BETTER FERTILITY AND AGRONOMIC MANAGEMENT HELPS TO LESSEN THE CONTINUOUS CORN YIELD PENALTY

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EXECUTIVE SUMMARY:

There is wide acceptance that corn (*Zea mays* L.) grain yields are generally greater when corn is rotated with soybean [*Glycine max* (L.) Merr.] than when grown continuously, even though producers of the Midwestern U.S., are adopting more continuously grown corn acres. As a result, there is a need to determine how to overcome the yield penalty associated with continuous corn production. In this project we assessed the yield penalty associated with 11th year continuous corn vs long-term corn following soybean grown in either a standard or an intensive management system, with contrasting plant populations. The standard management system consisted of a base rate of nitrogen fertilizer, no additional fertility, and no fungicide application. The intensive management system consisted of additional sidedressed nitrogen fertilizer, broadcast and banded fertility, and a foliar fungicide application. Additionally, two levels of plant population (32,000 vs 45,000 plants acre^{-1}) were applied across management systems. Eight commercially-available hybrids that had distinctly different genetic makeups were evaluated across all treatments (previous crop, management, and planting population). We determined highly significant treatment effects for cropping rotation, hybrid selection, and agronomic management.

This study demonstrated that:

- The highest yields were consistently achieved in the corn-soybean rotation with intensive management (i.e., better fertility, sidedressed nitrogen, and a foliar fungicide application) and with the standard planting density.
- The continuous corn yield penalty still existed under the favorable weather conditions of 2014, across treatments the penalty was 28.9 bu acre^{-1} (-15%), consistent with 2011 and 2012 yield reductions (-37%).
- Without enhanced fertility (i.e. standard management) continuous corn production yielded significantly less grain than corn following soybean (-37.9 bu acre^{-1}).
- Intensive agronomic management significantly improved grain yield across rotations (40.9 bu acre^{-1}), through increased kernel number and kernel weight.
- There was a 60% greater yield response to high tech management in continuous corn vs the corn-soybean rotation suggesting intensified management as a method to mitigate the continuous corn yield penalty (49.9 vs 31.8 bu acre^{-1}).
- With select hybrids, intensive management reduced the continuous corn yield penalty by 60 to 80%.
- Continuous corn did not magnify the effect of increased planting density as originally predicted, and the high density only resulted in a modest reduction in yield (average of -3.6 bu acre^{-1} across cropping systems).

- There was higher accumulation of potassium by V6 plants grown under continuous corn compared to rotated corn, which occurred in both plant populations and management levels, and which was primarily the result of a higher tissue concentration.

INTRODUCTION:

Through research to obtain high yield corn, the Crop Physiology Laboratory at the University of Illinois, Urbana-Champaign has identified seven principle factors contributing to increased corn yields. Those factors include: weather, nitrogen, hybrid, previous crop, population, tillage, and growth regulators. With producers of the Midwest adopting more continuously grown corn acres, further research conducted by the Crop Physiology Laboratory indicated that the primary agents of yield reduction in continuous corn were nitrogen availability, residue accumulation, and weather (Gentry et al., 2013). To alleviate the continuous corn yield penalty (CCYP), the current study isolated the effects of better fertility and agronomic management, planting population and hybrid selection for increased corn yields.

It is widely accepted that there is a yield reduction in continuously grown corn vs a corn following soybean rotation. This reduction was emphasized by the nationwide heat and drought stress of 2012. Despite the near-perfect, presumably stress-free weather conditions of 2014, however, the CCYP still existed. This study further evaluated the magnitude of the CCYP as a function of the weather in combination with management, planting population, and hybrid selection.

Management plays a critical role in offsetting negative causative effects of continuously grown corn. With expectations that the penalty associated with continuous corn can be reduced with intelligent intensification of agronomic management, management was further evaluated in the current study. Intensive management (i.e., high technology) encompassed additional nitrogen fertilizer, broadcast (i.e., K and B source) and banded (i.e., P, S, Zn and N source) fertility, and a foliar fungicide. Compared to standard management practices, intensive management extends the growing season of the crop, including the grain filling period. Improved agronomic management combined with ideal weather conditions may improve kernel number and kernel weight yield components compared to the stressed environment of 2012.

To improve corn yields past the 300 bu acre^{-1} goal, increased planting population is a necessity. Previous work suggested that under ideal growing conditions population would contribute to increased yields in the corn-soybean rotation. Increased plant population, however, results in a more stressful environment exacerbating the yield reducing effects of continuously grown corn. We believe additional nutrient management can mitigate the magnifying effects of increased population. Contrasting planting populations were used to further investigate the effect of population on the yield penalty associated with corn following corn.

In previous years of this study hybrid selection significantly influenced the effect of the CCYP. In 2011-2013 the penalty associated with hybrid selection was 5x greater in standard management conditions and 33% greater in intensive management. We believe that hybrids that can tolerate continuous corn are probably those that are more competitive for resources, and as such the proper hybrid selection in combination with intensive management practices will result in a multifaceted approach to alleviate the continuous corn yield penalty. **These three principle factors – management (i.e., fertility and leaf protection), planting population, and hybrid selection – were evaluated to determine their role in increasing yield through intensive management, and as means of reducing the continuous corn yield penalty.**

RESEARCH APPROACH:

The CCYP was evaluated using commercially-available hybrids that had distinctly different genetic makeups. Hybrids were tested in standard and intensive management systems with contrasting plant populations (Table 1). The trial was planted April 27, 2014 at the Crop Sciences Research and Education Center in Champaign, IL using a long-term site dedicated to crop rotation research. The site was weed- and disease-free, level and well-drained, and well-suited to provide evenly distributed soil fertility, pH, soil organic matter, and water availability. Plots were 37.5 feet in length with 30-inch row spacing and four rows in width.

The standard management system included a base nitrogen rate of 180 lbs N acre^{-1} as urea and planted to obtain an approximate final density of 32,000 plants acre^{-1}. The intensive management system was planted to obtain an approximate final stand of 45,000 plants acre^{-1} with an additional 60 lbs N acre^{-1} sidedress application stabilized with a urease inhibitor, banded fertility 4 to 6 inches directly beneath the crop row preplant to provide enhanced P (100 lbs P_2O_5 acre^{-1}), S (25 lbs acre^{-1}), and Zn (2.5 lbs acre^{-1}) nutrition (supplied as Mosaic's MicroEssentials-SZ; 12 – 40 – 0 – 10S – 1Zn), broadcast fertility just prior to planting to provide enhanced K (75 lbs K_2O acre^{-1}) and B (0.4 lbs B acre^{-1}) (supplied as Mosaic's Aspire; 0 – 0 – 58 – 0.5B), and protected with a foliar fungicide application at Vt/R1.

To assess the range in rotational yields (i.e., CCYP), eight commercially-available hybrids were selected, coded, and grown across 11th year corn and first year corn following soybean rotations. Treatments were arranged in a split-split plot design with crop rotation as the main plot, hybrid as the split plot, and treatment as the split-split plot. A total of three replications were evaluated for a total of 192 plots.

Table 1. Treatments implemented at Champaign, IL during 2014.

Trt	Management Level	Plant Population (plants acre^{-1})
1	Standard	32,000
2	Standard	45,000
3	High Tech	45,000
4	High Tech	32,000

Measured Parameters

Soil samples were taken from plot areas in continuous corn and corn following soybean during the growing season (V7 growth stage) to assess fertility levels. Corn tissue sampling for nutrient analysis was conducted on 6 June 2014 (V6), and the plant tissue was analyzed for N, P, K, Ca, Mg, S, Zn, Mg, B, Fe, and Cu. Only the nutrients that were part of the fertilizer products are presented and include N, P, K, S, and Zn are presented.

The center two rows of each plot were mechanically harvested for measurement of grain yield. Subsamples of harvested grain were used for determination of grain quality (i.e., protein, oil, and starch) using a NIT grain analyzer. Yield components (individual seed weight and seed number) were measured for each plot.

RESULTS:

With below-average temperatures and above-average precipitation throughout much of the growing season, corn grown in this trial experienced very little weather-induced heat or moisture stress. As a result, conditions were generally conducive to favorable grain yields. Cropping rotation, hybrid selection, and agronomic management significantly influenced all of the measured parameters, with numerous interactions among the fixed effects for most parameters (Table 2).

Table 2. Analysis of variance for fixed effects on grain yield, yield components, and yield quality for the continuous corn trial conducted at Champaign, Illinois during 2014.

Fixed Effect	Yield	V6 Biomass	Seed Number	Seed Weight	Oil	Protein	Starch
				P > F			
Rotation (R)	<0.001	0.349	0.009	0.003	0.035	0.001	0.011
Hybrid (H)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R x H	<0.001	0.001	0.020	0.342	<0.001	<0.001	<0.001
Management (M)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R x M	<0.001	0.444	0.001	0.046	0.067	<0.001	0.583
H x M	0.125	0.148	0.600	0.554	0.001	0.197	0.004
R x H x M	0.101	0.043	0.132	0.369	0.355	0.051	0.559
Population (P)	0.018	<0.001	0.005	<0.001	<0.001	<0.001	<0.001
R x P	0.372	0.457	<0.001	<0.001	0.937	0.942	0.646
H x P	0.145	0.257	0.090	0.440	0.096	0.599	0.165
R x H x P	0.892	0.848	0.065	0.091	0.403	0.704	0.238
M x P	0.692	0.131	0.286	0.453	0.007	0.010	0.002
R x M x P	0.711	0.255	0.973	0.653	0.488	0.056	0.505
H x M x P	0.750	0.558	0.853	0.998	0.557	0.362	0.179
R x H x M x P	0.224	0.062	0.304	0.851	0.278	0.665	0.228

Yield

Rotation, hybrid, management, and population treatments significantly influenced grain yield (Table 2). When averaged across all treatment combinations, the CCYP associated with 11^{th} year continuous corn compared to first year corn following soybean was 28.9 bu acre^{-1} (-15%; $P < 0.001$). Although increased planting densities decreased yield by an average of 3.6 bu acre^{-1}, continuous corn did not magnify this response as originally predicted (Table 3). Unexpectedly, the yield reduction associated with increased planting densities was greater in the corn-soybean rotation (-5.1 bu acre^{-1}) vs continuous corn (-2.1 bu acre^{-1}).

Intensive agronomic management significantly improved grain yield across crop rotations (40.9 bu acre^{-1}; Table 4) but the effect was nearly 60% greater in continuous corn vs the corn-soybean rotation (49.9 vs 31.8 bu acre^{-1}; Table 5). These data clearly suggest that the continuous corn yield penalty can be ameliorated with agronomic management. Although the highest yields were consistently achieved in the corn-soybean rotation with intensive management and low planting densities, individual hybrids were found to respond differently to management. Select hybrids, for example, were able to nearly overcome the CCYP with intensive management (Table 5). The CCYP was reduced by 60 to 80% with intensive management for four hybrids: 2 (58%), 6 (76%), 7 (72%), and 8 (77%).

In general, the effect of management was lower and more stable (e.g., predictable) in the corn-soybean rotation in contrast to the continuous corn (Table 5). Additionally, the effect of population was not consistent with the past work which showed a yield advantage in the corn-soybean rotation and a yield disadvantage in continuous corn under higher planting densities. Conversely, in the current study lower population resulted in higher yields with each rotation and management system (Table 3). Contradictory to expectations the ideal weather conditions of 2014 did not overcome the increased inter-plant competition of higher planting densities in the corn-soybean rotation.

Table 3. Effect of management level and plant population (plants acre^{-1}) on grain yield for eight Monsanto hybrids. Hybrids were grown in continuous corn (11th year) and following soybean rotations at Champaign, IL in 2014.

Rotation	Continuous Corn				Soybean/Corn Rotation			
Management	Standard		High Tech		Standard		High Tech	
Population	32,000	45,000	32,000	45,000	32,000	45,000	32,000	45,000
Hybrid	bu acre^{-1}							
1	158.9	161.8	210.7	211.3	202.2	210.0	233.0	247.1
2	178.1	169.4	221.2	227.8	208.8	199.7	236.8	237.7
3	150.6	152.4	185.1	174.5	194.1	180.5	223.2	216.4
4	174.1	170.6	232.7	226.6	223.5	207.8	253.7	245.5
5	170.2	165.5	218.1	211.2	217.4	208.9	248.9	242.6
6	181.6	184.5	237.1	237.5	218.1	203.6	243.3	245.0
7	163.9	160.4	219.5	228.1	201.0	212.0	244.4	227.8
8	164.6	161.0	216.9	207.6	197.3	189.0	224.0	214.4
Average	167.7	165.7	217.7	215.6	207.8	201.5	238.4	234.5

Table 4. Effect of management level and plant population on grain yield for eight Monsanto hybrids. Hybrids were grown in continuous corn (11th year) and following soybean rotations at Champaign, IL in 2014. Values are the average of the plant populations, 32,000 and 45,000 plants acre^{-1}.

Rotation	Continuous Corn		Soybean/Corn Rotation	
Management	Standard	High Tech	Standard	High Tech
Hybrid	bu acre^{-1}			
1	160.4	211.0	206.1	240.0
2	173.7	224.5	204.3	237.2
3	151.5	179.8	187.3	219.8
4	172.4	229.7	215.7	249.6
5	167.8	214.7	213.2	245.7
6	183.1	237.3	210.9	244.1
7	162.2	223.8	206.5	236.1
8	162.8	212.3	193.1	219.2
Average	166.7	216.6	204.6	236.5

Table 5. The yield penalty associated with continuous corn under two levels of crop management and the yield response to high tech management under both cropping rotations at Champaign, IL in 2014.Values are the average of the plant populations 32,000 and 45,000 plants acre^{-1}.

	Continuous Corn Yield Penalty		Yield Response to High Tech Management	
	Management Level		Cropping System	
Hybrid	Standard	High Tech	Continuous Corn	Corn/Soybean
	Δbu acre^{-1}			
1	45.8	29.0	50.7	33.9
2	30.5	12.7	50.8	33.0
3	35.8	40.0	28.3	32.5
4	43.3	19.9	57.3	33.9
5	45.4	31.1	46.8	32.6
6	27.8	6.8	54.2	33.3
7	44.4	12.3	61.7	29.6
8	30.4	6.9	49.5	26.0
Average	37.9	19.8	49.9	31.8

Table 6. Effect of rotation, management, and planting density on yield components and grain quality at Champaign, IL during 2014. Kernel weight is measured in mg seed^{-1} at 0% moisture concentration. Values represent the average of hybrids 1-8.

Continuous Corn							
Management	**Population**	**Yield**	**Kernel Number**	**Kernel Weight**	**Oil**	**Protein**	**Starch**
	plants acre^{-1}	bu acre^{-1}	seed m^{-2}	mg seed^{-1}	%		
Standard	32,000	167.7b	4133d	216.3c	3.60b	6.23c	74.60b
Standard	45,000	165.6b	4436c	199.6d	3.47c	6.13c	74.88a
High Tech	32,000	217.7a	4681b	248.3a	3.82a	7.14a	73.87c
High Tech	45,000	215.6a	5088a	226.1b	3.51bc	6.77b	74.68ab

Corn/Soybean Rotation							
Management	**Population**	**Yield**	**Kernel Number**	**Kernel Weight**	**Oil**	**Protein**	**Starch**
	plants acre^{-1}	bu acre^{-1}	seed m^{-2}	mg seed^{-1}	%		
Standard	32,000	207.2b	4707bc	236.2b	3.79b	7.48c	73.87b
Standard	45,000	201.4c	4581c	237.2b	3.63c	7.26d	74.18a
High Tech	32,000	238.2a	4906a	257.1a	4.07a	7.98a	73.15c
High Tech	45,000	234.6a	4891ab	256.7a	3.80b	7.73b	73.80b

Mean separation tests were conducted using an LSD calculation with the Tukey adjustment. Different letters within a main effect analyzed by rotation are significantly different at α=0.05.

Yield Components and Grain Quality

The improved grain yields as a result of intensified agronomic management increased both kernel number and kernel weight (Table 4 and Table 6). When grown with standard management, the yield advantage of the corn-soybean rotation over continuous corn was due to both higher kernel number and heavier kernel weight (Table 6). Conversely, with intensive management the difference in yield between rotated and continuous corn was the result of differences in kernel weight as kernel numbers were similar for both cropping systems. In continuous corn, the increased kernel number from higher planting densities was offset by a lower kernel weight, while in the corn-soybean rotation higher planting populations led to decreased kernel number with equivalent kernel weight (Table 6).

The nearly 60% greater yield response in continuous corn vs the corn-soybean rotation with intensified management was associated with greater kernel number (+15% vs +5%) and heavier kernel weight (+15% vs +10%) (Table 6). The consistently higher yields of the corn-soybean rotation were derived from a combination of improved kernel number and kernel weight.

For both cropping systems, peak oil and protein concentrations were achieved with intensified management at lower planting densities (Table 6). Protein levels were notably higher in the corn-soybean rotation vs continuous corn suggesting additional nitrogen availability for protein production. Oil levels were also higher with the corn-soybean rotation, while starch levels were slightly lower (Table 6).

Biomass and Nutrient Accumulation

Surprisingly, early season biomass accumulation was greater in the continuous corn compared to the corn-soybean rotation (Table 7). However, across planting densities, there was a larger early season biomass response to intensified management in the corn-soybean rotation. With this sampling occurring prior to the additional application of sidedressed nitrogen to the high tech system, management differences in crop growth must have resulted from the broadcasted Aspire (K and B) and banded MicroEssentials (P, S, Zn) that occurred at planting. Regardless of crop rotation, greater planting populations resulted in increased biomass accumulation (Table 7).

Table 7. Effect of management level and plant population (plants acre^{-1}) on V6 biomass accumulation for eight Monsanto hybrids. Hybrids were grown in continuous corn (11th year) and following soybean rotations at Champaign, IL in 2014.

Rotation	Continuous Corn				Soybean/Corn Rotation			
Management	Standard		High Tech		Standard		High Tech	
Population	32,000	45,000	32,000	45,000	32,000	45,000	32,000	45,000
Hybrid	lbs acre^{-1}							
1	327	403	504	672	288	363	498	611
2	282	489	582	609	281	330	533	670
3	349	509	766	770	322	369	508	635
4	377	469	562	746	377	483	630	791
5	363	372	661	779	352	433	635	670
6	341	458	497	704	319	422	562	729
7	297	460	581	763	286	359	599	722
8	323	429	586	680	264	384	551	731
Average	332	448	593	716	311	393	565	695

Early season nutrient accumulation was two times greater with intensified management for both cropping systems (Table 8). This difference was primarily derived from an increase in biomass (Table 7). Unlike all the other nutrients, potassium concentrations of the V6 plants were approximately 70% higher in continuous corn vs corn-soybean rotations (data not shown), resulting in a net increase in K_2O uptake of nearly 80% for plants grown under continuous corn (Table 8). The higher potassium uptake of plants grown with continuous corn occurred for all hybrids and at both planting densities and management levels (Table 9).

Table 8. Effect of management level and plant population (plants $acre^{-1}$) on V6 biomass nutrient uptake. Hybrids were grown in continuous corn (11th year) and following soybean rotations at Champaign, IL in 2014. Values represent the average of hybrids 1-8.

Rotation	Continuous Corn				Soybean/Corn Rotation			
Management	Standard		High Tech		Standard		High Tech	
Population	32,000	45,000	32,000	45,000	32,000	45,000	32,000	45,000
Nutrient	lbs $acre^{-1}$							
N	15.9	20.0	27.9	31.7	14.8	17.9	27.1	29.8
P_2O_5	3.4	4.1	6.4	7.2	3.1	3.6	6.2	6.7
K_2O	11.9	14.8	19.4	20.4	6.2	7.2	11.0	12.1
S	0.9	1.1	1.7	2.0	0.9	1.1	1.8	2.0
Zn (oz $acre^{-1}$)	5.8	7.2	9.7	10.5	6.0	7.2	10.7	12.0

Table 9. Effect of management level and plant population (plants $acre^{-1}$) on V6 biomass nutrient uptake of K_2O. Hybrids were grown in continuous corn (11th year) and following soybean rotations at Champaign, IL in 2014.

Rotation	Continuous Corn				Soybean/Corn Rotation			
Management	Standard		High Tech		Standard		High Tech	
Population	32,000	45,000	32,000	45,000	32,000	45,000	32,000	45,000
Hybrid	lbs K_2O $acre^{-1}$							
1	10.5	12.4	13.9	19.9	4.9	5.6	8.8	10.2
2	10.0	15.8	17.1	17.6	5.1	5.6	8.5	10.8
3	13.0	17.4	29.8	14.6	5.8	5.9	10.4	11.5
4	13.8	16.1	20.7	24.3	8.5	9.1	12.8	13.3
5	12.4	13.0	21.0	18.7	6.7	7.5	11.1	11.2
6	13.1	14.7	16.0	23.5	6.7	7.7	12.1	12.5
7	10.8	15.5	17.5	23.1	6.6	9.0	12.9	13.8
8	11.9	13.9	19.1	21.4	5.2	7.2	11.6	13.3
Average	11.9	14.8	19.4	20.4	6.2	7.2	11.0	12.1

Soil Results

Soil organic matter, CEC, and pH were equivalent in both cropping systems suggesting that soil quality was evenly distributed throughout the trial and suggesting that differences in plant growth and yield between the two rotations were not due to any of these quantities (Table 10). At greater depths in the soil profile there were marked reductions in P and K levels, conversely, there were no or minor differences in pH, CEC, Ca or Mg levels as a function of soil depth.

In-season soil test results measured a slightly higher potassium level in continuous corn compared to the corn-soybean rotation (Table 10). Because the amount of potassium removal would be greater in an average yielding soybean crop than an average yielding corn crop, the continuous corn soil may have had more K returned to the soil via the non-grain biomass. The opposite was true for P, Ca, and Mg which were measured at higher levels in the corn-soybean rotation.

Table 10. In-season (at the V7 growth stage) soil test results for the Monsanto continuous corn trial conducted in Champaign, IL during 2014. Soils tests were conducted to assess baseline soil fertility and supply capacities important for season-long nutrient availability.

			Continuous Corn				
Depth	**Organic Matter**	**CEC**	**pH**	**P**	**K**	**Ca**	**Mg**
inches	%	meq/100g	units		ppm		
0-6	4.2	24.0	5.8	40	237	3064	607
6-12	3.9	23.4	6.0	19	102	3175	604
			Corn/Soybean				
Depth	**Organic Matter**	**CEC**	**pH**	**P**	**K**	**Ca**	**Mg**
inches	%	meq/100g	units		ppm		
0-6	4.2	23.6	6.1	46	225	3317	628
6-12	3.8	22.9	6.3	19	107	3474	588

CONCLUSION:

Although the near-perfect, presumably stress-free weather conditions of 2014 were more favorable than previous years of this study, the CCYP was not eliminated. In this ideal growing season, cropping rotation, hybrid selection, and agronomic management significantly influenced all of the measured parameters, with numerous interactions. The highest yields of this study were achieved in the corn-soybean rotation with intensive management (i.e., enhanced fertility and leaf protection) and standard planting density.

Clearly, the data suggest the CCYP can be mitigated with intensified management. Without enhanced fertility (i.e. standard management) continuous corn production yielded significantly less grain than corn following soybean. Intensive agronomic management increased grain yield by enhancing kernel number and kernel weight, while the advantage of the corn-soybean rotation over continuous corn was more due to increased kernel weight. Through yield component responses, there was a 60% greater yield response to high tech management in continuous corn vs the corn-soybean rotation.

Attributed to the unique weather of 2014, increased planting populations resulted in minimal yield reductions regardless of previous crop, and surprisingly, the yield penalty from continuous corn was not magnified with the higher planting density as was observed in previous years. In continuous corn, the increased kernel number from higher planting densities was offset by a lower kernel weight, while in the corn-soybean rotation higher planting populations led to decreased kernel number with equivalent kernel weight. These patterns resulted in no yield advantage with increased planting population.

There were notable differences in grain quality components as a function of crop rotation, particularly grain protein. Grain from the corn-soybean rotation had protein levels that were notably higher than continuous corn grain suggesting additional nitrogen availability for protein production.

There was higher V6 biomass of the continuous corn plants regardless of the plant population or the management level, resulting in increased levels of nutrient accumulation for continuous corn. Interestingly, as a function of higher potassium concentrations in the continuous corn tissues, there was a higher accumulation of potassium in V6 plant tissues grown under continuous corn compared to rotated corn; which again occurred with both plant populations and in both management levels. Potassium was the only mineral nutrient altered to any appreciable effect due to crop rotation. The reason for this difference is not clear, but may be a function of the greater surface residue in the continuous corn plots, or to differences in removal with the grain of the previous crop. Because the amount of potassium removal would be greater in an average yielding soybean crop than an average yielding corn crop, the continuous corn soil may have had more K returned to the soil via the non-grain biomass compared to rotated corn.

The initial results of this ongoing work suggest that intensive management and hybrid selection will continue to play important roles in managing the CCYP. Additionally in less favorable growing years, we believe that planting population will have a greater impact in managing the yield penalty associated with continuous corn. The significant impact of key factors - management, planting population, and hybrid selection - on the magnitude of the CCYP in this study shows that continuous corn can be managed for better productivity.

REFERENCES:

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