Influence of Corn Hybrid on Kernel Traits

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Summary

Sixty commercially available corn hybrids were used to identify kernel traits that may be used as an indicator of feeding value to cattle. Three separate tests were conducted and 12 traits were evaluated for each hybrid. Most production traits were negatively correlated or not correlated to physical traits making them less indicative of cattle performance compared to some lab techniques. Based on the dry matter disappearance in the rumen, a harder kernel will be more efficiently digested. An approximately 10% change in dry matter disappearance is shown between the most and least digestible hybrid. Physical kernel traits can be helpful in determining corn hybrids used for feeding cattle.

Introduction

A large amount of research has been devoted to corn processing and the feeding value of corn for feedlot cattle. Considerably less research has been conducted to see the effect of the corn hybrid type on feeding value. Chemical and physical traits of the corn kernel are similar within a hybrid even across years, but can vary greatly among hybrids. Using seven commercially available corn hybrids, a feedlot trial showed differences are present and can influence cattle performance (*2004 Nebraska Beef Report*, pp.54 - 57). In that study many different factors were used to distinguish differences between these hybrids, using chemical and physical characteristics. In the following experiment many of these same tests, on 60 commercially available hybrids which had been entered in hybrid performance tests by the Department of Agronomy and Horticulture, were investigated. The objective of our experiment was to identify factors that would give an indication of feeding performance, allow us to evaluate differences in feeding value present among corn hybrids, and determine if common grain marketing tests could distinguish those differences.

Procedure

Corn Production

Sixty hybrids were grown in four field replicates and used to determine hybrid differences. At harvest, approximately 2 lb of grain was collected, placed in nylon bags, and stored dry. After approximately two months of storage, each sample was cleaned, by sieving, to obtain a sample of whole kernels for analysis.

1,000 Kernel Weight

Following cleaning, 1,000 kernels were separated using an automated seed counter. Kernels were then weighed and a 1,000 kernel weight was recorded for each sample on an air-dry basis. A DM analysis was performed on each sample and the kernel weights were adjusted to a DM basis and represented the dry kernel weight.

Stenvert Hardness Test

Twenty grams of each whole corn sample were ground through a micro hammer mill. The softer particles grind first and fall to the bottom of the collection tube, while the harder particles grind slower and remained on top. The mill was attached to a tachometer which measured the revolutions per minute (rpm) of the machine. The machine started at 3600 RPM and the lowest RPM reached during grinding was recorded. A test tube placed at the bottom of the machine collected the ground sample and was also used to determine the grinding time. The grinding time was the time from placing the whole sample into the machine until 17 mL, represented by a line on the tube, of ground sample was obtained. The total height of sample in the tube and height of the soft material were measured, after the entire sample was ground. The soft height was measured by identifying the change in color between the soft powder and the harder pericarp near the top of the tube. After these measures were taken, the ground sample was placed in a 425 μm sieve which was placed on a Strand shaker for three minutes. The hard pericarp remained on top of the screen and was weighed to determine the kernel's hard percentage.

In Situ

Based on 1,000 kernel weight and Stenvert grinding, 20 hybrids were selected for an *in situ* trial to measure the dry matter disappearance (DMD) as an indication of feeding value. The 20 hybrids represented a range in kernel weights, as well as hard percentage and grinding time. The four replicates from each hybrid were ground using a Wiley Mill to simulate a masticate grind. After being ground, 5 g of each sample was weighed and placed in an *in situ* bag to be incubated. The samples were replicated twice per animal per day, for a total of eight replications of each of the four field replications per hybrid. The procedure was conducted during a five day period using two ruminally cannulated steers, an incubation period of 24 hours, and one day between the two incubation periods. Upon removal of the bags from the steers, they were washed and placed in a 60º C oven for 48 hours to dry. After drying, each sample bag was weighed back to determine amount of residue left. The residue which remained was divided by the original sample, corrected for DM, to determine the DMD of each hybrid.

Results

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Kernel characteristics averaged across hybrid are presented in Table 1. With a few exceptions, the production traits of yield and test weight had no correlation or were negatively correlated ($P < 0.05$) to the Stenvert and *in situ* traits. Yield was correlated to the soft height and soft height percentage, ($P = 0.04$ and $P < 0.01$ respectively), but negatively correlated to dry kernel weight ($P = 0.02$). Test weight (volume weight usually in lb/bu) was correlated to RPM ($P < 0.01$), but was negatively correlated to total height, hard percentage, and 24 hour DMD ($P < 0.01$, $P < 0.01$, and $P = 0.02$ respectively). These observations would seem to suggest that our most common market time quality measurement, test weight, is not related to laboratory tests which correlate with the feeding value of the corn. An important observation is an insignificant negative correlation ($P = 0.22$) was observed between test weight and kernel weight. Previous studies (*2004 Nebraska Beef Report,* pp.54-57), have shown a positive correlation between kernel weight and feeding performance. This suggests that higher weight kernels result in better performance. However since test weight is based on density more than solid weight, these two measures do not result in similar relationships to feeding performance. Revolutions per minute was the only Stenvert observation that had a correlation with the in situ procedure. RPM was negatively correlated to the DMD ($P < 0.01$), which indicates a hybrid with a harder kernel has a higher DMD. These data are contrary to previous data. Previous studies indicated softer kernels have a higher DMD compared to harder kernels (*2003 Nebraska Beef Report,* pp.32-34; and *2004 Nebraska Beef Report,* pp. 54-57). Another current study (*2006 Nebraska Beef Report,* pp. 45-47) also indicates that a softer kernel is more digestible though the relationship between the two was rather weak (r = 0.27). The overall change in DMD between the highest and lowest percentage was 9.33 %, which indicates that although the hybrids were chosen using some extremes from the Stenvert and 1,000 kernel weight data, overall differences in feeding value were less than 10%.

Table 1. Kernel characteristics of all 60 hybrids.

Trait	Mean	Standard Dev.	Range	r[b]
Yield, bu/ac	185	13.0	156-210	- 0.35
Test wt., lb/bu	59.2	1.16	56.8-62.6	- 0.53
1,000 Kernel wt., g	328	22.9	273-365	0.27
Stenvert Hardness				
RPM	2390	53.2	2280-2520	- 0.70
Soft Height, %	75.4	2.19	70.1-80.3	- 0.25
Grind Time, s	6.90	0.56	5.50-8.25	- 0.43
Hard, %	81.6	1.93	74.2-83.7	0.18
24 Hr DMD[a],%	50.5	1.50	47.5-52.4	

[a]24 Hr DMD = Percentage dry matter disappearance over 24 hours of incubation.
[b]Correlation coefficient to DMD; test wt, and rpm significant at $P < 0.05$.

The current study reaffirms hybrid testing as important, because hybrid feeding performance differences are present and significant. Through further research we will find the general characteristics of corn grains used more efficiently by feedlot cattle.

For more information about the Department of Agronomy and Horticulture's hybrid performance tests visit http://varietytest.unl.edu/corntst/2004/index.htm. For more information about the specific hybrids used in this study visit the Lancaster county tab on that Web site.

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