Joliet Junior College
Demonstration & Research Guide
2006

Find out how your cropping management decisions impact yield

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 2006. 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 Jacob Winans with Stone Seed Co. for assisting in the planting of our corn hybrid demonstration, Lucia Douglas for fall help, and Andy Rousonelos for his invaluable assistance during much of the growing season. Matt Foes 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. Additionally, the Tordai's volunteered thier time, a combine, grain cart, and semi's for an entire day to help harvest our corn hybrid demonstration and the remaining acrage at our Laraway Road facility. Our field day speakers were; Allen Becker, Russel Higgins, Dawn Nordby, 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 2006.

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

Contributors

Table 2.

List of people and companies they represent that donated seed to Joliet Junior College in 2006.		
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
Lagger	Scott	Wyffels
Lauderman	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	Garst
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	
Thumma	Todd	Garst
Tordai	Dan	
Venters	Allan	Garst
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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Scott Keller - Veterinary Technology
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Karen Magno - Veterinary Technology secretary
Eileen McKee - Veterinary Technology
Fredric Miller - Nursery Management
Tammy Miller - Soils / Fertilizers
Roxanne Olson - Veterinary Technology
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.

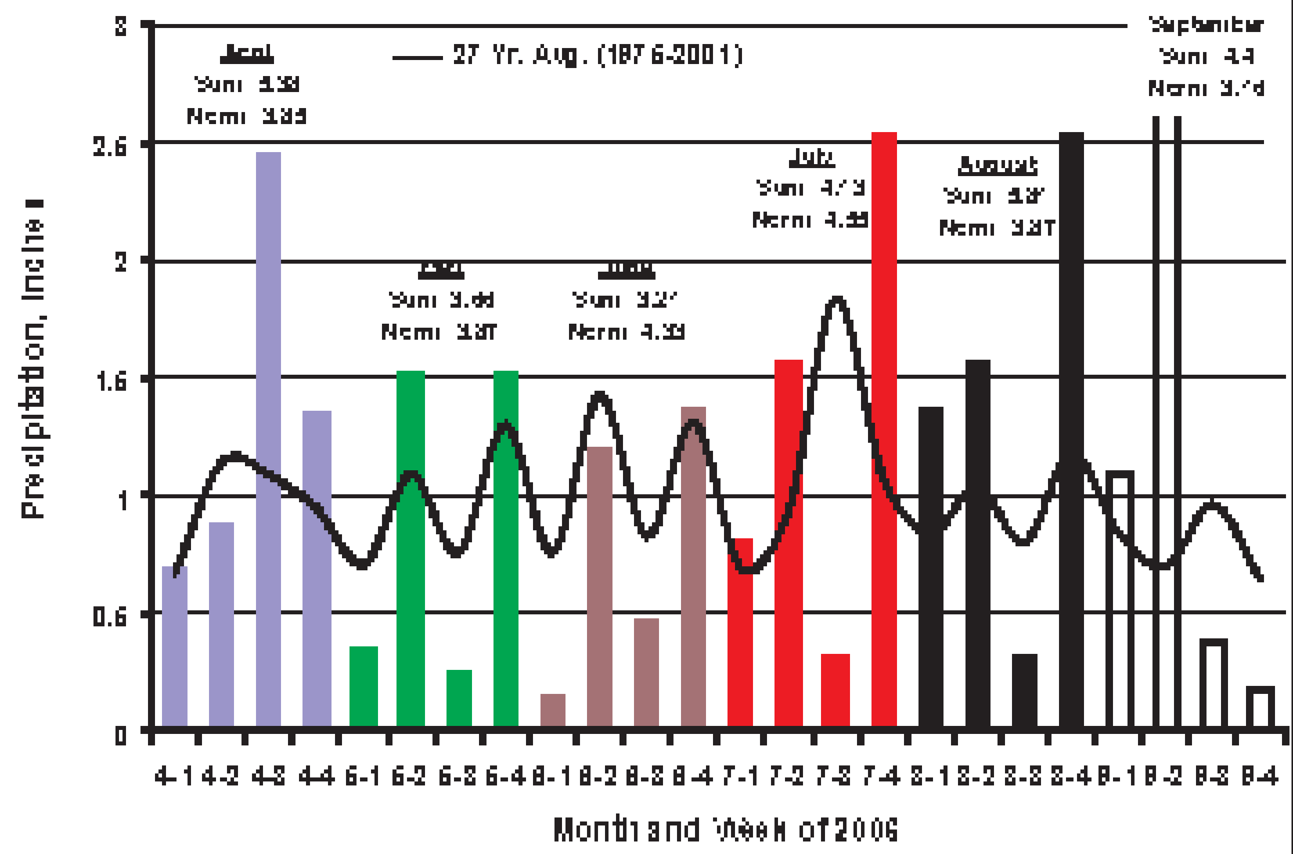
The Demonstration and Research Farm consists of 108 cropped acres with 61 acres of corn and 47 of soybean in 2006. Fifteen agronomic studies and two demonstrations were implemented, they included the evaluation of corn and soybean herbicides and insecticides, tillage systems, row spacing and plant populations, and planting dates in both corn and soybean. Nitrogen(N) fertilizer rates and corn root protection were among other replicated studies. Demonstrations (unreplicated) of corn and soybean varieties were also included in our work during 2006.

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 167 and 49 bushels per acre respectively.

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 2005 where soybean was to be planted in 2006 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 + COC @1% by volume, 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 HarnessXtra followed by RoundupWM or Callisto, or by postemerge applications of SteadfastATZ+Callisto. Weed control for soybean, in addition to the Fall burndown, was accomplished with a V4 application 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 April12th through April 28th. Soybean was seeded at a rate of 175,000 seeds per acre in 15-inch rows, and 150,000 seeds per acre in 30-inch rows. Most soybean was planted the second week of May. Soy-bean was harvested the last ten days of October, and most corn during mid month. The average corn yield was 174 bushels per acre, while soybean averaged 54. Both crop yields produced the second highest for the JJC Demonstration and Research Farm, corn was surpassed only by 2003, and soybean 1998.

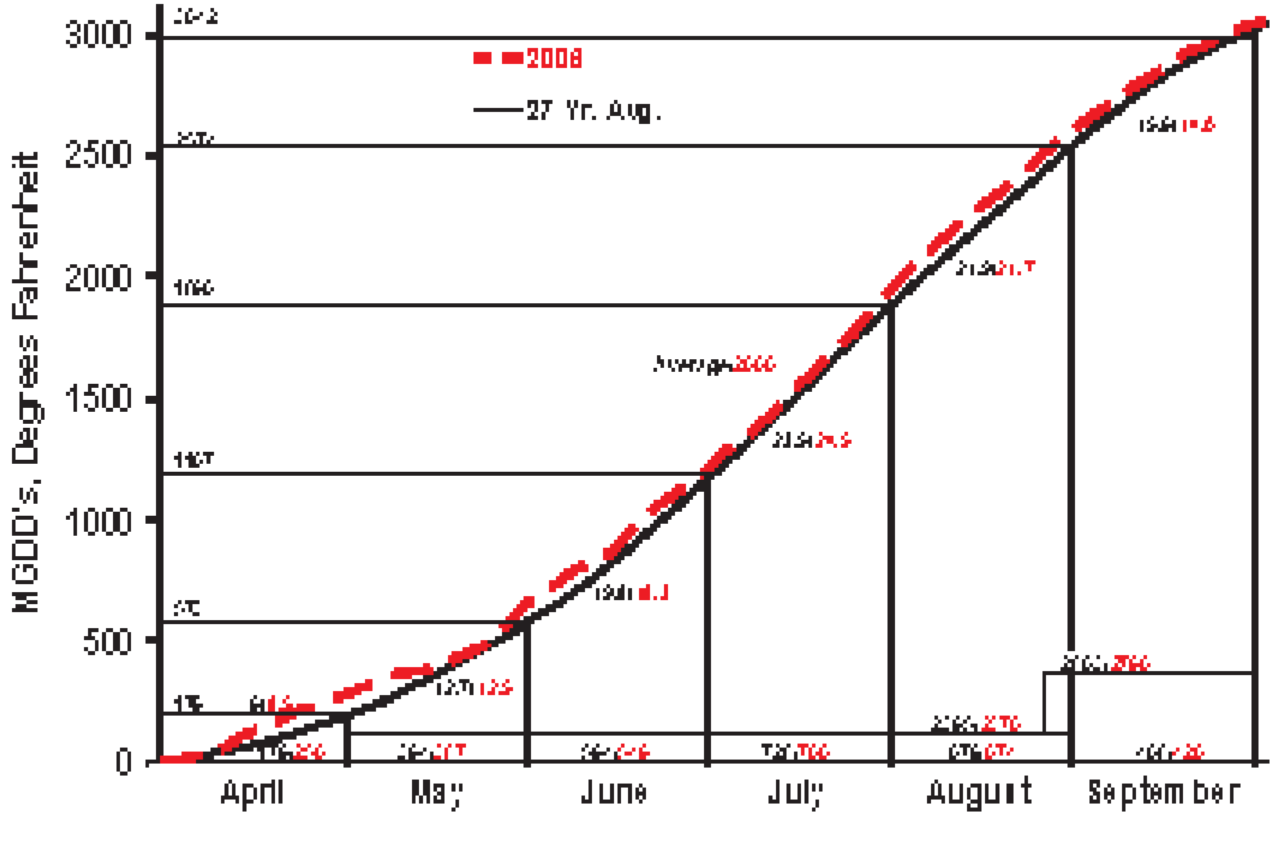


Weekly precipitation at Joliet Junior College in 2006 for April through September (bars) and a 27 year average (solid line). A 27-year average (1975-2001) is 23.62 inches, in 2006 27.72 inches of precipitation fell.

Introduction

Figure 2.

Accumulation of modified growing degree days (MGDD's) at Joliet Junior College for April-September of 2008 (dashed curve) and a 27 year average. Historically 2395 MGDD's are accumulated from May through August in 2008 there were 2370.



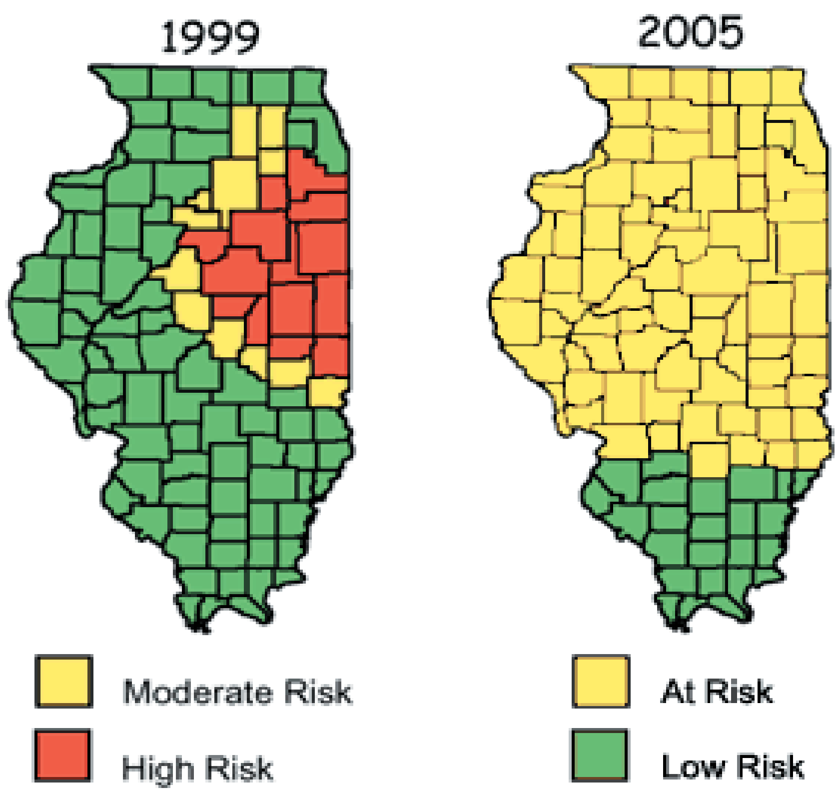
Pictured to the left is Andy Rousonelos, a JJC Ag student who worked long hours, donating most of his time, on the Farm throughout the growing season

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 8, 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, three Bacillus thuringiensis (Bt) transgenic corn hybrids with activity on corn rootworm larvae (BtRW), and an untreated control were evaluated for their impact on corn root injury, lodging, and grain yield. Of the three BtRW hybrids, two were YieldGard RW (YGRW) producing the Cry3Bb1 protein, and one was Herculex RW (HXRW) producing the dual proteins Cry34Ab1 and Cry35Ab1. The HXRW hybrid was Pioneer 35Y61, and one of the two YGRW hybrids (Dekalb DKC57-79) (YGRW/2) was also evaluated in 2005. The YGRW hybrid Trelay 6K808 (YGRW/1) was also evaluated, along with it's non-YGRW isoline Trelay 6N433 used for all four granular insecticides, a seed treatment insecticide, and the untreated control. The product rate of granular insecticides was (oz per 1000ft. of row); Lorsban15G (8), Fortress2.5G (7.35), Force3G (4), and Aztec2.1G (6.7). The seed treatment insecticide Poncho 1250 was applied at 1.25mg active ingredient (clothianidin) per kernel. All four hybrids were; either 106 or 107 day relative maturity, protected from European Corn Borer (ECB) with Bt, and roundup ready. Each treatment was replicated three times and the entire study planted on April 24th. The previous crop was late planted corn (trap crop), the tillage system was mulch which included fall chisel plowing and spring discing. 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 17th (R1) five plants were randomly selected from each experimental unit, roots dug, washed with a high pressure washer, and rated for injury using the 0 to 3 scale. Lodging counts were recorded after physiological maturity on September 19th. The crop was harvested on October 13th with a grain moisture of approximately 17%.

Treatments: 9
Replications: 3
Planting Date: 24- April

Hybrid-1: Trelay 6N433 (YGCB/RR)
Hybrid-2: Trelay 6K808 (YG+/RR)
Hybrid-3: Deklalb DKC57-79 (YG+/RR)
Hybrid-4: Pioneer 35Y61 (HXX/LL/RR)

Previous Crop: Late planted (June) Corn
Tillage: Mulch (fall chisel & spring discing)
Soil Series: Will silty clay loam
Herbicides: Harness Xtra @ 60oz per acre applied preemerge.
Roundup WeatherMax @21oz/acre applied post-emerge (V5).
Insecticides: Many

Corn Rootworm Larval Control Product Performance

Results and Discussion

In 2006 severe corn rootworm (CRW) larval injury (2.83, 0 to 3 scale) to corn roots occurred in the untreated control (page 11, figure 4), with approximately 94% of roots destroyed. Additionally, the very high level of potential root injury created large differences in root ratings, lodging, and grain yields among CRW larval control products. All control products significantly (P< 0.10) reduced root injury (page 11, figure 4) and lodging (page 13, figure 6), with the exception of the seed treatment insecticide Poncho 1250 (P. 1250). Similarly, all CRW control products significantly (LSD(0.10) increased yield relative to the untreated control, except P. 1250. The two granular insecticides Lorsban and Fortress produced an identical yield (132 bushels per acre), but significantly (P< 0.10) less than Force and Aztec, and the transgenic control products. Force and Aztec however, produced yields similar to the transgenic CRW control product YGRW/1. This is an appropriate comparison given that the hybrid (Trelay 6N433, YGCB/RR) used for all insecticides and the untreated control is an isoline of (Trelay 6NK808, YG+/RR) YGRW/1. It is somewhat surprising that Force had a similar yield to Aztec and YGRW/1, as it's root injury is significantly greater than either Aztec or YGRW/1, and equal to Lorsban and Fortress. A second (YGRW/2) hybrid was also evaluated (Dekalb DKC57-79, YG+/RR), which produced a relatively low root injury rating, and the numerically highest grain yield. Finally, a Pioneer brand corn hybrid (35Y61, HXX/RR) with binary Bt proteins for control of CRW larvae was also evaluated. 2006 was the first year of commercialization for the Herculex root protection technology, and despite the extreme conditions under which this product was evaluated, it performed very well. The HXRW treatment produced the numerically lowest root injury rating of the seven products evaluated, and significantly (P< 0.10) less than all other products except YGRW/2.

Lodging varied the least among the CRW larval control products (page x, figure 6), with only the untreated control and P. 1250 having nearly all plants lodged, and the balance of treatments ranging from 10 to 50% lodged. Figure 7 on page 13 depicts yield loss with increasing root injury for the 2006 growing season. Only data for the hybrid Trelay 6K808 YG+/RR, or it's isoline 6N433 YGCB/RR was used. Much greater yield loss occurs with increasing root injury when compared to 2004 and 2005, although maximum yields are some 80 to 60 bushels per acre greater than 2004 and 2005 respectively (data not shown). For a year with similar maximum yield (2003) depicted in figure 8, yield loss can be seen to follow a curvilinear shape, where little loss occurs with ratings < 1.5. In 2006, root injury ratings <1.5 did not occur, and so it is not surprising that given the range of root injury, the relationship is linear. Table 5 on page 14 depicts root ratings for the past five years (2002-2006) of several control products. Only three of the seven products listed have been included each year, and two of the three (Aztec and Force) had their poorest performance in 2006. Both Aztec and Force have generally maintained root injury ratings at or below about 1.1, a level considered to be an economic injury threshold (Oleson et al., 2005). In 2006 this threshold was surpassed by not only Aztec and Force, but all control products except the HxRW treatment.

Corn Rootworm Larval Control Product Performance

The high injury ratings are particularly surprising for the YGRW treatment, which historically has been consistent, and provided excellent root protection (page 14, table 5). The level of root injury sustained on YGRW raises some interesting questions. Some have speculated full blown resistance, while the more logical explanations seem to include a low dose event, that produces the toxic protein (Cry3Bb1) in root tissue at concentrations less than that required to kill 50% of CRW larvae, and that the protein concentration declines at later growth stages (Vaughn et al., 2005). Additional speculations include; early planting dates, differences in the protein toxin expression among hybrids, hybrids with poor root architecture do not “fit” well for root protection with transgenic technology, and soil nitrogen levels influence the production of the toxic protein (Gray et al., 2006). Many of these seem to be likely scenarios for which moderate to heavy injury to YGRW corn could occur, and the possibility seems even more likely with some combination of the scenarios. Still, we have observed good to excellent protection of roots with YGRW for the previous three years, and with nearly identical management practices as 2006. Our YGRW hybrid has changed every year, although one YGRW hybrid has been constant in both 2005 and 2006 (DKC57-79), and injury increased from 0.20 to 1.10 for 2005 to 2006 respectively. Although it is somewhat reassuring to note a large increase in injury with Aztec and Force in 2006 compared to the previous three years, but the magnitude of this increase is far less than that observed with YGRW.

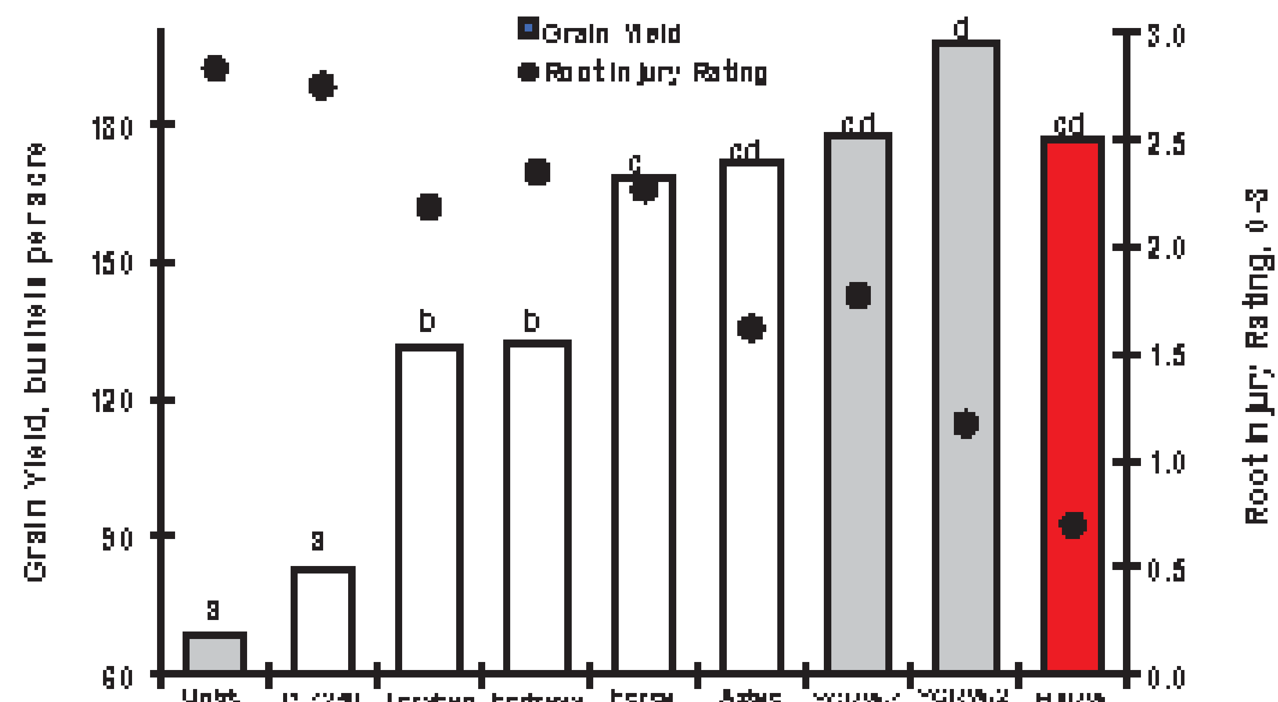


Figure 4.

Influence of corn rootworm (CRW) larval control products on the grain yield and root injury ratings (0-3 scale) of corn grown after late planted corn (trap crop) at Joliet Junior College in 2006. The hybrid was [illegible] YGCB/RR for all four granular insecticides, Poncho 1250 (P 1250), and the untreated control (Untrt). The YGRW [illegible] was seeded for treatment YGRW1, while a second YGRW hybrid (Dekalb DKC57-79) was also evaluated (YGRW2). Additionally, the Pioneer hybrid [illegible] HX/RR utilizing Herculex RW technology (HXRW) was included. Columns followed by the same letter are not significantly different [illegible].

Corn Rootworm Larval Control Product Performance

Table 4. 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)

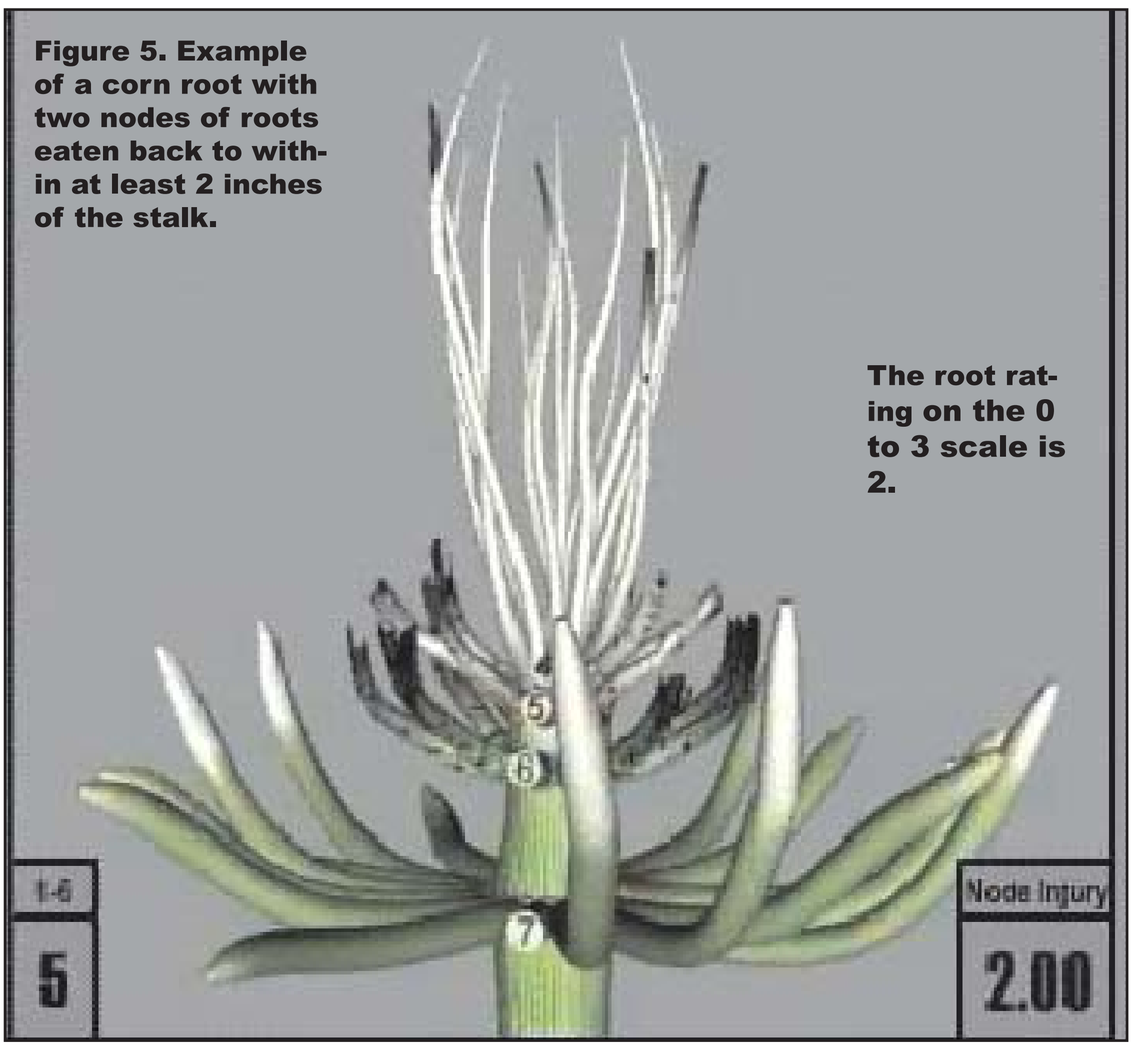
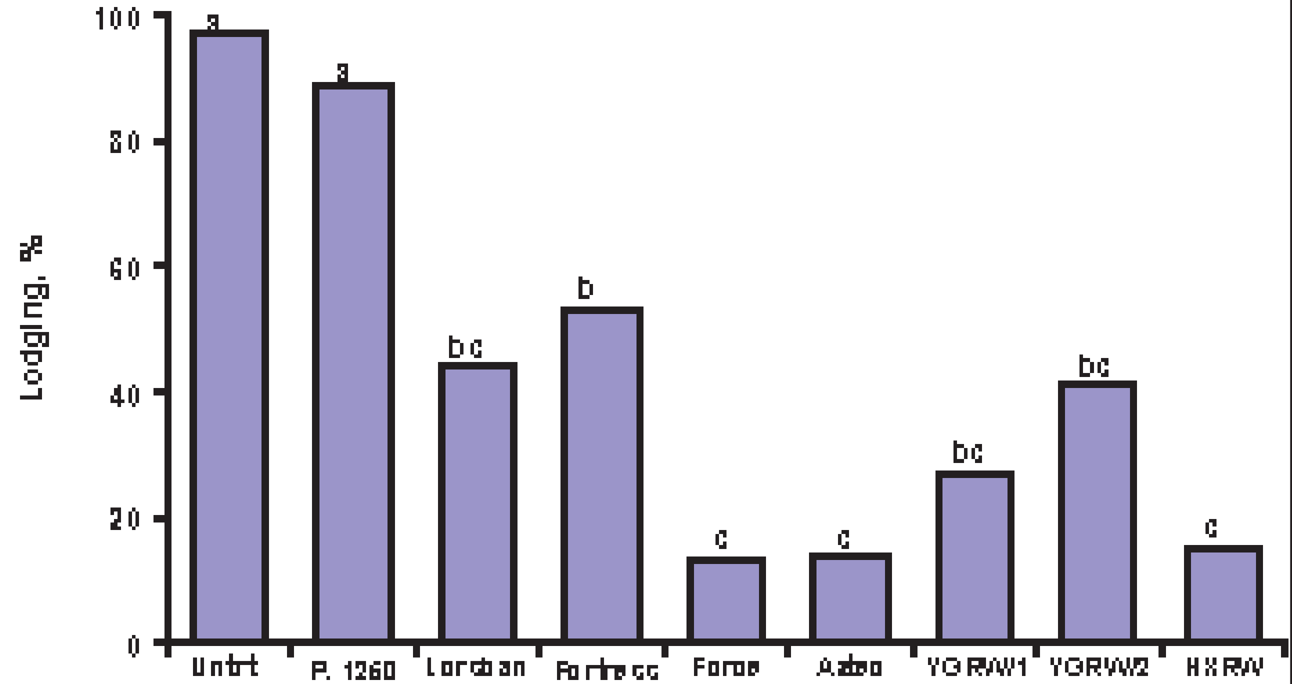


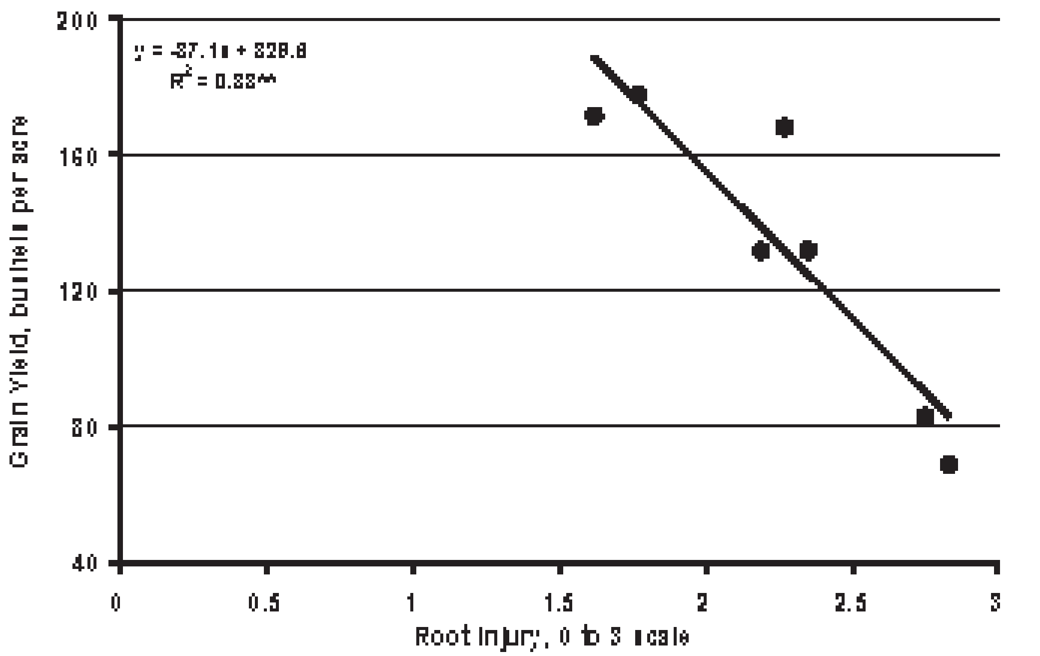
Figure 5. Example of a corn root with two nodes of roots eaten back to within at least 2 inches of the stalk.

The root rating on the 0 to 3 scale is 2.

Corn Rootworm Larval Control Product Performance

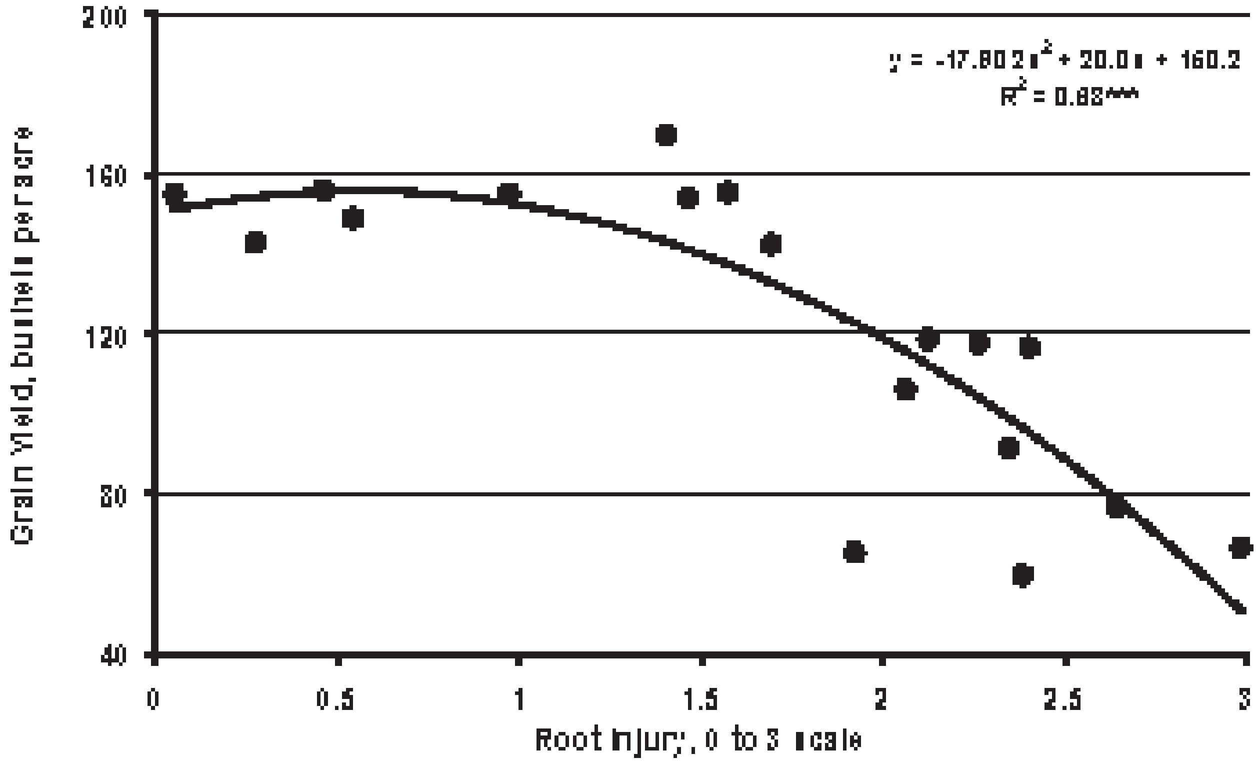


Influence of corn rootworm (CRW) larval control products on lodging of corn grown after late planted corn (trap crop) at Joliet Junior College in 2008. The hybrid was [illegible] for all four granular insecticides, Poncho 1250 (P. 1250), and the untreated control (Untrt). The YGRW [illegible] was seeded for treatment YGRW1, while a second YGRW hybrid [illegible] was also evaluated (YGRW2). Additionally, the Pioneer hybrid [illegible] utilizing Herculex RW technology (HXRW) was included. Columns followed by the same letter are not significantly different [illegible].



Influence of corn rootworm larval root injury (0-3 node-injury scale) on the grain yield of corn grown at Joliet Junior College in 2008.

Corn Rootworm Larval Control Product Performance



Influence of corn rootworm larval root injury (0-3 node-injury scale) on the grain yield of corn grown at Joliet Junior College in 2003.

Table 5

Root injury ratings (0 to 3, node-injury scale) of corn for the evaluation of corn rootworm larval control products over five years at Joliet Junior College. The previous crop was late planted corn (trap crop).

Corn Rootworm	Year of Root Rating				
Control Product	2002	2003	2004	2005	2006
	——————0 to 3†——————				
Untreated	2.4	2.4	2.7	2.6	2.8
Aztec2.1G	0.3	1.2	1.0	1.0	1.6
Force3G	0.3	1.1	1.1	0.7	2.3
Fortress2.5G	——	——	2.1	0.9	2.4
Lorsban15G	2.7	2.3	2.8	1.3	2.2
Poncho1250	——	——	1.6	1.3	2.8
YGRW	——	0.3	0.6	0.3	1.8
HxRW	——	——	——	——	0.7
LSD(0.10)	0.5	0.5	0.4	0.6	0.5

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

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

Seven 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 12th with the Dekalb hybrid 57-79 (YG+/RR). 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 a preemerge burndown herbicide application of RoundupWM @11oz + 2,4-D @16oz per acre was applied on April 21st. Additionally, all preemerge treatments were also applied on April 21st. The crop emerged on April 24th, V2 postemerge applications were performed on May 9th, V6 applications on May 30th, and V8 on June 9th. The crop flowered on July 10th, was physiologically mature on August 30th, and harvested on October 18th with grain moisture approximately 16%. Weed control was visually assessed on October 5th. All glyphosate (Roundup) applications were made using Roundup WeatherMax (RoundupWM) applied at 21oz per acre with 17lbs per 100 gallons of solution ammonium sulfate. SteadfastATZ+Callisto was applied with ammonium sulfate at the same concentration as with RoundupWM,and crop oil concentrate (COC) was also added to the tank mix at 1% by volume (v/v). 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.

Treatments: 8	Tillage: Zero-Till
Soil Series: Warsaw, Sil	Previous Crop: Soybean
Herbicides: Many	Hybrid: Dekalb 57-81(YG+/RR)
Insecticides: None	Planting Date: 12-April
Silking (R1) date: 10-July	Replications: 3

Corn Herbicides

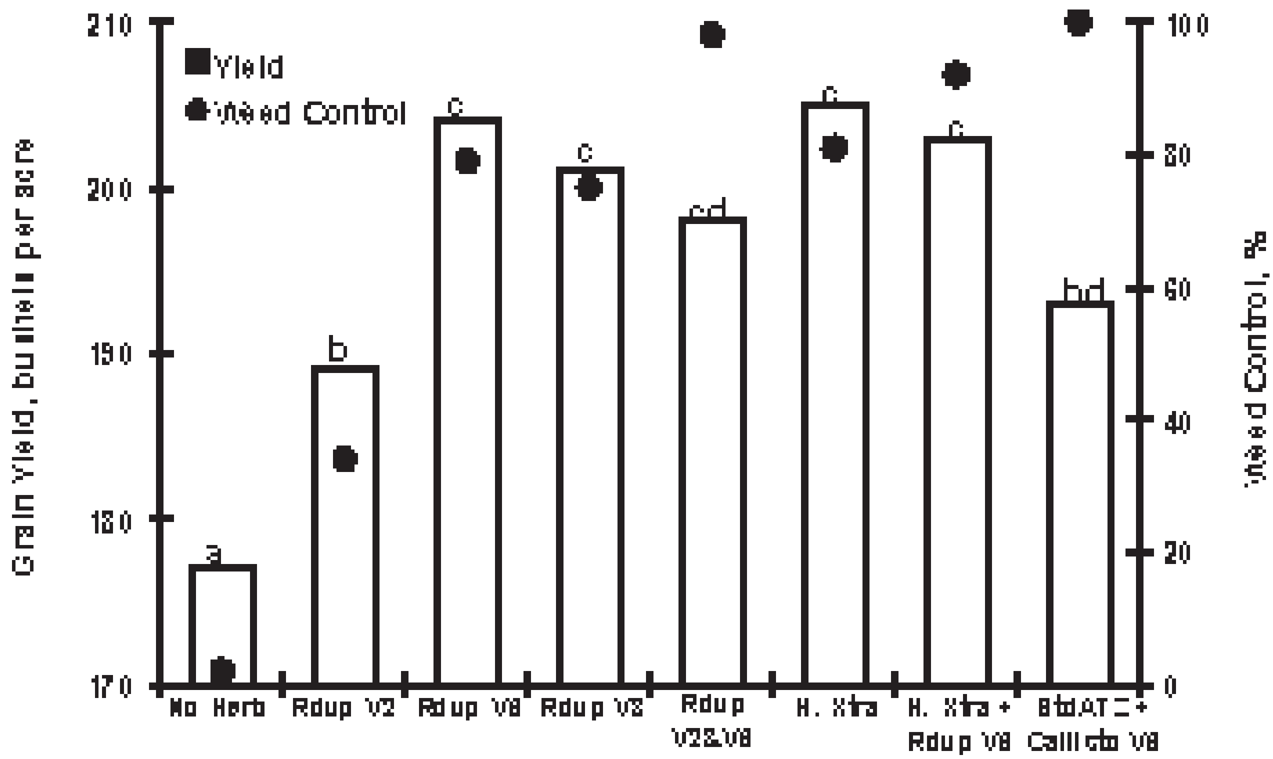
Results and Discussion

All seven herbicide treatments significantly (alpha= 0.10) increased weed control compared to the no-herbicide control (page 17, figure 10). However, Roundup applied at V2 (Rdup V2) provided only 34% control, probably not an acceptable level for most producers. When Roundup application was delayed to V6 or V8 however, a reasonably high percentage (75-79) of weeds were controlled. Similar to weed control, grain yield increased significantly (LSD(0.10)) with the two delayed single applications of Roundup, when compared to the single early application (V2). This observation is in contrast to that of many others (Wood et al., 1996), where typically sizable yield loss occurs with a delay in weed removal such as V2 to V6, and especially a delay to V8 (Gower et al., 2003). In 2005 we also noted no yield loss when application was delayed from V4 to V9, although yield was not improved with the delay. In 2004 however, a delay in Roundup application to V7 decreased yield. Making two applications of Roundup (V2+V6) significantly increased weed control when compared to the average of the V6 and V8 applications, and control was near perfect (98%). Interestingly, the added application of Roundup did not have any positive impact on grain yield, suggesting the approximately 77% control with a V6 or V8 application is sufficient to maximize grain yield. The moderate yield level for the twin post application further reinforces that yield reducing early-season weed competition did not occur at this location.

Both treatments with Harness Xtra (H. Xtra) produced equal weed control and grain yield. This is not too surprising, as a single preemerge treatment of Harness Xtra has normally (2003-2005) produced adequate weed control, and relatively high yields at Joliet Junior College. SteadfastATZ (StdATZ) continued to provide perfect weed control, as has been noted for the past two years at Joliet Junior College. Although SteadfastATZ yielded slightly less than some of the higher yielding treatments, which has not been observed previously, it produced a statistically (LSD(0.10)) similar yield to the twin Roundup treatment.

As we have noted for the past three years, most herbicide systems provide adequate weed control and grain yield. Producers should therefore focus on cost, and ensure appropriate rates and application times are followed as suggested by manufacturers. While we have observed some yield loss due to delayed Roundup application (2004), we have also seen no impact of herbicide application time (2005), and in 2006, noted a substantial yield increase associated with delayed application. Our 2006 findings do not suggest that producers purposely delay weed removal time to V8, as yield loss can occur (Wood et al., 1996; Gower et al., 2003), but that very early Roundup applications made without residual herbicides in the program will often produce poor weed control, and sometimes yield loss.

Corn Herbicides



Influence of seven corn herbicide systems and a no-herbicide control on the grain yield and weed control of corn grown at Joliet Junior College in 2006. Weed control represents the average of broadleaf and grassy weed species. Columns followed by the same letter are not significantly different (0.10). The LSD(0.1) for weed control is 20%. Abbreviations: Rdup= Roundup WeatherMax, H. Xtra= Harness Xtra, StdATZ= SteadfastATZ.

Table 6.

Herbicide trade names, active ingredient, and application rate of eight corn herbicide systems evaluated at Joliet Junior College in 2006. Symbols "&" signifies active ingredients combined in a pre-mix, while a "+" indicates a herbicide added to the current tank mix. ";" is used to separate herbicides applied at different times.

Herbicide Trade Name	Active Ingredient	Application Rate	
		[illegible] / acre	[illegible] / acre
No Herbicide	—	—	—
Rdup†	Glyphosate	[illegible]	[illegible]
Rdup	Glyphosate	[illegible]	[illegible]
Rdup	Glyphosate	[illegible]	[illegible]
Rdup; Rdup	Glyphosate; Glyphosate	[illegible]	[illegible]
Harness Xtra	Acetochlor & Atrazine	[illegible]	[illegible]
Harness Xtra; Rdup	Acetochlor & Atrazine; Glyphosate	[illegible]	[illegible]
StdATZ + Callisto	[illegible]	[illegible]	[illegible]

† Abbreviations; Rdup= Roundup WeatherMax, H. Xtra= Harness Xtra, StdATZ= SteadfastATZ.

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 10th, April 26th, and May 21st. The corn hybrid Burrus 644RWR was seeded at 32,000 seeds per acre. Weed control was achieved with preplant tillage and HarnessXtra @30oz per acre applied preemerge for tilled plots, and 2,4-D, Basis, and Atrazine @16, 0.50, and 32 oz per acre respectively 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. The late April planted crop flowered on July 17th, and the entire experiment harvested on October 18th.

Treatments: 9 (3 tillage systems and 3 planting dates).
Replications: 3
Planting Date: April 10th, April 26th, and May 21st.
Hybrid: Burrus 644RWR
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.
  HarnessXtra@ 30oz/acre applied preemerge in mulch-till only.
  RoundupWM@ 21 ounces per acre applied postemerge (V3).
Insecticides: None

Tillage & Planting Dates for Corn

Results and Discussion

Relatively high grain yields (>190 bushels per acre) were achieved for all tillage systems and planting dates in 2006 (page 20, figure 11). Although there was no significant interaction (P< 0.10) between tillage systems for changing planting dates on corn grain yield, planting date had no significant (P< 0.10) effect on zero-till corn yield, while both strip and mulch tillage systems lost 20 and 15 bushels per acre respectively. The yield decrease with strip and mulch tillage when planting was delayed from early to late April is consistent with our findings in 2004, but contrasts our 2005 results. Early spring temperatures were above normal in 2004 and 2006, however in 2005 when early April planting reduced yield, spring temperatures were cool and multiple frosts occurred after the emergence of early planted corn. All three tillage systems produced similar yields at the late April planting date, however, when planting in early April strip and mulch tillage produced significantly greater yield compared to zero-till. This is an expected result, as the soil warming effect associated with tillage would be expected to improve yield under relatively cool environments. Unexpectedly however, is the reduced yield of zero-till compared to either strip or mulch tillage when planting in late May. Although harvest populations did tend to increase with increasing tillage for late May planted corn, the differences are small and not significant (page 19, table 7). Additionally, populations for all tillage systems are relatively high for May planted corn, and as such a rather large change in population would be necessary for a yield decrease. Furthermore, zero-till had a significantly lower harvest population compared to strip and mulch tillage for the late April planting date, however yields were similar for the three tillage systems.

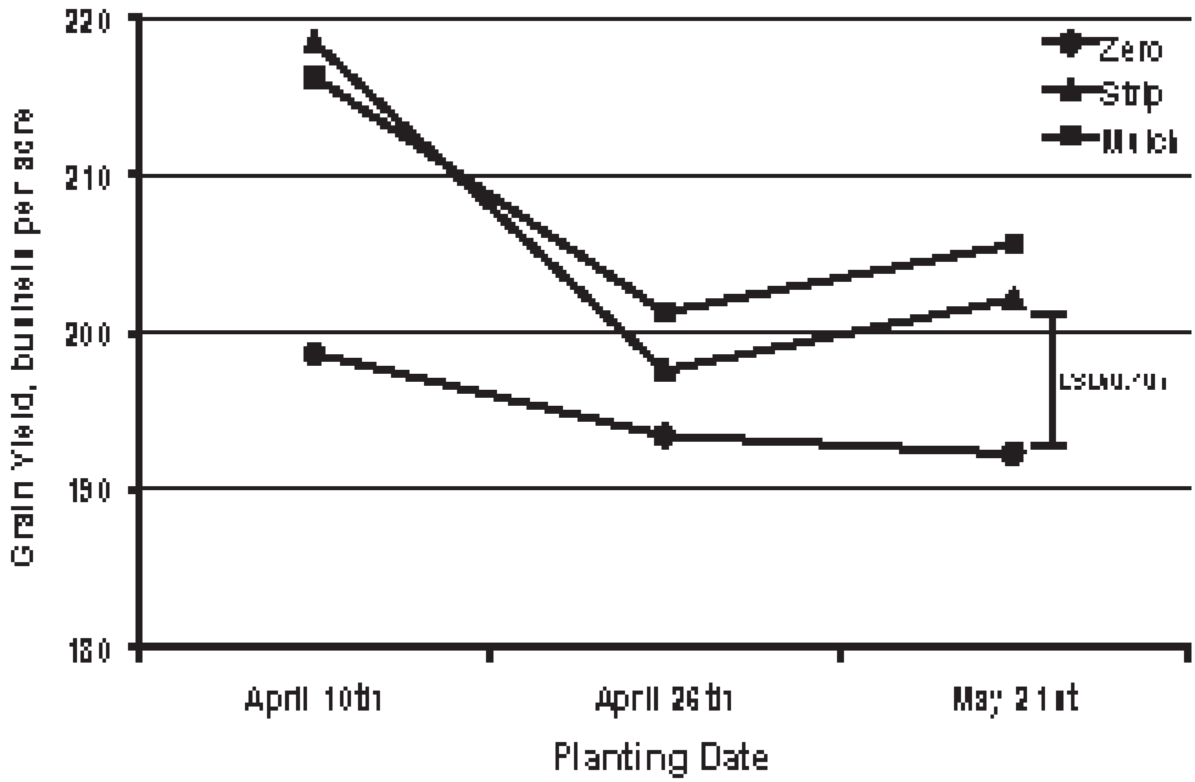
Table 7.

Influence of tillage and planting date on the harvest population of corn grown at Joliet Junior College in 2006. LSD is for seperating populations within a tillage system.

Planting Date	Tillage: Zero	Strip	Mulch
	——Harvest Population——		
	————plants per acre————		
April 10th	29110ab†	29780a	26220b
April 26th	24720a	28330b	28280b
May 21st	29280a	29610a	30560a
LSD(0.10)	2,297	N/S	2,297

† Plant populations within a planting date and followed by the same letter are not significantly different (alpha= 0.10).

Tillage & Planting Dates for Corn



Influence of planting date (April 10th and 26th, and May 21st) and tillage system (Zero, Strip, and Mulch) on the grain yield of corn grown at Joliet Junior College in 2006. The LSD ([illegible]) bushels per acre can be used for comparing yields between tillage systems for a given planting date, or between planting dates within a given tillage system.

Table 8

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 2006. 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	209	28,353	April 10th	211	28,370
Strip	206	29,240	April 26th	197	27,110
Zero	195	27,703	May 21st	200	29,817
LSD (0.10)	7	N/S	LSD (0.10)	5	1,325

June 20th

Figure 12. Corn planted on April 26th (center of photo) and photographed on June 20th, 2006 was at the V9 growth stage. April 10th planted corn (upper left) was V11, while May 21st planting (upper right) was V6.

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 22nd with a KINZE model 3000 pull-type planter. The planter was equipped 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% of seed. A YGRW 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. Weed control was achieved by a preplant combination of herbicides for burndown and residual weed control, and followed by a pre-emerge application of HarnessXtra. Both 15 and 30 inch row spacings were harvested with a 30-inch row spacing corn head. Random counts of ear drop were made in both row spacings after harvest to determine the effect harvesting had on grain loss, few differences were noted.

Corn Row Spacing and Population

Methods
Treatments: 10 (2-row spacings and 5-seeding rates)
Replications: 4
Planting Date: 22 April
Hybrid: Crows 6W866(Bt-RW) 109-day
Previous Crop: Soybean
Tillage: None
Soil Series: Warsaw silt loam
Herbicides:
Basis @0.50oz + Atrazine @32oz + 2,4-D @16oz per acre applied preplant.
HarnessXtra @ 60oz per acre applied preemerge.
Insecticides: None

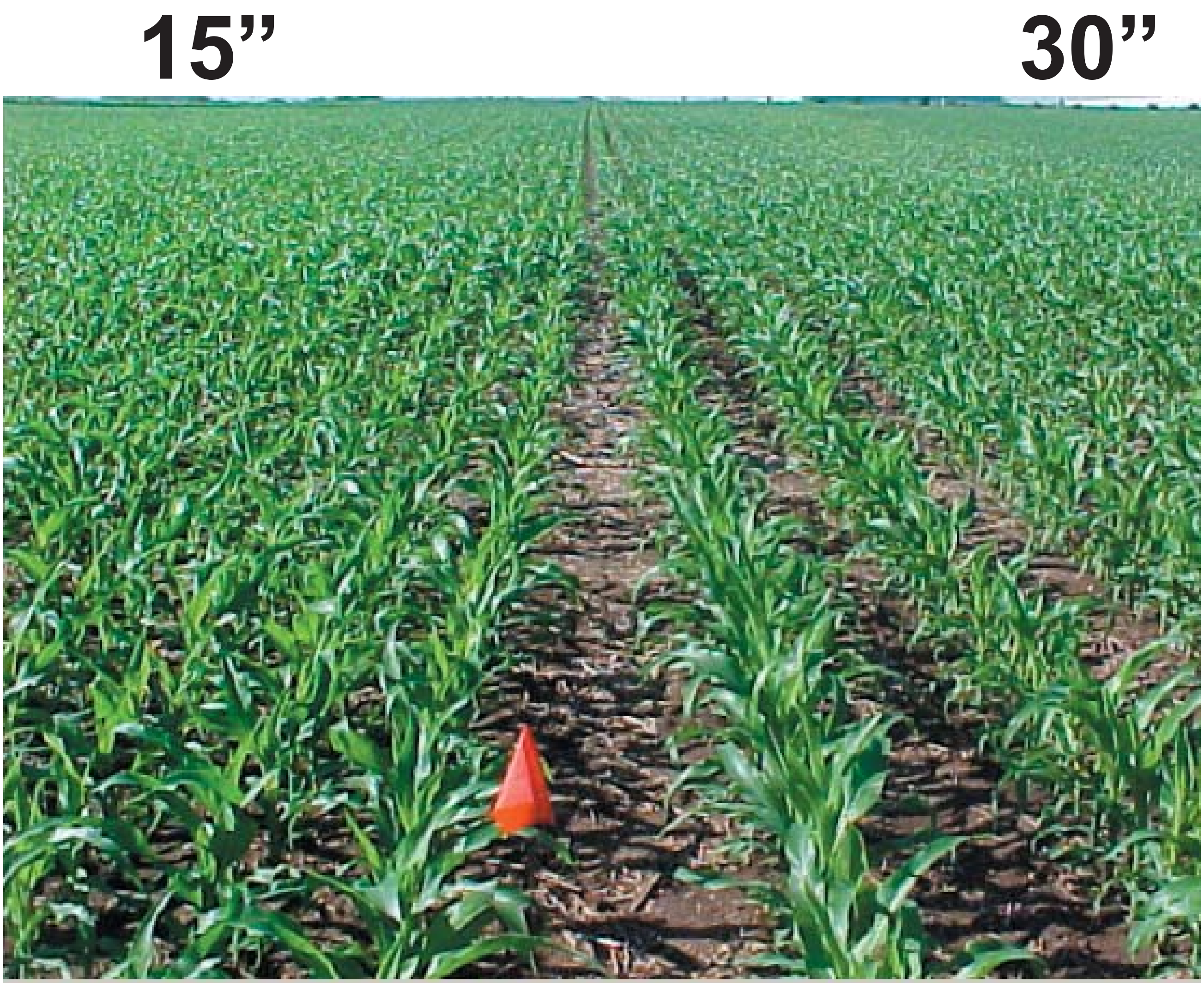


Figure 14. Pictured is corn seeded in 30 and 15-inch row spacings at approximately the V5 growth stage on June 8th.

Corn Row Spacing and Population

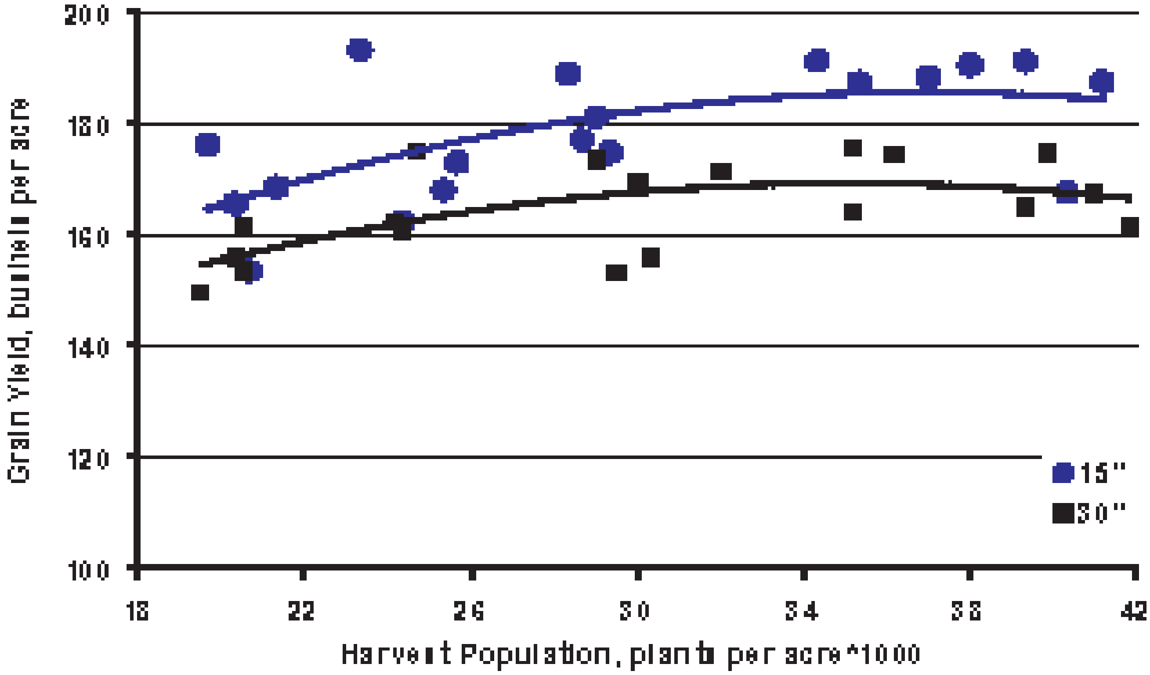
Results and Discussion

Corn planted in both 15 and 30 inch row spacing increased yield with increasing harvest population up to about 37 and 35 thousand plants per acre for the 15 and 30 inch row spacings respectively (page 25, figure 13). Using current corn grain and seed prices, the economic optima for 15-inch row spacings is about 35,000 plants per acre, while for 30-inch spacings the optima is about 32,000 plants per acre. These harvest populations to maximize income are similar to other Illinois findings (Nafziger, 2002). Although our yield response to increasing population seems fairly normal in 2006, it differs considerably from our 2004 and 2005 results. In the previous two years 30-inch row corn did not respond to increasing population, while 15-inch row corn tended to increase up to about 31,000 plants per acre.

Other contrasts with the preceding two years are; a lack of row spacing by harvest population interaction for 2006, and a significant row spacing main effect. When row spacing is averaged over population (main effect), corn grown in 15-inch rows significantly increased yield when compared to 30-inch row spacing. Although there is no row spacing by population interaction, there is a slight trend for more similar yields at lower populations, and individual data points for the two row spacings can be seen to overlap somewhat more at populations less than 30,000 plants per acre. Previously (2004 and 2005), we have seen somewhat lower yields with 15-inch row corn at populations near 20,000 plants per acre, while somewhat higher yields have occurred with populations near 40,000 plants per acre. These findings seem counterintuitive, as low populations would be expected to favor narrow rows versus wide rows. At low populations when light interception is less than adequate, the improved efficiency of narrow row light use, due to a reduction in the proportion of leaves shading leaves, should improve yield when row spacing is reduced.

Producers considering narrow row corn production (<30-inch row spacing) should consider the cost of equipment changes necessary to do so. Equipment changes may include; planters, corn heads, post-emerge N applicators, row crop cultivators, tires, ect. Any improved yield seems unlikely to be substantial enough to overcome a much greater equipment expense. Of the three years of this ongoing study, only one year (2006) showed any significant improvement in yield due to narrow row corn production. Given the somewhat low possibility of yield improvement, and the certainty of increased production costs, it doesn't currently seem a prudent choice to narrow the row spacing for corn production.

Corn Row Spacing and Population



Influence of harvest population and row spacing (15 and 30 inch) on the grain yield of corn grown at Joliet Junior College in 2008.

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 corn rootworm (CRW) larval control products. Control products were; no-insecticide, Lorsban15G, and BtRW+Lorsban15G. Forty lbs N per acre was applied during planting (2X2), and the balance of an N treatment sidedressed at V5 (June 5th). The N source was urea ammonium nitrate (UAN) ($CO(NH_2)_2$ NH_4^+ NO_3^-) injected four inches deep 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 CRW control product 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+Lorsban15G plots. Corn was seeded at 31,000 plants per acre after soybean on April 21st. Lorsban15G was applied in-furrow, and weed control was achieved by preplant burndown herbicides, followed by a postemergent application. The crop was harvested on October 15th.

Corn Nitrogen Requirements & Root Injury

Methods

Treatments: 6 (0-200 lbs N/acre in 40lb increments)
Replications: 4
Planting Date: 21 April
Hybrid: Garst 8461 and it's YGRW isoline Garst 8502, 110-day.
Previous Crop: Soybean
Tillage: Zero
Soil Series: Warsaw silt loam
Herbicides: Basis @0.50oz + Atrazine @32oz + 2,4-D @16oz per acre applied preplant.
SteadfastATZ @14oz + Callisto @2oz per acre applied postemerge.
Insecticide: Lorsban15G @ 8oz/1000 ft. of row.
Flowering: 14-July
Physiological Maturity: 12-September

Results and Discussion

All three types of corn rootworm (CRW) larval control products had increasing yield to increasing N fertilizer up to 131lbs N per acre for the no-insecticide control, 200lbs for the Lorsban treatment, and 158lbs for BtRW+Lorsban (page 29, figure 15). All three N response curves also fit a quadratic+plateau function quite well ($P \leq 0.05$, $R2 \geq 0.99$). The shape of the response curves were generally similar, as there was no control product by N rate interaction, however the magnitude of yield was consistently less with the no-insecticide compared to either control product. Although a relatively large increase in N (42lbs N per acre) was required to maximize grain yield for the Lorsban compared to the BtRW+Lorsban treatment, maximum yield between the two products was nearly identical (Lorsban= 194, BtRW+Lorsban= 190). Similar maximum yield between the two products indicates root protection from CRW larvae was adequate enough for plants in both scenarios to maximize yield. Despite no significant difference (LSD(0.10) in root injury rating between the Lorsban and BtRW+Lorsban treatments, the nearly 3.5-fold increase in root injury with Lorsban may have contributed to the much greater N requirement for maximum yield (page 29, figure 15). A problem with assigning too much importance to the enhanced Lorsban injury versus the injury of BtRW+Lorsban, is the increased injury is equal to roughly three roots cut off compared to about one root of the approximately 30 or so roots looked at. Furthermore, a root injury level often considered to cause economic losses (1.0, 0 to 3 scale), is well above the injury level sustained by the Lorsban treatment (Oleson et al., 2005).

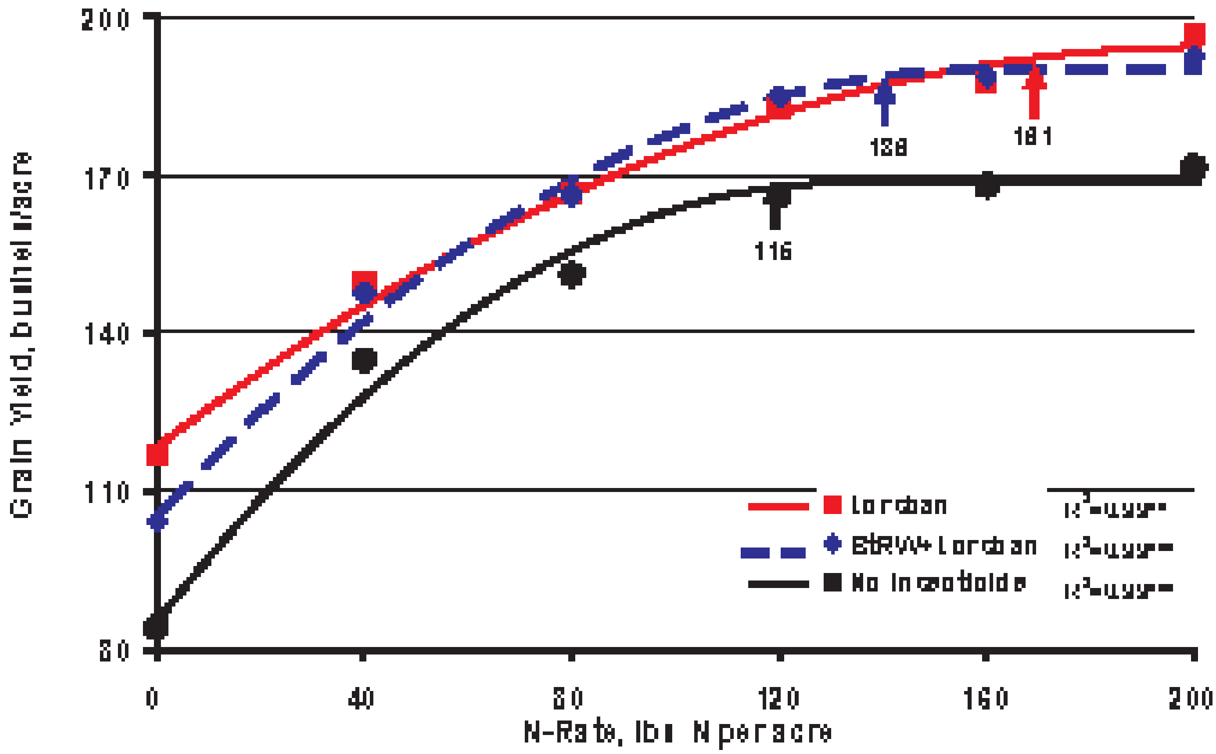
Corn Nitrogen Requirements & Root Injury

Results and Discussion

For corn grown without a CRW larval control product, root injury ratings were significantly greater than either the Lorsban or BtRW+Lorsban. As would be expected, yield was somewhat less at all N rates for corn grown without an insecticide, compared to control product treated plants. Table 9 depicts the main effect (control product averaged over N rates) of CRW control product on grain yield, which also indicates similar yields for control product treated plots, while no-insecticde plots produced significantly less yield. Economic optimum N rates (EONR) are depicted with vertical arrows in figure 15. It is not too surprising that the lowest EONR is associated with the lack of a control product, as it produced the lowest yield. However when control products were used, and similar yields obtained, differences in N rates required to reach the EONR, or to maximize yield, may be related to varying levels of CRW larval root injury that effects the crops ability to absorb mineral nutrients such as N.

Figure 14. A typical looking corn N response at Joliet Junior College on July 10th. Center four rows have no fertilizer N applied.

Corn Nitrogen Requirements & Root Injury



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 2006. Arrows indicate economic optimum N rates (EONR).

Table 9.

Influence of corn rootworm larval control products on grain yield, root ratings (0-3), lodging, population, and chlorophyll meter measured at V10 and R1 for corn grown after soybeans at Joliet Junior College in 2006. Grain yield for each control product is averaged over all six N-rates, while all other measurements were taken only on plots with 120 lbs N per acre.

Corn Rootworm Control Product	Grain Yield Main Effect	Root Rating	Harvest Lodging	Harvest Population	Chlorophyll Meter V10	Chlorophyll Meter R1
	bu/acre	0 - 3†	—%—	plants/acre	—relative units—	
None	146	1.28	9	28,300	59.3	61.8
Lorsban 15G ‡	167	0.31	2	28,100	58.9	63.0
BtRW+ Lorsban 15G ‡	164	0.07	2	31,500	61.1	63.2
LSD(0.10)	10.7	0.56	7	2,300	2.1	1.1

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

‡ Lorsban 15G was applied in-furrow at 8oz per 1000 ft 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 12th into either a warsaw silt loam with shallow depth to bedrock (~3 feet) and about 1.5 feet of sandy gravel on top the bedrock, or a symerton silt loam with relatively deep, or normal soil depth (>6 feet). It has been noted in the past that the area of the warsaw soil is greatly limited in growth and yield with normal precipitation. Forty pounds N per acre was applied 2X2 during planting to both hybrids . 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 V5. Thirty-two % UAN ($CO(NH_2)_2$ NH_4^+ NO_3^-) solution was the N source injected into the soil at planting, and injected 4-inches deep on 60-inch centers for sidedressing on May 30th (V5). Preplant burndown herbicides with residual activity were used to control preexisting weeds, at V6 SteadfastATZ and Callisto were applied. The crop emerged on April 25th, flowered on July 14th, matured on September 8th, and was harvested on October 16th.

Methods

Treatments: 8
Replications: 4
Planting Date: 12 April
Hybrid: Burrus 576 & 623B
Previous Crop: Soybean
Tillage: Zero
Soil Series: Warsaw silt 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.

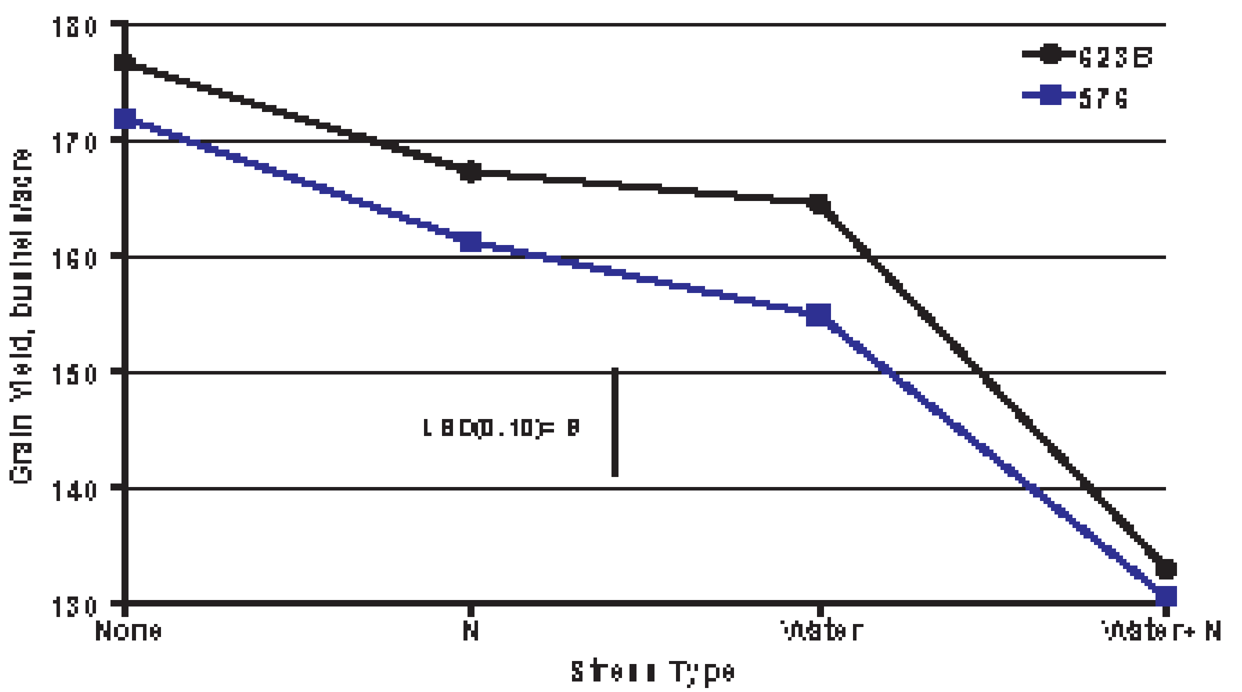
Insecticides: None
Flowering: July 14th
Maturity: September 10th

Water & N Stress in Corn

Table 10.

Main effect of hybrid, nitrogen, and water levels on the grain yield of corn grown at Joliet Junior College in 2006.

Main Effect	Treatment Levels	Grain Yield
		bushels/acre
Hybrid	576	155
	623B	160
	LSD(0.10)	4
Nitrogen	40lbs N/acre	148
	120lbs N/acre	167
	LSD(0.10)	5
Water	Coarse soil	146
	Fine soil	169
	LSD(0.10)	11



Effects of corn hybrid and stress type on grain yield at Joliet Junior College in 2006. Two Burrus hybrids (623B and 576) were treated with four types of stress; none, nitrogen (N), water, and water + N. LSD(0.10) is for comparing a given stress type between and within hybrids.

Water & N Stress in Corn

Results and Discussion

Increasing stress greatly reduced corn grain yield for both hybrids, and yield loss was on the order of: None < Nitrogen(N) = Water << Water+N (page 31, figure 16). There is no hybrid by stress type interaction, suggesting both hybrids lose yield at a similar rate with increasing stress type. The difference in yield between the two hybrids was not significantly ($P \leq 0.05$) different at three of the four stress types, although with water stress only, 623B produced significantly greater yield than 576. 623B did however, yield numerically greater than 576 at all stress types. The tendency for 623B to yield higher than 576 was also observed in 2005. Also similar to 2005, N stress (40 vs. 120lbs N per acre) significantly reduced yield. In contrast to 2005 however, water stress was not significantly more detrimental to yield compared to N stress. Additionally, in 2005 water stress alone produced the same yield as water+N stress, in 2006 the combined stresses were 2.5 fold greater than either water or N stress alone. Furthermore, the combined stresses caused nearly one fold greater yield loss than the sum of N and water stress. It's not surprising water stress alone was considerable more detrimental in 2005, as 2005 was somewhat droughty at Joliet Junior College, and maximum yield for both hybrids averaged together was about 26 bushels per acre less than 2006. Under relatively good growing conditions such as 2006, combined stresses are much more detrimental than a single stress, or even the sum of stresses. During the droughty 2005 growing season however, water stress alone caused maximum yield loss. The critical nature of water to crop plants would be expected to cause maximum yield loss when added as a stress in an already water stressed environment, while added mineral nutrient stress would have little impact because crop yield would be completely dependent on water availability.

Main effects (a variable average over other variables) for the three experimental variables and their respective treatment levels can be seen on page 31, table 10. All three variables had treatment levels that differed significantly ($P < 0.10$). The difference in hybrid however, was considerable smaller than either water or N stress. Two years of data (2005 & 2006) suggest that hybrid selection is important, however claims that specific hybrids should be matched-up to certain soils, N levels, and weather conditions may not be a cause for much concern. Our data indicates that a hybrid outperforming another in an unstressed environment, will likely do the same, or produce similar yields in stressful environments.

This type of data also has some application to precision farming, specifically the spatial management of cropping inputs. Recently some equipment manufacturers have developed planters and drills with the ability to store multiple varieties of seed, and the capacity to deliver the various seed varieties as the equipment is moving through a field. These planters and drills can be pre-programed to choose a certain variety for placement in specific field areas. The use of such mechanical-computer technology benefits producers only if there are known, well established differences in spatial hybrid performance. In other words if it is known that hybrid A performs better than hybrid B in certain field areas, such as droughty, or N stressed soils. Although we have only evaluated two hybrids, company literature suggest these two hybrids are genetically far apart. Currently, we have not found any evidence to support spatial management of corn hybrids.

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

Four Dekalb corn hybrids DKC60-17(RR), 60-19(RR+CB), 60-13(RR+RW), and 60-18(RR+CB+RW) were planted on April 26th to achieve four levels of crop protection; an unprotected control, european corn borer protection (ECB), corn rootworm (CRW) larval protection, and herbicide injury (Herb). Two combinations of the crop protection strategies were also evaluated, they were; ECB+CRW, and ECB+CRW+Herb. An additional treatment utilizing the three-way combination but substituting a CRW insecticide (CRW-I) for the transgenic trait (CRW), was also included. Varying crop protection levels were achieved by planting 60-17 and either applying SteadfastATZ+Callisto or Roundup WeatherMax for the unprotected control and herbicide injury protected (Herb) treatments respectively.

Stress Mitigation Using Transgenic Corn Hybrids

Methods

The hybrids 60-19 and 60-13 were also sprayed with the conventional herbicide to achieve ECB and CRW protected treatments. The Dekalb hybrid 60-18 was used for the ECB+CRW and ECB+CRW+Herb treatments by postemerge applying either SteadfastATZ+Callisto or Roundup WeatherMax. Finally, 60-19 was seeded with the CRW insecticide Fortress2.5G, and sprayed postemerge with Roundup WeatherMax to produce the Herb+ECB+CRW-I treatment. The four Dekalb hybrids are considered to be in the same “base” genetics, or near-isolines differing only in regards to a few genes providing the complimentary crop protection capabilities.

When the CRW insecticide Fortress2.5G was used, it was applied during planting in the seed furrow behind the disc openers and in front of the closing wheels. All four corn hybrids were planted at 32,000 seeds per acre into a zero-till system where soybean was the previous crop. Burndown herbicides with residual activity were applied one week preplant. At V4 (June 1st) the postemerge herbicide treatments were applied, a few days later 80lbs N per acre was injected into the soil. On July 10th (V17) 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 three of the eight treatments, representing the unprotected control, the insecticide Fortress2.5G, and YieldGardRW protected plants. The crop flowered on July 17th, matured on September 14th, and was harvested on October 19th.

Treatments: 8
Replications: 3
Planting Date: 26 April
Hybrids: Dekalb, DKC: 60-17(RR), 60-19(RR+CB), 60-13(RR+RW),
60-18(RR+CB+RW).
Previous Crop: Soybean
Tillage: None
Soil Series: Warsaw silt loam
Herbicides:
-Preplant Burndown; Basis@ 0.50oz + Atrazine@ 1qt + 2,4-D@ 1pt / acre.
-Postemerge(V4): SteadfastATZ@ 0.875lbs + Callisto@ 2oz / acre., or RoundupWM @21oz/acre.
Insecticides: None or Fortress2.5G @7.35oz/1000ft. of row.
Flowering: July 17th
Physiological Maturity: September 14th

Stress Mitigation Using Transgenic Corn Hybrids

Results and Discussion

High grain yields occurred for all treatments in this stress mitigation study. Yields ranged from a low of 207 to a high of 227 bushels per acre. Five of the seven stress mitigation treatments produced a statistically (P> 0.10) similar yield to the no stress mitigation control (page 35, figure 17). This finding is not surprising given that corn rootworm (CRW) larval injury with no CRW control product was 0.18 on the 0 to 3 scale (page 36, table 11), equal to about 2 roots cut off of the 30 or so evaluated per plant. Corn rootworm larvae injury is one of the two insect pests that stress from was to be alleviated by either a transgenic trait (CRW), or a granular insecticide (CRW-I). In the absence of injury from this pest fairly high yields were achieved for all treatments. Stress from european corn borer (ECB) injury was also intended to be reduced with the use of a transgenic trait (ECB), and although we do not have defoliation or injured plant data to asses it's potential injury level, little ECB damage was observed in the no-stress mitigation control plots.

Despite a lack of injury from either CRW or ECB, the two treatments (ECB+CRW, and ECB+CRW+Herb) with transgenic protection from both insect pests produced significantly greater yield than the no-stress mitigated control. It is unclear as to why transgenic ECB+CRW treatments increased yield under these circumstances. Although there is a very slight yield increase with either ECB or CRW alone, they are not significantly different from the control, and therefore combining the two traits should not impact yield.

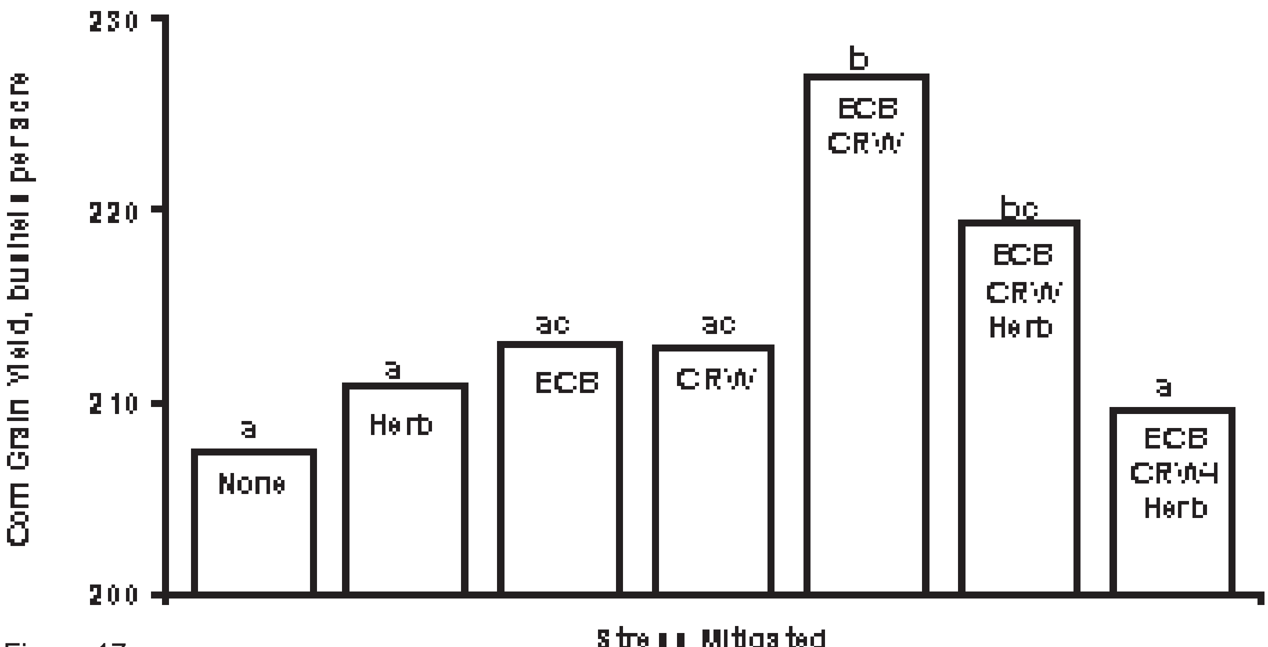


Figure 17.

Influence of mitigating corn stresses through the use of transgenic traits or herbicide tolerance (RR) and insect resistance (YieldGard) and a corn rootworm larval insecticide (CRW-I) on the grain yield of corn grown at Joliet Junior College in 200[illegible]. Stresses mitigated are: none= no stress mitigated, herb= herbicide stress (RR), ECB= european corn borer stress (YGCB), CRW= corn rootworm larval stress (YGRW). Columns followed by the same letter are not significantly different (0.10).

Stress Mitigation Using Transgenic Corn Hybrids

Table 11.

Influence of corn rootworm larval control products on the root ratings (0-3 scale) of corn grown after soybean at Joliet Junior College in 2006. The hybrid is Dekalb DKC60-17 and a near isoline Dekalb DKC60-13 with YieldGard Rootworm technology (YGRW).

Corn Rootworm Control Product	Root Rating
	0 - 3†
None	0.18
Fortress‡	0.09
YGRW	0.05
LSD(0.10)	N/S

† Roots were rated using the 0 to 3 node-injury scale, Oleson et al., 2005.
‡ Fortress2.5G was applied in-furrow at 7.35oz/1000 feet of row.

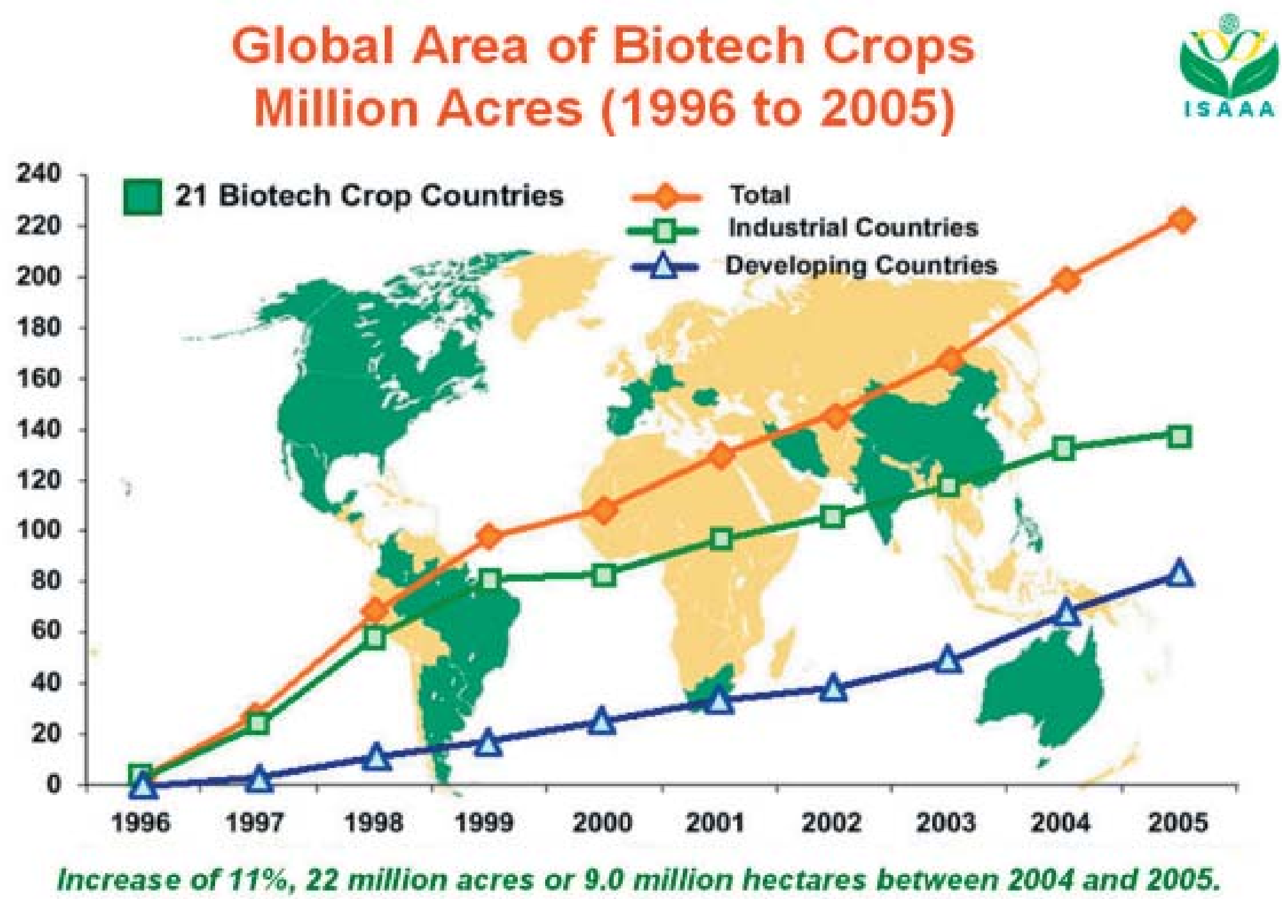


Figure 18. Source: Clive James, 2005

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

Forty corn hybrids were planted on April 28th 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 (Garst 8533) was entered eight 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 Case IH model 1660 combine, and two weigh wagons calibrated to match weights were used to determine grain yield. Grain moisture for each entry was measured with a single hand-held moisture meter. The demonstration area was zero-tilled into a previous crop of corn. 120lbs N per acre was applied in late February as ammonium sulfate, followed by 40lbs N per acre of UAN at planting. The crop flowered in late July, and was harvested on November 3rd.

Hybrids: 35
Replications: Unreplicated demonstration
Planting Date: 28 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.

Table 12.

Corn Hybrids

[illegible]

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 7th 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. Weed control was accomplished with a Fall burndown that included herbicides with soil residual activity, followed by a postemerge application of glyphosate on June 20th (V5). The crop was harvested on October 24th.

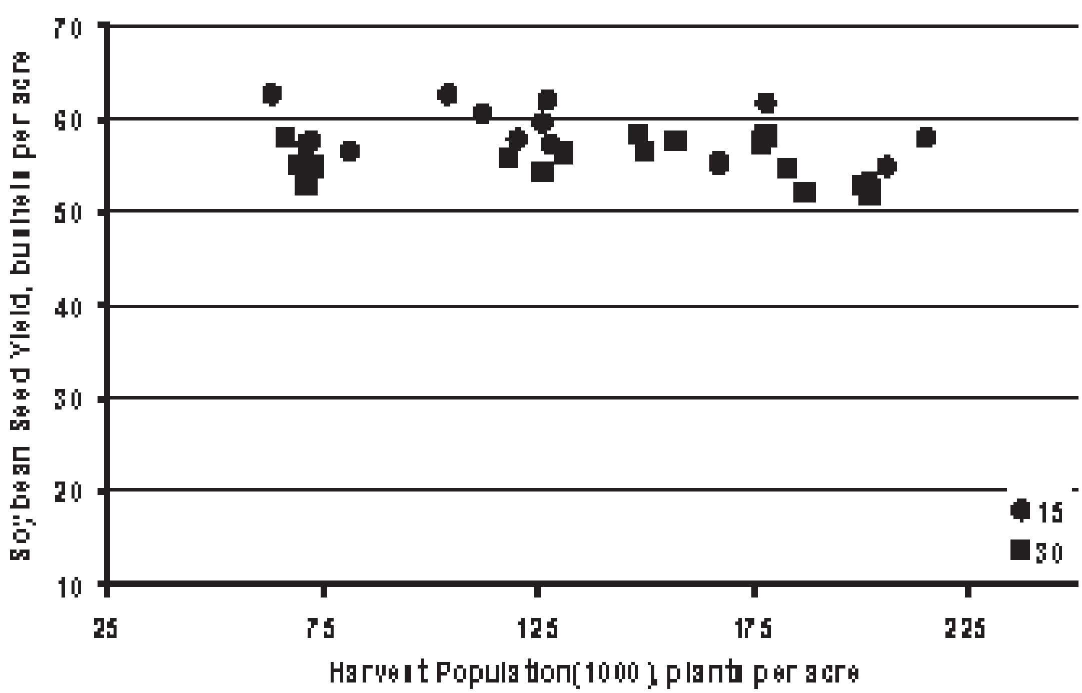
Treatments: 8
Replications: 4
Planting Date: 7-May
Soybean Cultivar: Pioneer 92M70
Previous Crop: Corn
Tillage: Zero
Soil Series: Symerton silt loam
Herbicides:
  CanopyXL@2.5ounces+Express@0.10ounces+2,4-D@1pint per acre applied Fall preplant.
  RoundupWM @21oz/acre applied post-emerge(V4).
Insecticides: None

Soybean Row Spacing and Population

Results and Discussion

The 2006 growing season marks the fifth year of soybean row spacing by population studies at Joliet Junior College. The 2006 seasons results are comparable to our findings for most of the previous years. Increasing harvest populations in the range of 75 to 225 thousand plants per acre has no effect on soybean seed yield in 2006, regardless of row spacing (page 40, figure 19). When narrow (15-inch) and wide (30-inch) rows were averaged over their respective populations (main effects of row spacing), narrow rows increased yield nearly three bushels per acre (page 41, figure 21). The near three bushel narrow row advantage is slightly less than our five year average yield increase with narrow rows of 3.3 bushels per acre. The narrow yield advantage, while small, is very consistent over years (figure 21.) In only one year (2004), was there a significant (P< 0.10) increase in yield with narrow rows, however when averaged over years the increase is statistically significant.

Since no row spacing by population interaction existed, only population data is presented in figure 20. There was however, a year by population interaction, thus years are depicted for harvest population. The year by population interaction is the result of population influencing yield only in years 2003 and 2004, and the effect of population on yield in these two years is opposite. In 2003 yield decreases with increasing population, while in 2004 increases can be seen. Commonly used mathematical functions to describe crop yield responses did not fit data for either year, however it is fairly clear that the yield trend for either year is a very shallow slope. The practical implications are that soybean is generally being overseeded, and sizable seed savings could be realized.



Influence of row spacing (15" circle, 30" square) and harvest population on soybean seed yield at Joliet Junior College in 2006.

Soybean Row Spacing and Population

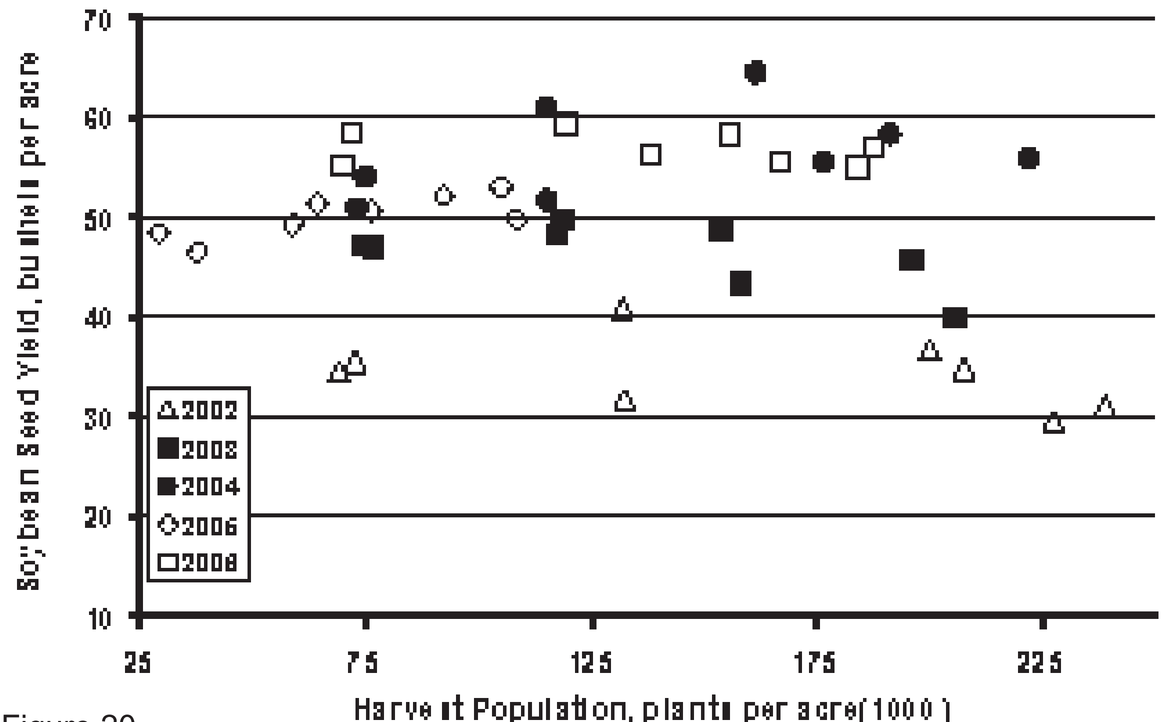


Figure 20.

Influence of harvest population and year on the seed yield of soybean grown at Joliet Junior College over five years (2002 to 2006). Symbols represent treatment means (3 or 4 replications) for 15 and 30 inch row spacing.

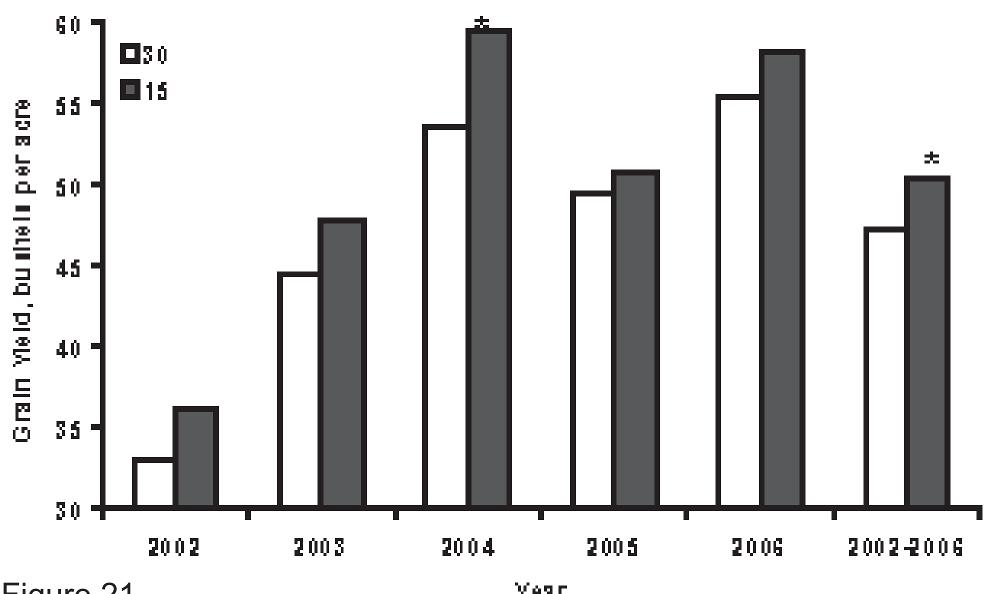


Figure 21.

Influence of row spacing (30 and 15 inches) and year on the seed yield of soybean grown at Joliet Junior College over five years (2002 to 2006). Row spacing is averaged over four harvest populations. Asterisks indicate significant differences (P≤0.10) between row spacings.

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 $\geq$ 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, and Plow tillage, and three planting dates were selected to determine potential tillage by planting date interactions on soybean seed yield. 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 NK S29-J6 was planted in 15 inch rows at a rate of 175,000 seeds per acre on April 24th, May 7th, and May 24 in each of the three tillage systems. 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 late October.

Tillage & Planting Date for Soybean

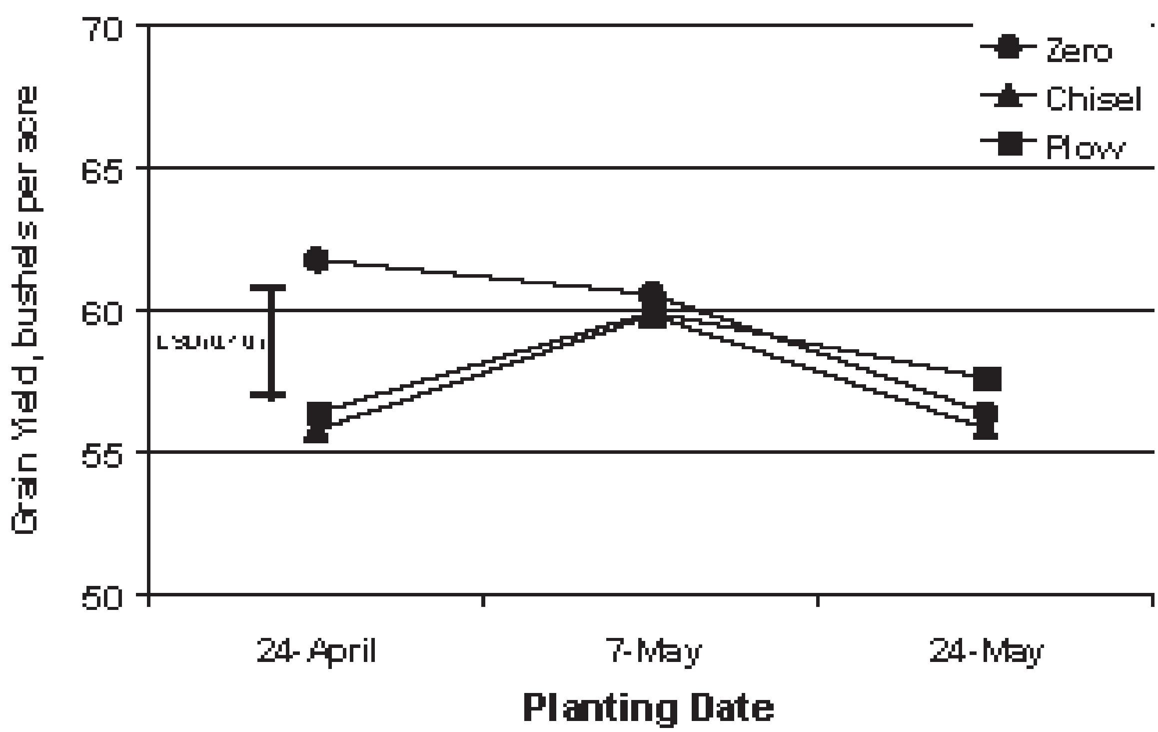
Methods

Treatments: 3
Replications: 3
Planting Date: Early= 24-April, Normal= 7-May, Late= 24-May
Soybean Cultivar: NK S29-J6
Previous Crop: Corn
Tillage: Zero, Chisel, 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: None

Results and Discussion

Soybean seed yield was not greatly affected by tillage or planting date in 2006, as yields ranged from a low of 56 to a high of 62 bushels per acre at the early planting date (page 45, figure 22). It is somewhat expected to find greater yield differences due to tillage with early versus late planting, as early planting is normally associated with cooler, and often wetter soils causing stand establishment problems. It is generally thought though, that more tillage would be helpful in stand establishment and seedling vigor compared to zero or reduced tillage systems. Surprisingly, zero-till produced significantly greater yield than either chisel or plow tillage systems at the early planting date. Although this result is seemingly the reverse of what might be expected, a similar trend was noted in the same study from 2004. One possible explanation is that the early planted soybean was planted into somewhat wet conditions, causing surface soil crusting. Additionally, early planting typically results in more rainfall events prior to crop emergence, further worsening the soil crusting effect on seedling emergence. Zero tillage is known to better maintain surface soil structure, through greater organic matter content near the soil surface, thus the stand reducing effects of soil crusting may partially be alleviated with zero-till. Our data do not support a harvest population increase with zero-till at the early planting date, although field notes indicate that early planted tilled soybean may have emerged more slowly. Accordingly, field notes also indicate a greater likelihood of diseased seedling plants with slow emergence. So while harvest populations did not differ with tillage, it’s possible more slowly emerging plants under tilled and crusted conditions could have had greater seedling disease incidence.

Tillage & Planting Date for Soybean



Influence of planting date and tillage system (Zero, Chisel, and Plow) on the seed yield of soybean grown at Joliet Junior College in 2008. The LSD is for comparing tillage systems within a planting date.

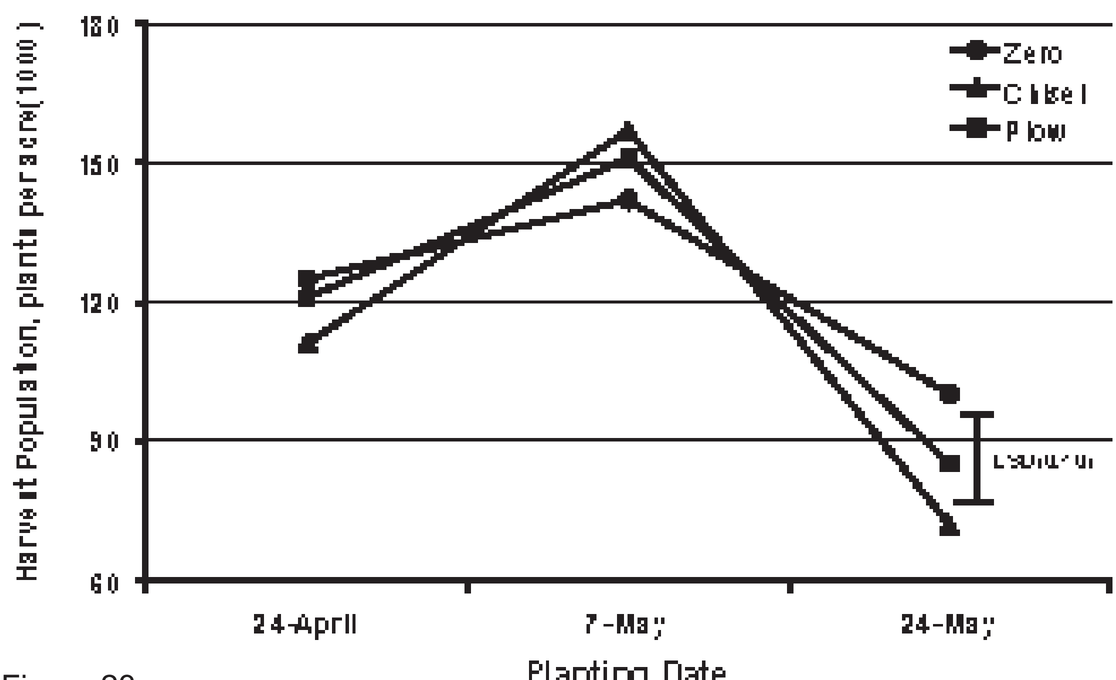


Figure 23.

Influence of planting date and tillage system (Zero, Chisel, and Plow) on the seed yield of soybean grown at Joliet Junior College in 2008. The LSD is for comparing tillage systems within a planting date.

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 7th with the FS cultivar HS2956. 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. Weed efficacy was measured at R8 by visual assessment (% control), and the crop was harvested on October 25th. The crop was V2 on June 9th, and V8/R2 on July 8th.

Treatments: 7
Replications: 3
Planting Date: May 7th
Soybean Cultivar: FS HS2956
Previous Crop: Corn
Tillage: Zero
Soil Series: Will silty clay loam
Herbicides: Many
Insecticides: None

Soybean Herbicides

Results and Discussion

All six herbicide treatments produced significantly (P< 0.10) greater yield when compared to the no herbicide control. Soybean grown without herbicides produced 18 bushels per acre, indicating heavy weed pressure (page 47, table 13). When only a preplant spring burndown treatment was applied, yields were about 20 bushels per acre less than a combination of a burndown and a postemerge RoundupWM application. Broadleaf weed control of the burndown only treatment was also nearly four fold less than the poorest performing post RoundupWM treatment. For both V2 RoundupWM treatments, the addition of herbicides with soil residual activity to the burndown significantly (P< 0.10) increased both weed control and seed yield. When RoundupWM was applied at V2 without residual burndown herbicides, weed control was much poorer compared to any post applied RoundupWM treatments. As Roundup application was delayed to either V4 or V6, yield and weed control increased significantly compared to the V2 application. The delayed applications are apparently early enough to prevent yield loss due to early season weed competition, yet late enough to allow sufficient canopy closure before new weed seedlings emerge through the canopy. When RoundupWM was delayed even further to V8, weed control was reduced compared to both the V4 and V6 timings, although yield remained similar. At V8 many of the broadleaf weed species (lambsquarter and Giant Ragweed) become large enough that control is increasingly difficult, many Giant Ragweed individuals at this time are four feet in height. Furthermore, nearly all Giant Ragweed individuals have some stem boring insect, which would greatly reduce the translocation of gylphosate, thus reducing it's effectiveness.

Table 13.

Influence of herbicide application time and burndown type on broadleaf weed (BLW) control and seed yield of zero-till soybean grown at Joliet Junior College in 2006. Herbicide efficacy was evaluated at soybean maturity.

Herbicide	Timing	Burndown type	Appl. Rate§	BLW Efficacy	Seed Yield
			oz/acre	% Control	bushels/acre
No Herbicide	——	——	——	0	18
RoundupWM + 2,4-D	Pre-Plant	Spring‡	11 & 16	12	28
RoundupWM	Post(V2)	Fall/Residual†	21	83	63
RoundupWM	Post(V2)	Spring	21	63	47
RoundupWM	Post(V4)	Spring	21	86	62
RoundupWM	Post(V6)	Spring	21	88	62
RoundupWM	Post(V8)	Spring	21	83	48
LSD (0.10)	——	——	——	11	4

†Fall burndown consisted of Canopy XL at [illegible] oz/acre + Express at [illegible] oz/acre + 2,4-D at [illegible] pt/acre and COC at [illegible]% by volume applied November 2005.

‡Spring burndown consisted of RoundupWeatherMax at [illegible] oz/acre + 2,4-D at [illegible] pt/acre + COC at [illegible]% by volume + AMS at [illegible] lbs per 100 gallons of water applied April 30th.

§All RoundupWM (glyphosate) applications were made at [illegible] lbs a.e./acre.

Fungicidal/Insecticidal Seed & Foiar Treatments in Soybean

Justification and Objective

The observation of soybean rust in the continental U.S. in recent years has spurred the use of foliar applied fungicides. Similarly, the outbreak of soybean aphid during the summer of 2003 incited the application of many foliar insecticides. Whether perceived or real, the additional threat of insect pests previously thought to be of secondary importance, such as bean leaf beetle and Japanese beetle, injury from these pests have also stimulated greater interest in foliar pesticide applications in soybean production. Soybean seed treatment fungicides have been fairly common over the past decade, however with the advent of the neonicotinoid insecticidal seed treatments used in conjunction with YieldGard RW corn, there has been interest in also using these compounds on soybean. Zero till has recently been reported to be used on the majority of soybean acres, a system often thought to be more responsive to managing fungal disease with pesticides than chisel or plow tillage systems. Additionally, in recent years many soybean producers have noted relatively stagnant soybean yields when compared to corn. Because of the potential for increased pest injury, and the perception of relatively low yields, soybean producers and agronomists have been increasingly interested in both fungal and insect pest protection. Two common means of supplying fungicidal and insecticidal compounds are through seed treatments, and foliar applications. Our objective was to determine the impact of seed and foliar applied fungicides and insecticides on soybean seed yield.

Methods

The experiment was composed of 12 treatments arranged as a split-plot with four replications. Main plots were four levels of foliar pesticide (fungicide and or insecticide) applications which consisted of; an untreated control, fungicide, insecticide, and fungicide+insecticide. Sub-plots (plots within main-plots) consisted of three levels of seed applied pesticides, they were; no treatment, fungicide, and fungicide+insecticide. The fungicidal seed treatment consisted of using the product ApronMaxx, which includes the fungicidal compounds fludioxonil, and mefenoxam. The fungicidal and insecticidal seed treatment product was Cruiser Maxx Pak, which includes the aforementioned ApronMaxx, and the neonicotinoid Cruiser, with the insecticidal compound Thiomethoxam. The foliar fungicide application was accomplished with Warrior at 2oz per acre, while the foliar insecticide was Quadris applied at 7oz per acre. The foliar fungicide+insecticide treatment utilized both Warrior and Quadris. All foliar treatments were applied on August 4th at the R4/5 soybean growth stage. The Asgrow soybean cultivar 3101 was seeded in 30-inch rows at 150,000 seeds per acre on May 6th.

Fungicidal/Insecticidal Seed & Foiar Treatments in Soybean

Methods

Treatments: 12
Replications: 4
Planting Date: 6-May
Soybean Cultivar: Asgrow 3101
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(V4/5).
Insecticides: Cruiser seed treatment, and or Warrior applied postemerge.

Results and Discussion

Relatively high yields were achieved with all seed and foliar applied fungicide and insecticide combinations (page 50, figure 25). In fact yields ranged from a low of 59.5 to a high of 63.3 bushels per acre. Normally with such little yield change one could conclude that no treatments effected yield. However, while there is no foliar by seed treatment interaction, the main effect of both seed and foliar pesticide applications are significant (P< 0.10). Table 14 on the following page shows the main effects for both seed and foliar treatments. For seed applied pesticide treatments, both the addition of a fungicide, and a fungicide+insecticide increased yield compared to the untreated control. For the foliar applied pesticide treatments, only the combination of a fungicide and insecticide improved yield.

The data in this study was very tight, having extremely small coefficients of variation, indicating that very little of the yield variation was due to anything but the treatments imposed. As a result, LSD(0.10) values for the main effects are very small, and thus only small yield changes are required for significance to be declared. So while there are differences between some of the pesticide treatments (two bushels maximum), the return on investment for the crop protection products may not be positive.

Fungicidal/Insecticidal Seed & Foiar Treatments in Soybean

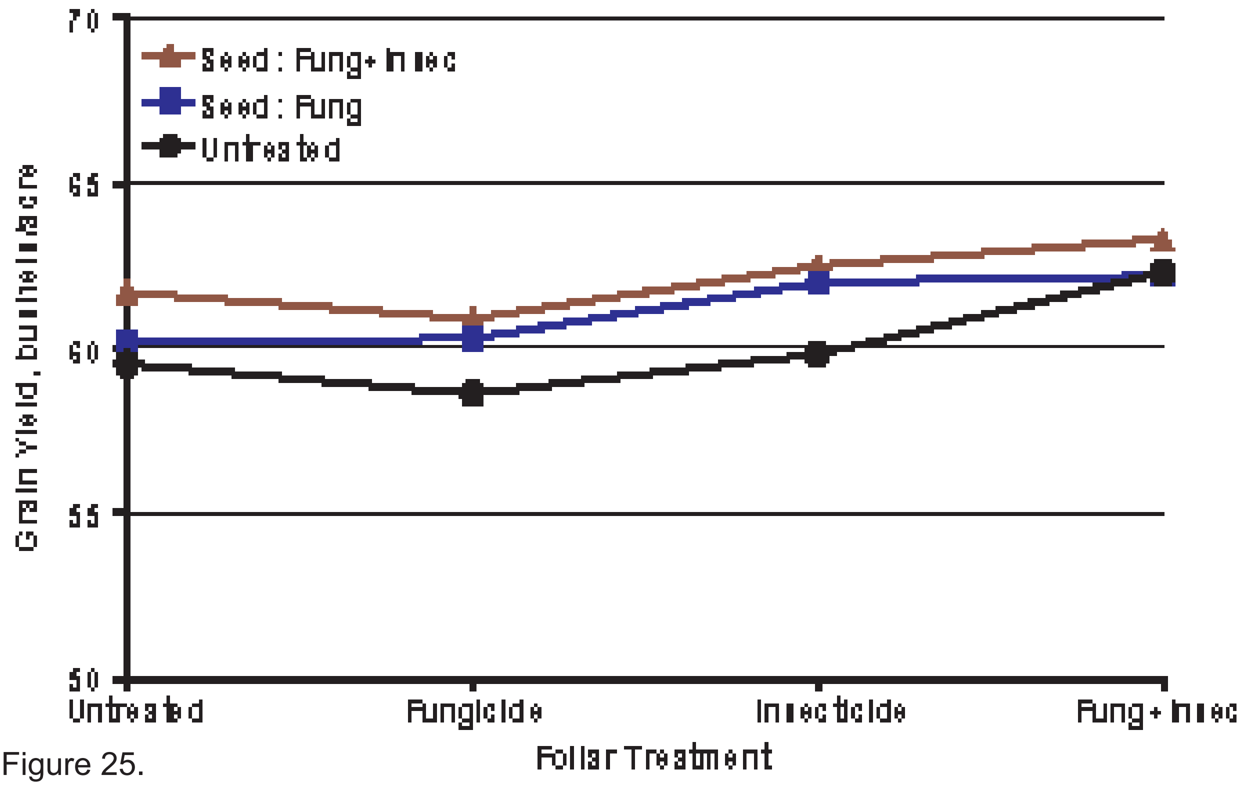


Figure 25.

Influence of foliar and seed treatment fungicide and insecticide use on the seed yield of soybean grown at Joliet Junior College in 2006. Seed treatments were; ApronMaxx® for fungicide, and CruiserMaxx® Pak for fungicide + insecticide. Foliar treatements were; Quadris® for fungicide, and Warrior® for insecticide, applied at the R4/R6 growth stage on August 4th.

Table 14.

Influence of seed or foliar applied fungicide and or insecticide treatments on the seed yield of soybean grown at Joliet Junior College in 2006. Main effects are the average of either a foliar treatment averaged over the three seed treatments, or a seed treatment averaged over the four foliar treatments.

Pesticide	Main Effect	
Treatment	Seed	Foliar
	——bushels per acre——	
None	60.1	60.5
Fungicide	61.2	59.9
Insecticide	——	61.4
Fung+Insec	62.1	62.6
LSD (0.10)	0.7	1.1

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 5th and seeded at 150,000 seeds per acre in 30-inch rows. Twenty-five cultivars were entered in this unreplicated varietal demonstration. The check variety (Becks, 321NRR) was entered four times in the demonstration, and each entry consisted of 4 rows 380 feet in length. The check entries were separated by five varieties, as such any given variety was never more than three entries (30 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 harvested on October 25th.

Number of entries: 25
Replications: None
Planting Date: 8-May
Soybean Cultivar: Many
Previous Crop: Corn
Tillage: Zero
Soil Series: Symerton 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

Table 15.

Demonstration of the grain moisture, yield, and relative yield of 29 soybean varieties grown at Joliet Junior College in 2006. The check variety (bold font) averaged 49.4 bushels per acre and was entered four times in the demonstration area. Each check was separated by five or six entries. The varieties with the highest relative yield are underlined, and the average of all varieties is 53.9 bushels per acre.

Company	Nomenclature	Grain Moisture	Grain Yield	Relative Yield†	Grain Yield(2yr)‡
		--%--	bu/acre	--%--	bu/acre
Crow's	[illegible]	11.6	56.1	108.3	
Dairyland Seed	[illegible]	11.2	56.5	109.1	
NK	[illegible]	10.9	61.4	122.4	
Becks	[illegible]	11.2	[illegible]	100.0	
Pioneer	[illegible]	11.1	59.8	113.9	
NK	[illegible]	10.9	57.3	110.6	
[illegible]	[illegible]	11.6	[illegible]	[illegible]	
Kruger	[illegible]	11.1	[illegible]	81.7	[illegible]
NK	[illegible]	10.9	58.7	111.6	
Becks	[illegible]	10.6	52.6	100.0	
Pioneer	[illegible]	10.9	65.3	124.1	
Dairyland Seed	[illegible]	11.1	[illegible]	76.2	
NK	[illegible]	11.2	[illegible]	90.7	
Great Lakes	[illegible]	10.9	56.6	126.4	
Becks	[illegible]	10.4	56.3	122.1	56
[illegible]	[illegible]	11.6	[illegible]	105.9	
Becks	[illegible]	10.6	[illegible]	100.0	
Kruger	[illegible]	10.4	52.6	115.1	
Crow's	[illegible]	11.6	55.5	121.4	51
Pioneer	[illegible]	11.2	56.6	121.7	[illegible]
FS	[illegible]	11.2	[illegible]	99.3	
Dairyland Seed	[illegible]	11.1	56.3	117.2	56
Becks	[illegible]	10.6	[illegible]	100.0	
NK	[illegible]	10.2	[illegible]	[illegible]	
Asgrow	[illegible]	10.2	[illegible]	[illegible]	53
[illegible]	[illegible]	11.1	53.1	111.6	
LG	[illegible]	10.9	[illegible]	[illegible]	
LG	[illegible]	10.4	[illegible]	[illegible]	52
	Average	11.6	53.9	109.7	

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

‡ The two-year average includes 2005 and 2006.

Herbicides: [illegible]

Insecticides: None

Planting Date: May [illegible]

Planting Rate: [illegible] seeds/acre

Tillage: None

Row-spacing: [illegible] inches

Harvest Date: October [illegible]

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