Genetics Important in Nutrient Removal

Modern high-yielding crops remove more nutrients per unit of yield.

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***Summary:** This study underscores the importance of good nutrition for these modern high yield genetics from start to finish. Genetics have played a major role in determining yield potential and grain composition.*

Estimates of nutrient composition of corn grain have varied widely in the past and still do. Many of these estimates are based on studies conducted far earlier than the introduction and use of modern corn hybrids. This article is not an attempt to report the exact composition of corn grain but rather demonstrates the variations among modern hybrids. Hopefully, these data will be of some value in constructing larger data bases, calculating nutrient removal by high yielding hybrids, and making recommendations for replacement of these materials through fertilization. The question is frequently raised in calculating nutrient removal as to whether modern high yield hybrids remove more nutrients per unit of yield than older hybrids on which removal figures have been based. Let's see what these data show.

Hybrid samples

The 146 hybrid samples were collected in 2012 and 2013 in the Mississippi Delta, primarily in Arkansas, by G&H Associates personnel located in Stuttgart, AR. Obviously, the genetics will not be identical to those used in other geographic areas but the results of these studies imply that similar differences exist elsewhere. The implications of the grain analyses are of interest to contemplate first in terms of N-P-K-S removal differences among hybrids and secondly in terms of the values of grain analyses in calculating feed formulations and animal nutrition.

TABLE 1	High P hybrids grain nutrient concentrations 2012				
HYBRID	%N	%P	%K	%S	ppm Zn
24	1.24	0.343	0.34	0.06	34.7
43	1.33	0.343	0.38	0.17	28.2
56	1.11	0.35	0.34	0.1	31.7
23	1.32	0.335	0.32	0.07	37.5
55	1.12	0.353	0.4	0.12	34.3
67	1.22	0.336	0.39	0.09	29.5
Mean	1.22	0.343	0.36	0.1	32.4
HYBRID	Low P hybrids grain nutrient concentrations 2012				
62	1.08	0.218	0.26	0.08	19.1
27	1.24	0.192	0.26	0.06	29.9
28	1.17	0.219	0.25	0.07	22.3
41	1.4	0.205	0.26	0.18	23.1
38	1.15	0.229	0.28	0.07	24.4
33	1.18	0.227	0.28	0.07	19.7
Mean	1.2	0.215	0.26	0.09	23.8

TABLE 2	High P hybrids grain nutrient removal 2012			
HYBRID	lb/A			
	N	P_2O_5	K_2O	S
24	173.6	110.6	57.3	8.4
43	186.2	110.6	64.1	23.8
56	155.4	112.9	57.3	14
23	184.4	108.1	53.9	9.8
55	156.8	113.9	67.5	16.8
67	170.8	110.6	65.8	12.6
Mean	170.8	110.6	60.7	14.2
	Low P hybrids grain nutrient removal 2012			
HYBRID	lb/A			
	N	P_2O_5	K_2O	S
62	151.2	70.3	43.8	11.2
27	173.6	61.9	43.8	8.4
28	163.8	70.6	42.2	9.8
41	196	66.1	43.8	25.2
38	161	73.9	47.2	9.8
33	165.2	73.2	47.2	9.8
Mean	168	69.4	43.8	12.3

TABLE 3	High P hybrid grain nutrient concentrations 2013				
HYBRID	%N	%P	%K	%S	ppm Zn
43	1.34	0.363	0.38	0.11	35.6
33	1.31	0.358	0.35	0.1	31.9
9	1.43	0.352	0.4	0.09	32.1
42	1.32	0.342	0.33	0.09	33.7
15	1.38	0.335	0.33	0.11	28.4
1	1.51	0.334	0.43	0.1	32
Mean	1.38	0.347	0.37	0.1	32.2
HYBRID	Low P hybrid grain nutrient concentrations 2013				
13	1.15	0.214	0.32	0.09	28.9
23	1.12	0.181	0.27	0.1	20.8
31	1.27	0.219	0.26	0.09	30.2
20	1.11	0.225	0.37	0.1	28.9
26	1.09	0.227	0.33	0.09	28.6
37	1.15	0.224	0.31	0.09	26.4
Mean	1.1 5	0.215	0.31	0.09	27.3

TABLE 4	High P hybrid grain nutrient removal 2013			
HYBRID	lb/A N	P_2O_5	K_2O	S
43	187.6	117.1	64.1	15.4
33	183.4	115.5	59	14
9	200.2	113.5	67.5	12.6
42	184.4	110.3	55.7	12.6
15	193.2	108.6	55.7	15.4
1	211.4	107.7	72.5	14
Mean	193.2	111.9	62.4	14
	Low P hybrid grain nutrient removal 2013			
HYBRID	lb/A			
	N	P_2O_5	K_2O	S
13	161	69	54	12.6
23	156.8	58.4	45.5	14
31	177.8	70.6	43.8	12.6
20	155.4	72.6	62.4	14
26	152.6	73.2	55.7	12.6
37	161	72.2	52.3	12.6
Mean	161	69.4	52.3	12.6

Grain composition

This study did not include grain yields because the samples were collected from farmer fields. Right or wrong and using a uniform high yield of 250 bu/A, grain composition effects on nutrient removal were calculated and are reported below. Hybrids were classified as high and low grain P concentrations. Six hybrids were pulled together into each group in both years of the study. Analyses were conducted by the Soil and Plant Analysis Lab at Kansas State University. Hybrid numbers in 2012 and 2013 are not indicative of the same genetics.

P concentrations

In 2012, P concentrations (Table 1) ranged from 0.192 to 0.353% total P. The low P group values ranged from 0.192% to 0.227% while values in the high P group ranged from 0.335 to 0.353%. Mean P value for the low group was 0.215 and 0.343 for the high group, a difference of greater than 59% based on the low group mean. For a 250 bu/A corn yield, that translates to a crop removal of more than 41 lb P_2O_5/A (Table 2).

NPK concentrations

Using the same P concentration criteria, grain N concentration means varied only by 0.02% (1.22 vs 1.20) and by only a 2lb N/A grain removal difference. Potassium concentrations were a different story. The high P concentration group had much higher K concentrations (0.36%) versus 0.26% for the low P grain. The grain K_2O removal difference was about 17 lb/A higher for the high P group (Table 2).

2013 grain sample mean P values for the high and low P concentration groups (Table 3) were almost identical, 0.343% for 2012 versus 0.347% P for the 2013 high concentrations and identical 0.215% values for grain K. Nitrogen concentrations were a different story for at least the high P group. 2013 N concentrations were 1.38% and 2012 were 1.22%. But the dramatic difference was in the 2013 grain N concentration differences between the high P (1.38%) and low P groups (1.15%). On a very crude computation (N x 6.25 = % protein), that translates to a difference of 1.43% crude protein, significant in construction of a ration for animals and indicative of the value of grain analyses. The N removal in grain was 32 lbs/A greater for the high P hybrid group (Table 4).

S & Zn concentrations

Grain S concentrations varied somewhat in each group in 2012 but differences between the high P and low P groups were only slightly over 0.01%. Insignificant. The 2013 grain S concentrations were less variable but the difference between high and low P groups was the same 0.01%.

Grain Zn concentration differences were interesting. One might initially surmise that the high grain P concentrations might have been associated with low Zn concentrations, the classic P-Zn interaction. However, grain Zn concentrations were from 5 to 9 ppm higher in the high P group in both years.

Admittedly, fertility programs may have had effects on grain composition, but assuming that good fertility was provided in these locations, genetics played a major role in determining yield potential and grain composition.

Summing up

There is obvious reason to plan for higher nutrient removal in the modern, high yield corn hybrids. Of course, higher yields mean more nutrients leaving the field but the race horse type hybrids not only produce higher yields but those yields contain higher concentrations of nutrients, at least N, P, K, and Zn. The study also underscores the importance of good nutrition for these modern high yield genetics from start to finish.

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