

## Influence of Maturity on the Yield and Nutritional Quality of Four Pioneer Corn Hybrids Harvested as High Moisture Ear Corn

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### Introduction

Harvesting and feeding High Moisture Ear Corn (HMEC) is becoming a popular practice amongst beef and dairy producers. Most HMEC (sometime referred to as snapplage or earlage) is harvested with silage choppers equipped with a snapper head and an internal kernel processor. This equipment allows for a one-step harvest and is much more fuel efficient than older silage choppers using re-cutter screens. Harvesting the whole ear increases the yield by approximately 10-15% compared to harvesting the grain only. HMEC will typically have a feed value which is intermediate to high moisture corn and whole plant corn silage and depends largely on the amount to non-grain component (i.e. cobs, husk, ear shank) in the product. The objective of this study was to evaluate the impact that maturity has on the yield and nutritional value of four commercial Pioneer hybrids when harvested as HMEC.



### Plot Design

Four Pioneer hybrids (35A30, 34A86, 35Y65, and 35D28) were planted in replicated 17 ft. rows having 30 inch row widths on May 5<sup>th</sup>, 2005 at the Pioneer LaSalle Research Station in LaSalle CO. Four harvest blocks containing four ranges (8 rows) were assigned to each hybrid. Harvest blocks were bordered by a common buffer hybrid. Two ranges from each harvest block were harvested as high moisture ear corn while the two adjacent ranges within each harvest block were harvest as grain yield checks. The plot was irrigated with a lateral sprinkler to receive approximately 15 inches of water. It should be noted that a serve infestation of spider mites occurred in mid September, which severely effected plant health resulting in premature foliage death.

### Harvest and Processing Procedure

The first harvest block was harvested on September 13<sup>th</sup>, 2005 and the subsequent 3 harvest blocks were harvested at weekly intervals. Dry grain checks for each harvest block were harvested on Oct 25-26<sup>th</sup>. Whole ears were hand snapped so that the ear shank and husk were still attached to the ear. All ears were collected from each row and weighed to calculate wet yields. Ten ears from each hybrid per harvest range were processed through a chipper/shredder and a

composited sample vacuum sealed and immediately frozen. In addition, eight representative ears of each hybrid per harvest block were vacuum sealed intact and immediately frozen. Whole ears were later separated into three components; grain, cob, and husk plus shank. Each component was weighed, sealed in a freezer bag and frozen for subsequent nutritional analysis. Composited ground ear samples and component samples were sent to the Pioneer Livestock Nutrition Center in Sheldahl, Iowa where they were dried and ground. Dry ground samples were sent to Dairyland Labs in Arcadia, WI for nutritional analysis utilizing wet chemistry.

### Yield Results

A HMEC yield is shown in Table 1. HMEC dry matter yield continued to increase through the third harvest period. Harvest period 4 yields were lower than expected and were attributed to water stress and spider mite infestation in that area of the plot.

Table 1. HMEC Yield (Tons DM per acre)

<i>Harvest Date</i>	<b>35A30</b>	<b>34A86</b>	<b>35Y65</b>	<b>35D28</b>
<i>Sept 13</i>	5.27	4.41	4.34	3.58
<i>Sept 20</i>	5.83	4.92	4.51	3.82
<i>Sept 27</i>	5.82	5.23	5.30	4.29
<i>Oct 4</i>	5.47	4.60	4.12	3.44

Pioneer 35A30 had the highest yield across all harvest periods while Pioneer 34A46 and Pioneer 35Y65 were similar in yield and Pioneer 35D28 was consistently lower. It should be noted that Pioneer 35D28 was located in the area of the plot where there was severe spider mite infestation and those plants had premature death.

Dry grain yields ranged from 119 bu. per acres for Pioneer 35D28 to 194 bu. per acre for Pioneer 35A30. Pioneer 34A86 and

Pioneer 35Y65 were intermediate with 155 and 157 bu. per acre; respectively.

HMEC yield was positively correlated to dry grain yield ( $r^2=.70$ ). The regression equation shown in Figure 1 suggest that for every one ton increase in HMEC DM yield that dry grain (84.5% DM) yield increased by 33 bushel per acre.

### Change in Moisture Content

Grain maturity was estimated to be at 80-90% milk-line at harvest period 1 and reached full black-layer by harvest period 3. Whole ear moisture decreased linearly across harvest periods. Average moisture for the first harvest period was 51.7% and declined to 29.5% for harvest period 4. Average decline in moisture was 1% unit per day. The change in whole ear moisture is shown in Figure 2. All hybrids dried at a similar rate; however, Pioneer 35D28 was significantly drier than the other hybrids at all harvest periods.

Whole ear moisture was closely related to grain moisture ( $r^2=.94$ ) and averaged 5.76% units higher than grain moisture. The relationship between whole ear, grain and cob moisture is shown in Figure 3. Cob and husk/shank moisture were 1.6 and 1.3, times higher in moisture than the grain.

### Change in Ear Components

The average percent grain (100% DM basis) increase from 73.2% at harvest period 1 to 78.5% at harvest period 4. The average percent cob declined from 18% at harvest period 1 to 14.2% at harvest period 4. The percent husk and shank remained relatively constant across harvest periods (7-9%). Hybrids differed in components percentage with Pioneer 35A30 having significantly higher percent grain and lower percent cob

than the other three hybrids at all harvest periods.

Table 2. Percent Grain in HMEC by Hybrid

<i>Harvest Date</i>	<b>35A30</b>	<b>34A86</b>	<b>35Y65</b>	<b>35D28</b>
<i>Sept 13</i>	77.2	70.8	70.3	73.6
<i>Sept 20</i>	78.2	73.7	74.7	73.3
<i>Sept 27</i>	82.3	75.6	76.8	74.4
<i>Oct 4</i>	82.2	77.6	77.5	75.4

### Nutrient Composition

The average nutrient composition across hybrids and harvest periods for the whole ear and each component is shown in Table 3.

Table 3. Average Nutrient Composition in HMEC (100% DM Basis)

<i>Component</i>	<b>Protein %</b>	<b>Starch %</b>	<b>NDF %</b>	<b>Ash %</b>
<i>Grain</i>	9.87	68.99	7.82	1.44
<i>Cob</i>	1.92	-	84.29	1.32
<i>Husk/shank</i>	4.00	-	78.97	3.81
<i>Whole ear</i>	8.23	52.14	23.74	1.56

The change in whole ear and grain starch is shown in Figure 4. Grain starch content increased by 2% units from harvest period 1 to harvest period 4. However, whole ear starch increased by 3% by harvest period 3 and dropped off slightly on harvest period 4. The reason that whole ear starch increased at a faster rate than grain starch is due to the fact that the % grain is also increasing with maturity.

Whole ear and grain NDF content (shown in Table 4) remained relatively constant across harvest periods. However, cob and husk/shank NDF levels increase by 9% units and 3.5% units; respectively, from harvest period 1 to harvest period 4. Since the percent cob in the ear decreased by approximately 4% units from harvest period 1 to harvest period 4 the overall ear NDF

remains relatively constant due to the dilution effect of increasing grain.

Table 4. Percent NDF in HMEC by harvest Period (100% DM Basis)

<i>Component</i>	<b>Sept 13</b>	<b>Sept 20</b>	<b>Sept 27</b>	<b>Oct 4</b>
<i>Grain</i>	7.55	8.03	7.89	7.82
<i>Cob</i>	78.92	84.58	85.81	87.86
<i>Husk/shank</i>	76.78	78.51	80.01	80.06
<i>Whole ear</i>	23.53	23.40	23.30	24.74

NDF levels by hybrid are shown in Table 5. Pioneer 35A30 had lower whole ear and cob NDF than all other hybrids. The whole ear NDF content was lower for 35A30 due to the fact that it contained nearly 5% units more grain in the ear and the cob contained less NDF than other hybrids.

Table 5. Percent NDF in HMEC by Hybrid (100% DM Basis)

<i>Component</i>	<b>35A30</b>	<b>34A86</b>	<b>35Y65</b>	<b>35D28</b>
<i>Grain</i>	7.72	8.00	7.81	7.77
<i>Cob</i>	80.26	84.76	85.87	86.28
<i>Husk/shank</i>	78.57	79.55	79.35	78.43
<i>Whole ear</i>	20.38	24.59	25.15	24.84

The relationship between whole ear NDF percentage and starch level is shown in Figure 5. As expected, starch percentage was negatively correlated ( $r^2=.81$ ) with NDF percentage.

### Digestibility Measurements

*In Vitro* DM digestibility (48 hr) for whole ear samples (shown in Table 6) averaged 84.2% and remained relatively constant across harvest periods. However, digestibility of the cob declined nearly 20% units from harvest period 1 to harvest period 4. Husk and shank digestibility declined with advancing maturity but remained surprisingly high across harvest periods. Grain digestibility was not measured in this study; however, past Pioneer studies

evaluating high moisture shelled corn suggest the grain digestibility will exceed 90% until the moisture declines below 25%. Grain moisture in this study did not fall below 25% until harvest period 4.

Table 6. Percent IVDMD by harvest Period (100% DM Basis)

<i>Component</i>	Sept 13	Sept 20	Sept 27	Oct 4
<i>Cob</i>	67.57	55.77	56.23	48.21
<i>Husk/shank</i>	77.09	74.23	68.94	71.29
<i>Whole ear</i>	84.36	84.13	84.26	83.98

Hybrid digestibility is shown in Table 7. Pioneer 35A30 had the highest whole ear and cob IVDMD, which is consistent with its lower NDF content and higher starch level. Pioneer 34A86 had the lowest husk/shank digestibility and lowest whole ear IVDMD.

Table 7. Percent IVDMD in HMEC by hybrid (100% DM Basis)

<i>Component</i>	35A30	34A86	35Y65	35D28
<i>Cob</i>	62.14	56.81	52.32	56.51
<i>Husk/shank</i>	73.37	68.66	73.87	75.65
<i>Whole ear</i>	85.94	82.98	84.19	83.62

Cob fiber digestibility (48 hr. NDFD) shown in the Figure 6 followed a similar trend as IVDMD.

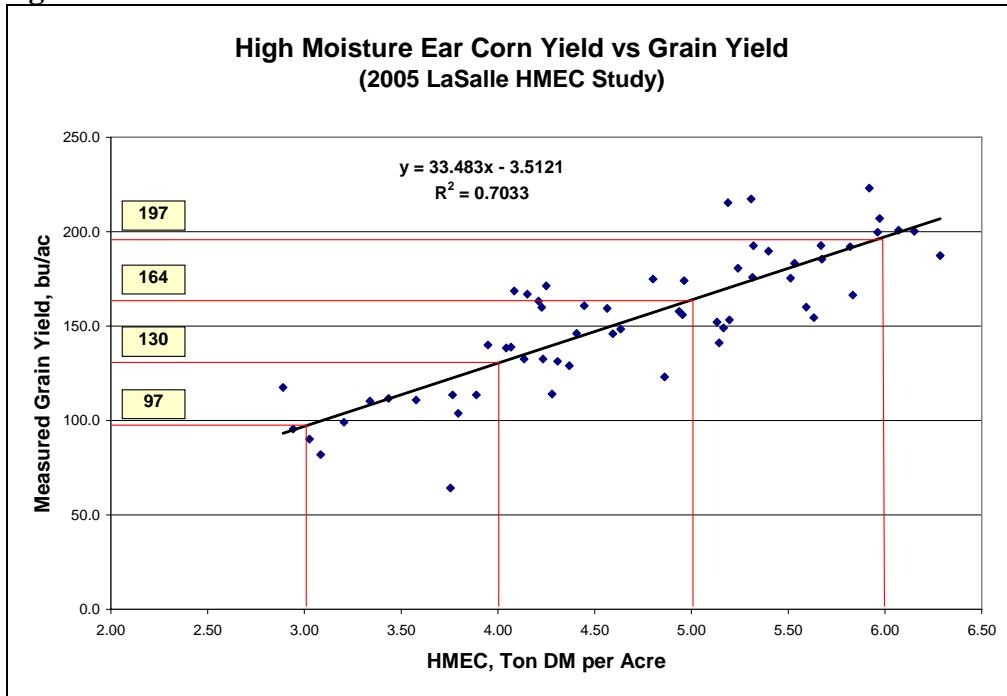
### Summary

HMEC can be a high energy feed having an energy value approaching 85-90% of that of dry shelled corn by selecting suitable hybrids and harvesting at the proper maturity.

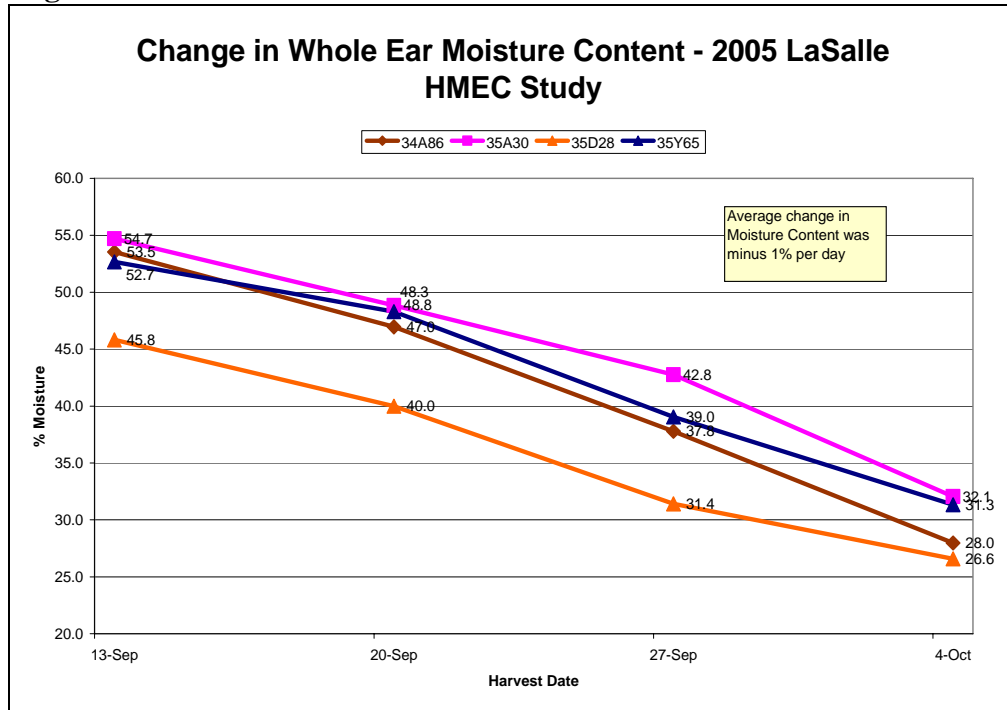
HMEC yield, component mix and nutritional value are influenced by both harvest

maturity and hybrid. Our data suggest that whole ear moisture will be approximately 6% units higher than the grain moisture and will decline at approximately 1% unit per day. Optimal harvest moisture for maximizing both yield and nutritional value of HMEC appears to be between 36-42%. Regression analysis indicated that HMEC DM yield is driven primarily by grain yield. Measured dry grain (84.5%DM) yield increased approximately 33 bushel per acre for each one ton increase in HMEC dry mater yield. This suggests that the average grain content in the HMEC would be approximately 78% once the grain reaches physiological maturity. The actual percentage grain in the whole ear averaged 75.9% but ranged from 70% to 82% and was influenced by both harvest maturity and hybrid. The percent cob averaged 16% but ranged from 10-20% and was inversely related to the grain content. Percentage of husk and shank average 8% and was relatively constant across harvest maturity and hybrids. One important finding from this study was that cob digestibility drops rapidly as the ear matures and will provide little nutritional value past 45% dry matter (approximately 28% grain moisture). Husk and shank digestibility was higher than expected and may provide a good roughage source if properly processed so that separation in minimized. Pioneer 35A30 was clearly the superior hybrid in this study having the highest yield and the highest nutritional value. This hybrid appears to be an ideal for HMEC since it had the highest percent grain and lowest per cent cob. In addition, its cob had the highest % digestibility and the grain dried at a slower rate with advancing maturity than other hybrids in this study providing a longer optimal harvest window.

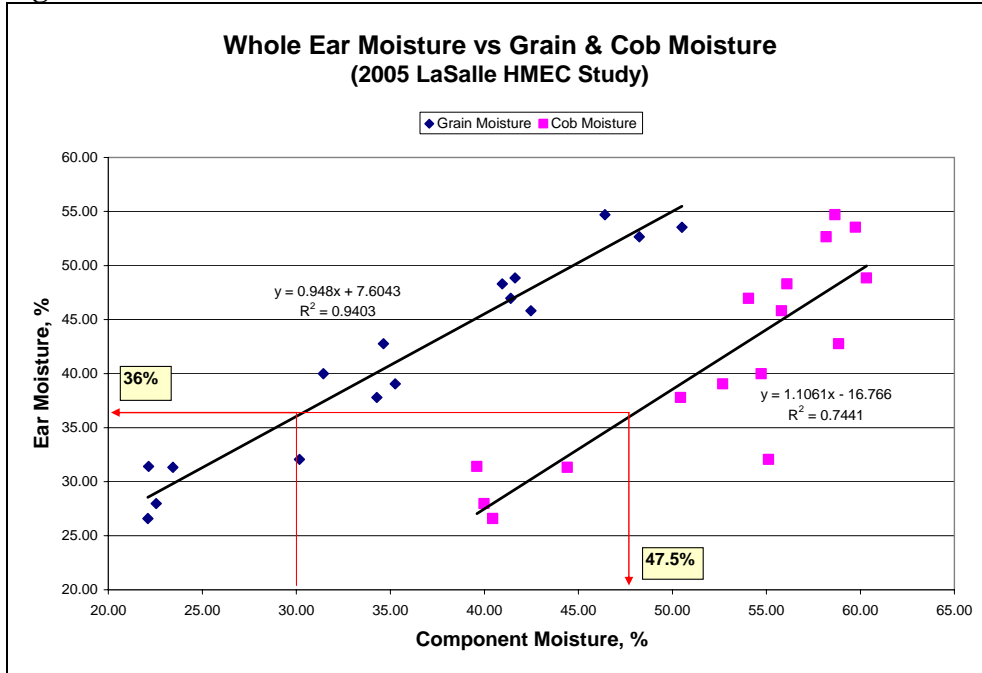
**Figure 1.**



**Figure 2.**



**Figure 3.**



**Figure 4.**

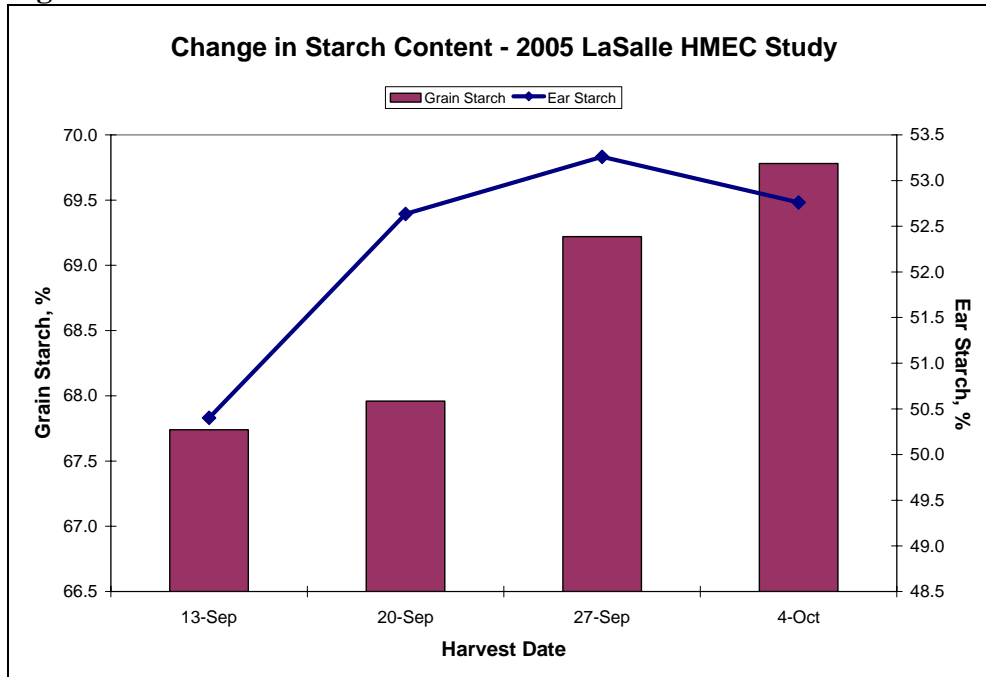


Figure 5.

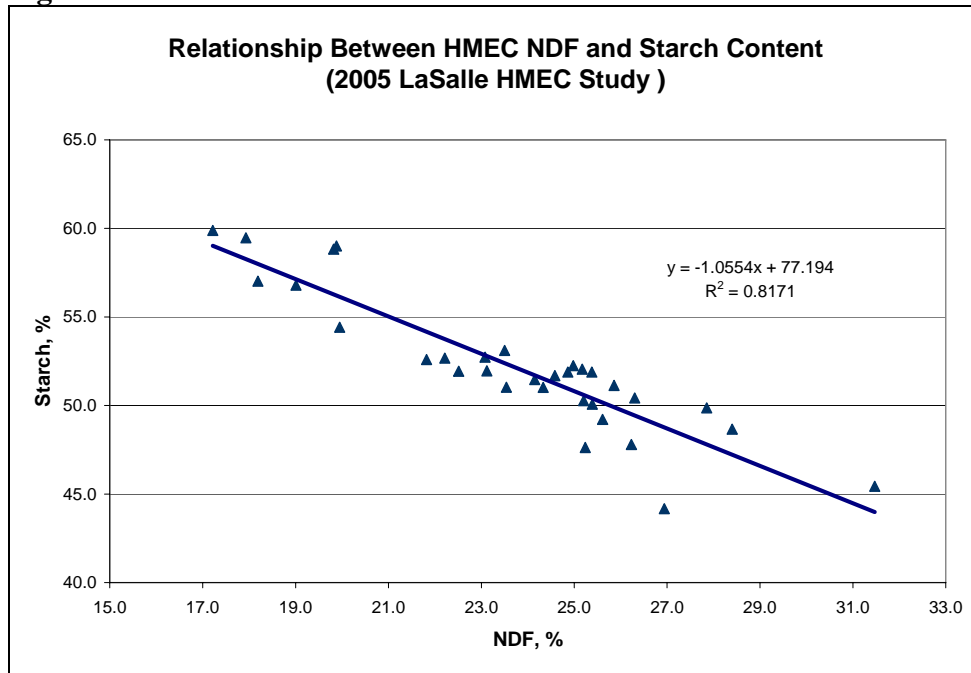


Figure 6.

