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RESEARCH REPORT
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Non-GMO Corn Strip Trials: Yield and Quality

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Abstract

Corn (Zea mays) is a major crop across the Midwestern U.S. Yields have been steadily increasing in Iowa from an average of 48.5 bu/ac in 1950 to an average of 171 bu/ac in 2011 (USDA NASS). Grain quality, specific fractions of protein, starch, essential amino acids, and other contents have not stayed steady over this time period. Varieties of non-GMO corn grown in Iowa and Ohio in 2011 were tested for grain quality: oil, protein, lysine, methionine, and cystine. Quality traits were highly variable with protein ranging from much lower than expected (6.65%) to above average (9.06%). At the Gilbert farm eMerge 619 yielded both the most grain and the highest percentage protein resulting in the greatest pounds-of-protein/A at 792.46 (α=.05 level) while no differences among hybrids were measured at the Kress farm.

Cooperators
John Gilbert, Iowa Falls, Iowa
Bruce Kress, Laura, Ohio

Project Timeline
2010-2011

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Web Link
http://bit.ly/pfi_fieldcrops

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Background

Corn is a major source of nutrition for cattle, hogs, and poultry across the United States. As grain yields have increased, quality has changed and farm-prepared rations have not necessarily been adjusted to reflect these changes. A multi-year study of Midwestern corn found crude protein has fallen from traditional levels above nine percent to near eight percent (Baker, 1997). Another review claims that protein is now closer to 7.7 percent (Sutton and Hug, 2011). In addition to protein, animals require certain essential amino acids in their diets. For instance, growing pig diets are considered most limited by lysine while broiler chickens are limited by methionine (Touride, 2004). Poultry diets may be further complicated in organic systems, where synthetic methionine may be removed from the National Organic Standard Board; synthetic methionine is regularly discussed as a candidate for removal.

Overall, a lack of data exists for corn quality, making comparisons more difficult. One estimate of other corn quality traits is 4% oil, 0.24% lysine, and 0.2% Methionine (Scott, personal communication, 2012). Another estimate is shown in **Table 1**.

A standard of 9% protein in corn has been traditionally used in calculating on-farm rations for animals. If this is no longer the nutritional content of corn feed, animals are not getting the optimal nutrition from a farm-mixed ration like what is currently used on the Gilbert farm. Supplementing animal diets with the additional protein or amino acids needed could add significant cost.

Table 1

	Midwest Corn				Illinois Corn		
Year	1994	1995	1996		1994	1995	1996
No. Samples	263	468	704		36	13	70
Crude protein, %	8.40	8.38	7.95		8.38	8.07	8.01
Lysine, %	0.26	0.24	0.23		0.26	0.24	0.24

Table 1. Protein and Lysine in Midwest and Illinois-Produced Corn, Baker, 1997.

Methods

Two farms (Gilbert Farm - Iowa Falls, Iowa and Kress Farm - Laura, Ohio) grew non-GMO corn hybrids (see **Table 2**). Varieties were suited for the area and planted in strips randomized and replicated across the field. After harvest, an aggregate sample was taken for each hybrid type. Samples labeled "feed corn" are non-GMO corn hybrids and taken from different Gilbert farm locations to use as a comparison.

Corn was planted May 4 in Iowa Falls and June 1 in Laura, OH. Weed control in Iowa Falls consisted of two mechanical and two chemical application passes. The Kress farm managed weeds organically, which consisted of a rotary hoe pass and two cultivations. At Laura, Canada thistle was present in the test plot area but overall weed control was good. At Iowa Falls the previous crop was four years of hayground. Dairy manure plus 100 lbs of pell lime and 200-300 lbs of dry phosphorus fertilizer was applied. Also starter fertilizer 9-18-3 was applied at planting. At Laura 650 lbs of aragonite, ground up sea corral, was applied to the field. The previous year the plot had been fallow.

Corn samples were tested through the Iowa State University Grain Quality Laboratory (ISU GQL), using near infrared (NIR) equipment and methods developed by the ISU GQL.

Statistics were analyzed using JMP Pro 10 (SAS Institute Inc., Cary, NC) and yield comparisons employ least squares means for accuracy. Statistical significance is determined at a α=.05 level.

Table 2

Location	Hybrid	Cost/bag
Iowa Falls	eMerge 600	$148
Iowa Falls	eMerge 619	$148
Iowa Falls	Agrigold 6395	$156
Iowa Falls	GEI 9500	$165
Iowa Falls	Crows 213	$140
Iowa Falls	GEI 9999	$165
Iowa Falls	Crows 214	$140
Iowa Falls	GEI 102	$165
Laura	Becks 4088	$169
Laura	Viking 069 99	$169
Laura	Becks 4488	$169
Laura	Welter WS 2292	$169

Table 2. Seed varieties and costs.

Results and Discussion

Yield

Yield between some hybrids at Iowa Falls were significantly different (α=.05 level), while yields from hybrids at Laura were not (**Graph 1**). Crows 214 yielded statistically higher than all three GEI hybrids but was not different than Agrigold 6395, Crow 213 or the eMerge hybrids.

In Iowa Falls, yield was typical for the particular location of the test plot. Due to lower row crop suitability (CSR), the test plot area is in a longer rotation including alfalfa. This lower suitability rating helps to explain the lower average yield, 147.5 bu/A, when compared to the 2011 state of Iowa average yield of 172 bu/A (NASS, 2011). Average yield at Laura, OH was 124.4 bu/A. Early season wetness and late season drought conditions negatively affected the yield and quality of the hybrids tested.

Quality Components

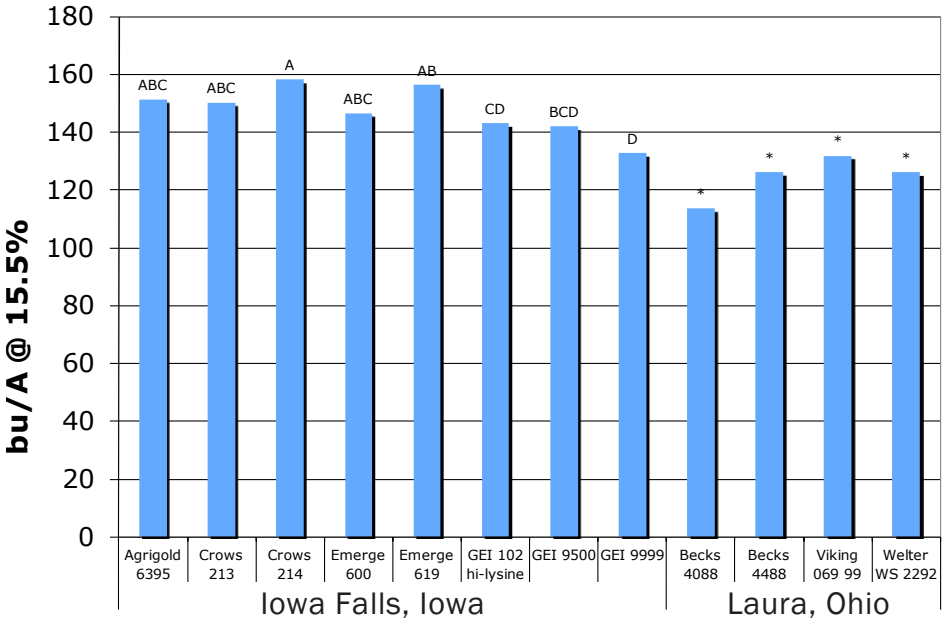
Amino Acids

Lysine levels in all hybrids were above the expected 0.24%, and especially high in the advertised high-lysine hybrid. Methionine levels were above the expected 0.2% in Iowa Falls, but not in Laura, Ohio; poor growing conditions may be responsible.

Protein and Oil

Yields of protein per acre were highly varied across the hybrids. Weather likely lowered protein levels in the Ohio location,

Graph 1



Graph 1. Corn yields adjusted to 15.5% moisture grown in Iowa and Ohio in 2011. Bars that do not share the same letter are statistically different while bars without letters represent hybrids on the Kress farm, which had no significant differences in yields.

but protein levels at Iowa Falls ranged widely from 422.94 #/A to 792.46 #/A. For a farm feeding animals with their own grain, higher values mean less dependence on supplemental products such as soybean meal.

A local feed mill reported that the average protein levels for the 2011 corn crop in the Iowa Falls area was reported to be 7.84% (Gilbert, personal communication, 2012). All corn hybrids grown at the Iowa Falls location contained higher protein than the local average. On January 28, 2012 the Chicago Board of Trade valued a 48% protein, short ton of soybean meal priced at $322.20. Based upon this price, a pound of protein was valued at $0.34/lb. A 56-pound bushel of corn with increased protein from 7% to 9% would result in 3.92 lbs versus 5.04 lbs of protein per bushel, or an additional $0.38 of value per bushel. The value of additional protein would likely be useful if the grain is being fed directly to farmer-owned livestock.

Conclusion

Grain quality may not be as high as traditional estimates suggests. Only one of the tested varieties met the nine percent protein benchmark. Due to high variability, testing of grain components of animal diets would help to optimize feed efficiency. More testing is needed to determine accurate grain quality, best varieties to be grown for animal feed, and average values of quality components contained in today's grain hybrids. Additional research is also needed to determine the reasons for quality differences, agronomic or genetic.

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