge burndown herbicides consisted of Roundup Weather Max(WM) @11ounces + 2,4-D @ 1pint per acre + Ammonium Sulfate @ 17lbs per 100 gallons of water, or Basis @0.50oz + Atrazine4L @1qt + 2,4-D @1pt per acre. 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 preemerge applications of Epic+Atrazine, or HarnessXtra + Atrazine followed by RoundupWM, or Callisto. Weed control for soybean, in addition to the Fall burndown, was accomplished with V2 applications of RoundupWM.

Introduction

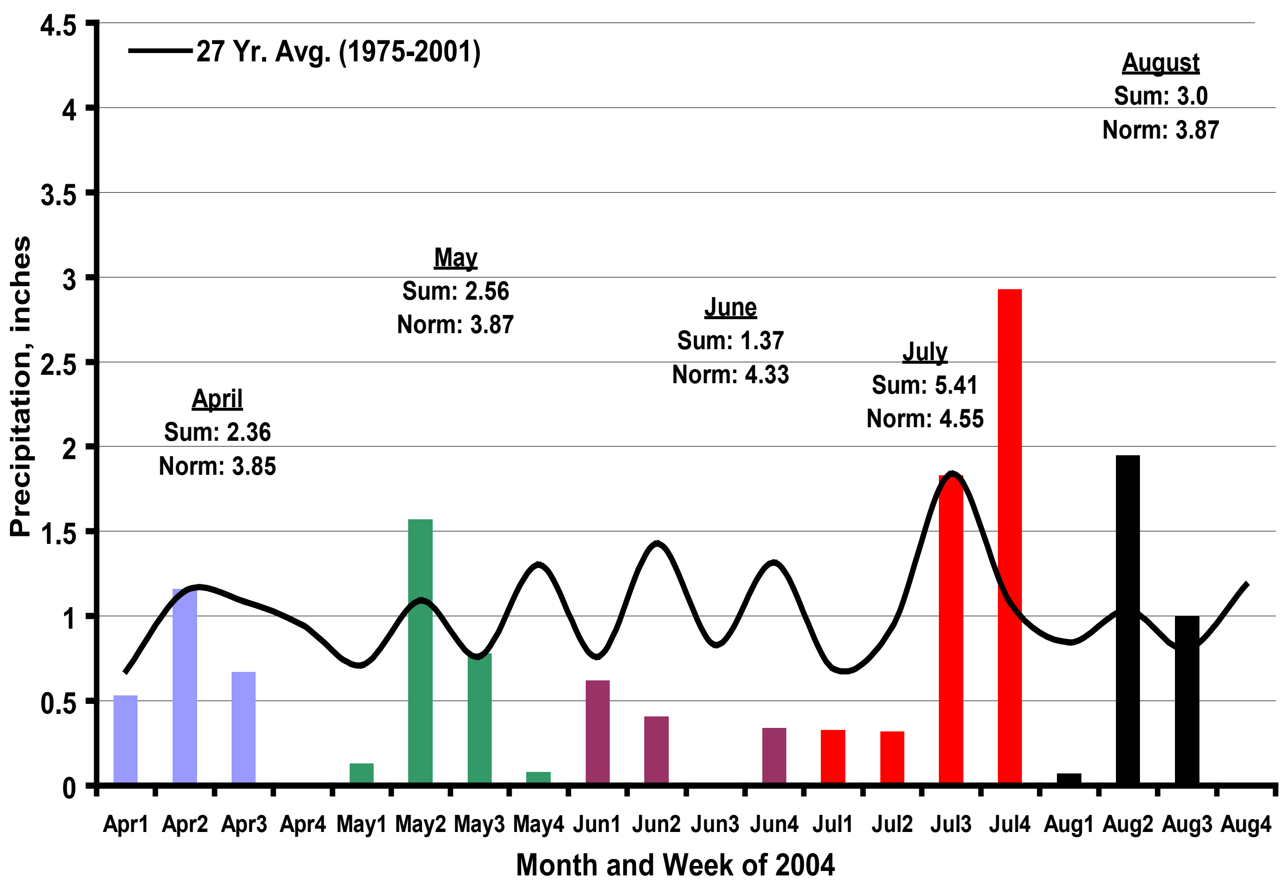
Both corn and soybean were planted using a Kinze model 3000 pull-type planter manufactured in 2002 and equipped with a colter and residue remover combination for zero-till planting. Corn was planted in 30 inch rows at a rate of 32,000 seeds per acre and planting dates for most corn ranged from April18th through April 27th. Early planted corn (April 6th) emerged by April 19th, aided in it's emergence by warm April temperatures. The last freezing air temperature occurred on May 4th, and was probably the fourth or fifth time early planted corn experienced frost.

Late afternoon on May 19th a heavy hail storm severely injured most of the soybean crop which was at the VC growth stage. On average, the hail injury reduced soybean plant populations by roughly 50%, such that harvest populations typically ranged between 50,000 to 80,000 plants per acre. Most of the soybean was not replanted, with the exceptions of the tillageXplanting date and herbicide systems, which had populations well below 50,000 plants per acre. Injury to corn was far less severe. Corn was V2 and although considerable leaf shredding, cutting, and wrapping around the whorl occurred, it was estimated only 5 to 10% of plants were killed.

Soybean was harvested the first week of October, and most corn the second week. The corn and soybean varietal demonstrations averaged 137 and 37 bushels per acre respectively. Both crops produced one bushel per acre less than the five year moving average.

Figure 1.

Weekly precipitation at Joliet Junior College in 2005 for April through August (bars), and a 27 year average. The historical sum is 20.5, in 2005 14.7 inches of precipitation fell.

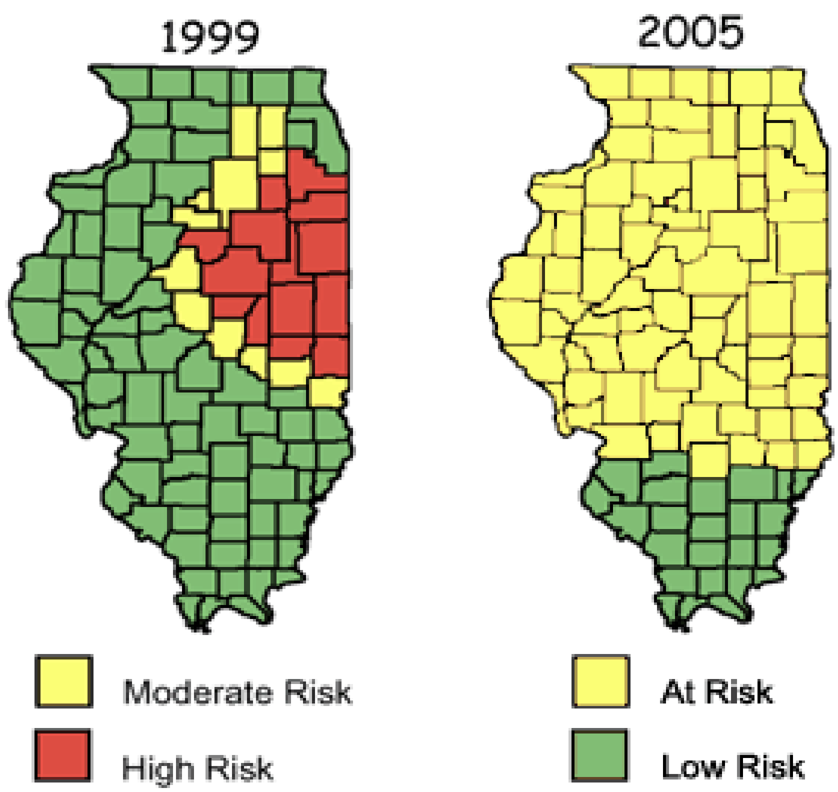


Corn Rootworm Larval Control Product Performance

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). Since the 1980's this pest has been known to inflict an estimated one billion dollars of annul losses to U.S. producers through yield reductions and control measures, and hence has earned the nickname "the billion dollar pest" (Metcalf, 1986). Pre 1995, rotated corn in most of Illinois was not vulnerable to root injury from Western Corn Rootworm (WCR) (Spencer et al., 1997). Since 1995 however, a variant WCR exhibiting a behavioral shift to oviposition in crops other than corn has resulted in a failure of crop rotation to control WCR in first year corn fields (Levine et al., 2002). Figure two on page eight depicts a large increase in insecticide treated acres from 1993 to 1998 in what was considered the problem area (for variant WCR) in Illinois. A dramatic increase in rotated corn acres treated with corn rootworm larval insecticides or transgenic Bacillus thuringiensis Rootworm (Bt-RW) hybrids has likely accompanied the expansion of the variant. The latest development has been the expansion of the variant into Southern Illinois (I-70 South) as reported by Steffey (2005). The WCR variant has steadily spread from it's East Central Illinois origination over the last decade and now threatens most of the entire state (page 7, figure 3). Our objective was to evaluate the efficacy of corn rootworm larval insecticides (seed treatment & granular) and transgenic Bt-RW corn in an effort to demonstrate root injury and it's effect on grain yield.

Figure 3. Area of potential WCR root injury to first-year corn in 1999 and 2005.



Source: Unversity of Illinois Extension, IPM Field Crops. [Online] available at: http://ipm.uiuc.edu/fieldcrops/insects/western_corn_rootworm/index.html

Corn Rootworm Larval Control Product Performance

Methods

Four granular insecticides, one seed treatment, two Bacillus thuringiensis corn rootworm (Bt-RW) hybrids, and an untreated control were evaluated for their impact o corn root injury, lodging, and grain yield. An additional treatment with the granular insecticide Aztec 2.1G plus the seed applied insecticide thiamethoxam and fungicides mefenoxam, fludioxonil, and azoxystrobin (SafeStart) were also evaluated. Each treatment was replicated three times and planted on April 18th. All non Bt-RW treatments were planted with Golden Harvest 8682, while the two Bt-RW hybrids were either Golden Harvest 8615YGRW or Dekalb DK57-81YGRW. The previous crop was corn, the tillage system was mulch which included fall chisel plowing and spring field cultivation. Our previous work (2003 and 2004)utilized late planted corn as the previous crop, in 2005 however, it was necessary to move this study to a different farm location which did not have corn planted late in 2004. Corn was planted at a rate of approximately 32,000 seeds per acre and granular insecticides were applied "in-furrow" , behind the disc openers and in front of the closing wheels, with heavy chains drug directly behind the closing wheels. Weeds were controlled with herbicides applied pre and post emerge. On July 25th (R2) five plants were randomly selected from each experimental unit, roots dug, washed with a high pressure washer, and rated (0 to 3 scale). Four select treatments (Untreated, Aztec, and both Bt-RW hybrids) were dug a second time on August 23rd (R5) using the same procedure as above. The crop was harvested on October 6th.

Treatments: 9
Replications: 3
Planting Date: 18 April
Hybrid-1: Golden Harvest 8682 & it's Bt-RW isoline 8615YGRW.
Hybrid-2: Dekalb DK57-81YGRW.
Previous Crop: Corn
Tillage: Mulch (fall chisel & spring field cultivation)
Soil Series: Will silty clay loam
Herbicides: Harness Xtra @ 83oz + Atrazine @ 12oz per acre applied preemerge.
Callisto @ 3oz + Atrazine @ 8oz per acre applied postemerge(V6).
Insecticides: Many

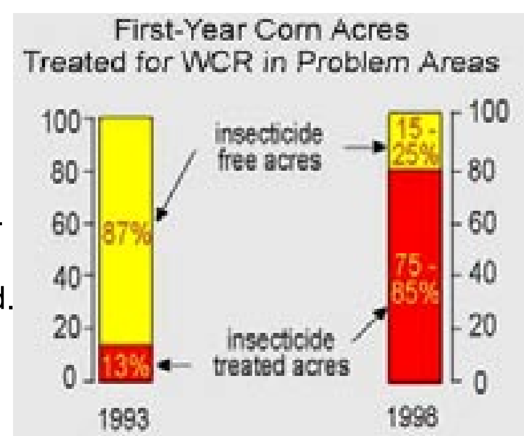


Figure 2. Change in corn rootworm larval insecticide use in first year corn over five years (1993 to 1998) in the East Central portion of Illinois, where the variant WCR was initially found. Source: http://www.staff.uiuc.edu/~s-isard/Cornrootworm/Insecticide.htm

Corn Rootworm Larval Control Product Performance

Results and Discussion

In 2005 heavy corn rootworm (CRW) larval injury (2.6, 0 to 3 scale) to corn roots occurred in the untreated control (page 11, table 5), with approximately 87% of roots destroyed. All CRW larval control products significantly ($P<0.05$) reduced root injury and lodging, and increased yields relative to an untreated control. Poncho 1250 and Lorsban15G performed similarly, and were numerically the poorest performing control products. Statistically ($P<0.05$), they differed only from Bt-RW, Force3G and Aztec2.1G +SafeStart, which all performed similarly and provided good root protection. Aztec 2.1G and Fortress2.5G had numerically lower root injury ratings compared to Poncho 1250 and Lorsban15G, although statistically they were the same. The two Bt-RW hybrids afforded similar root protection, and had the numerically lowest ratings of all treatments. These findings regarding Bt-RW efficacy are consistent with our results from the previous two years, where this transgenic technology has provided consistently greater root protection than any granular or seed treatment insecticide (page 12, table 6).

These results have not always been the observation of producers and researchers in Illinois (Gray and Steffey, 2005a). There is some concern regarding the decline in concentration of the insecticidal protein (Cry3Bb1) produced in YieldGard Rootworm corn as the crop develops (Crop Science, March 28th 2005). Additionally, these same authors found that the expression of Cry3Bb1 (the insecticidal protein in YieldGard Rootworm corn) is less than the amount required to kill half of exposed larvae. Low protein levels combined with possible slow development of CRW larvae exposed to the toxic protein (Crowder et al., 2005) may be part of the reason for some observations of late season root injury to YieldGard corn. This prompted us to examine root injury a second time (about a month later) in a few select treatments of our CRW insecticide experiment this year. Page 12 table 7 lists the results of both times roots were dug and rated. This data suggests no “late-season” injury to either Bt-RW hybrids, nor to the granular insecticide treated and untreated plants. Although in not all cases has YieldGard Rootworm produced the excellent root protection found at Joliet Junior College, overall the level of root protection has been “very good” in other Illinois experiments (Gray and Steffey, 2005b).

The granular insecticide treatments and G.H. 8615 BtRW (same hybrid) produced similar grain yields despite large differences in root injury ratings (page 11, table 5). An exception is Aztec2.1G, which produced a significantly lower yield when compared to Aztec2.1G + SafeStart. It is not apparent why SafeStart, added to a normally very efficacious CRW insecticide, increased yield. SafeStart does contain an insecticide (thiamethoxam), and while there is a slight reduction in root injury rating, it is not significant and much larger changes in root injury between treatments produced equal yields. Additionally, harvest populations were not affected by SafeStart (page 11, table 4). SafeStart also contains three fungicides, (mefenoxam, fludioxonil, and azoxystrobin) which may have improved seedling vigor and thus reduced uneven emergence that causes non-uniform competition among plants and usually reduces yield (Nafziger et al., 1991; Liu et al., 2004).

Corn Rootworm Larval Control Product Performance

Among the CRW control products, Poncho 1250 produced the numerically lowest grain yield, and was significantly (0.05 alpha) less than all but one control product (Aztec2.1G). Interestingly, Lorsban15G with the same root injury level as Poncho 1250 produced a significantly higher grain yield. This has been our observation at Joliet Junior College for the past three growing seasons. Lorsban15G has typically provided no root protection compared to the untreated check plots (page 12, table 6), but always significantly increases yield (data not shown). In fact, 2005 is the first year out of four that Lorsban15G provided any root protection. Additionally, despite a > three fold increase in root injury compared to G. H. 8615 BtRW, Lorsban15G produced the same yield. Although there was little difference in yield between the CRW control products, hybrid did influence yield. The Dekalb hybrid DKC57-81 produced higher yields than any other treatment, this was likely to due it's higher yield potential in our environment this year and completely unrelated to root injury. As further evidence, DKC57-81 produced the highest yield in our corn hybrid demonstration (page 51, table17).

Although severe root pruning occurred in the untreated control, and nearly half of roots were destroyed in other treatments, very little lodging had occurred by harvest. All plots where a corn rootworm control product was used had zero lodging, while only 28% were lodged in the untreated control. In 2004 when a root injury rating of approximately 2.0 or higher was given, most (75%+) plants were lodged at harvest. This may simply be due to a lack of forceful winds occurring between the time root injury was near maximum, and before excessive root regrowth occurred. Excessive root regrowth was noted at both root "digs" in all but the untreated and BtRW plots.

A negative linear relationship between root injury and grain yield was found in 2005 (page 13, figure 8). While the relationship is significant (alpha=0.05), it describes only about half of yield variability with 11.3 bushel per acre yield loss per node of roots destroyed and an estimated maximum yield of 125 bushel per acre for uninjured corn. Two thousand four was a more stressful environment, represented by a lower maximum yield (100 bu./acre) in the absence of root injury (page 13, figure 9). In this environment a linear equation more closely predicted the effects of root injury on grain yield (R^2=0.68) compared to 2005, and yield loss occurred at a more rapid pace (15.7bu./acre per node of pruned roots). In contrast to both 2004 and 2005, 2003 was the least stressful environment with a Y intercept of 150 bushels per acre (page 14, figure 10). In this low stress environment, a quadratic model described the impact of root injury on yield (R^2=0.68, alpha=0.05). By looking at the shape of the quadratic curve and the associated root injury levels it can be seen that root injury greater than 1.0 (1/3 of roots destroyed) is necessary to reduce yield below the predicted value without root injury, or 150 bushels per acre.

The implication is that environment (temperature, rainfall, rainfall time) can have a large impact on the response of corn to CRW larval injury. Environments with low stress (2003) may require considerable root injury for yield losses to occur, while high stress environments (2004) are likely to cause yield reductions with little root injury. Sutter et al., (1990) found fairly high levels of root injury (>1 node) necessary for yield losses to occur under "good growing conditions". In contrast Stamm et al. noted only minor root injury (< a few roots pruned) caused yield losses (1985). More recently Iowa entomologists described economic thresholds for varying environmental stress (Oleson et al., 2005).

Corn Rootworm Larval Control Product Performance

Figure 3. Iowa State 0 to 3 node-injury scale (Oleson et al., 2005).

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)

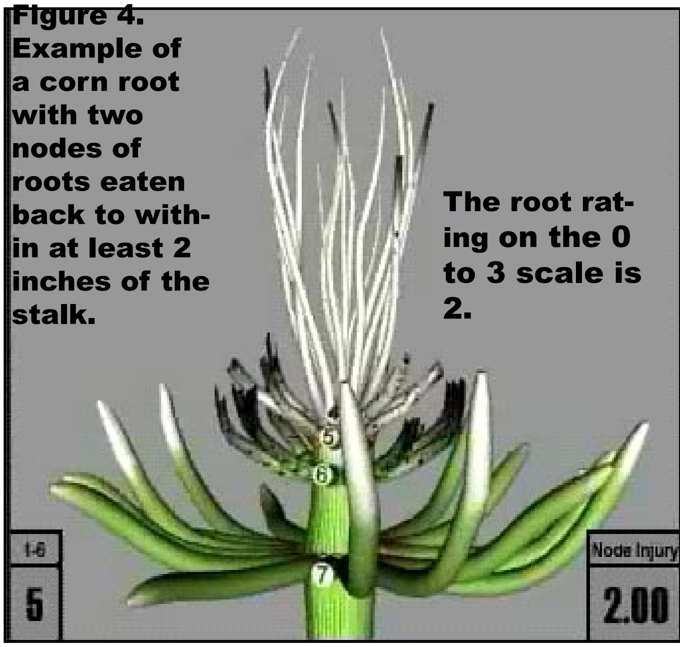


Figure 4. Example of a corn root with two nodes of roots eaten back to within at least 2 inches of the stalk.

Table 4.

Influence of corn rootworm larval control products on the harvest population of corn grown at Joliet Junior College in 2005.

Corn Rootworm Control Product	Harvest Population
	plants/acre
Untreated	26,670
Aztec 2.1G	25,833
Aztec 2.1G+SafeStart‡	26,553
Force 3G	25,780
Fortress 2.5G	26,780
Lorsban 15G	26,553
Poncho 1250	26,387
8615, Bt-RW	26,890
DKC57-81, Bt-RW	28,333
LSD(0.05)	N/S

Table 5.

Influence of corn rootworm larval control products on lodging, root rating(0-3), and grain yield of corn grown at Joliet Junior College in 2005. The previous crop was corn and the hybrid is Golden Harvest 8682 for the non-BtRW treatments, and it's Bt-RW (YieldGard Rootworm) isoline Golden Harvest 8615. An additional Bt-RW hybrid (Dekalb DKC57-81) was also evaluated. The four granular insecticides were applied in-furrow, and roots were rated on July 25th (R2).

Corn Rootworm Control Product	Active Ingredient	Product Application Rate	Harvest Lodging	Root Rating	Grain Yield
		oz/1000 ft. row	—%—	0 to 3†	Bu. per Acre
Untreated	——	——	28	2.6	84
Aztec 2.1G	Cyfluthrin+Phosphorothioate	6.7	0	1.0	115
Aztec 2.1G+SafeStart‡	Cyfluthrin+Phosphorothioate	6.7	0	0.7	124
Force 3G	Tefluthrin	4	0	0.7	117
Fortress 2.5G	Chlorethoxyfos	7.35	0	0.9	117
Lorsban 15G	Chlorpyrifos	8	0	1.3	119
Poncho 1250	Clothianidin	1.25mg a.i. / Kernal	0	1.3	108
G.H. 8615, BtRW	Bt Protein Toxin & Thiomethoxam	0.25mg a.i./kernal	0	0.4	119
DKC57-81, BtRW	Bt Protein Toxin & Clothianidin	0.125mg a.i. / Kernal	0	0.2	152
LSD(0.05)	——	——	6	0.6	8

‡SafeStart, a combination of a seed treatement insecticide (thiamethoxam) and three fungicides (mefenoxam, fludioxonil, and azoxystrobin).

† Roots were rated using the 0 to 3 node-injury scale, Oleson et al., 2005.

Corn Rootworm Larval Control Product Performance

Given current economic considerations of $2.25/bu. corn price and $18.00/acre insecticide cost they suggested only four pruned roots were necessary for losses under high environmental stress. Conversely, when environmental stress was moderate, 11 pruned roots were required for losses to occur. Our observations of lessening yield loss due to root injury with increasingly favorable environments is in agreement with other findings.

Table 6.

Root ratings (0 to 3, node-injury scale) of corn for the evaluation of corn rootworm larval control products over four years at Joliet Junior College. Different hybrids were used annually, however the Bt-RW hybrid (YieldGard Rootworm) was always an isoline of the hybrid used for the balance of the study.

Corn Rootworm Control Product	Year of Root Rating 2002	2003	2004	2005	Average
	0 to 3†				
Untreated	2.4	2.4	2.7	2.6	2.5
Aztec2.1G	0.3	1.2	1.0	1.0	0.9
Force3G	0.3	1.1	1.1	0.7	0.8
Fortress2.5G	——	——	2.1	0.9	1.5
Lorsban15G	2.7	2.3	2.8	1.3	2.3
Poncho1250	——	——	1.6	1.3	1.5
Bt-RW	——	0.3	0.6	0.3	0.4
LSD(0.10)	0.5	0.5	0.4	0.6	——

† Roots were rated using the 0 to 3 node-injury scale, Oleson et al., 2005.

Table 7.

Influence of corn rootworm larval control products on the root injury ratings of corn grown at Joliet Junior College in 2005. Ratings represent select treatments rated a second time (rating-2) on August 23rd (R5), in addition to the values from the first rating (rating-1) on July 25th (R2). The hybrid is Golden Harvest 8682 for the non-BtRW treatments, and it's Bt-RW (YieldGard Rootworm) isoline Golden Harvest 8615. An additional Bt-RW hybrid (Dekalb DKC57-81) was also evaluated.

Corn Rootworm Control Product	Root Injury Rating Rating-1	Rating-2
	0 to 3†	
Untreated	2.6	2.9
Aztec 2.1G	1	0.6
G.H. 8615, BtRW	0.4	0.4
DKC57-81, BtRW	0.2	0.3
LSD(0.05)	0.6	0.3

† Roots were rated using the 0 to 3 node-injury scale, Oleson et al., 2005.

Corn Rootworm Larval Control Product Performance

Figure 8. **Influence of corn rootworm larval root injury (0-3 node-injury scale) on the grain yield of corn grown at Joliet Junior College in 2005.**

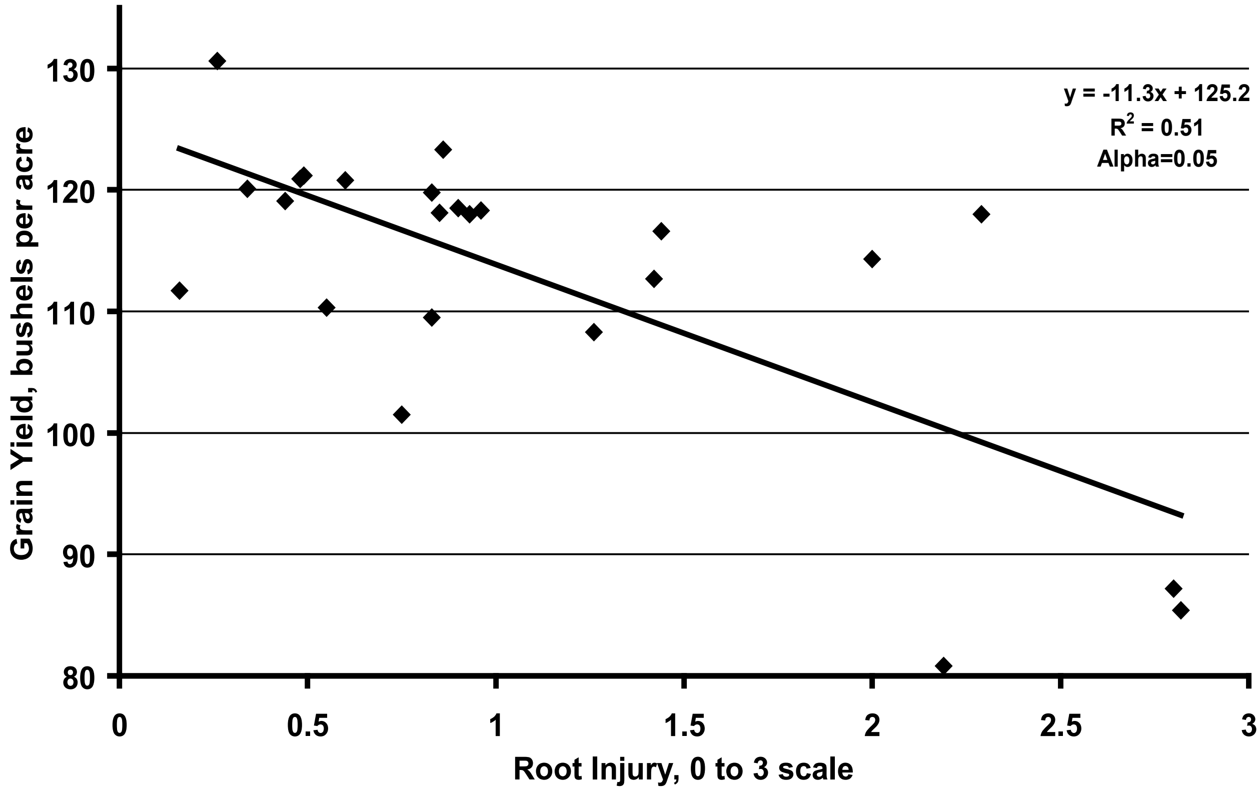
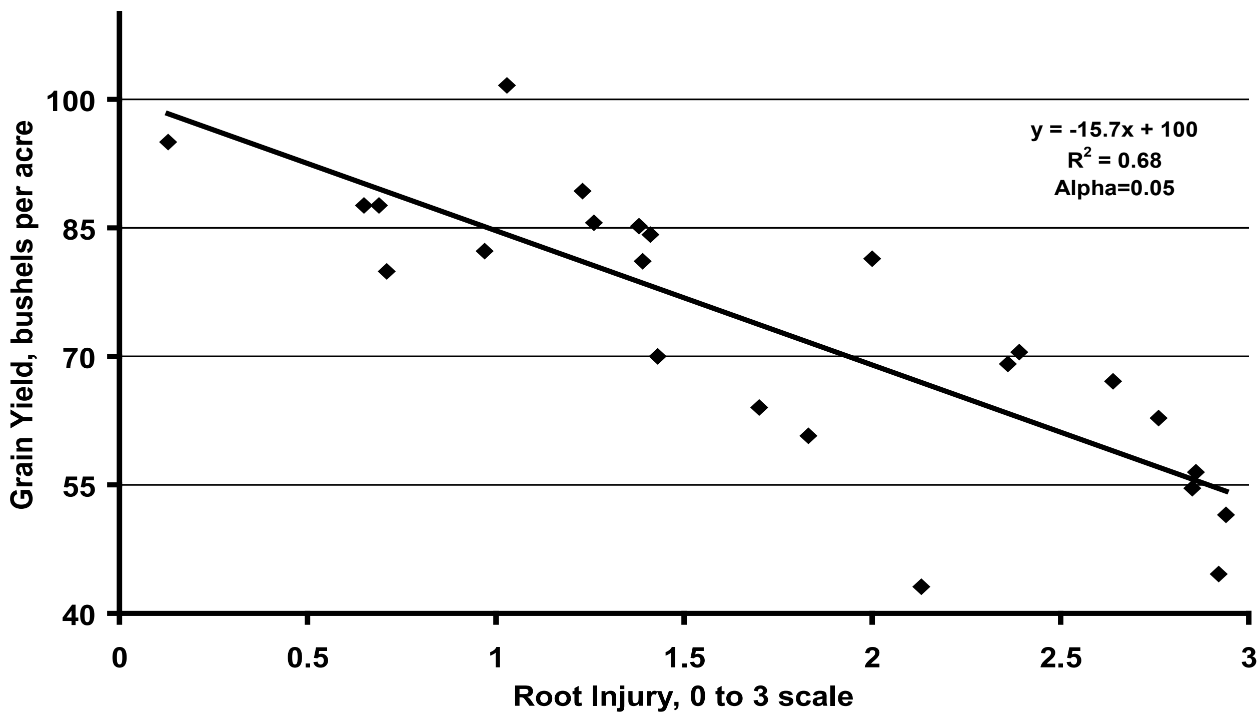
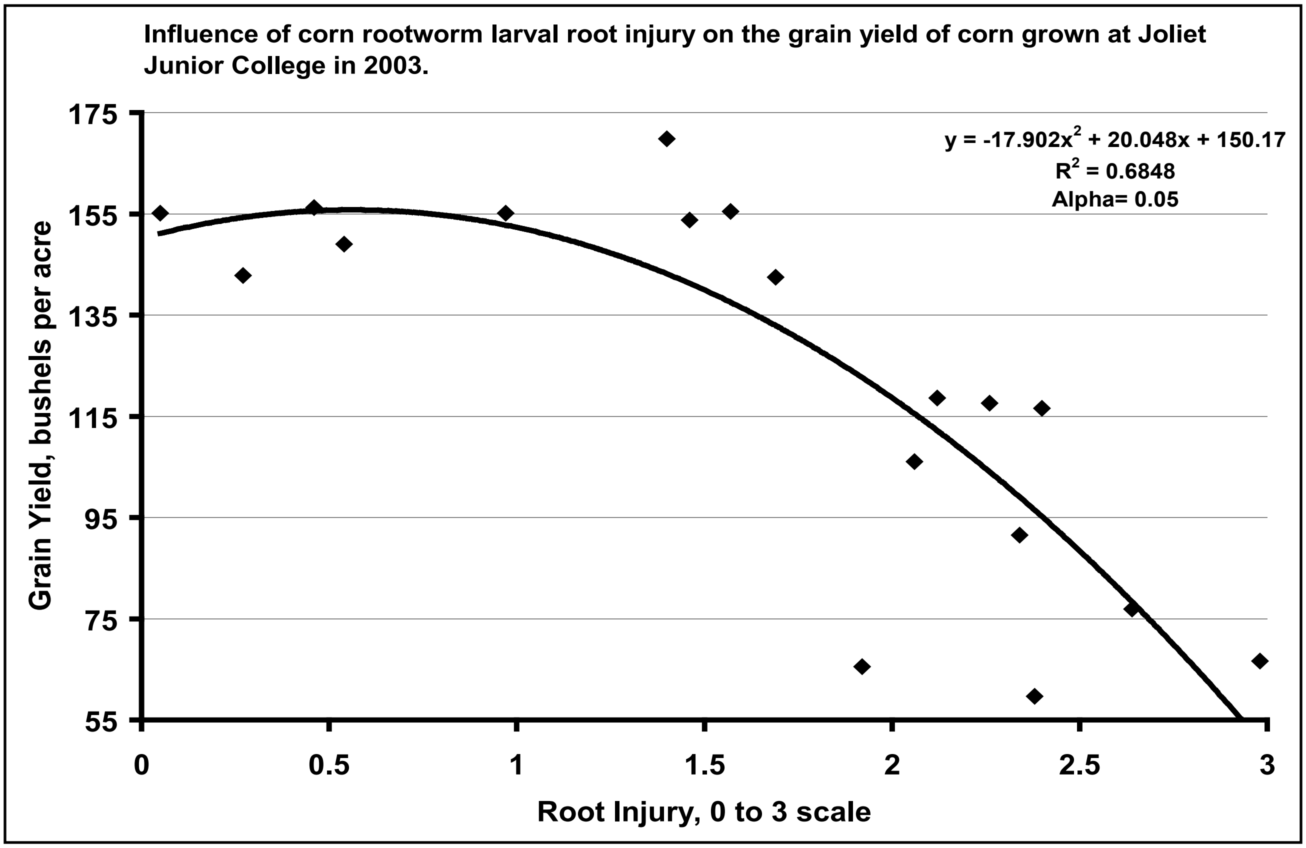


Figure 9. **Influence of corn rootworm larval root injury (0-3, node-injury scale) on the grain yield of corn grown at Joliet Junior College in 2004.**



Corn Rootworm Larval Control Product Performance

Figure 10.



Corn Herbicides

Justification and Objective

Large numbers of herbicidal compounds are available for weed control in corn. The Illinois Agricultural Statistical Service (2004) lists 26 herbicidal compounds for corn. Nineteen of the 26 herbicides listed are used on less than 10% of corn acres. Seedling shoot and root inhibitors (chemical family: Amide) are used extensively, as 76% of corn acres receive an application of one of several seedling shoot & root inhibitors (acetochlor, metolachlor ect...). Additionally, a mobile photosynthesis inhibitor (atrazine) is used on 77% of 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 Illinois to students at Joliet Junior College. Second, demonstrate the effects of herbicidal weed efficacy and potential herbicide injury on corn grain yield.

Methods

Eight corn herbicide treatments and a no-herbicide control were used to determine the efficacy of commonly used corn herbicide systems. Each treatment was replicated three times and planted on April 19th with the Dekalb hybrid 57-81 (RR+YGRW). The previous crop was soybean and corn was planted at a rate of 32,000 seeds per acre. The entire experimental area was zero-tilled and preplant burndown+residual herbicides [Basis @ 0.50oz/acre + Atrazine 4L @ 1qt/acre + 2,4-D @ 1pt./acre (Adjuvants: COC @ 1%v/v, and AM.S. at 17lbs/100gal solution)] were used to control existing vegetation and provide some residual weed activity. Herbicides were broadcast with flat fan spray nozzles (XR11004, Spray Systems Co.) on a Hardy pull-type sprayer applying 20 gallons per acre of spray solution and 20 pounds per square inch nozzle tip pressure. Weed efficacy was measured at R6 by visual assessment (% control), and the crop was harvested on October 7th.

Treatments: 9
Replications: 3
Planting Date: 19 April
Hybrid: Dekalb 57-81YGRW
Previous Crop: Soybean
Tillage: Zero-Till
Soil Series: Will silty clay loam
Herbicides: Many
Insecticides: None (Bt-RW)
Silking (R1) date: 15-July

Corn Herbicides

Results and Discussion

All eight herbicide treatments significantly (alpha= 0.05) increased weed control compared to the no-herbicide control (page 17, table 6). However, none of the herbicides significantly increased grain yield compared to the no-herbicide treatment. Plots without a herbicide, while weedy relative to herbicide treated plots, were without dense weeds and was likely the reason for no significant yield loss, although numerically the lowest yields were observed there. Previously (2003, 2004) yields were considerably lower (50 to 60 bu./acre) in the no-herbicide treatment compared to herbicide treated plots, which may partly be explained by the lack of any residual activity herbicides contained in the burndown. In 2005 the burndown, which is applied over the entire experimental area, contained some herbicides (Basis & Atrazine) with soil residual activity.

Overall, the efficacy of herbicide treatments was excellent and averaged 95%, with a range of 83 to 100% control. The poorest performing herbicide treatment was Harness Xtra + Atrazine, which was significantly less (alpha= 0.05) than all but one of the herbicide treatments (RoundupWM Late-Post). Additionally, Harness Xtra + Atrazine was one of two herbicide treatments that was not followed by a postemerge applied herbicide. The other preemerge only herbicide treatment was Epic + Atrazine which significantly increased weed efficacy (96%) compared to Harness Xtra + Atrazine, and provided weed control similar to the other treatments. These observations mirror our findings in 2003, but differ slightly with 2004 where Harness Xtra + Atrazine provided excellent weed control.

Surprisingly, no yield reduction occurred when a RoundupWM application was delayed from a “normal” post application time (V4) to V9 (page 17, table 6). In general, crop yields suffer from early season weed interference (1st 4-6 weeks after emergence) (Wood et al., 1996), and yield loss usually increases as weed removal is delayed (Gower et al., 2003). Previously at Joliet Junior College (2004), fairly large yield losses (21bu./acre) occurred with delayed post herbicide applications. The lack of any yield loss in 2005 may partly be explained by the low weed pressure, although the low soil moisture and rainfall that occurred throughout most of the crops vegetative development should have enhanced the negative effects of weed interference.

Most of the herbicide treatments (7/8) provided excellent weed control and maximum yield, which has been our observation for the previous two years with similar herbicide treatments (2003 and 2004). Assuming appropriate use rates and application timing, many herbicide systems will perform adequately and producers may consider focusing more attention on cost. Table 6 on page 17 lists the costs associated with each herbicide treatment, costs range from $11.38 to $44.62 per acre, nearly a four-fold change in cost for herbicide systems with comparable efficacy.

Corn Herbicides

Table 6.

Influence of corn herbicide systems on weed efficacy, grain yield, and herbicide cost for corn grown at Joliet Junior College in 2005. Herbicide costs were calculated using pricing information from WeedSOFT2005, costs include AM.S. and COC.

Corn Herbicide - Application Time†	Application Rate	Weed Efficacy	Grain Yield	Cost
	oz (lbs) / acre	% Control	bushels/acre	$/acre
No Herbicide‡	——	0	139	0
Harness Xtra + Atrazine - Pre	60+39	83	144	29.49
Harness Xtra + Atrazine - Pre; Callisto + Atrazine - Post(V6)	60+39; 3+8	100	155	44.62
Harness Xtra + Atrazine - Pre; RoundupWM - Post(V6)	60+39; 21	98	153	40.87
RoundupWM - Normal Post(V4)	21	95	151	11.38
RoundupWM - Late Post(V9)	21	94	150	11.38
RoundupWM - Normal Post(V4); RoundupWM - Late Post(V9)	21; 21	98	155	22.76
Epic + Atrazine - Pre	(0.75)+64	96	156	33.27
SteadfastATZ + Callisto - Post	(0.875)+2	97	155	28.86
LSD (0.05)	——	12	N/S	——

†Pre=Pre-Emerge, Post=Post-Emerge, RoundupWM=Roundup Weathermax.

‡ A burndown herbicide was applied to the entire experimental area, it included: Basis @ 0.50oz/acre + Atrazine 4L @ 1qt/acre + 2,4-D @ 1pt./acre. Adjuvants were: COC @ 1%v/v, and AM.S. at 17lbs/100gal solution.

Table 7.

Herbicide trade name, active ingredient, and application rate of nine corn herbicide systems evaluated at Joliet Junior College in 2005. Symbols: "&" signifies active ingrediants combined in a pre-mix, while a "+" indicates a herbicide added to the current tank mix. ";" is used to seperate herbicides applied at different times.

Herbicide Trade Name	Active Ingredient†	Application Rate
		lbs a.i.(a.e.) / acre
No Herbicide	——	——
Harness Xtra + Atrazine	Acetochlor & Atrazine + Atrazine	2.00 & 0.79 + 1.21
Harness Xtra + Atrazine; Callisto + Atrazine	Acetochlor & Atrazine + Atrazine; Mesotrione + Atrazine	2.00 & 0.79 + 1.21; 0.09 + 0.25
Harness Xtra + Atrazine; RoundupWM	Acetochlor & Atrazine + Atrazine; Glyphosate	2.00 & 0.79 + 1.21; (0.75)
RoundupWM	Glyphosate	(0.75)
RoundupWM	Glyphosate	(0.75)
RoundupWM; RoundupWM	Glyphosate; Glyphosate	(0.75); (0.75)
Epic + Atrazine	Isoxaflutole & Flufenacet + Atrazine	0.075 & 0.36 + 2.0
SteadfastATZ + Callisto	Nicosulfuron & Rimsulfuron & Atrazine + Mesotrione	0.024 & 0.011 & 0.75 + 0.06

Tillage & Planting Dates for Corn

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 have been recorded (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 high water holding capacity often produce higher yields with tillage. The influence tillage has on optimum corn planting date 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 if tillage influences optimum corn planting date.

Methods

Three planting dates and tillage systems (9 treatments) were replicated three times to determine whether tillage influences optimum corn planting date. Tillage systems were zero, strip, and mulch-tillage. Mulch tillage consisted of fall chisel-plowing followed by one spring shallow tillage operation. Strip-tillage consisted of fall tilled bands (~ 8-inches wide) spaced 30-inches apart where corn was planted the following spring. Planting dates were April 6th, April 25th, and May 18th. The corn hybrid Burrus 628BtRR was seeded at 32,000 seeds per acre and the soil insecticide Force 3G was applied in-furrow. Weed control was achieved with preplant tillage and Domain applied preemerge for tilled plots, and burndown herbicides with residual soil activity applied preplant (Basis+Atrazine+2,4-D) in strip and zero tillage plots. The entire experimental area was treated with Roundup Weather Max postemerge (V3). 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 V3. Corn was harvested October 5th.

Treatments: 9 (3 tillage systems and 3 planting dates).
Replications: 3
Planting Date: April 6th, April 25th, and May 18th.
Hybrid: Burrus 628BtRR
Previous Crop: Soybean
Tillage: Zero, Strip, and Mulch
Soil Series: Symerton silt loam
Herbicides:
  Basis@ 0.50oz + Atrazine@ 1qt. + 2,4-D@ 1pt/acre applied preplant (burndown) in zero and strip tillage only.
  Domain@ 11oz/acre applied preemerge in mulch-till only.
  RoundupWM@ 21 ounces per acre applied postemerge (V3).
Insecticides:
  Force3G @ 4oz/1000 ft. of row.

Tillage & Planting Dates for Corn

Results and Discussion

Grain yields for all three tillage systems tended to increase (11 to 15 bu./acre) when planting was delayed from April 6th to April 25th (page 20, figure 11). Although the increase was not significant [LSD (0.05)= 17], it was consistent for all three tillage systems. Yields declined sharply from their numeric high for the strip and mulch tillage systems when planting was delayed until May 18th. This significant reduction was 27 bushels per acre for strip-till and 38 bushel for mulch-till. When the main effect of planting date is viewed (page 22, table 9), grain yield for April 25th planted corn is significantly higher ($P<0.05$) than either of the other two planting dates, with April 6th greater than May 18th. These results are not unexpected, as nearly identical trends have been found in earlier Illinois work (Nafziger, 2002). The findings do, however, differ from our results over the previous two years (2003 &2004), when higher yields occurred with early rather than late April planting. A possibility for the lower yields associated with early April planting in 2005 is the very cool late April and early May temperatures, and multiple frosts. Additionally, early planted corn was V3/V4 when a damaging hail storm injured crops, while late April planting were V1/V2. Greater variation in emergence and seedling growth due to the hail storm and repeated frosts likely caused uneven interplant competition that reduces yield (Carter and Nafziger, 1989).

Unlike the mulch and strip tillage, zero-till corn did not follow the large yield reduction noted in the other two tillage systems, and in fact was statistically unaffected by planting date. The lack of a large yield loss with zero-till from April 25th to May 18th relative to strip and mulch tillage caused a significant interaction ($P= 0.09$). The interaction was likely caused by a lower harvest population with increasing tillage at the May 18th planting date (page 20, table 8). Although all three tillage systems had significant reductions ($P<0.05$) in harvest population with late planting, there is a trend of further reductions with increasing tillage. Harvest population of late planted mulch-till corn was approximately 1/2 of earlier planting, the extremely low population (13,500 ppa) undoubtedly reduced yield, while the significantly higher populations with strip and zero tillage may have been the reason for their higher yields.

The very large decrease in harvest population for late planted corn was due to a heavy hail and thunderstorm event occurring the day after the last planting date (May 19th). The storm reduced soybean stands on the JJC Demonstration & Research Farm in half, and it was estimated that corn stand reduction for April planted corn (V2) was 5 to 10%. Additionally, the soil surface became very dense or crusted and severely hampered seedling corn emergence. Although no measurements were taken to measure surface density after the storm, it was obvious the mulch tilled soil surface was considerable more dense than with zero-till. The surface residue cover probably reduced the force applied to the soil surface by rain droplets and hail stones by intercepting them before soil impact. The significant increase in yield with zero compared to mulch tillage for late planted corn can probably be attributed to higher populations resulting from reduced soil crusting.

Tillage & Planting Dates for Corn

Results and Discussion (continued)

There were no significant differences between tillage systems for the two April planting dates, although the mulch and strip tillage were consistently higher than the zero-till in the range of 7 to 10 bushels per acre. The main effect of tillage (page 22, table 9) shows no significant difference in yield between any of the three tillage practices. For the past three years (2003-2005) there has been no significant nor consistent trend of a tillage effect on grain yield. This finding is in agreement with research conducted in Illinois (Hoeft et al., 2000; Hoeft et al., 2002; Soils Project, 2003) and elsewhere (West et al., 1996; Al-Kaisi and Licht, 2004).

Figure 11.

Influence of planting date (April 6th and 25th, and May 18th) and tillage system (Zero, Strip, and Mulch) on the grain yield of corn grown at Joliet Junior College in 2005. Asterisk indicates a significant difference (LSD(0.05)=19) between tillage systems at a given planting date. LSD-1 is for comparing planting dates within a tillage system.

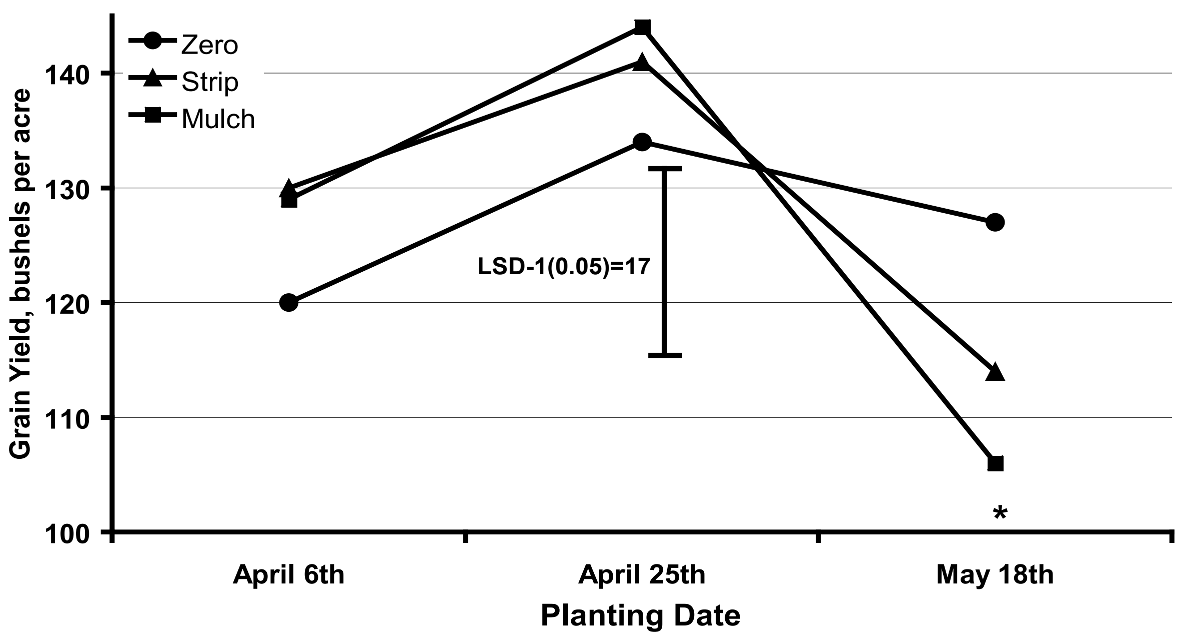


Table 8.

Influence of tillage and planting date on the harvest population of corn grown at Joliet Junior College in 2005.

Planting Date	Tillage: Zero	Tillage: Strip	Tillage: Mulch	LSD(0.05)
	——Harvest Population——			
	plants per acre			
April 6th	26,278	29,056	27,111	4,200
April 25th	25,945	27,611	27,555	4,200
May 18th	20,389	17,722	13,500	4,200
LSD(0.05)	2,900	2,900	2,900	

Tillage & Planting Dates for Corn

Figure 12. Corn planted on April 6th (left of orange stake) and April 25th (right of orange stake) and photographed on May 19th (top) and May 23rd (bottom). April 6th planted corn was V3/4, while april 25th planting was V1/2. Note the destruction of crop vegetation from a hail storm late in the day on May 19th.

Tillage & Planting Dates for Corn

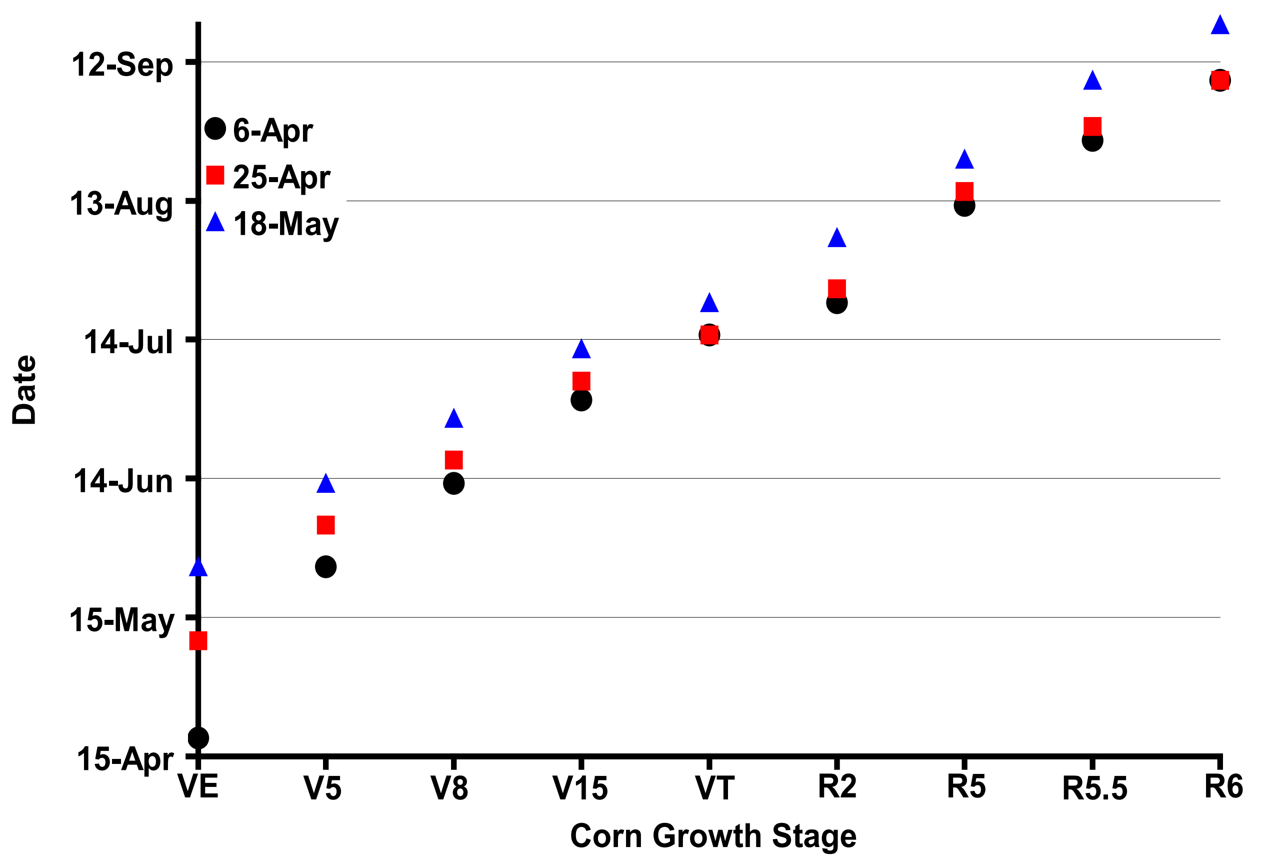
Table 9.

Main effects of tillage and planing date on the grain yield (G.Y.) and harvest population (H.P.)of corn grown at Joliet Junior College in 2005. Each tillage system was averaged over three planting dates, and each planting date over three tillage systems.

Main Effects					
Tillage			Planting Date		
	G.Y.	H.P.		G.Y.	H.P.
	—bu/ac—	—ppa—		—bu/ac—	—ppa—
Mulch	126	22,722	April 6th	126	27,482
Strip	128	24,796	April 25th	140	27,037
Zero	127	24,204	May 18th	116	17,204
LSD (0.05)	N/S	N/S	LSD (0.05)	10	1,694

Figure 13.

Date of growth stage attainment for corn planted on April 6th, 25th, and May 18th at Joliet Junior College in 2005.



Corn Row Spacing and Population

Justification and Objective

Optimum grain yields for corn grown in Illinois includes planting between April 20th and May 4th, and seeding to achieve 30,000 plants per acre at harvest (Nafziger, 2002). While most (>80%) Illinois corn is grown in 30-inch row spacing, equipment has been developed to plant and more noticeably harvest corn in 15-inch rows. Because we can physically manage 15-inch row corn (appropriate equipment), it begs the question as to whether or not their is an economic or yield benefit from narrowing rows. Chapter two of the Illinois Agronomy Handbook (23rd edition) summarizes a considerable amount of work to answer the above question. In six Northern Illinois environments (3 years and 2 locations) rows spaced 20 and 30 inches apart did not yield differently when optimum populations were used. However, when plant population was relatively low (10,000-25,000 ppa), 20-inch row spacing produced more grain than 30-inch rows.

Later in the 1990's row spacing and populations over nine Illinois environments were again studied, but potential hybrid differences were also evaluated. A latter maturing relatively tall hybrid produced 1 bushel per acre more (~ 1/2%) in 15-inch rows compared to 30-inch rows. However, the second hybrid (presumably with less leaf area) responded to 15-inch rows with a 6 bushel per acre increase at optimum plant populations. The difference in response to narrow rows by hybrids is probably related to differences in plant height and presumably leaf area. A goal of cropping management is to achieve 95% or more light interception prior to flowering, hybrids with reduced leaf area can more easily accomplish this goal when row spacing is reduced.

Numerous practical considerations should be included in a row spacing change. While an average 6 bushel per acre increase has been found in numerous row spacing studies located throughout the North Central US A, (Lambert and Lowenberg-DeBoer, 2003) the cost of equipment changes must be weighed with the potential increase in gross income. Our objective was to determine the effect of row spacing and harvest population on corn grain yield in a Will silty clay loam located in North Eastern Illinois.

Methods

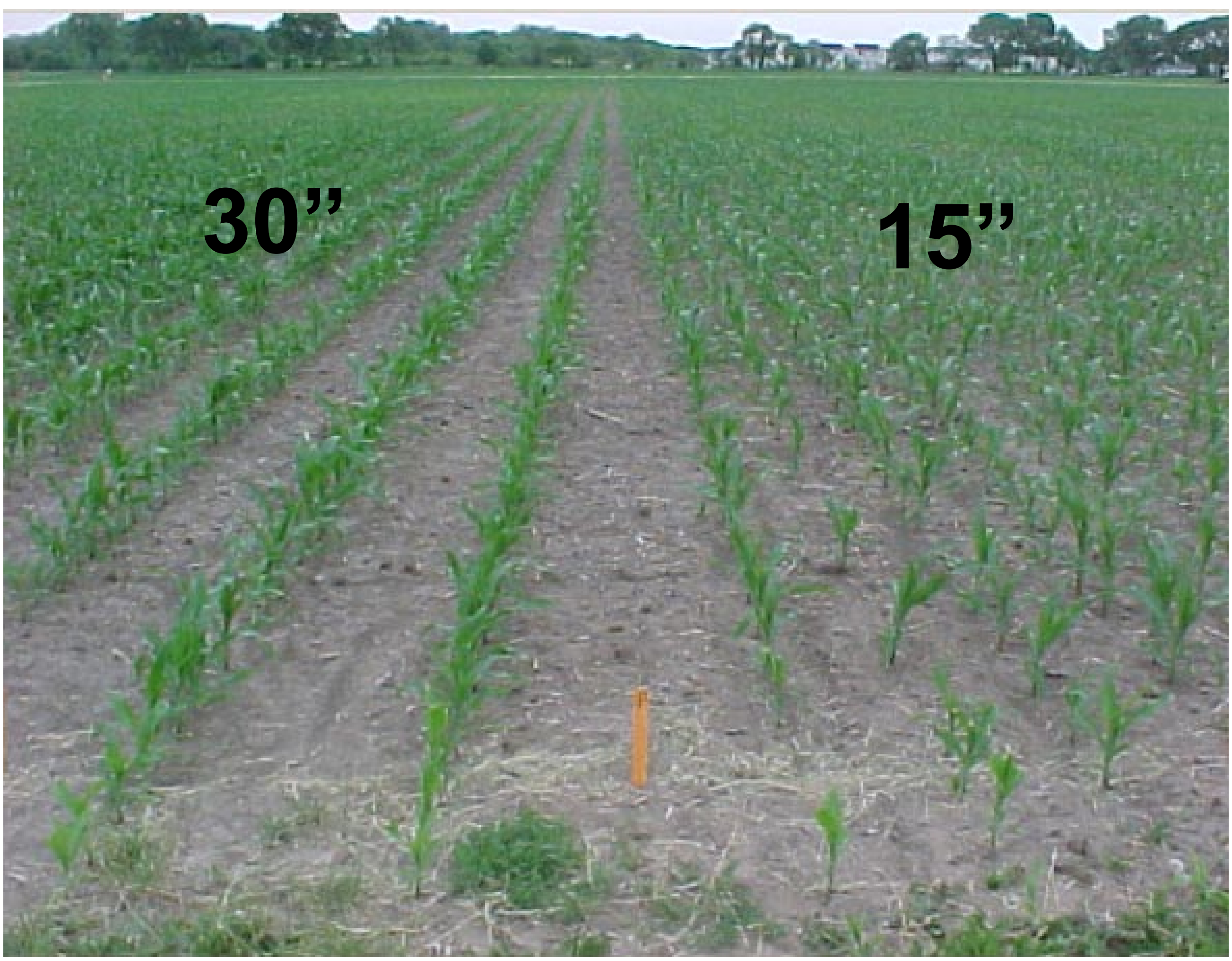
Two row spacings (15 and 30 inch) and five seeding rates to approximate harvest populations ranging from 20 to 40 thousand plants per acre in 5,000 plant increments was planted on April 18th with a KINZE model 3000 pull-type planter. The planter was equiped with "interplant" row units that can be lowered for 15-inch row spacing, or raised for 30-inch row spacing. In an effort to obtain harvest populations of 20, 25, 30, 35, and 40 thousand plants per acre, it was attempted to seed at the above rates with an additional 10% seed. A Bt-rootworm (Bt-RW) hybrid (Crows 6W866) was used for corn rootworm larval control. The nitrogen (N) source was $(NH_4^+)_2\ SO_4^{2-}$ broadcast on the soil surface in mid-February at a rate of 140lbs N per acre. The entire experimental area was field cultivated and lightly disced ahead of planting. Weed control was achieved by a pre-emerge application of Harness Xtra and Atrazine. Both 15 and 30 inch row spacings were harvested with a 30-inch row spacing corn head. Random counts of ear droppage were made in both row spacings after harvest to determine the effect harvesting had on grain loss, no differences were found.

Corn Row Spacing and Population

Methods

Treatments: 10 (2-row spacings and 5-seeding rates)
Replications: 4
Planting Date: 18 April
Hybrid: Crows 6W866(Bt-RW)
Previous Crop: Soybean
Tillage: Mulch, spring shallow
Soil Series: Symerton silt loam
Herbicides:
Harness Xtra@ 83oz + Atrazine@ 12oz per acre applied preemerge.
Insecticides: Bt-RW+Cruiser seed treatment.

Figure 14. Pictured is corn seeded in 30 and 15-inch row spacings at approximately the V5 growth stage on June 8th.



Corn Row Spacing and Population

Results and Discussion

Corn planted in 30-inch row spacing did not increase grain yield with increasing harvest population, as average harvest populations of 20,146 and 39,167 plants per acre produced similar yields (page 26, table 10). Fifteen-inch row spacing did, however, produce a significant ($P<0.05$) increase in yield with increasing population to the average harvest population of 25,063 plants per acre. At only one population (20,146) were significant differences detected between row spacings. When the two row spacings were averaged together the response to population was the same as the 15-inch row spacing, where yields plateaued at 25,063. An optimum harvest population near 30,000 plants per acre is recommended for Illinois corn producers (Nafziger, 2002), however it is not surprising that some variation upon the recommended optima occurs in a given environment. Averaged over all five seeding rates, the 30 and 15-inch row spacings produced an identical yield of 140 bushels per acre (data not shown). This is in contrast to our 2004 results where a 6 bushel advantage was found for the narrow row spacing, and a narrow row yield advantage has been reported by others (Lambert and Lowenberg-Deboer, 2003). In Illinois, however, very little narrow row spacing advantage has been found, especially at populations above 25,000 plants per acre (Nafziger, 2002). Despite the very close proximity of plants within the row in some treatments (3.6 inches between plants for 15-inch row spacing at 39,000 ppa), no lodging was detected in the entire experimental area.

Significantly higher yields in 30 compared to 15-inch row spacing at low population is intuitively a reverse response that one would expect, as light interception would be most negatively effected by wide rows at lower populations. Although not significant ($P>0.05$), a 13 bushel advantage for 30-inch rows at the lowest seeding rate was found in the same study in 2004. The lack of a response to harvest population for corn grown in 30-inch rows was also noted in 2004. Analysis of variance (ANOVA) indicates a significant row spacing by population interaction ($P<0.05$), that resulted from a differing response to population for the two row spacings. A row spacing by population interaction is unusual, as the authors of two recent studies concluded that optimum corn population is not effected by row spacing (Farnham, 2001; Widdicombe and Thelen, 2002).

It is not clear why the 15-inch row spaced corn improved yield with increasing population while 30-inch row corn did not. Some researchers have suggested that narrow row corn may improve the consistency of corn yield. This is clearly not the case with our study, as yields in 30-inch rows seemed to be more consistent given hgiher yields at low populations in 2005 and 2004.

Corn Row Spacing and Population

Table 10.

Influence of harvest population and row spacing on the grain yield of corn grown at Joliet Junior College in 2005.

Harvest‡ Population 30"- 15"	Average† Harvest Population	Row Spacing 30"	Row Spacing 15"	Row Spacing 30"&15"
		Grain Yield		
plants/acre		bushels per acre		
-875	20146	137*	111	124
792	25063	143	140	142
-542	30479	144	148	146
375	33521	145	152	149
0	39167	131	146	139
	LSD(0.05)	N/S	15	11

† Harvest population averaged over 30 and 15 inch row spacings.

‡ Increase in harvest population of 30 compared to 15-inch row spacing.

* Indicates a significant difference (alpha=0.05) between row spacing at a given population level.

Figure 15. A seedling corn plant much defoliated by a hail storm on May 19th. The photograph was taken on May 23rd. Note how most of the leaf area was destroyed on this V2/V3 plant.

Corn Nitrogen Requirements & Root Injury

Justification and Objective

Nitrogen(N) fertilizer is usually required by corn to maximize producer profitability. Numerous factors such as N application time (Welch, 1971), N placement (Roberts et al., 1995), use of nitrification inhibitors (Bundy, 1986), tillage (Stecker, 1993), grain yield and previous crop (Hoeft and Peck, 2002), soil N supply (Rehm et al., 1994), and soil N loss characteristics (Smith et al., 1983) can impact corn fertilizer N requirements. In many cases either one or a number of these factors vary from field to field with changes in management and soil characteristics.

Economics and environmental concerns are usually at the forefront of N fertilizer considerations. During the past decade there has been increasing interest over the efficiency by which N is used. The largest zone of oxygen depleted waters in the U.S., Northern Gulf of Mexico, is often the focal point of concerns over N fertilizer 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, possibly due to N fertilizer loss from Mid-Western cropland (Rabalias, 1998).

One management factor not widely studied that may impact corn N requirements is root injury caused by corn rootworm (CRW). In one of two years with plentiful soil moisture Spike and Tollefson (1991) observed higher corn N requirements with increasing root injury, and yield reductions were overcome with higher fertilizer N rates. Alternatively, N requirements have been shown to be reduced with increasing root injury (Spike and Tollefson, 1989). Overcompensatory root regrowth has commonly been observed when moderate levels of root injury occur (Riedell, 1989; Kahler et al., 1985; Spike and Tollefson, 1988). Extensive root regrowth, in addition to yield reductions, may partly explain the reduced N requirements observed in some studies. In addition to root overcompensation from CRW larval injury, shoot overcompensation has also occurred, although grain yield was always reduced (Godfrey et al., 1993). Our objective is to determine the impact of corn root injury from CRW larvae on nitrogen requirement.

Methods

Five nitrogen (N) fertilizer rates (40-200lbs N/acre in 40lb increments) and an unfertilized control were applied to three levels of root protection. Root protection levels were achieved by growing corn without any insecticide, Lorsban15G treated, and BtRW+Aztec. Forty lbs N per acre was applied during planting (2X2), and the balance of an N treatment sidedressed at VE (May 16th). The N source was $CO(NH_2)_2$ NH_4^+ NO_3^- (32% N) injected four inches deep into into every other row middle (60” spacing) during the sidedressing operation. All treatments were replicated four times and arranged in a split-plot design, with root injury level as the main plots and N rate the sub plots. The corn hybrid Garst 8461 was planted for the untreated and Lorsban15G main plots, and it’s isoline Garst 8502 was used for the BtRW+Aztec plots. Corn was seeded at 30,500 plants per acre after soybean on April 25th. The corn rootworm larval insecticides were applied in-furrow and weed control was achieved by a pre-emerge application of Harness Xtra + Atrazine. The crop was harvested on October 6th.

Corn Nitrogen Requirements & Root Injury

Treatments: 6 (0-200 lbs N/acre in 40lb increments)
Replications: 4
Planting Date: 25 April
Hybrid: Garst 8461 and it's YGRW isoline Garst 8502.
Previous Crop: Soybean
Tillage: Mulch
Soil Series: Symerton silt loam
Herbicides: Harness Xtra + Atrazine @ 83oz + 12oz per acre.
Insecticide: Aztec2.1G @ 6.7oz or Lorsban15G @ 8oz/1000 ft. of row.

Results and Discussion

Grain yields for all three levels of corn rootworm larval root protection increased significantly ($P<0.05$) with the addition of fertilizer N (page 30, figure 17). There was no significant interaction among the three N response curves, although the no-insecticide curve was best described by a linear model, while the other two a quadratic model. Corn grown with root protection (Lorsban15G or BtRW+Aztec) had similar slopes and Y intercepts, however, relatively large differences were observed in economic and biological (where maximum yield occurs) optimum N rates. Additionally, the more efficient of the two root protection methods (lower N requirement) changed with the type of optima calculated. Lorsban15G protected plants had an economic optima of 25lbs N per acre less than BtRW+Aztec corn. Conversely, the biological optima for BtRW+Aztec was 31lbs N per acre lower than Lorsban15G. The most striking difference about the two curves is the range between economic and biological optimum N rates, with a range of 44lbs N per acre for BtRW+Aztec treated plants, and 100lbs for the Lorsban15G treatment.

The higher economic optima for the higher yielding BtRW+Aztec treated plants might be expected because of greater yield, however it is the lower yielding Lorsban15G treatment with a greater N requirement (31lbs N per acre) to maximize yield. Page 30 table 11 depicts root injury ratings for the two corn rootworm control products and the untreated control measured at the 120lb N rate. Although not statistically different, Lorsban15G treated plants had nearly three times the root injury compared to BtRW+Aztec, and untreated plants had significantly more injury than either of the protection treatments. The increasing level of root injury has the effect of "flatening" the N response curves, leading to the linear response seen without an insecticide. No optima can be estimated for the linear response because at no point does yield stop increasing, we only know that the optimun is greater than 200lbs. The "flatter" Lorsban15G curve with the much wider range in economic to biological optima relative to the BtRW+Aztec may indicate that corn becomes increasingly N responsive with additional root injury.

Increased root mass after CRW larval injury ceases compared to uninjured plants has been observed by a number of authors (Kahler et al., 1985; Spike and Tollefson, 1988; Riedell, 1989. In some cases the moderately injured plants had reduced N requirements attributed to the lower grain yields (Spike and Tollefson, 1989), while in other instances higher levels of root injury necessitated greater N fertilizer that overcame yield losses (Spike and Tollefson, 1991).

Results and Discussion, continued

In addition to extensive root regeneration, over compensatory responses have also been observed with shoot mass (Riedell, 1989), and photosynthesis (Godfrey et al., 1993).

It appears some differences may exist between the two root protected N response curves, although this study will be continued in the future and will likely require a few years before any strong conclusions can be made. The main effect of grain yield showed no differences between the two root protection methods (page 30, table 11), although unprotected plants suffered significant yield loss. This is not surprising, as oleson et al. (2005) found under normal stress levels root injury in excess of one node of roots destroyed (1.0, 0-3 scale) is required for yield losses to occur.

Figure 16. A typical looking corn N response at Joliet Junior College on June 29th. Left two rows are fertilized with 200lbs N per acre, right two rows are unfertilized.

Corn Nitrogen Requirements & Root Injury

Figure 17.

Influence of fertilizer N rate and corn rootworm larval control product on the grain yield of corn grown after soybean at Joliet Junior College in 2005. Arrows indicate economic (left) and biological optima (right) for the Lorsban and BtRW+Aztec curves.

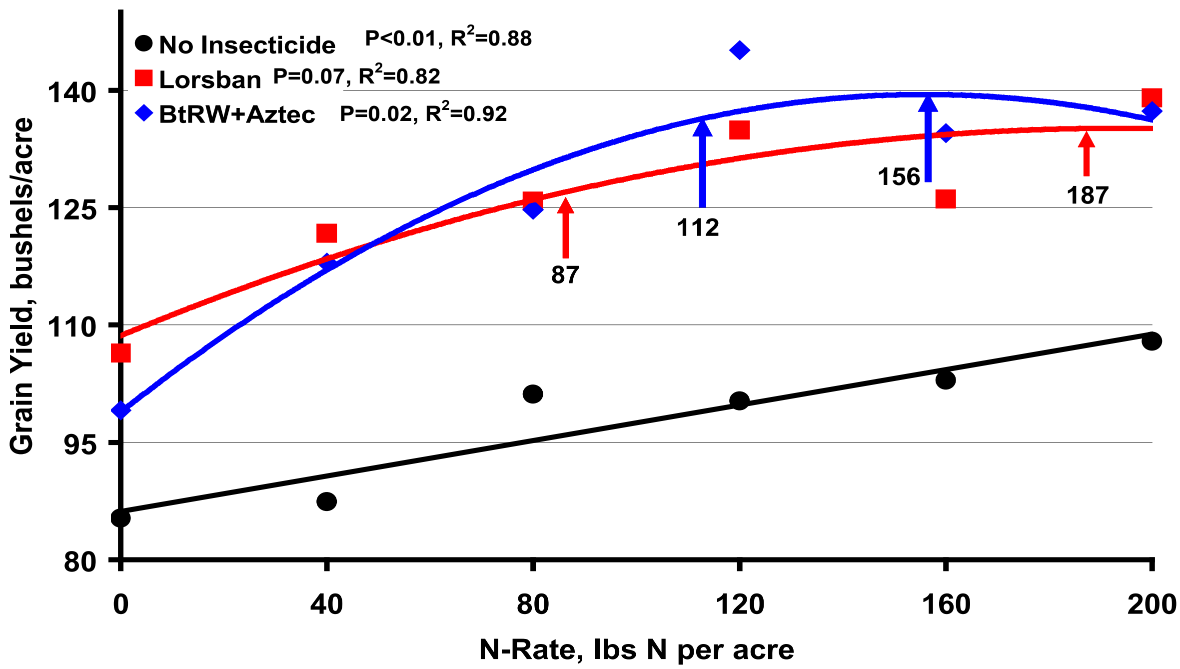


Table 11.

Influence of corn rootworm larval control products on grain yield, root ratings (0-3), lodging and population at harvest, and flowering (VT) of corn grown after soybean at Joliet Junior College in 2005. Grain yield for each control product is averaged over all six N-rates, while the remaining four measurements were taken in plots receiving 120lbs N per acre only.

Corn Rootworm	Grain Yield	Root	Harvest		Flowering
Control Product	Main Effect	Rating	Lodging	Population	15-July
	bu/acre	0 - 3†	—%—	plants/acre	—%—
None	98	1.77	13	26,050	27
Lorsban 15G‡	126	0.60	0	25,917	43
BtRW + Aztec 2.1G§	126	0.21	0	26,250	66
LSD(0.05)	16	0.62	7	N/S	——

† Roots were rated using the 0 to 3 node-injury scale, Oleson et al., 2005.

‡ Lorsban 15G was applied in-furrow at 8oz per 1000ft. of row.

§ Aztec 2.1G was applied in-furrow at 6.7oz per 1000ft. of row.

Water & N Stress in Corn

Justification and Objective

Producers and agronomists are interested in finding ways to alleviate plant stress (reduced photosynthesis) under high stress environments in a effort to maintain corn grain yield. One potential risk aversion strategy is to utilize hybrids with enhanced stress tolerance, while maintaining high yields under good growing conditions. Increased stress tolerance has been noted as one factor that has lead to higher corn grain yields for new compared to older hybrids (Tollenaar, 1994; Duvick, 1992). However, hybrids of the same era may also differ in their tolerance to stresses such a nitrogen (N) and water. O'Neill et al., (2004) found a 27% difference in grain yield between two hybrids of the same era when grown under water stress, however, they produced similar yields without added stress. Likewise, a 42% difference in yield between two hybrids was found when plants were N stressed, with similar yields without N stress and stress related yield reductions were closely associated kernel number. The most critical period for water stress is the first three weeks after silking (R1), with the first week most detrimental and associated with reduced kernal number (Grant et a., 1989). Our objective was to determine the difference in grain yield between two modern corn hybrids when exposed to water and or N stress.

Methods

Two Burrus corn hybrids (576 and 623B) were zero-till planted on April 25th into either a will silty clay loam with shallow depth to bedrock (~3 feet) or symerton silt loam with relatively deep, or normal soil depth (>6 feet). It has been noted in the past that the area of the will soil is greatly limited in growth and yield with normal precipitation. Both hybrids were planted with Aztec2.1G for CRW larval protection, and 40lbs N per acre was applied during planting. To achieve N stress, both hybrids in either soil were not sidedressed with an additional 80lbs N per acre, while the non-N stress treatments were sidedressed at VE on May 16th. Thirty-two % UAN ($CO(NH_2)_2$ NH_4^+ NO_3^-) solution was the N source injected into the soil 2X2 at planting, and injected 4-inches on 60-inch centers for sidedressing. A pre-plant burndown herbicide with residual activity was used to control preexisting weeds, after planting Harness Xtra + Atrazine were applied preemerge. The crop flowered on approximately July 21st, matured on September 12th, and was harvested on October 7th.

Water & N Stress in Corn

Methods

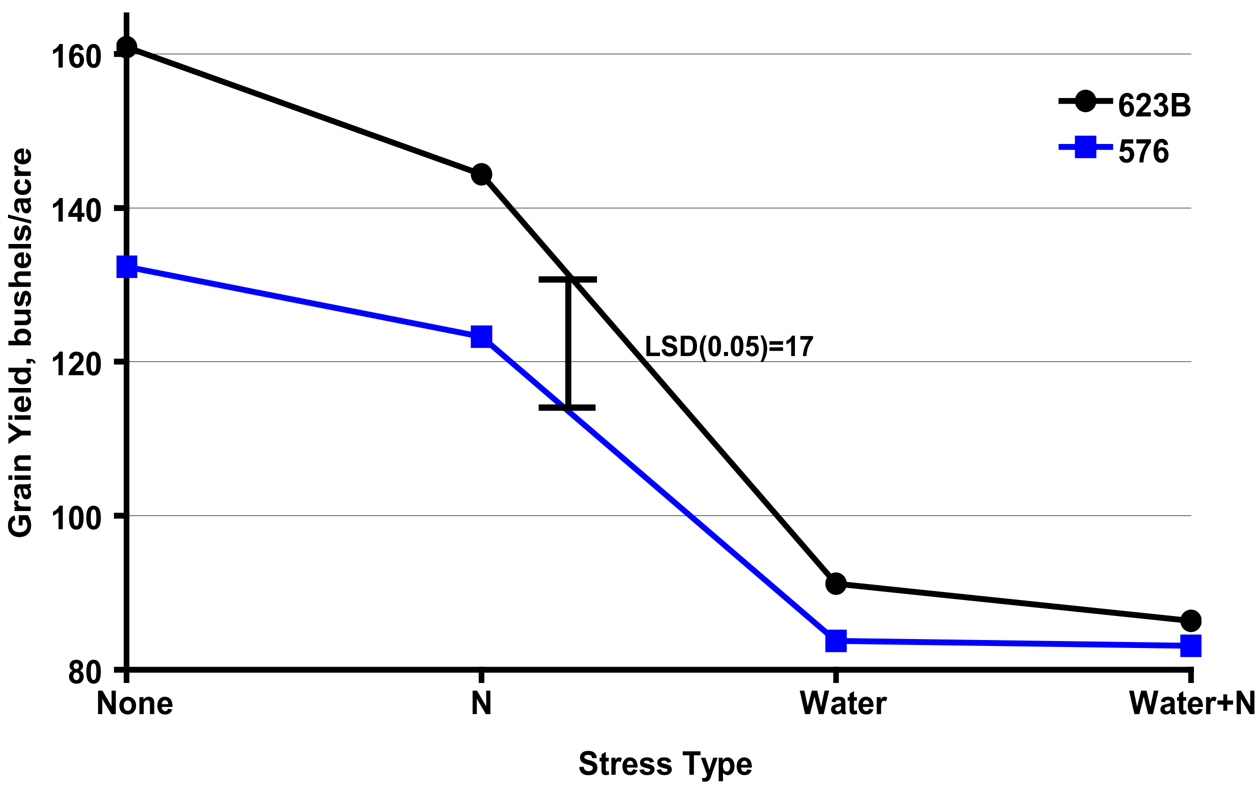
Treatments: 8
Replications: 4
Planting Date: 25 April
Hybrid: Burrus 576 & 623B
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam, Symerton silt loam
Herbicides:

Preplant Burndown; Basis@ 0.50oz + Atrazine@ 1qt + 2,4-D@ 1pt / acre.
Postemerge(V5); SteadfastATZ@ 0.875lbs + Callisto@ 2oz / acre.

Insecticides: Aztec2.1G @ 6.7oz per 1000 feet of row.

Figure 18.

Effect of corn hybrid and stress type on grain yield at Joliet Junior College in 2005. Two Burrus hybrids (623B and 576) were treated with four types of stress; none, nitrogen (N), water, and water + N.



Water & N Stress in Corn

Results and Discussion

Stress greatly reduced yield of both corn hybrids, with added stress reducing yield in the order: none < N <<< water = water+N. 623B produced numerically higher yields in all stress types, although it was significantly greater with none and N stress when compared to 576 (page 32, figure 18). As stress level increased 623B lost yield at a faster rate than 576, because of higher initial yield in low stress conditions. Grain yield for 623B was relatively high given the 2005 season at Joliet Junior College. Under large yield reducing stresses however (water & water+N), both hybrids produced similar yields. These findings are in contrast to O'Neill et al. where yield differences occurred only when two modern hybrids were subjected to N or water stress, and produced very similar yields when stress was lacking (2004). Additionally, yield improvements for new compared to old hybrids has partly been attributed to enhanced stress tolerance (Tollenaar, 1994; Duvick, 1992). These findings suggest hybrid selection is crucial only for corn grown without stress or low stress conditions.

Figure 19. Corn grown with water stress pictured shortly after flowering. Note the extreme short plant height (~4 feet).

Water & N Stress in Corn

Figure 20. Corn grown without water or N stress pictured shortly after flowering. Note the much greater plant height compared to figure 19.

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 when applied within six weeks after planting (Reeves et al., 1993). Additionally, Scharf et al., (2002) found N applications could be delayed through V11 without reducing yield. 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 treatments including timing and number of N applications 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 V1 on May 17th. The sidedress treatment had 120 pounds N per acre applied at V1. An unfertilized control was included to determine the crops response to fertilizer N. Each treatment was replicated three times and corn was planted on April 19th. The hybrid was Dairyland Seed Stealth 8515YG+ zero-tilled into soybean stuble. The crop was harvested on October 8th.

Treatments: 3
Replications: 3
Planting Date: April 19th
Hybrid: Dairyland Seed, Stealth 8515YG+
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
Preplant Burndown; Basis@ 0.50oz + Atrazine@ 1qt + 2,4-D@ 1pt / acre.
Postemerge(V3); SteadfastATZ@ 0.875lbs + Callisto@ 2oz / acre.
Insecticides: None

Split Versus Single Spring N Applicaitons

Results and Discussion

The No-N control produced a relatively high yield, indicating that soil N supply was quite good in the area of this experiment despite at times an extremly dry surface soil. Grain yield increased with the addition of N fertilizer for both N treatments, unlike 2004 where N did not increase yield. A significant increase in yield resulted from split-applying N (planting+sidedress) compared to a sidedress applicaiton. This is in contrast to our findings in 2003 and 2004 where both fertilzer treatments produced the same grain yield. Additionally, Scharf et al. (2002) found that N application could be delayed until V11 without incurring yield losses. It is unclear why split applied N benefited the crop this year. One possibility however, is that the very cool late April and early May, followed by a mid-May hail storm, reduced early vegetative growth such that greater N availability improved light interception and photosynthetic efficiency during reproductive growth. Increases in yield due to small amounts of fertilizer placed near the row at planting (starter) are more often associated with corn produced at higher latitudes, where seedling growth is more limited due to cool temperatures. An often cited "rule of thumb", is to apply N withing 6-weeks after planting (V5) to avoid yield loss with delayed N fertilization (Reeves et al., 1993).

Influence of time and number of N applications on the grain yield of corn grown at Joliet Junior College in 2005. Table 12.

N Application Time	Grain Yield
	bushels / acre
No - N	120
Sidedress	148
Planting+Sidedress	160
LSD (0.05)	12

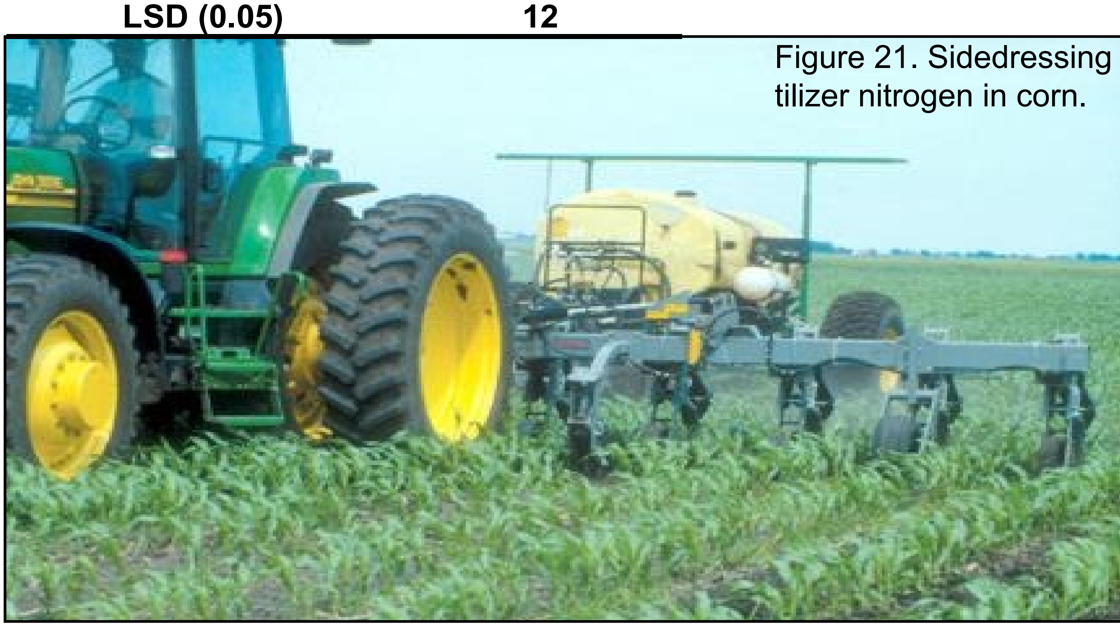


Figure 21. Sidedressing fertilizer nitrogen in corn.

Stress Mitigation Using Transgenic Corn Hybrids

Justification and Objective

Two thousand five marked the 10 year anniversary for the commercialization of transgenic crops, and each year increases in planting have maintained double digit figures (James, 2005). In 2005 transgenic crops, often referred to as genetically modified (GM) or "Biotech" crops, were seeded in 21 countries and surpassed one billion acres planted worldwide over their first decade of existence. The U.S. is the number one producer accounting for 55% (123 million acres) of the worlds transgenic crop acres in 2005, followed by Argentina (42 million acres) and Brazil (23 million acres). Trangenic corn was planted on 36% of Illinois corn acres in 2005, while transgenic soybean accounted for 81% of Illinois soybean acres (IASS, 2005). Insect resistance (Bt-Corn Borer and Bt-Corn Rootworm) comprised most of the Illinois transgenic corn (25% of acres), down slightly from 2004, however increases in herbicide resistance and "stacked gene" (>1 transgenic trait) resulted in a 3% increase over 2004.

Despite some controversy involving food safety and environmental impacts, it is estimated that herbicide tolerant (HT) soybean in the U.S. has reduced potential negative environmental effects by 28% through reduced herbicide use (PG Economics, 2005). Similarly, insect resistant corn has lessened insecticide usage such that the environmental "footprint" left by these compounds has decreased 4.4%. In addition to the positive environmental effects, transgenic crops have improved U.S. farm income by an estimated 10.7 billion dollars. Some of these benefits have been observed by field researchers, Singer et al., noted yield increases ranging from 0-10% with Bt-Corn Borer resistant hybrids compared to their non-transgenic near-isolines (2003). At Joliet Junior College, our experience with Bt-Root Worm resistant hybrids has been either similar (2005) or increased grain yield compared to a non-transgenic near-isoline.

Our objectives were to determine the effect of three levels of transgenic traits; (a) European Corn Borer (ECB) resistance, (b) ECB+glyphosate tolerance (RR), and (c) ECB+RR+Corn Rootworm resistance (RW) on corn grain yield. An additional objective was to determine the effect of the transgenic traits with and without a corn rootworm insecticide.

Methods

Three Dekalb corn hybrids (57-01, 58-80, 58-73) were planted on April 18th to achieve four levels of crop protection, including protection from two pests (ECB and RW), herbicide injury (RR), and a non-protected control. Varying crop protection levels were achieved through the use two transgenic traits (ECB+RR, and ECB+RR+RW), by either applying a conventional herbicide or glyphosate to the ECB+RR treatment, and by planting a non-transgenic hybrid. Dekalb 57-01 is considered the "base" genetics for 58-80 and 58-73 which are near-isolines differing from 57-01 only in regards to Roundup (RR) and ECB resistance (58-80), and RR+ECB+RW resistance (58-73). The non-transgenic control treatment consisted of the hybrid 57-01 with a V5 application of SteadfastATZ+Callisto. Two treatments (ECB and ECB+RR) were planted with 58-80, the ECB treatment received SteadfastATZ+Callisto at V5, while the ECB+RR received Roundup at V5. ECB+RR+RW included resistance to ECB and RW, and was treated at V5 with glyphosate.

Stress Mitigation Using Transgenic Corn Hybrids

Methods

All four levels of transgenic traits were planted either with or without the RW insecticide Aztec2.1G. The insecticide was applied during planting in the seed furrow behind the disc openers and in front of the closing wheels. All three corn hybrids were planted at 32,000 seeds per acre into a fall strip tillage system. Burndown herbicides with residual activity were applied one week preplant. At V5 (June 6th) the conventional herbicide SteadfastATZ+Callisto was applied on the non-transgenic and ECB treatments, with Roundup WeatherMax applied to the ECB+RR and ECB+RR+RW treatments. On July 27th (R2) five roots per experimental unit (plot) were dug, washed, and rated for injury on the 0 to 3 node-injury scale. Roots were dug from four of the eight treatments, which included both non-transgenic treatments (with and without Aztec2.1G), and both ECB+RR+RW treatments (with and without Aztec2.1G). The crop flowered on July 15th, matured on September 8th, and was harvested on October 7th.

Treatments: 8
Replications: 3
Planting Date: 18 April
Hybrids: Dekalb DKC57-01; 58-80; 58-73 (107 day)
Previous Crop: Soybean
Tillage: Strip
Soil Series: Symerton silt loam
Herbicides:
- Preplant Burndown; Basis@ 0.50oz + Atrazine@ 1qt + 2,4-D@ 1pt / acre.
- Postemerge(V3); SteadfastATZ@ 0.875lbs + Callisto@ 2oz / acre., or RoundupWM @21oz/acre.

Insecticides: None or Aztec2.1G @ 6.7oz per 1000 feet of row.

Results and Discussion

Grain yield was not significantly (P>0.05) influenced by any of the four levels of transgenic traits providing crop protection (page 40, table 14). This lack of response to transgenic traits was consistent wether a corn rootworm insecticide was included at planting or not. Additionally, when traits were averaged over insecticide use (main effect) no differences were found.

These findings are somewhat surprising for several reasons. a)European corn borer injury was evident in the non-transgenic plots. At flowering approximately 30% of plants were injured, and large borers could be found tunneled into the stalk near the soil surface. This level of ECB injury, albeit not extreme or even heavy, is greater than any I’ve observed at Joliet Junior College over the past four years. b)Herbicide injury was quite evident on treatments with a postemerge application of SteadfastATZ+ Callisto (None and ECB in table 14).

Stress Mitigation Using Transgenic Corn Hybrids

Results and Discussion

Injury was noticed about one week after postemerge herbicides were applied (June 13th). Symptoms appeared as a light yellow-flashing in plant whorls, indicating classic injury from a phloem mobile ALS inhibitor such as nicosulfuron (Accent), a component of SteadfastATZ. c)Corn rootworm larval injury to corn roots was significantly greater (P<0.05) for the non-transgenic treatment without a soil insecticide when compared to the CRW insecticide Aztec2.1G, RW, or both control measures combined (page 39, table 13). While corn grown without rootworm protection averaged less injury than noted in the untreated plots of our CRW insecticide efficacy study (page 11, table 5), the level of injury observed (1.84, 0-3 scale) represents over half of roots destroyed. For corn growing under normal weather conditions, economic injury usually occurs when root injury exceeds a 1.0 on the 0 to 3 scale (Oleson et al., 2005). d)Finally, droughty growing conditions for the six week period beginning the second week of June and ending the 20th of July stressed the crop (reduced photosynthesis), making additional crop stresses such as ECB, herbicide, and RW injury more likely to cause yield loss.

Yield losses did not occur despite insect and herbicide injury in addition to relatively poor growing conditions from roughly V7 to R2. It is not abundantly obvious why the use of transgenics did not relieve some stress and thereby enhance yield. However, it's probable that much of the stress that occurred was not during critical yield producing growth stages. It's well known that drought stress during vegetative growth has the least amount of impact on yield compared to the flowering and grain fill stages (Shaw, 1988). Since the crop flowered only five days before a large quantity of precipitation fell, the most critical grain yield determining stages of crop development (reproductive growth) did not occur during the preceding droughty conditions.

Although it is widely held that stress during seed set is more critical than during fill (Adrade et al., 1999; Shaw, 1988), and that any type of significant stress during the critical flowering period will decrease kernel number and cause yield loss (Adrade et al., 2002), there is some thinking that given a minimum number of kernels seed fill is more critical to grain yield (Nafziger, 2005). It is thought that yield is maintained even with relatively low kernel numbers (~450/plant) by simply increasing kernel mass, a process known as yield compensation. Assuming some minimum level of kernels per plant, the much improved conditions shortly after flowering which continued through much of reproductive growth, may have resulted in heavy kernel weights and contributed to the lack of yield loss when stress was added.

Corn Rootworm Control Product	Root Rating
	0 - 3†
Untreated	1.84
Aztec2.1G‡	0.39
RW	0.07
RW + Aztec2.1G	0.08
LSD(0.10)	0.55

† Roots were rated using the 0 to 3 node-injury scale, Oleson et al., 2005.

‡ Aztec2.1G was applied in-furrow at 6.7oz/1000 feet of row.

Table 13.
Influence of CRW larval control products on the root ratings (0-3) of corn grown after soybean at Joliet Junior College in 2005. The hybrid is Dekalb DKC57-01 and a near isoline Dekalb DKC58-73 with YieldGard Rootworm technology (RW).

Stress Mitigation Using Transgenic Corn Hybrids

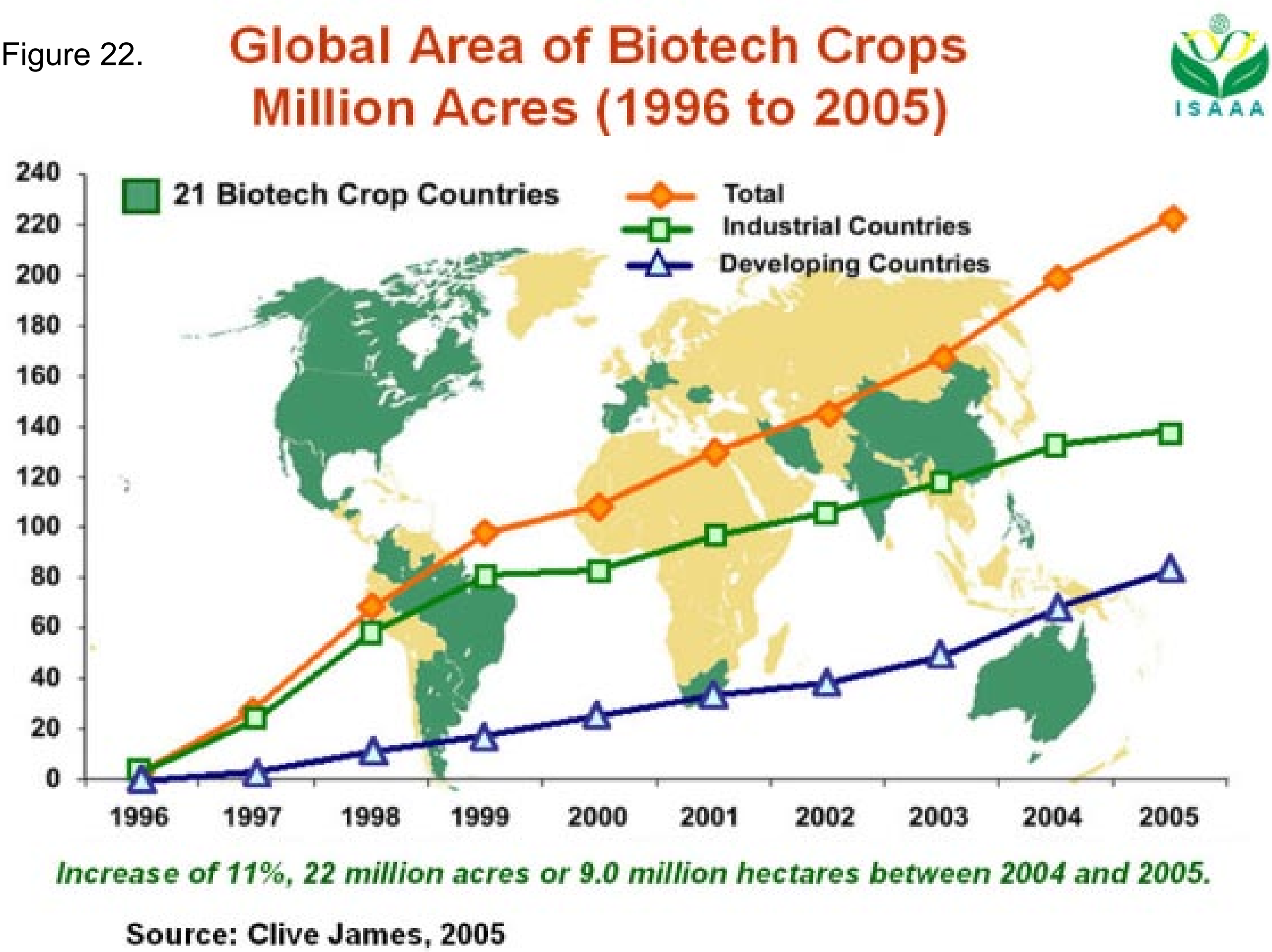
Table 14.

Influence of transgenic corn traits and a corn rootworm insecticide on the grain yield of corn grown at Joliet Junior College in 2005. A non-transgenic Dekalb corn hybrid (DKC57-01) and two transgenic near isolines, were used in conjunction with an application of either SteadfastATZ+Callisto or Roundup to achieve four levels of crop protection with transgenic traits.

Transgenic Trait	Insecticide NO	Insecticide YES	†Main Effect
	—bushels per acre—		
None	126	138	132
ECB	130	131	131
ECB+RR	123	129	126
ECB+RR+RW	128	126	127
LSD(0.05)	N/S	N/S	N/S

† Yield of transgenic traits averaged over both inseciticide treatments.

Figure 22.



Planting Depth-Corn

Justification and Objective

Depth of corn planting is probably an age old question that deserves attention from time to time. Indeed, planting depth can have a direct impact on stand establishment and consequently grain yield. Under normal conditions corn should be planted 1.5 to 1.75 inches deep, or into soil moisture to a maximum of 3 inches (Nafziger, 2002). The shallower seeds are planted the faster seedlings emerge and quick emergence is beneficial for a number of reasons, such as reduced pest and herbicide injury. Shallow planting enhances seedling emergence because soils are drier and warmer, and less mesocotyl elongation is required. But shallow planting must be balanced with the need to get all seeds in soil moisture for uniform seedling emergence, as uniformity of emergence virtually always effects yield (Carter and Nafziger, 1989). Recent interest in planting depth revolves around the idea that nodal rooting depth can be increased by deep planting. Nodal rooting depth however, is not influenced by planting depth assuming planting is 1 inch or so deep, the depth that nodal roots usually occur at. Deep planted seeds simply have greater mesocotyl elongation which maintains nodal root depth around 1 inch (Ritchie and Hanway, 1993). Our objective was to determine the impact of planting depth on harvest population and corn grain yield.

Methods

The corn hybrid Wyfells W4824RW was planted into fall strip-tilled mounds at three soil depths, 0.75, 1.5, and 3.0 inches on April 19th at a seeding rate of 32,000 seeds per acre. Treatments were replicated three times. The planter was a Kinze model 3000 manufactured in 2002, and retrofitted with a Yetter manufactured coulter and residue mover combination for zero-till planting. Weed control was accomplished with a preplant burndown/residual herbicide combination, followed by a post-emerge treatment of SteadfastATZ+Callisto. Plant population was measured at V10 (June 21st) and the crop was harvested on October 7th.

Methods

Treatments: 3
Replications: 3
Planting Date: 19 April
Hybrid: Wyfells W4824RW
Previous Crop: Soybean
Tillage: Strip-till
Soil Series: Symerton silt loam
Herbicides:
2,4-D @1pt.+Atrazine @1qt.+Basis @0.50oz per acre applied pre-plant. SteadfastATZ @0.875lbs+Callisto @2oz per acre applied post-emerge(V3).
Insecticides: None

Planting Depth-Corn

Results and Discussion

Harvest population and grain yield were unaffected by seeding depth (page 42, table 15). These findings are similar to our results from 2004. A good stand accompanied the 3.0 inch planting depth, which was surprising given that deep planting often results in a reduced stand (Nafziger, 2002). Observations of the crop did not suggest any large differences in rate of emergence or seedling vigor. It is possible one reason for the lack of injury to seedlings or reduced stand is the herbicide program used. No soil applied seedling shoot and root inhibitor (Chloroacetamides and Oxyacetamides) was applied for grassy weed control, instead, SteadfastATZ with nicosulfuron applied post was used for the control of grassy weeds. The seedling shoot and root inhibitors are known to injure emerging corn seedlings, especially slow emerging plants that may result from deep planting. Considerable marketing efforts by a number of private companies to improve the uniformity of seeding depth with various seed firming devices may have given rise to the popularity of such devices, and to their often cited benefits in the popular press.

Table 15.

Influence of planting depth on harvest population and grain yield of corn grown at Joliet Junior College in 2005.

Planting Depth	Harvest Population	Grain Yield
—inches—	plants/acre	bushels/acre
0.75	27,667	134
1.50	29,208	134
3.00	29,417	138
LSD (0.05)	N/S	N/S

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. 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 corn grain yield.

Methods

Soil compacted and non-compacted treatments 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 late March to early April, annually, beginning in 2002 through 2005. Soil was compacted before planting by excessive wheel traffic when relatively wet (too wet for Spring tillage and planting operations) but less than completely 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 (3-point hitch) was driven at 3mph over the compacted plots so that the tractor "footprint" was run over the entire soil surface. Soil resistance to penetration using a penetrometer was measured at eight soil depths from 3 to 24 inches deep in 3-inch increments before spring compaction (March 23rd), and following compaction (October 20th) during 2005. The soybean cultivar was LG C2844NRR seeded at 175,000 seeds per acre. The crop was harvested on October 4th.

Treatments: 2
Replications: 3
Planting Date: May 5th
Cultivar: LG C2844NRR
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
CanopyXL@2.5ounces+Express@0.10ounces+2,4-D@1pint per acre applied Fall preplant. RoundupWM @21oz/acre post emerge.
Insecticides: None

Soil Compaction

Results & Discussion

Soybean seed yield was unaffected by soil compaction (page 44, table 16), this is consistent with our 2003 soybean crop and with our 2002 and 2004 corn crops in this experiment. When observations were made throughout the growing season of the compacted and non-compacted plots, no visual effect was noted. In September of 2004, soil resistance to penetration (RTP) indicated some numerical increase in RTP at the three and six inch soil depth for the compacted treatment (page 45, figure 23). However, the following March (2005) before compacted treatments were implemented for the fourth annual time, numerical differences between treatments were minimal (page 46, figure 25). Seven months later however, the top 12 inches of the soil profile in the compacted plots had significantly greater RTP compared to the non-compacted treatment, and differences increased as depth decreased (page 47, table 27). Thus there seems to be an annual cycle of compaction alleviation between the fall and following spring, presumably due to a cycle of freezing and thawing.

Although no significant differences ($P<0.05$) were found for the main effects of RTP-1 or RTP-2 (treatments averaged over all soil depths), both indicated greater resistance for the compacted treatment, with larger differences at RTP-2 than RTP-1 (page 44, table 16). Volumetric water content (VWC) was also measured in October 2005, no differences were detected. Although soil compaction is routinely thought by many agronomists to cause yield losses in corn and soybean, we have seen no yield losses over the four years of this ongoing study. Soil compacted by heavy wheel traffic has been found to reduce corn grain yield (Wolkowski and Bundy, 1990), and while our soil may not be compacted by "heavy" wheel traffic, compacted plots do indicate increased RTP. 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 16.

Influence of soil compaction on volumeteric water content (VWC), resistance to soil penetration (RTP) measured in March(1) and October(2), and grain yield of soybean grown on a silt loam soil at Joliet Junior College in 2005.

Treatment	VWC†	RTP-1‡	RTP-2	Grain Yield
	—%—	—lbs/square inch—		—bu/acre—
Non-Compacted	16.6	162	242	50
Compacted	17.9	172	294	50
LSD(0.10)	N/S	N/S	N/S	N/S

† VWC is the proportion of soil volume filled with water.

‡ RTP is averaged over 8 depths ranging from 3 to 24 inches.

Soil Compaction

Figure. 23

Effect of soil compaction on resistance to penetration (penetrometer) at five soil depths measured on September 1st, 2004 at Joliet Junior College. Soil was compacted twice each year in the early spring (March/April) of 2002 through 2004 when soil was wet, but less than completely saturated.

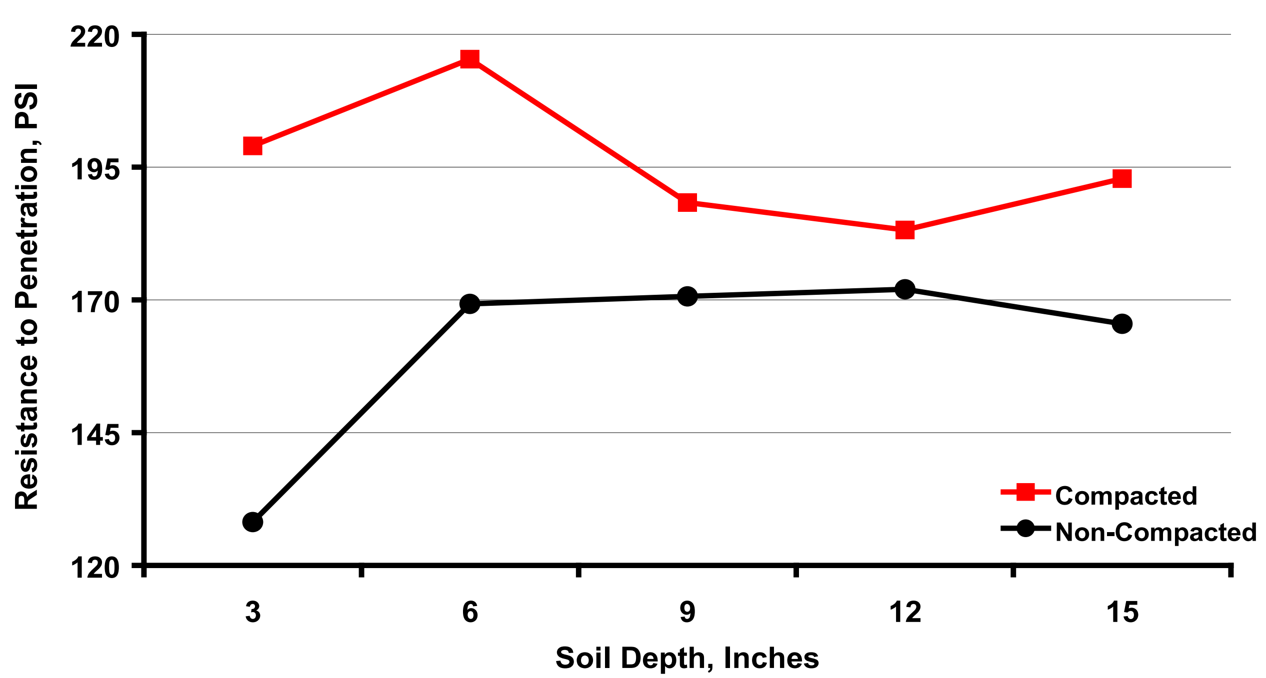
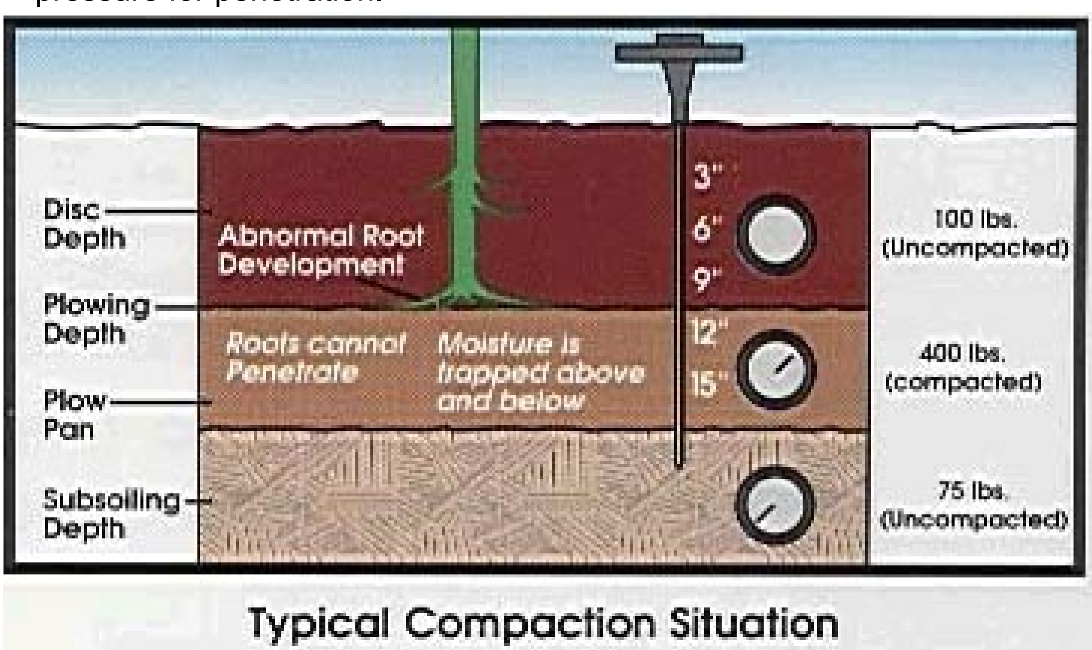


Figure 24. A typical soil compaction situation caused by continuous use of a moldboard plow. Note the center layer requiring very high pressure for penetration.



Soil Compaction

Figure. 25

Effect of soil compaction on resistance to penetration (penetrometer) at various soil depths sampled on March 23rd, 2005 (before annual compaction) at Joliet Junior College. Soil was compacted twice each year in the early spring (March/April) of 2002 through 2005 when soil was wet, but less than complete saturation.

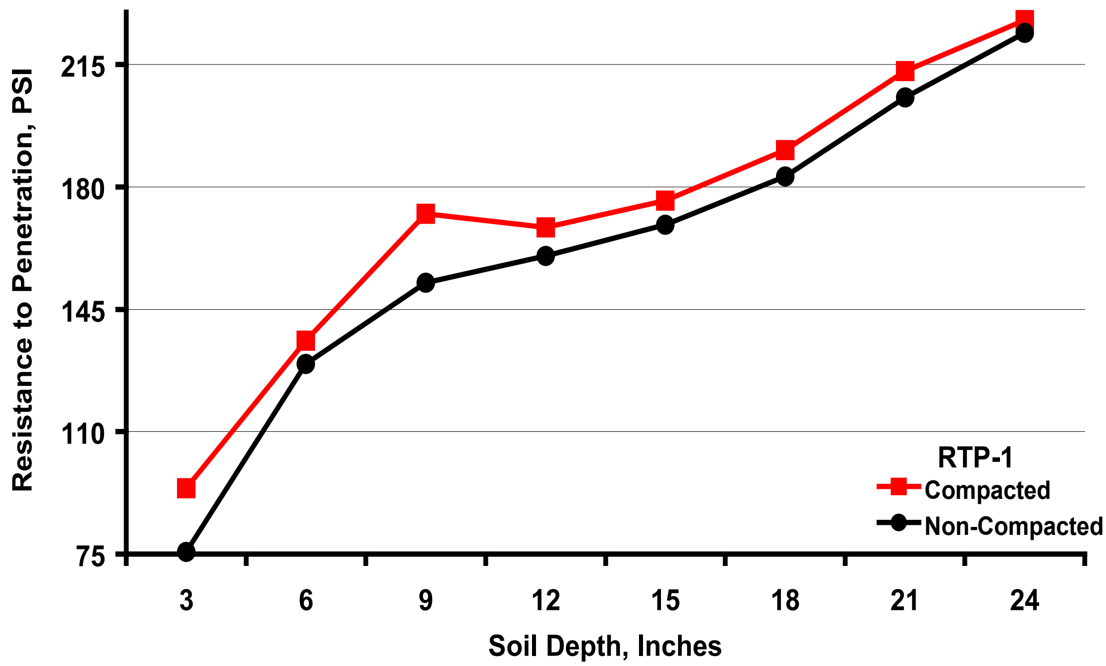
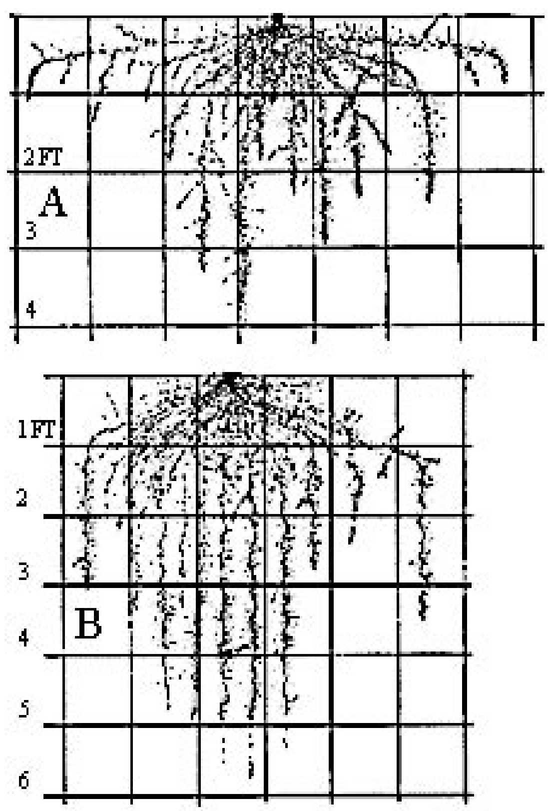


Figure 26. Effect of compacted soil on corn root distribution. Note the horizontal and shallow growth of roots in the compacted soil (A) compared to the non-compacted (B).



Compacted

Non-Compacted

Soil Compaction

Figure. 27

Effect of soil compaction on resistance to penetration (penetrometer) at various soil depths sampled on October 20th, 2005 at Joliet Junior College. Soil was compacted twice each year in the early spring (March/April) of 2002 through 2005 when soil was wet, but less than completely saturated.

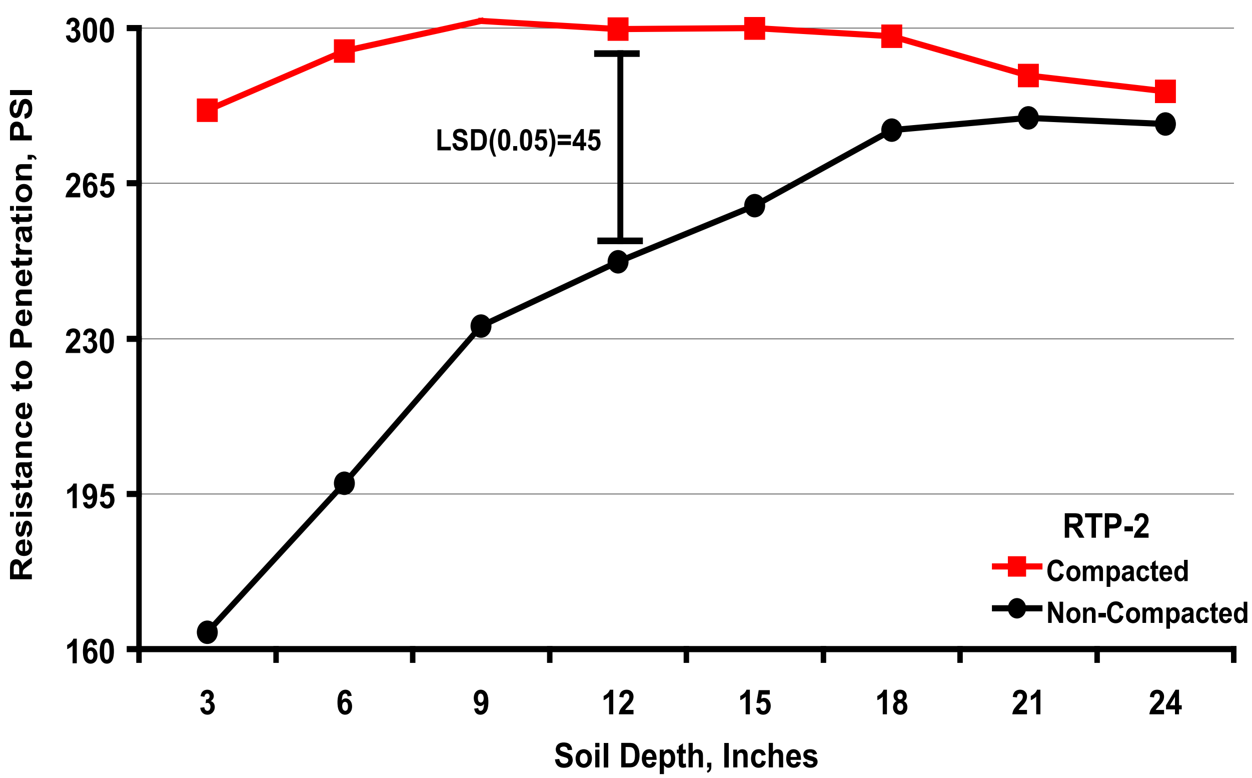


Figure 28. Equipement used to compact designated plots twice each spring.

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 from 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 (lbsP_2O_5) and 112 (lbsK_2O) per acre per year (Illinois Agricultural Statistical Service, 2002). This overapplication represents a misallocation of resources. 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 2005 crop is the fourth 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 at a rate of 50lbs per acre P_2O_5 and K_2O. 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 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, 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.

Soil Fertility-Corn

Methods

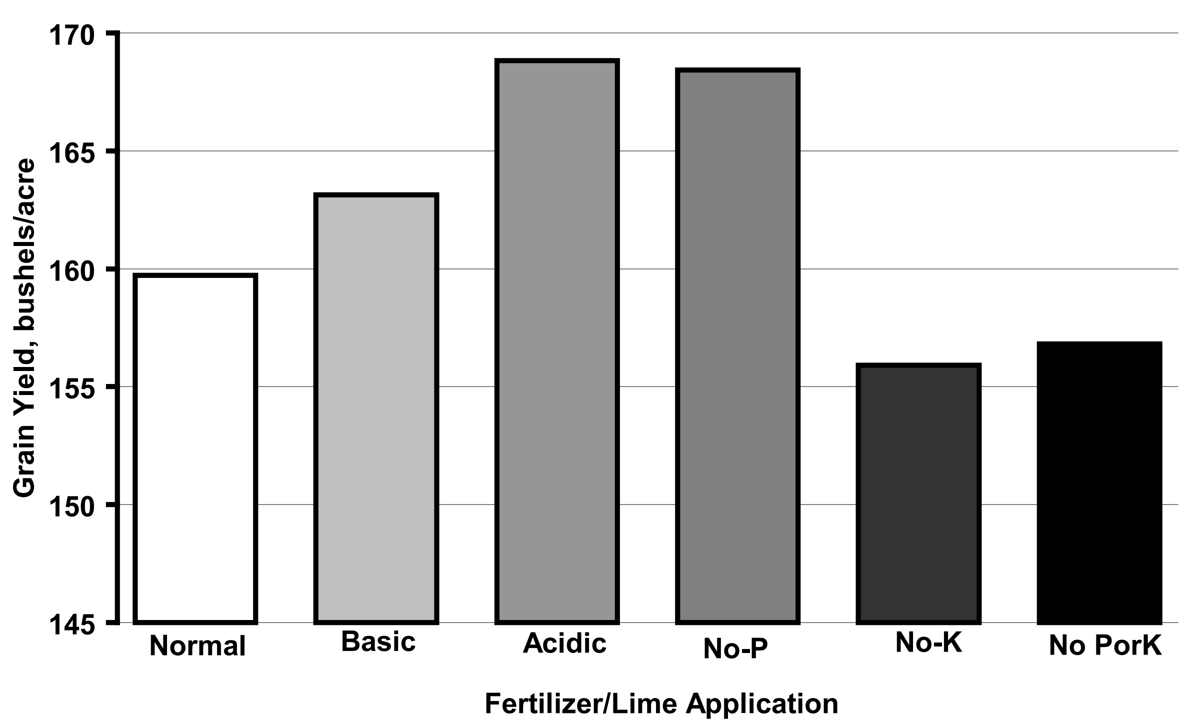
Treatments: 6
Replications: 2
Planting Date: 19- April
Hybrid: Dairyland Seed: DS8515YG+
Previous Crop: Soybean
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
  Preplant Burndown; Basis@ 0.50oz + Atrazine@ 1qt + 2,4-D@ 1pt / acre.
  Postemerge(V3); SteadfastATZ@ 0.875lbs + Callisto@ 2oz / acre
Insecticides: None

Results and Discussion

No significant differences (P>0.05) in grain yield were found among the six soil fertility treatments (page 49, figure 29). For the fourth year in a row no yield penalty occurred due to a lack of P or K, or pH maintenance. Field notes of observations made throughout the growing season indicate no visual symptoms of mineral nutrient deficiency. Treatments of this study were begun in the Fall of 2001, four crops have been produced with the current soil fertility regimes and it is thought that over time differences between treatments will occur.

Figure 29.

Influence of fertilizer and lime applications on the grain yield of corn grown at Joliet Junior College over three years (2003 - 2005). Fertilizer/lime applications are not significantly different (alpha=0.05).



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

Thirty-five corn hybrids were planted on April 27th at a rate of 32,000 seeds per acre with a model 3000 Kinze planter which uses a finger-type seed pickup and drop mechanism. After each hybrid was planted leftover seeds were vacuumed out of the seed box and finger pickup mechanism. The corn rootworm larval insecticide Fortress15G was applied in-furrow during planting to all hybrids not transgenic with *Bacillus thuringiensis* (Bt) for corn rootworm (Bt-RW). The check hybrid (Hughes 7105) was entered seven times and separated by six hybrid entries (60 feet) 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 three entries (30 feet) away. Corn was harvested with a John Deere model 6600, while an Ag Leader PF3000 yield monitor was used to determine grain yield and moisture. The demonstration area was zero-tilled into a previous crop of corn.

Hybrids: 35
Replications: Unreplicated demonstration
Planting Date: 27 April
Hybrid: Many
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
RoundupWM @21oz + 2,4-D @16oz + Harness Xtra @59.5oz + Atrazine @39oz per acre applied preemerge. HornetWDG @5oz per acre applied post-emerge.
Insecticides: Fortress15G @ 7.35oz / 1000 ft. of row, except Bt-RW hybrids.

Results and Discussion

The 35 corn hybrids had an average grain yield of 114 bushels per acre, while the check hybrid (Hughes 7105) averaged 124 bushels per acre. Relative yields of the non-check entries averaged 91% and ranged from 49 to 118 percent of the check (page 51, table 17). The highest yielding hybrid was Dekalb 57-81, produced 148 bushels per acre and 118% of the check yield. Dekalb 57-81 has performed very well at Joliet Junior College over the past two growing seasons. The check hybrid performed relatively well, as only six other hybrids produced greater relative yields.

Corn Hybrids

Table 17.

Demonstration of the grain moisture, grain yield, and relative yield of 35 corn hybrids grown at Joliet Junior College (Laraway Rd. location) in 2005. The two year average grain yield includes 2004 and 2005. The check hybrid (bold font) averaged 124 bushels per acre and was entered six times and seperated by 6 entries. The hybrid with the highest grain and relative yield is underlined, and the average yield of all hybrids is 114 bushels per acre.

Company	Nomen-clature	Transgenic Trait†	Relative Maturity	Grain Moisture	Grain Yield	Relative Yield‡	Grain Yield(2yr)
			—days—	—%—	bu/acre	—%—	bu/acre
Hughes	**7105**	**Bt-CB**	**111**	**18.7**	**116**	**100**	
Stone Seed	HC7B404	Bt-CB	111	18.3	108	93	155
Ag Venture	6705CB	Bt-CB	105	18.2	56	49	
Crows	4803	———	108	16.6	83	72	
Adler	4005	———	110	17.3	115	104	
*Great Lakes	5961BtRW	Bt-CB&RW	110	17.5	129	117	156
Stone Seed	7j522	Bt-RW, RR	109	17.7	106	96	
Hughes	**7105**	**Bt-CB**	**111**	**19.2**	**111**	**100**	
Kruger	5416	Bt-CB	114	20.2	117	106	
FS	5425	Bt-RW	107	17.9	117	105	
Hughes	7101	———	111	19.0	114	104	149
Dekalb	DK6018	Bt-CB&RW, RR	110	18.8	130	100	
Becks	5214HX1	LL	107	18.8	105	81	
Garst	8545	———	109	18.8	93	71	
Hughes	**7105**	**Bt-CB**	**111**	**19.4**	**130**	**100**	
Laser	L-9H93BT	Bt-CB	113	23.7	125	96	
Burrus	576	———	111	20.5	100	77	128
Dairyland Seed	5014	Bt-CB	112	20.4	119	91	
Pioneer	33N56	———	112	21.3	113	90	
Stone Seed	8N481	Bt-CB, RR		23.7	126	101	
Ag Venture	8210	———	112	20.7	105	84	
Hughes	**7105**	**Bt-CB**	**111**	**19.8**	**125**	**100**	
Crows	4635B	Bt-CB	109	18.8	93	74	
Adler	5010	Bt-CB	111	20.4	112	90	
Great Lakes	5522	———	105	18.8	104	83	
Kruger	5514	Bt-CB	112	18.9	122	97	
FS	6485	Bt-CB	112	20.0	117	93	
Hughes	5812	———	109	18.2	102	81	
Hughes	**7105**	**Bt-CB**	**111**	**17.1**	**126**	**100**	
<u>Dekalb</u>	<u>DK57-81</u>	<u>Bt-RW, RR</u>	<u>107</u>	<u>17.9</u>	<u>148</u>	<u>118</u>	
Becks	5222	———	108	17.4	124	99	
Garst	8488IT	———	112	20.1	115	91	
Golden Harvest	H9231	———	112	18.8	117	88	
Dekalb	DK61-45	Bt-CB, RR	111	17.9	129	97	155
Burrus	623B	Bt-CB	112	17.4	125	94	
Hughes	**7105**	**Bt-CB**	**111**	**18.6**	**133**	**100**	
Dairyland Seed	5007	Bt-CB	106	17.2	122	92	
Pioneer	35D28	———	106	17.4	102	77	
Ag Venture	783CB	Bt-CB	110	19.6	119	90	109
Hughes	5945+	Bt-CB&RW	109	18.3	103	78	
			Average	19.0	114	91.0	

† Transgenic traits are: Bt(<u>Bacillus thuringiensis)</u> insecticidal proteins with activity on European Corn Borer(CB), Corn Rootworm(RW), and herbicide tolerant corn with tolerance to glyphosate(RR) and glufosinate(LL).

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

Soybean Row Spacing and Population

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

Soybean was planted on May 4th in narrow (15 inch) and wide (30 inch) row spacings at seeding rates to obtain four target harvest populations (75, 125, 175, and 225 thousand seeds per acre) for both row spacings. Planting was accomplished with a kinze model 3000 planter using wavy colters for residue cutting in the zero-till environment. Shortly after emergence on May 19th a severe hail storm reduced plant populations by approximately 50%, a few days later it was decided not to replant the study. Weed control was accomplished with a Fall burndown that included herbicides with soil residual activity, followed by a postemerge application of glyphosate. Some weed escapes were noted late in the season for wide rows and low populations, typically even low populations have produced good weed control, however the extreme low populations from hail injury were not sufficient for good weed control.

Treatments: 8
Replications: 3
Planting Date: 4-May
Soybean Cultivar: Pioneer 92M70
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
CanopyXL@2.5ounces+Express@0.10ounces+2,4-D@1pint per acre applied Fall preplant.
RoundupWM 21oz/acre applied post-emerge(V5).
Insecticides: Nufos4E @1pt/acre on July 15th(R2) for spider mite control.

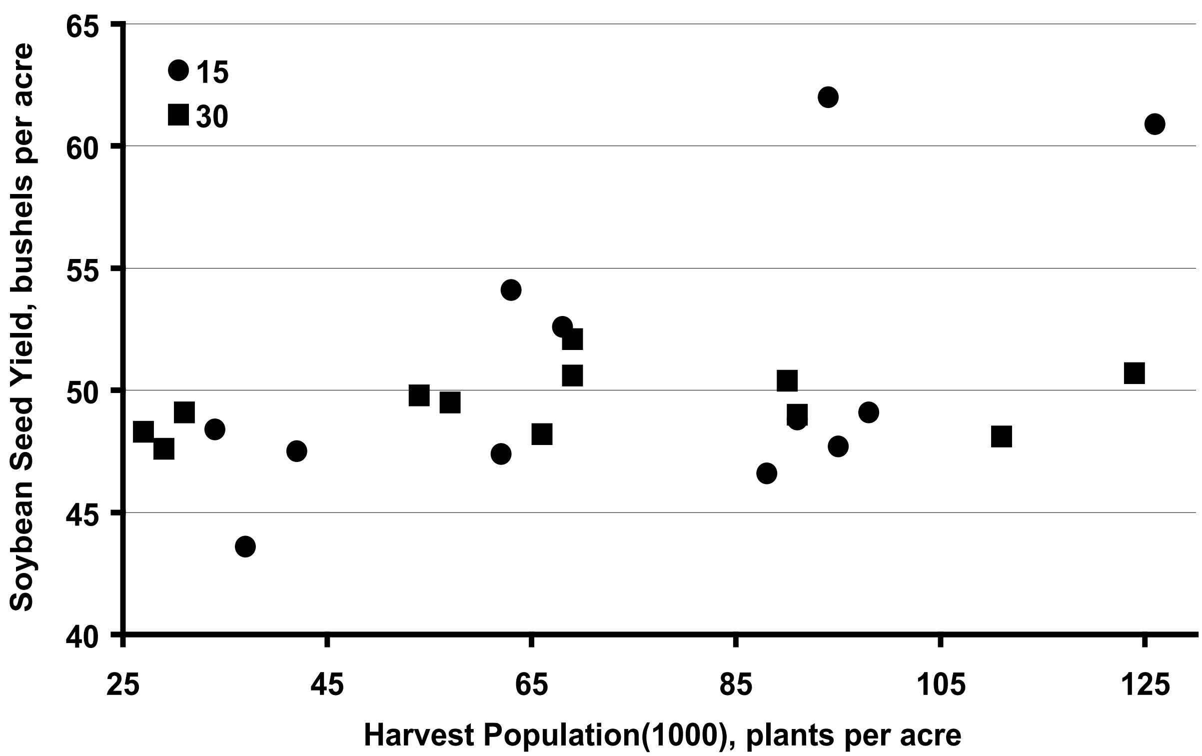
Soybean Row Spacing and Population

Results and Discussion

Soybean grown in 15 (narrow) and 30 (wide) inch row spacings responded similarly to increasing harvest populations (page 53, figure 30). No yield increase occurred for soybean with harvest populations above 25,000 plants per acre. This is quite surprising given that soybean is known to respond to populations near 150,000 plants per acre in Illinois (Nafziger, 2002a), and in 2004 yield platued near 170,000 harvestable plants per acre at Joliet Junior College. However, our results from 2002 and 2003 clearly indicate no yield improvement for populations greater than the lowest rate of 75,000 plants per acre. Our intention was for the same range in populations as the previous three years (75,000 to 225,000), however a hail storm shortly after emergence reduced populations by approximately one half. When averaged over populations narrow rows produced a numeric yield advantage of 1.2 bushels per acre, the smallest yield advantage over the past four years. The largest yield increase with narrow rows was 5.9 bushels per acre, and when the main effect of row spacing is averaged over the four years of this study, narrow rows produced a significant (P<0.05) yield increase of 3.3 bushels per acre. The narrow row yield advantage is consistent with findings of numerous soybean row spacings studies conducted throughout the North-Central U.S. (Dayton and Lowenberg-DeBoer, 2003).

Figure 30.

Influence of row spacing (15" circle, 30" square) and harvest population on soybean seed yield at Joliet Junior College in 2005.



Soybean Row Spacing and Population

Figure 22. Soybean in 30 (top) and 15 (bottom) inch rows.

Tillage & Planting Date for Soybean

Justification and Objective

With modern farm equipment, numerous tillage systems are available for successful soybean production. Tillage types range from zero to clean tillage, with varying degrees of full-width tillage (entire soil surface is tilled) that vary by amount of crop residue remaining on the soil surface after planting. Ridge and Strip tillage systems both require soybean to be planted in 30 inch rows to take advantage of tillage and drainage benefits of these within-row tillage systems. The Conservation Technology Information Center (CTIC) reports that soybean is zero-tilled on 37%, mulch-tilled on 27%, and conventionally tilled (moldboard plow) on 17% of Midwestern soybean acres (CTIC, 2004). The three tillage systems listed above represent 71% of Midwestern soybean, with much of the balance considered reduced tillage (15 to 30% residue cover after planting.

Zero-till is defined as no tillage operations prior to planting, mulch-till is full width tillage with ≥ 30% residue cover after planting, and conventional tillage or moldboard plowing having little or no crop residue on the surface after planting. On average, tillage probably has little effect on soybean seed yield, however, soil productivity (water holding capacity) has been shown to be a good indicator of wether zero or full width tillage will produce a higher yield (Hoeft et al., 2000a). Optimum soybean planting date in Illinois has been found to range over a four week period that begins in late April and ends in late May (Nafziger, 2002a). Our objective is to determine the influence of tillage on optimum soybean planting date.

Methods

Three tillage systems (Zero, Chisel/Mulch, and Plow/Conventional) and three planting dates were selected to determine optimum soybean planting date in three tillage systems. Moldboard plowing was done in the fall, followed by two shallow tillage operations with a field cultivator. Chisel plowing was performed in the Fall, followed by two shallow tillage passes with a disc in the spring. Zero-till had no tillage performed at any time, but for preplant (burndown) weed control CanopyXL, Express, and 2,4-D were fall applied. The soybean cultivar Dekalb DKB26-52 was planted in 15 inch rows at a rate of 175,000 seeds per acre over the entire experimental area on May 25th. A severe hail storm on May 19th reduced the stand by approximately 80%, thus planting date treatments were not possible. In tilled plots preplant weed control was accomplished with tillage, and Roundup WeatherMax was applied postemerge at 21oz per acre over the entire experimental area. Plant population was measured at maturity, and seed yield by machine harvest in early October.

Tillage & Planting Date for Soybean

Methods

Treatments: 3
Replications: 3
Planting Date: Replanted, May 25th.
Soybean Cultivar: Dekalb DKB26-52
Previous Crop: Corn
Tillage: Zero, Mulch, and Plow.
Soil Series: Symerton silt loam
Herbicides:
CanopyXL@2.5ounces+Express@0.10ounces+2,4-D@1pint per acre applied Fall pre-plant, for zero-till only.
RoundupWM @21 ounces per acre applied post-emerge (V2).
Insecticides: Nufos4E @1pt/acre on July 15th(R2), for spider mite control.

Results and Discussion

Tillage had no effect on soybean seed yield or harvest population, which is consistent with our findings in 2004. No planting date treatments were possible because of the severe hail damage that necessitated replanting the crop in late May. These results concerning tillage are in agreement with other Midwestern findings (Hoeft et al., 2000a).

Table 18.

Influence of tillage on the seed yield and harvest population of soybean grown at Joliet Junior College in 2005.

Tillage System	Seed Yield	Harvest Population
	bu. / ac	bu. / acre
Plow	54	114
Chisel	55	126
Zero	56	118
LSD (0.05)	N/S	N/S

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 used to determine their effect on weed efficacy and seed yield of soybean. Each treatment was replicated three times and replanted in 15 inch wide rows on May 25th with the Asgrow cultivar AG2801. The previous crop was corn and soybean was planted at a rate of 175,000 seeds per acre. The entire experimental area was zero-tilled and preplant burndown herbicides were either applied in the Fall, (CanopyXL @ 2.5oz + Express @ 0.10oz + 2,4-D @ 16oz + COC @ 1% by volume) or Spring (Roundup Weather Max @ 11oz + 2,4-D @ 16oz + COC @ 1% by volume + AM.S. @ 2% by mass) to control existing vegetation. All Roundup Weathermax applications were made at 21oz or 0.75lb acid equivalent per acre. Herbicides were broadcast with flat fan spray nozzles (XR11004) on a Hardy sprayer applying 20 gallons per acre of spray solution and 20 pounds per square inch nozzle tip pressure. The fall burndown application was made in mid November, while the spring burndown was late April.

The original planting date was 4-May, however after a hail storm reduced the stand by approximately 70%, the crop was replanted on May 25th. Weed efficacy was measured at R8 by visual assessment (% control), and the crop was harvested in early October. The crop emerged about one week after planting, was V2(post applications) on June 20th, V4 on June 30th(mid-post application), V8 on July 11th(late-post application), flowered on July 8th, and matured on September 17th.

Treatments: 7
Replications: 3
Planting Date: Replanted 25-May
Soybean Cultivar: Asgrow AG2801
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silty clay loam
Herbicides: Many
Insecticides: Nufos4E @1pt./acre applied July 15th(R2) for spider mite control.

Soybean Herbicides

Results and Discussion

All six herbicide treatments produced significantly (P<0.05) greater yield when compared to the no herbicide control. Soybean grown without herbicides produced 12 bushels per acre, indicating heavy weed pressure (page 58, table 19). For Roundup WeatherMax (glyphosate) applied post-emerge(V2) without a pre-plant "burndown" type herbicide application in our zero-till environment, significant yield losses occurred. Additionally, weed efficacy was also greatly reduced when compared to all other post applied glyphosate treatments. When compared to Dual II Magnum+Sencor weed efficacy was greater for post glyphosate without a burndown, yield however was significantly less (11bushels per acre). This large yield loss despite better weed control at maturity reflects the importance of weed control early in the growing season. Duall II Magnum+Sencor had no weed pressure early in the growing season from emergence through approximately V8, however, some broadleaf weeds emerged through the canopy mid to late season making the appearance of these plots very rough. The late-post(V8) glyphosate application on July 11th also allowed for early season weed competition for an extended period (> one month), and although it produced nine bushels more than an early glyphosate application without a burndown, it did produce significantly less yield when compared to a post(V2) application with a burndown.

These results differ from our 2004 findings, where delayed glyphosate applications and the lack of a burndown had no effect on yield. In 2003 however, when weed pressure was similar to 2005, delayed glyphosate application and early glyphosate without a burndown reduced yield. Regardless of how early season weed competition occurs, whether from no burndown or late glyphosate applications, weeds need to be controlled during the critical period that lasts roughly four to six weeks after crop emergence.

Table 19.

Influence of herbicide, herbicide application time, and burndown type on broadleaf weed (BLW) efficacy and seed yield of zero-till soybean grown at Joliet Junior College in 2005. Herbicide efficacy was evaluated at soybean maturity. Post application time is V2.

Herbicide	Timing	Burndown type	Appl. Rate§	BLW Efficacy	Seed Yield
			oz(lbs)/acre	% Control	bushels/acre
No Herbicide	——	——	——	0	12
RoundupWM	Post	None	21	78	38
RoundupWM	Post	Fall/Residual†	21	98	52
RoundupWM	Post	Spring‡	21	93	53
RoundupWM	Mid-Post(V4)	Spring	21	97	49
RoundupWM	Late-Post(V8)	Spring	21	87	47
Dual II Mag+Sencor	Pre	Spring	27 + (0.67)	62	49
LSD (0.10)	——	——	——	4	5

†Fall burndown consisted of: CanopyXL at 2.5oz./acre + Express at 0.10oz./acre+2,4-D at 1pt./acre and COC at 1% by volume applied November 2004.

‡Spring burndown consisted of: Roundup Weather Max at 11oz./acre + 2,4-D at 1pt./acre + COC at 1% by volume + AM.S. at 17lbs per 100 gallons of water applied April 30th.

§All RoundupWM (glyphosate) applications were made at 0.75lbs a.e./acre. Dual II Magnum (s-metolachlor) was applied at 1.59lbs a.i./acre. SencorDF (metribuzin) was applied at 0.50lbs a.i./acre.

Soybean Fungicidal Seed Treatment

Justification and Objective

Zero-tillage represents 37% of Midwestern soybean acres (CTIC, 2004). One reported disadvantage of zero and reduced tillage soybean is a greater propensity for seedling diseases, and thus 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* spp. (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).

Methods

A soybean seed treatment (SecureKote) and an untreated control were planted in 30-inch rows on May 5th at 150,000 seeds per acre. SecureKote contains six components, three compounds with fungicidal activity; including fludioxonil, mefenoxam, and thiram. Additionally, treated seed is also covered with the insecticidal compound thiamethoxam (Cruiser), and two micronutrients, of which the identification and rates are proprietary. The insecticide and fungicidal rates are per manufacturers recommendations. On May 19th a hail storm severely reduced plant population, because of the lack of seed to replant this study the available stand was left undisturbed. The crop flowered(R1) on July 8th and had only obtained the V5 vegetative growth stage. Although flowering had begun and much light was not being intercepted by the canopy, excessive vegetative growth and branching was noted. The R6 growth stage continued for one month until maturity(R7) on September 23rd, and the study was harvested on October 3rd.

Treatments: 2
Replications: 3
Planting Date: 5-May
Soybean Cultivar: High Cycle HG2351NRR
Previous Crop: Corn
Tillage: Zero
Soil Series: Symerton silt loam
Herbicides:
CanopyXL@2.5oz + Express@0.10oz + 2,4-D @ 1pint per acre applied preplant.
RoundupWM @21oz per acre applied postemerge(V2).
Insecticides: None in addition to the treated seed.

Soybean Fungicidal Seed Treatments

Results and Discussion

SecureKote, a fungicidal, insecticidal, and micronutrient soybean seed treatment had no effect on yield or harvest population (page 60, table 20). A fungicidal seed treatment did enhance soybean yield at Joliet Junior College in 2002 and 2003, however, no response was noted in 2004. The crop was zero-tilled, which is thought by some to increase the likelihood of a yield enhancement with fungicidal seed treatments (Pederson, 2001), yield benefit has been observed for the past two years. A relatively dry spring in 2005 may partly explain the lack of response.

Table 20.

Influence of the fungicidal, insecticidal, and micronutrient seed treatment "SecureKote" on the seed yield of soybean grown at Joliet Junior College in 2005.

Seed Treatment	Harvest Population	Seed Yield
	plants per acre	bushels/acre
Untreated	36,501	55
SecureKote†	32,667	49
LSD (0.10)	N/S	N/S

†Seed treated with three fungicides (fludioxonil, mefenoxam, and thiram), a insecticide (thiamethoxam), and >1 micronutrient.

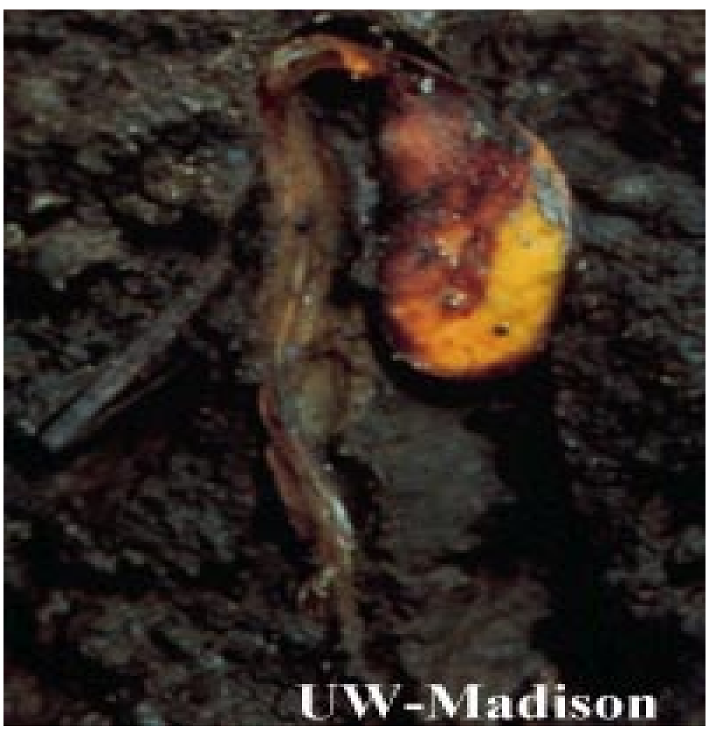


Figure 31. Damping off of soybean caused by the water mold fungus *Pythium.* This type of seedling injury can also be caused by *Phytophthora*. Injury from *Pythium* and *Phytophthora* is common when soybean is planted into cool wet environments that reduce seedling growth rates and allow greater infection of fungi.

Spider Mite Control in Soybean

Justification and Objective

Because of the extreme droughty conditions during much of the growing season in Illinois and Joliet Junior College in 2005, the two spotted spider mite became an economic pest for some soybean producers. The June 3rd issue of the *Pest Management & Crop Development Bulletin* was the start of numerous articles throughout the 2005 growing season where spider mites and their potential for causing economic damage were a topic of discussion. In late June at Joliet Junior College spider mites were easily found along with their webbing on the underside of soybean leaflets, although no visible symptoms were obvious. During the first week of July mite populations seemed to have subsided slightly, although they remained easily detectable. Heading into mid-July mites seemed to have spread relatively even over the entire farm, but no visible injury symptoms were noticeable. By July 15th mite populations were higher than at any other point during the season, and the first few visible injury symptoms were detected on a field margin. The symptoms included mottling and light chlorosis. At this time it was decided to treat some fields with a miticide, and to initiate a spider mite control study to determine if a miticide applicaiton was beneficial, and what application timing was most appropriate.

Methods

On July 15th 2005, a spider mite control study was initiated. Treatments were a no-insecticide control, and Chlorpyrifos4E applied at 1 pint per acre or 0.50lbs of chlorpyrifos per acre. Chlorpyrifos was applied at R2(July 15th), R4(August 5th), and at both R2 and R4. Only slight chlorotic discoloration was noted at either application time, although mites were readily found along with webbing. Chlorpyrifos, also known as Lorsban, was applied at 20 gallons per acre with 20psi at nozzle tip with a pull-type sprayer at four miles per hour. Plots were 30 feet wide and 380 feet long, the center 15 feet was used to determine seed yield.

Soybean was planted on May 5th at 175,000 seed per acre, the crop had emerged before a hail storm on May 19th, and as a result harvest populations were approximately 75,000 plants per acre. The crop flowered the 1st week of July, matured on September 9th, and was harvested October 3rd.

Treatments: 4
Replications: 3
Planting Date: 5-May
Soybean Cultivar: Becks 323
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
CanopyXL@2.5oz + Express@0.10oz + 2,4-D @ 1pint per acre applied preplant.
RoundupWM @21oz per acre applied post-emerge(V2).
Insecticides: Chlorpyrifos4E @1pt per acre.

Spider Mite Control in Soybean

Results and Discussion

Chlorpyrifos applications did not significantly improve soybean seed yield at any application time, or with multiple applications. Similarly, when relative chlorophyll was measured with a SPAD meter one week after the R2 treatment, chlorophyll did not improve. Numerous observations of this study were taken throughout the balance of the growing season, at no time were any visible differences noted due to chlorpyrifos treatment. Entomologists in Urbana begin a similar study earlier in the season using an additional insecticide, they observed no yield benefit with mite control treatments (Steffey, et al., 2005). Although much attention was give to the two spotted spider mite during the 2005 growing season, and presumably many acres of soybean were treated, our results indicate no advantage to having utilized a mite control tactic.

Table 21.

Influence of miticide (Chlorpyrifos 4E) application time and number on the relative chlorophyll (SPAD) and seed yield of soybean grown at Joliet Junior College in 2005.

Miticide†	SPAD	Seed Yield
	relative	bushels/acre
Untreated	46.6	45
Treated-R2	46.1	46
Treated-R4	———	41
Treated-R2+R4	———	44
LSD (0.05)	N/S	N/S

†Chlorpyrifos 4E was applied at 1pt./acre (0.50lbs a.i./acre).

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). Excess fertilizer application is a misallocation of resources and should be corrected. 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 2005 crop is the fourth 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 (50lbs/acre P_2O_5 and K_2O). 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

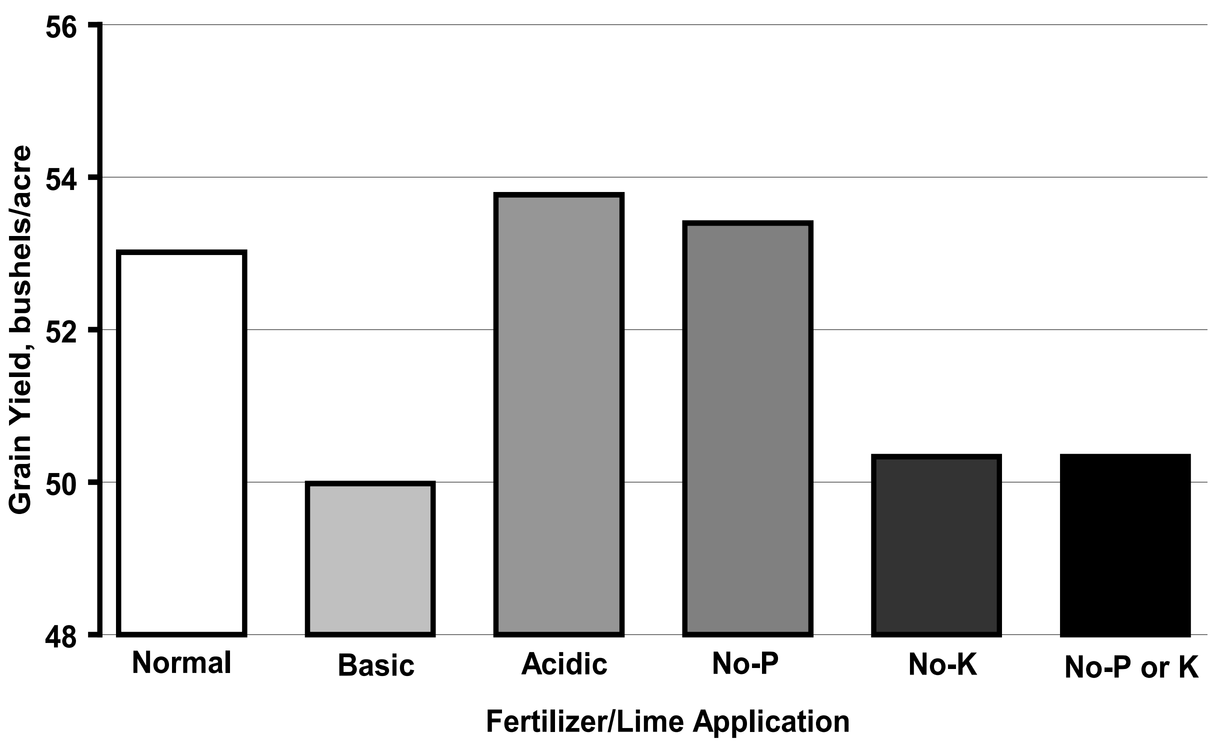
Methods

Treatments: 6
Replications: 2
Planting Date: 5-May
Cultivar: Crows 2815R
Previous Crop: Corn
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides:
CanopyXL@2.5oz + Express@0.10oz + 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 (P>0.05) were found among the six soil fertility treatments in 2005 (data not shown). Page 64, figure 32 depicts soybean yields averaged over the last three years, and no significant differences have been observed. In each of the past four years that this study has been in existence (2002-2005), yields have not differed. Treatments of this study were begun in the Fall of 2001, four crops have been produced with the current soil fertility regimes and it is thought that over time differences between treatments will occur.

Figure 32.
Influence of fertilizer and lime applications on the seed yield of soybean grown at Joliet Junior College over three years (2003 - 2005). Fertilizer/lime applications are not significantly different (alpha=0.05).



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 on May 6th and seeded at 175,000 seeds per acre in 15 inch rows. Twenty-seven cultivars were entered in this unreplicated varietal demonstration. The check variety (Becks, 323) was entered five times in the demonstration, and each entry consisted of 7 15-inch rows (8.75 feet) 380 feet in length. The check entries were separated by six varieties, as such any given variety was never more than three entries (26 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 6600 combine and yield was measured using an Ag Leader PF3000 yield monitor to estimate mass and moisture. The demonstration area was zero-tilled and weeds were controlled with a Fall applied preplant burndown followed by a postemerge application of RoundupWM. The crop was VC on May 19th when a hail storm reduced the plant population to 75,000 plants per acre. Flowering occurred on July 8th, plants were mature (R7) on September 9th, and harvested on October 2nd.

Number of entries: 27
Replications: None
Planting Date: 6-May
Soybean Cultivar: Many
Previous Crop: Corn
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides:
  CanopyXL@2.5ounces+Express@0.10ounces+2,4-D@1pint per acre applied Fall preplant.
  RoundupWM @ 21 ounces per acre applied postemerge.
Insecticides: None

Soybean Varieties

Results and Discussion

Soybean yield ranged 26 bushels per acre, the maximum was 47 and minimum 21 with an average of 37 bushels per acre. The highest yielding cultivar (LG C2777NRR) produced a relative yield of 134%, while the cultivar with the highest two year average (LG C2844NRR) produced 49 bushels per acre. The average yield of 37 bushels per acre is one bushel less than the five year moving average. The check variety Becks 323 averaged 36 bushels per acre and was entered five times. The check was separated by six entries, so the relative yield of a given cultivar was determined by a check not more than three entries away (26 feet).

Table 22.

Demonstration of the grain moisture, grain yield, and relative yield of 27 soybean varieties grown at Joliet Junior College in 2005. The two year average grain yield includes 2004 and 2005.

Company	Nomen-clature	Grain Moisture	Grain Yield	Relative Yield‡	Grain Yield(2yr)
		—%—	bu/acre	—%—	bu/acre
Pioneer	92M70	10.3	36	92	44
Dairyland Seed	DSR2800RR	10.3	44	113	
High Cycle	HC2351NRR	10.4	31	79	
Becks	**323**	**10.4**	**39**	**100**	**47**
Crows	C2815R	10.3	44	113	
LG	C2844NRR	10.5	43	110	49
Ag Venture	AV32T3NRR	10.4	40	103	
Becks	297NRR	10.5	43	110	
Asgrow	AG2403	10.2	41	105	
Asgrow	AG2801	10.4	42	108	48
Becks	**323**	**10.8**	**39**	**100**	**47**
Asgrow	AG3101	10.5	44	113	
kruger	355RR	10.6	41	105	
kruger	341RR	10.7	39	100	
LG	C2777NRR	10.6	47	134	
LG	C2227NRR	10.4	42	120	
Adler	296NRR	10.5	31	89	
Becks	**323**	**10.6**	**35**	**100**	**47**
Adler	292NRR	10.4	38	109	
Golden Harvest	H-2448RR	10.2	28	80	
Golden Harvest	H-2712RRTR	10.3	27	77	
Great Lakes	GL2705RR	9.7	26	68	38
Great Lakes	GL3119RR	10.2	36	95	
Crows	C3015R	10.3	45	118	
Becks	**323**	**10.4**	**38**	**100**	**47**
Crows	C3142R	10.6	37	97	
Ag Venture	AV28J6NRR	10.5	39	103	
Pioneer	92M91	10.1	31	103	
Dairyland Seed	DSR3002RR	10.4	21	70	
Dairyland Seed	DSR326RR	10.3	25	83	37
Becks	**323**	**10.7**	**30**	**100**	**47**
	Average	10.4	37	100	

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

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