New corn research findings and implications: Performance of era and modern hybrids; Hybrids for corn following corn; Impact of late vegetative stand reduction

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Research is never done. New questions remain as soon as we address the old ones. With that in mind, our corn research program at Iowa State moves in step with our extension program. In most cases, our research results feed directly into our extension programming. In this article, we present draft abstracts and data from three of our nearly-completed projects. We welcome your comments on these as well as the next research questions that need addressed!

Maize dry matter and nutrient uptake in era hybrids released between 1960 and 2007

Matthew J. Boyer, Roger W. Elmore and Lori J. Abendroth. 201_. In preparation for journal submission.

Abstract

Modern corn production practices rely on both advances in management practices and genetics to consistently produce higher yields than in the past. Modern hybrids better tolerate stress when planted at higher plant populations than older hybrids which leads to modern hybrids producing more dry matter and grain. With increased dry matter and grain production, do modern hybrids require more nutrients and demand them at different times throughout the growing season? We investigated dry matter and nutrient accumulation in this two-year field study using two popular commercial hybrids from each of five decades (eras): 1960's, 1970's, 1980's, 1990's, and the 2000's. Hybrids were planted at seeding rates used in the decades in which they were grown. We collected total above-ground biomass at 10 sampling dates (SD) throughout the growing season: V6, V10, V14, VT, R1, R2, R3, R4, R5 and R6. Total dry matter, nitrogen, phosphorous and potassium uptake were determined and analyzed on an area basis and as a percent of total uptake basis for each SD and each era. Grain yields increased 2.2 bu a^{-1} yr^{-1} with grain yields of 132 bu a^{-1} for the 1960's era hybrids and 225 bu a^{-1} for the 2000's era hybrids (Table 1). Dry matter, nitrogen, phosphorous and potassium uptake were greater in the modern hybrids as well. However, when comparing hybrids from the different eras on percentage of total uptake at any given SD, dry matter, nitrogen, phosphorous and potassium only varied on a few scattered sample dates from which we could determine no pattern. When averaged across all eras, at silking, R1, 45% of total dry matter was present. At the same growth stage uptake for nitrogen, phosphorous and potassium was 72%, 58%, and 97%, respectively. Potassium uptake was the most rapid of all nutrients; whereas phosphorous uptake was the slowest.

Although percent dry matter accumulation and nutrient uptake were similar across hybrids from all eras, the newer hybrids accumulated dry matter and nutrients at a faster rate. By using actual dry matter and nutrient accumulation data, producers can better manage nutrient removal rates as well as nutrient application timing to maize crops.

Implications

At typical planting populations for hybrids from each era, the more modern the hybrid, the more dry matter, nitrogen, phosphorous and potassium was accumulated on an area basis. Dry matter and nutrient uptake patterns of modern hybrids did not differ greatly on a percent of uptake at any given growth stage, but did differ in the final amount of dry matter, nitrogen, phosphorous and potassium that they contain. However, when comparing hybrids from the different eras on percentage of total uptake for any given SD, dry matter, nitrogen, phosphorous and potassium only varied on a few scattered SD.

In addition to an increase in dry matter and nutrient uptake in more recent hybrids, when looking at all 10 hybrids across the five eras, we observed an increase in grain yield of 2.2 bu a^{-1} $yr.^{-1}$ very similar to the actual increase in Iowa grain yield from 1960 to 2008. Information from this study is incorporated into the soon-to-be released *Corn Growth and Development*, ISU Extension Publication.

Table 1. Grain, harvest index, and moisture content by era, 2007 & 2008. From Boyer et al.

Era	Grain yield† (bu/acre)	Harvest index	Moisture content
		---------- % ----------	
2000	225.3 a‡	62 a	21.9 a
1990	199.0 b	62 a	21.6 a
1980	177.6 c	59 ab	20.6 b
1970	164.0 d	57 bc	21.7 a
1960	132.8 e	53 c	21.3 ab

† Grain yield adjusted to 15% moisture content

‡ Different letters following a mean within a column indicate differences among eras ($p \leq 0.05$)

Corn hybrid response to previous-year hybrid residue and cropping system

Wade A. Kent, Roger W. Elmore, and Lori J. Abendroth. 201_. In preparation for journal submission.

Abstract

Grain yields decrease when corn follows corn compared to corn grown in rotation with other crops. However, we do not understand well the factors responsible for this reduction. This limits recommendations available to corn growers. Do hybrids grown previously affect current hybrid performance? We conducted field studies to determine: (i) if residue from specific previous-year hybrids affects plant population, moisture, and yield of the current year's corn crop, (ii) evaluate if use of a single hybrid in two consecutive growing seasons influences grain yield, and (iii) compare 2nd year corn yields to corn grown in rotation with soybean. The experiment was conducted at six Iowa locations in 2008 and 2009; three locations in the north, and three in the south. In both 2007 and 2008, three corn hybrids were planted in 60 ft^2 blocks as the main plots. Then, in 2008 and 2009, we planted 12 hybrids on each of the main plots established the previous year. The same 12 hybrids were planted into a nearby field on soybean residue at each location in 2008, but established alongside the other main plots in 2009.

Plant population was not influenced by residues of the three previous-year hybrids. However, plant populations were greater when corn followed soybean compared to 2nd year corn. Likewise, grain moisture content was not influenced by crop rotation or previous-year hybrid residue. And most important, previous-year corn residue did not impact grain yield of the current-year hybrid (Table 2). In addition, the continued use of a single hybrid over two growing seasons did not influence grain yield. As expected though, previous-year crop residue reduced grain yield in both regions of Iowa. Second-year corn yields were 11% and 14% less in the north and south regions, respectively, compared to corn rotated with soybean. Previous-year corn hybrid did not influence plant population, grain moisture, or grain yield.

Implications

Previous-year corn hybrids and cropping sequence did not influence plant populations, grain moisture content, or grain yield. Continued use of a single hybrid over two growing seasons also did not influence grain yield. However, grain yields were greater when corn was rotated with soybean compared to 2nd year corn, reaffirming the results from previous literature. These results reaffirmed that hybrid selection is critical for corn following corn- some hybrids yielded more than others, but techniques may need to change to improve the selection and placement of commercial hybrids recommended for 2nd year corn. The absence of a significant interaction for plant population, grain yield and grain moisture indicates that current-year hybrids are not affected by the previous-year corn residue; we found that the previous hybrid grown did not affect performance of current hybrids. Corn producers should expect grain yields to decline by 10-15% when growing 2nd year corn compared to a corn soybean rotation; however, the yield reduction is not due to the specific previous-year hybrid.

Table 2. Grain yield for the Northern and Southern Iowa trials in 2008 and 2009. From Kent et al.

	North			South	
	2008	2009		2008	2009
Previous year residue[‡]	**Yield (bu/ acre)**	**Yield (bu/ acre)**	**Previous year residue[‡]**	**Yield (bu/ acre)**	**Yield (bu/ acre)**
DKC 52-40	181.6 a[§]	205.5 b	DKC 61-66	196.2 a	202.4 b
DKC 54-46	175.8 a	196.7 b	DKC 60-18	192.7 a	207.1 b
DKC 57-79	179.4 a	192.9 b	DKC 63-74	196.1 a	202.6 b
Soybean	195.3 [¶]	220.9 a	Soybean	227.5	232.7 a
C-C[#]	178.9	198.3	C-C	195.1	204.0
C-C+C-SB[††]	183.2	204.0	C-C+C-SB	203.1	211.2
Current year hybrid[‡‡]			**Current year hybrid**		
DKC 52-43	169.5 ed	205.2 bcd	DKC 60-18	197.4 ab	206.1 c
DKC 54-49	169.3 ed	208.8 bc	DKC 61-69	199.4 ab	224.1 a
DKC 57-79	188.7 b	211.8 ab	DKC 63-74	191.8 bcd	207.5 bc
NC+ 3583	177.8 cd	200.2 de	NC+ 3943	185.6 cd	195.0 d
NC+ 3613	186.0 bc	196.1 e	NC+ 4447	197.0 ab	216.8 ab
NC+ 4252	201.5 a	217.3 a	NC+ 5329	197.7 ab	214.2 abc
PHI 35F44	187.6 bc	203.2 cde	PHI 33W84	198.9 ab	216.3 abc
PHI 35K33	187.6 bc	200.4 de	PHI 34F29	182.5 d	208.5 bc
PHI 37Y14	165.2 e	202.1 cde	PHI 34P94	193.4 bc	212.8 bc
GH 8062	178.4 bcd	203.1 cde	NK 68B	206.4 a	206.1 c
NK N48-B5	169.8 de	200.4 de	GH 8953	187.2 cd	209.3 bc
NK N45-A5	166.0 e	200.4 de	GH 9145	203.7 a	217.9 ab

‡ Previous-year residue is the mean of the 12 current-year hybrids grown on each individual hybrid's previous-year residue

§ Yields followed by the same letter within a column are not different from one another, previous-year residue and current-year hybrid columns are separate from one another

¶ No valid comparison could be made between cropping systems due to experimental design in 2008

C-C= the mean of 12 current-year hybrids following the three previous-year DKC hybrids

†† C-C+C-SB = the mean of 12 current-year hybrids following the three previous-year DKC hybrids and soybean

‡‡ Current-year hybrid means include only 2nd year corn for 2008, the 2009 means include both 2nd year corn and corn following soybean. DKC=DeKalb Genetics Corp.; PHI=Pioneer HiBred Intl.; GH=Golden Harvest; NK=Northup King Seeds.