PROGRESS REPORT

Relationship between Soil-Test Potassium and Crop Yield

Summary for the 2006 Season
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Introduction

The objectives of this ongoing project have been to (1) study the variability in soil-test potassium (K) and corn response to K fertilizer and (2) evaluate K soil-test methods. In 2006 work focused on analyzing samples and data from previous years and field work on three groups of experiments. One group involved continued evaluation of eight long-term K trials, two of which were partly modified to evaluate potential crop response to chloride. A second group involved evaluating the last 2-year K rate trials (the second year) part of a study initiated in 2003. The third group involved the first four trials of a new project to evaluate the impact of corn genetic rootworm resistance on grain yield and K uptake. A significant donation of potash fertilizer by PCS and complementary funding made possible maintaining a heavy workload with the generous but modest funding from FAR. However, not all possible work could be conducted due to funding limitations as will be explained below. Highlights of the work and preliminary results for the 2006 season are summarized in the following sections.

1. Long-Term Trials

Summary of methods.
Eight conventional long-term K trials were evaluated as in the past. Three trials evaluated effects of annual K fertilizer rates applied since the middle 1970s for corn-soybean rotations at Ames (changed to continuous corn in 2005), Northeast (with both crop phases each year), and Northern (corn in 2006) research farms. At two trials (Ames and Northern farms) annual K rates were discontinued in 1998 to study decline of soil-test K over time and to expand soil-test calibration research and only the highest annual K (108 lb K_2O/acre) rate has been applied since then. Plots of these two trials were used to study response to chloride by applying 50 lb Cl/acre as either calcium chloride or potassium chloride to plots that had not received K since 1998 (five replications in one trial and six in the other). Five other trials at the Northeast, Northern, Northwest, Southeast, and Southwest research farms (with both crop phases each year) evaluated two tillage systems (no-till or chisel-plow tillage), four broadcast granulated K fertilizer rates (0 to 140 K_2O/acre), and two planter-band granulated K rates (35 and 70 lb K_2O/acre) applied with 2 x 2 starter attachments. Soil and grain samples have been collected from selected plots of these trials to minimize costs (approximately 350 soil samples and 130 grain samples). Grain samples have not been analyzed for K concentration since 2005 and were dried and stored because of the limited funding (samples from previous years were analyzed with partial in-kind support from the PPI). Only the most important samples collected in fall 2005 that were needed

to understand yield responses (from the non-fertilized plots) could be analyzed due to limited funding.

Highlights of grain yield results.
There were large grain yield reductions when K was not applied in plots where soil-test K was below a value of about 150 ppm in most trials. However, significant yield reductions were also observed in plots testing up to about 170 to 180 ppm in the two trials conducted in central and northern Iowa (mainly the moderately to poorly drained Nicollet and Webster soil series). There were no obvious or consistent differences between broadcast and planter-band K fertilizer placement methods at the five long-term trials these were evaluated.

Comparisons of calcium chloride and potassium chloride fertilization showed little or no significant effect of chloride in the two trials. Potassium chloride fertilizer at 50 lb K_2O/acre increased corn yield 31 and 44 bu/acre. However, calcium chloride applied at a similar Cl rate increased yield by only 8 and 5 bu/acre, respectively. This is an important result (not even a responsive trend in 2005 and this small response in 2006) because the control plots have not received any chloride for 30 years of cropping with corn-soybean rotations. They confirm that very large responses to K observed in these long-term trials were essentially due to K and not Cl. However, results from 2006 indicate that Cl sometimes may be needed when KCl or any other input with Cl is not applied to Iowa soils for many years.

2. Short-Term and Multi-Rate Conventional Trials

Summary of methods.
The objectives of this study based on 2-year K trials were to determine rates of K needed to maximize crop yield in different soils having soil-test K within the current Low or Optimum interpretation classes and to measure the residual response of a second crop, K fertilization effects on after-harvest soil K, and K removal with grain harvest. They were established at various research farms across the state as has been reported since 2004. Five K fertilizer rates ranging from 0 to 180 lb K_2O/acre are applied to the first corn or soybean crop, and for the second crop plots are subdivided to apply no K or 120 lb K_2O/acre. In 2006, eight second-year trials were evaluated; four with corn and four with soybean. Soil samples were collected from each plot of all trials before applying the treatments and after harvest. Soil samples from the first sampling date were analyzed for ammonium-acetate K and Mehlich-3 K. Small-plant (V5 to V6), ear-leaves at silking, and grain samples were collected and are being analyzed at this time.

Highlights of results.
Application of K treatments for first-year crops (in 2005) resulted in soil-test K values before the second-year crops ranging from 109 to 172 ppm across the eight sites and five first-year K rates. The yield results of these eight trials showed a wide range of responses that are being studied at this time, including response to residual K form the previous year's applications and response to the new application split (of all plots) of 120 lb K_2O/acre. For some reason not yet understood, responses to K were not as large as in the long-term trials, even with similar soils and rather similar soil-test K values. In contrast to results reported for 2005, when K fertilization did not build-up soil-test K nearly as much as expected in soils of the Webster or Canisteo soils, data for

this year showed significant build-up to the high initial K rates with values near those expected given the rates applied and crops planted. These results are being studied and summarized at this time.

During the past year we finished grain and plant analyses of samples collected from 18 of this type of trials that were conducted from 2003 to 2005. A poster was presented in November at the national ASA meetings summarizing effects of the five K rates applied to yield, plant-tissue K concentrations, early K uptake, and grain K removal first-year crops. Such a poster, with text and figures re-arranged to fit letter-size paper, is included in **Appendix 1** to this report. This year we will summarize all data from 2003 to 2006 for a student Dissertation, which will include analyses for K of selected post-harvest soil samples by the tetraphenyl-boron K test to be able to explain better relationships between applied K, post-harvest soil-test K, and grain K removal.

3. Analysis of On-Farm Strip Trials Conducted in 2005

Summary of methods.
This year we conducted the last trials of an on-farm study that has been evaluating a check and a high K fertilizer rate applied to long strips with four replications at each field. Soil-test K has been analyzed in samples taken before applying the fertilizer treatments from cells approximately 0.5 acres in size, and grain has been harvested with combines equipped with yield monitors and GPS receivers. In fall 2005, soil samples were collected again from three trials that would be continued for a second crop in 2006. The soil sampling density was multiplied by a factor of two because samples were collected from each treatment.

Highlights of results.
Two trials were conducted successfully but, unfortunately, due to a miscommunication between us, the farmer, and the coop involved the K fertilizer was accidentally applied across all strips at one field and we lost that trial. The yield maps are still being processed, only averages of raw data are available, and little can be shared at this time. We also continued chemical sample analyses of soil samples and GIS analysis for trials conducted in previous years. The averages along the strips for four corn trials in 2005 showed large variation in corn response across fields, and soil-test K data for each field confirmed that little or not crop response should be expected at values above about 170 ppm but that soil-test K is a very, very poor predictor of crop response below those values. Work on finishing GIS work to overlay grain yields, soil-test values, and soil map units to study response variation along the landscape within each field has been slow. The graduate student working on these trials (Pedro Barbagelata) graduated in December 2005, could not include previous year's trials on his Dissertation other than data useful for soil-test calibration using average results for each field, and a new student has been very busy establishing new trials and working in the laboratory, we had to focus on the most essential work.

4. Soil Test for K in Field Moist Samples

This year we finished all sample chemical analysis and grain yield data management for work conducted from 2003 to 2005 on selected samples from all the experiments described above to study K testing on field-moist samples as a possible way of improving the value of soil testing for K. The soil tests compared have been the routine ammonium-acetate K and Mehlich-3 K tests, and a field-moist based ammonium-acetate K test. The study included correlations of amounts of K extracted in the laboratory, field calibrations, and comparison of the moist test we are using with the slurry (moist) test used in Iowa during the 1970s and 1980s. Available results until 2004 were shown by graduate student Pedro Barbagelata in an oral presentation at the ASA meetings in fall 2005 and were summarized in his Dissertation. At this time, although Pedro went back to his job in Argentina, we are preparing a paper for publication by adding the 2005 data to data summarized in his Dissertation.

5. Relationship between Corn Rootworm Protection and Potassium Nutrition

As I indicated in last year's progress report, the incredibly fast adoption by farmers of corn hybrids with rootworm resistance and a surge in continuous corn has prompted many questions about impacts of this resistance on nutrient needs. Therefore, in 2006 I used some of the funds provided by FAR, help from the ISU Outlying Research Farms, and gifts to begin a new project looking at K nutrition of corn hybrids with or without rootworm resistance.

Summary of methods.
Four conventional plot trials with corn were established at four ISU research farms. The treatments replicated four times were a factorial of two Monsanto hybrids differing only on rootworm resistance and five K fertilizer treatments (0 to 180 lb K_2O/acre). All sites had corn in 2005, and some had evidence of rootworm infestation. Soil samples were collected from each site before planting corn and soil K testing methods were those recommended in Iowa (6-inch sampling depth, ammonium-acetate K extractant). Test results showed that soil-test K was in the Optimum class, for which maintenance K fertilization is recommended. Plant measurements included grain yield, an assessment of rootworm incidence in selected treatments, and plant tissue sampling to measure N-P-K nutrient concentration. Because of the high cost of field labor and chemical analysis for this project, rootworm incidence was measured for the two corn hybrids at three contrasting K treatments of all replications (0, 60, and 180 lb K_2O/acre). Roots from five plants were excavated from each selected plot in the middle of July, and rootworm effect on roots was evaluated visually by using the relative scale recommended by ISU and Monsanto. The above-ground part of the plants was weighed, chopped, and a tissue sample was collected to measure nutrient concentration by standard tissue testing methods. Also, ear leaves of corn were sampled from all plots and shelled to be analyzed for K concentration.

Highlights of results.
At this time we can provide preliminary results of corn grain yield and rootworm incidence measurements. Plant tissue and grain samples are still being analyzed and processed. The results summarized in this report should be interpreted with caution because they are based on rawdata from the field plots and do not include detailed outlier analysis or statistical analysis. The grain yield results showed a clear superiority of the hybrid with rootworm resistance, even in fields where study of roots showed very low rootworm incidence. This result was unexpected, because we had no clear indication that this trait would also result in higher yield in absence of rootworm infestation. The results were consistent across experiments and locations, however.

Table 1 of **Appendix 2** summarizes yield results, and shows a small yield response to K application in one trial. However, on average across K treatments, rootworm resistance resulted in 4.8 to 13.1 bu/acre of corn more (on average 8.9 bu/acre). Results of rootworm incidence assessments for selected plots of these trials shown in Table 2 of **Appendix 2** indicate that the yield advantage was the lowest at the two sites with the lowest rootworm incidence. Not much can be concluded about interactions between rootworm resistance and K nutrition given little or no response to K application and until the results of plant analyses are available. However, yield results for the responsive site suggest that rootworm resistance increased both grain yield levels and the yield response to K fertilizer. Calculations for this site indicate that the response to K (across rates of 30 to 180 lb K2O/acre) was 2% for the susceptible hybrid and 9% for the rootworm resistant hybrid.

6. Outreach Activities

A significant effort was dedicated to discuss K management issues and share previous years' results at scientific meetings and others targeted to farmers or professional agronomists. The main focus was on explaining the need for higher soil-test K levels for optimum crop production in many soils, results of new soil-test calibrations, problems associated with soil sampling drying in the laboratory, and factors that may induce K deficiency even when soil-test K is high. These issues were discussed and shared to Iowa farmers and professional agronomists at 11 meetings, conferences, or field days. The activities included presentations in Minnesota and several in Argentina during August. Potassium testing and management issues and project results also have been shared during many interviews to reporters of farm magazines.

Plans for the 2007 Crop Season

Assuming a similar FAR support as in the previous year, I plan to continue this large potassium project by finish summary of previous year information for publication and focusing on three specific field projects better adjusted to the level of funding.

1. Long-term K trials. The long-term trials will be continued to be evaluated at a lower level (only by collecting essential soil samples and grain yields) because they have been very productive, are providing new information (such as evaluation to response to chloride), and are very useful to study long-term yield and K trends over time. Also, I have no other source of funding for maintaining these trials other than in-kind contributions from the ISU Research Farms and fertilizer K donations by PCS.

2. Potassium by rootworm resistance in corn. I will continue for a second year the four trials established in 2006 to evaluate the impact of the rootworm resistant gene on K nutrition of continuous corn, by planting corn to the same plots using the same field and laboratory methods used in 2005. A fresh K rate will be applied to one of the first-year treatments to assure maximum yield and non-limiting K. Four new trials using the same K fertilizer treatments (five rates ranging form 0 to 180 lb K_2O/acre) will be established this year. The support from FAR will be used together with in-kind support from Monsanto (seed and for plant analysis mainly).

<u>3. Corn response to broadcast and starter K over the landscape</u>. Limited support form the Fluid Fertilizer Foundation (only $6,000) was secured to begin a new on-farm project to study the "true" starter effects of K applied in the seed furrow for corn and potential starter K effects at reducing yield loss and yield variability over the landscape with or without commonly used broadcast K rates. More than 30 field trials with in-furrow fluid fertilizer I have conducted in Iowa have included N-P-K or N-P mixtures and have shown how starter mixtures can be used to complement broadcast fertilization for corn. However these trials (and, in my humble view, no other field trial conducted in the Midwest) have clearly shown the role and benefits of in-furrow starter K. This is very important because a myriad of expensive low-salt fluid starter products are being sold based on assumed value for starter K. The methodology based on replicated treatments applied to long strips, GPS, yield monitors, and GIS will be similar to that used in previous projects. The FFF level of funding is barely enough to conduct one trial, and of course cannot commit even a ½-time graduate student because funding is not enough for an assistantship nor the ISU required tuition payment. I secured in-kind help from Nachurs/Alpine; they will provide the many gallons of fluid 0-0-30 fertilizer needed for the trials. The FAR support will be used to be able to establish at least three trials this year.

APPENDIX 1

Grain Yield, Plant Potassium Uptake, and Residual Soil Potassium as Affected by Potassium Fertilization in Corn and Soybean

Adapted from a Poster Presentation at the 2006 Annual Meeting of the ASA-CSSA-SSSA by M.W. Clover, A.P. Mallarino, and P.A. Barbagelata

Introduction

Soil-test K (STK) and K removal with harvest are used to determine K fertilization rates for crops. Field soil-test calibrations and reliable estimates of K removal are needed to optimize K management. Many studies and surveys have shown that K concentration in soybean grain is much higher than in corn grain and that the amount of K removed with harvest usually is greater for soybean. Research in Iowa and the Midwest has shown that K fertilization tends to increase K uptake by these crops and the K concentration of vegetative tissues even when there is little or no yield response. Comparatively less research suggested that K fertilization effects on grain K concentration are lower and inconsistent. More research is needed to better understand the magnitude of fertilization effects on grain yield, K uptake, and K removal for corn and soybean.

Objectives

The objectives of this study were to study the relative magnitudes of K fertilization on corn and soybean grain yield; young plants, leaves, and grain K concentrations; K removal, and post-harvest STK.

Materials and Methods

Eighteen conventional plot trials were established in Iowa from 2003 to 2005. Five K fertilizer rates consisting of 0, 34, 67, 134, and 202 kg K_2O ha_{-1} (KCl) were broadcast to each plot of four replications before tillage. Sites with corn residue were chisel plowed while sites with soybean residue were disked. Each plot measured 12 to 18 m in length and 9 to 12 m in width depending on the site. Treatments and replications were arranged as a randomized complete-block design. Soil-test P was maintained at optimum or higher levels while a rate of 150 kg N ha^{-1} was applied in spring before corn. Soil samples (12 cores, 15-cm depth) were taken from each plot before K application and following crop harvest. Soil samples were analyzed for K by the ammonium acetate test. The aboveground portion of 10 plants was sampled at the V5 to V6 growth stage to assess early growth and K uptake. Leaf K concentration was assessed by sampling and analyzing the blade portion of leaves opposite and below the ear from 10 corn plants at the 60 to 80% silking stage and the three top, fully mature triofoliolate leaves of 10 soybean plants at the R2 stage. Grain yield was adjusted to 155 and 130 g kg^{-1} moisture for corn and soybean, respectively. The vegetative plant parts and grain were dried at 65 °C, weighed (except the leaves) and analyzed for total K concentration.

Analysis of variance was conducted on grain yield for each site to determine whether or not there was a response ($P \leq 0.1$) to K. The sites were classified as yield responsive or non-responsive for both corn and soybean. Data for sites within each resulting four groups (corn or soybean, yield responsive or non-responsive) were averaged to describe the average response of early plant weight, plant K concentration, plant K uptake, leaf K concentration, grain K concentration, K removal, and post-harvest STK. Plant responses were described by fitting linear, quadratic, linear-plateau, and quadratic-plateau models. Complex models are shown only when their fit resulted in significant smaller ($P < 0.1$) residual error compared with simpler models. The highest K rate applied is considered as the rate that produced the maximum response when the estimated rate was higher.

Results

Potassium fertilization significantly increased yields at 7 of 18 sites, all of which tested near the boundary of the Optimum (130-171 mg K kg^{-1}) and High Iowa STK interpretation classes. However, 7 non-responsive sites tested Optimum (3 corn sites and 4 sites) and one corn site tested Low. The mean grain yields of the responsive corn sites showed a curvilinear response up to 202 kg K ha^{-1}, the highest rate applied. The mean yields of responsive soybean sites showed a curvilinear response up to 181 kg K ha^{-1}. Potassium fertilization seldom increased early growth of either crop (data not shown).

Potassium fertilization significantly increased early plant K concentration, early plant K uptake, and leaf K concentration for both crops regardless of the yield response. These responses were slightly higher for yield responsive sites than for non-responsive sites, and there was little difference in the K rate that produced the maximum K concentration or uptake. The magnitudes of responses were higher than for grain yield, K concentration, or K removal.

Potassium fertilization increased grain K concentration of soybean sites regardless of the yield response but did not increase K concentration of corn grain. In soybean, grain K concentration responded up to the highest K rate applied (202 kg ha^{-1}). Potassium fertilization increased grain K removal only for corn and soybean responsive sites.

On average, post-harvest STK of yield responsive sites was below the average initial STK values, even for K fertilization rates as high as 202 kg K ha^{-1}, and STK was increased by fertilization in corn sites but not in soybean sites. In non-responsive sites of both crops, STK remained at or below the initial average when low rates of K were applied but was increased by higher K rates. Potassium removal did not completely explain the differences in post-harvest STK between yield responsive and non-responsive sites. These differences might be explained by undetermined interactions between K removal, K recycling in crop residues, and K equilibria in soil K pools.

Conclusions

Potassium concentration of corn and soybean young plants and leaves showed a significant response to K fertilization regardless of the grain yield response. Potassium fertilization seldom increased early growth of either crop at yield responsive or non-responsive sites. Grain K removal was increased by K fertilization only in corn and soybean responsive sites. Amounts of K removed with grain harvest did not explain large differences in post-harvest STK between yield responsive and non-responsive sites.

Acknowledgments

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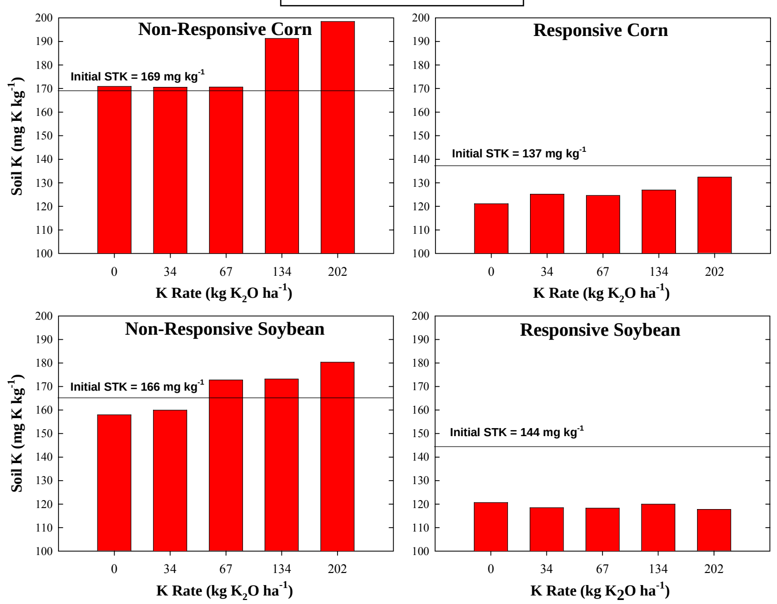
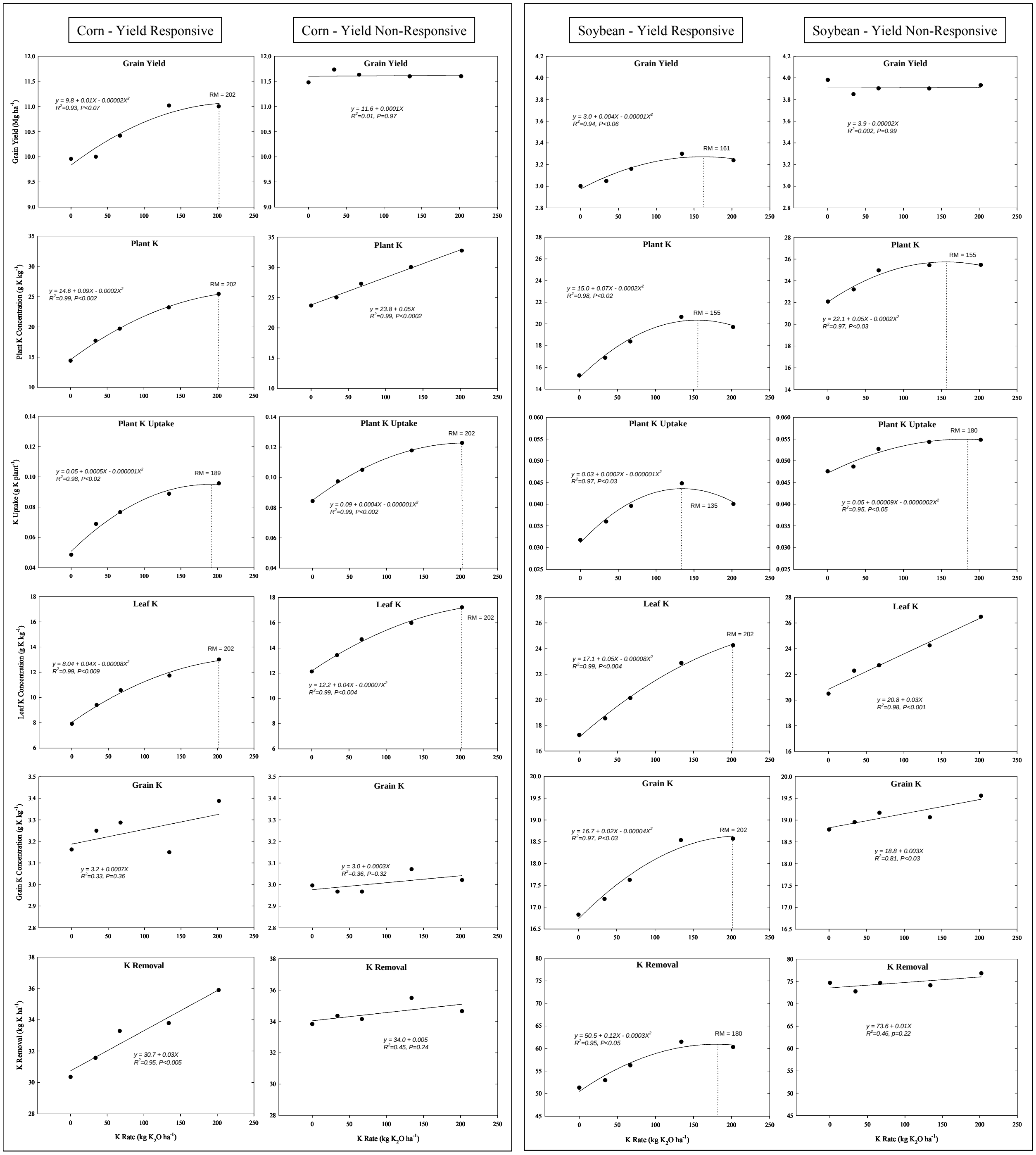
Site Information and Grain Yield Response

Site	Year	County	Crop	Soil Classification: Series	Soil Classification: Subgroup	Initial STK	Yield Response
						mg kg^{-1}	$P < F$
1	2003	Boone	SB	Webster	Typic Endoaquolls	153	0.05
2	2003	Boone	CO	Webster	Typic Endoaquolls	133	0.07
3	2003	O'Brien	SB	Galva	Typic Hapludolls	154	ns
4	2003	O'Brien	CO	Galva	Typic Hapludolls	173	0.07
5	2003	Washington	CO	Mahaska	Aquertic Argiudolls	141	0.03
6	2003	Washington	SB	Mahaska	Aquertic Argiudolls	130	0.01
7	2003	Boone	CO	Clarion	Typic Hapludolls	117	ns
8	2004	Floyd	CO	Clyde	Typic Endoaquolls	196	ns
9	2004	Floyd	SB	Kenyon	Typic Hapludolls	170	ns
10	2004	Hancock	CO	Nicollet	Aquic Hapludolls	162	ns
11	2004	Hancock	SB	Canisteo	Typic Endoaquolls	138	ns
12	2005	Boone	SB	Canisteo	Typic Endoaquolls	163	ns
13	2005	Boone	SB	Canisteo	Typic Endoaquolls	139	0.04
14	2005	Boone	CO	Nicollet	Aquic Hapludolls	234	ns
15	2005	O'Brien	SB	Primghar	Aquic Hapludolls	213	ns
16	2005	O'Brien	CO	Primghar	Aquic Hapludolls	170	0.04
17	2005	Washington	SB	Nira	Oxyaquic Hapludolls	148	ns
18	2005	Washington	CO	Taintor	Vertic Argiaquolls	134	ns

Post-Harvest STK





Corn - Yield Responsive
Corn - Yield Non-Responsive
Soybean - Yield Responsive
Soybean - Yield Non-Responsive
Grain Yield
Grain Yield (Mg ha^{-1})
$y = 9.8 + 0.01X - 0.00002X^2$
$R^2=0.93, P<0.07$
RM = 202
$y = 11.6 + 0.0001X$
$R^2=0.01, P=0.97$
$y = 3.0 + 0.004X - 0.00001X^2$
$R^2=0.94, P<0.06$
RM = 161
$y = 3.9 - 0.00002X$
$R^2=0.002, P=0.99$
Plant K
Plant K Concentration (g K kg^{-1})
$y = 14.6 + 0.09X - 0.0002X^2$
$R^2=0.99, P<0.002$
RM = 202
$y = 23.8 + 0.05X$
$R^2=0.99, P<0.0002$
$y = 15.0 + 0.07X - 0.0002X^2$
$R^2=0.98, P<0.02$
RM = 155
$y = 22.1 + 0.05X - 0.0002X^2$
$R^2=0.97, P<0.03$
RM = 155
Plant K Uptake
K Uptake (g K plant^{-1})
$y = 0.05 + 0.0005X - 0.000001X^2$
$R^2=0.98, P<0.02$
RM = 189
$y = 0.09 + 0.0004X - 0.000001X^2$
$R^2=0.99, P<0.002$
RM = 202
$y = 0.03 + 0.0002X - 0.000001X^2$
$R^2=0.97, P<0.03$
RM = 135
$y = 0.05 + 0.00009X - 0.0000002X^2$
$R^2=0.95, P<0.05$
RM = 180
Leaf K
Leaf K Concentration (g K kg^{-1})
$y = 8.04 + 0.04X - 0.00008X^2$
$R^2=0.99, P<0.009$
RM = 202
$y = 12.2 + 0.04X - 0.00007X^2$
$R^2=0.99, P<0.004$
RM = 202
$y = 17.1 + 0.05X - 0.00008X^2$
$R^2=0.99, P<0.004$
RM = 202
$y = 20.8 + 0.03X$
$R^2=0.98, P<0.001$
Grain K
Grain K Concentration (g K kg^{-1})
$y = 3.2 + 0.0007X$
$R^2=0.33, P=0.36$
$y = 3.0 + 0.0003X$
$R^2=0.36, P=0.32$
$y = 16.7 + 0.02X - 0.00004X^2$
$R^2=0.97, P<0.03$
RM = 202
$y = 18.8 + 0.003X$
$R^2=0.81, P<0.03$
K Removal
K Removal (kg K ha^{-1})
$y = 30.7 + 0.03X$
$R^2=0.95, P<0.005$
$y = 34.0 + 0.005$
$R^2=0.45, P=0.24$
$y = 50.5 + 0.12X - 0.0003X^2$
$R^2=0.95, P<0.05$
RM = 180
$y = 73.6 + 0.01X$
$R^2=0.46, p=0.22$
K Rate (kg K_2O ha^{-1})

APPENDIX 2

Summary Results of a Study of Corn Response to Potassium Fertilization and Genetic Rootworm Resistance

Table 1. Corn yield and rootworm incidence at four short-term trials.

		Location (Research Farm)				
Hybrid	Potassium	NERF	NIRF	SERF	SWRF	Avg
	lb K_2O/acre	-------------------- Grain Yield (bu/acre) -------------------				
Susceptible	0	168.3	182.8	212.5	186.7	187.6
	30	164.0	183.7	212.9	189.0	187.4
	60	166.7	186.0	206.4	180.9	185.0
	120	154.4	189.6	200.1	195.5	184.9
	180	166.6	185.2	195.3	186.5	183.4
	Avg	164.0	185.4	205.4	187.7	185.7
Resistant	0	180.1	177.9	216.2	203.2	194.3
	30	177.7	192.7	221.2	188.0	194.9
	60	177.5	190.4	223.7	184.3	194.0
	120	172.4	194.7	212.2	190.2	192.4
	180	177.8	197.5	218.5	196.8	197.6
	Avg	177.1	190.6	218.3	192.5	194.6

Table 2. Rootworm incidence at four short-term trials.

		Location (Research Farm)				
Hybrid	Potassium	NERF	NIRF	SERF	SWRF	Avg
	lb K_2O/acre	------------------ Root Feeding Index ------------------				
Susceptible	0	0.78	0.65	2.50	0.06	1.00
	60	1.12	0.38	2.20	0.07	0.94
	180	0.92	1.04	2.43	0.08	1.12
	Avg	0.94	0.69	2.37	0.07	1.02
Resistant	0	0.01	0.04	0.38	0.01	0.11
	60	0.02	0.01	0.20	0.01	0.06
	180	0.01	0.01	0.10	0.01	0.03
	Avg	0.01	0.02	0.22	0.01	0.07