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Is there loss of corn dry matter in the field after maturity?

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Background

Mystery yield loss, phantom yield loss, and now invisible yield loss – all are terms used for the concept that dry matter (yield) is being lost in-field between maturity (at about 28% moisture) and harvest (approximately 15% moisture). Popular press articles continue to indicate up to 1% dry matter loss per 1% grain moisture decrease. If this amount of dry matter loss occurs, it would be significant in marketing terms. Some believe that this loss is caused by seed respiration.

From 1991 to 1994, grain dry matter was determined for three hybrids over the course of four years in Indiana (Nielsen et al.). This work had an average yearly overall dry matter loss of 0.9% to 1.1% in 3 of 4 years. The fourth year was excluded because the results were non-significant. Follow up studies were published by Elmore and Roeth (1999), Pordesimo et al. (2006), and Thomison et al. (2011).

In Nebraska, Elmore and Roeth concluded that kernel dry matter weights were consistent across harvest dates even though there were slight differences between hybrids in 1996 and 1997. Pordesimo et al. conducted work in Illinois in 1995, showed that dry matter accumulation increased over the growing season, then plateaued over a 51-day sampling period; there was no decrease in dry matter following the plateau. Thomison et al. in Ohio investigated dry matter response to seeding rate, hybrid and harvest date. The results indicated that no yield reductions occurred between the October and November harvest dates. Yield losses between the November and December harvest dates were due to lower stalk strength and greater stalk lodging.

Nielsen et al. offers seed respiration as a possible cause of dry matter loss. Respiration is a metabolic reaction for retrieving stored energy and carbon while using up oxygen and releasing carbon dioxide. In 1973, Knittle and Burris determined that seed respiration decreased dramatically from 35 days after silking to 80 days after silking. Seed respiration was non-significant from 80 to 95 days after silking. Additional studies in storage environments have reported 1% dry matter loss over 10 to 50 days of corn storage (after harvest) for 23-28% corn at 75-85 degrees F (Saul and Steele, 1966; Seitz et al., 1982). These losses were primarily due to storage fungi, not seed respiration. Dry matter losses would be much less in unharvested field conditions since average temperatures in the Corn Belt are 55-65 degrees F in late September and 50-60 degrees F in early October.

Delaying harvest in order for in-field grain drydown to occur results in decreased stalk integrity (i.e. greater stalk and root lodging) potentially causing more dropped ears. Farmers should weigh the cost of harvesting grain at 20-25% moisture versus waiting for in-field drydown to occur and potentially increased yield losses due to field losses other than grain dry matter loss.

Timeliness losses at corn harvest were traditionally associated with dropped ears from a weakened ear shank, often from European corn borer damage. Each loss of a single ear in 1/100th acre (436 sq ft) is the equivalent of 1 bu/acre field loss. Losses due to corn borer damage were variable by year, but frequently are estimated at 1/3 %/day loss for each day beyond mid-October (ASABE, 2014). Widespread use of corn with bacillus thuringiensis (BT) traits has greatly reduced this type of damage. Lodged stalks with ears close enough to the ground to escape gathering by the corn head are now the primary cause of preharvest loss in most fields (due to the combine not capturing the crop).

Study methodology

Field procedure

Ears were collected from a date of planting maturity trial at the Iowa State University research farms near Kanawha and Crawfordsville, IA. The plots were 50 feet long by 20 feet wide, in 4 replications of each hybrid at a location. Selected planting dates and hybrids are listed in Table 1. Ear collection was weekly starting at physiological maturity for six to eight weeks. The selection of ears for sample collection was to collect seven consecutive ears from the second or seventh row of the eight row plots, skip seven consecutive ears before collection of the next set of ear samples. The middle four rows (rows 3 through 6) were used for grain yield determination in the planting date study.

Table 1. Dry-matter loss study field design

Location	2016		2017	
	Dates of Planting	Hybrid (Relative Maturity)	Dates of Planting	Hybrid (RelativeMaturity)
Kanawha	April 17	P9526AMX (95-d)	April 17	P0157AM (101-d)
	May 18	P0407AMXT (104-d)	May 9	P0589AM (105-d)
		P0987AMX (109-d)		P1197AM (111-d)
Crawfordsville	April 14	P0636AM (106-d)	April 13	P0589AM (105-d)
	May 9	P1151AM (111-d)	May 16	P1197AM (111-d)
		P1365AMX (113-d)		P1555CHR (115-d)

At each harvest date, 100 stalks (with ears) adjacent to the harvest area were evaluated. Each ear within one foot of the ground was assumed to equal one percentage point of preharvest loss due to stalk lodging.

This design gave 672 samples as three hybrids x two planting dates x four replications x six sampling dates x two locations in 2016 plus three hybrids x two planting dates x four replications x eight sampling dates x two locations in 2017. The samples were hand harvested, bundled in groups of seven ears in strong plastic trash bags and shipped to Ames immediately after harvest. The additional sampling dates were added in 2017 because of the late harvest and slow dry down rates in the first few weeks.

Laboratory analysis procedure

The samples were husked and refrigerated immediately on receipt. Two ears were picked randomly from each bag, hand shelled and tested for moisture in the GIPSA-approved UGMA moisture meters, Perten AM5200 and Dickey-john GAC2500. Three readings in each meter were averaged. This was the “harvest moisture” to be used for informational purposes in tracking maturity. This moisture was not used in dry matter balance calculations.

The remaining 5 ears in each sample were dried with forced room air to below 20% moisture. The ears were weighed, then shelled after drying. Both cobs and kernels were collected and weighed, which provided a mass balance check of ears versus cob and kernels. Moisture was measured of cobs and kernels, which established the dry matter weights on a full ear basis. Finally, the kernels were cleaned with a Kice laboratory aspirator; this improved the operation of the seed counter by preventing partial seeds from counting.

A Seedburo seed counter was used to count 1000 kernels, which were then weighed. The dry matter content per seed was determined using the kernel moisture measured after shelling. Corn composition (protein, oil, starch and density) was determined with an Infratec 1241 analyzer calibrated at Iowa State University.

Results from 2016

The progression of harvest moisture rapidly declines over the first three sampling periods (Figure 1). By the second three sampling periods, grain moisture begins to stabilize. This showed a predictable trend starting at about 30% moisture after black layer, to a relatively dry 15-16% in the fourth week. The field dry down rates were very nearly the same for all locations.

Kernel dry matter is inconsistent within planting date and hybrid groupings (Figure 2). This inconsistency for some combinations may indicate a slight increase in dry matter during moisture dry down while in other treatment combinations there is either a negative or no dry matter accumulation.

Results from 2017 (to date of proceedings)

The harvest moisture declined over the harvest period, but not as rapidly as in 2016 (Figure 1, bottom panels). The northern Kanawha, Iowa location lost approximately 2.6 percentage points per week, while the southern Crawfordsville, Iowa location lost approximately 3.1 percentage points per week. This difference was probably due to the widely varying weather conditions during grain fill and dry down periods in 2017.

As in 2016, there was some inconsistency in the kernel dry matter change during the dry down period (Figure 2, bottom panels). The trend over sampling weeks was generally either flat, especially after dry matter accumulation stabilized. P1197 at both locations and P1555 at Kanawha had dry matter accumulation increases in the first three to four sampling weeks.

Summary

Corn dry matter loss in the field after maturity was studied at two locations over two years with replication and repeated ear sample collection. Kernel dry matter weight over progressive harvest dates showed no change through the dry down period where grain moisture went from over 30% down to 15%.

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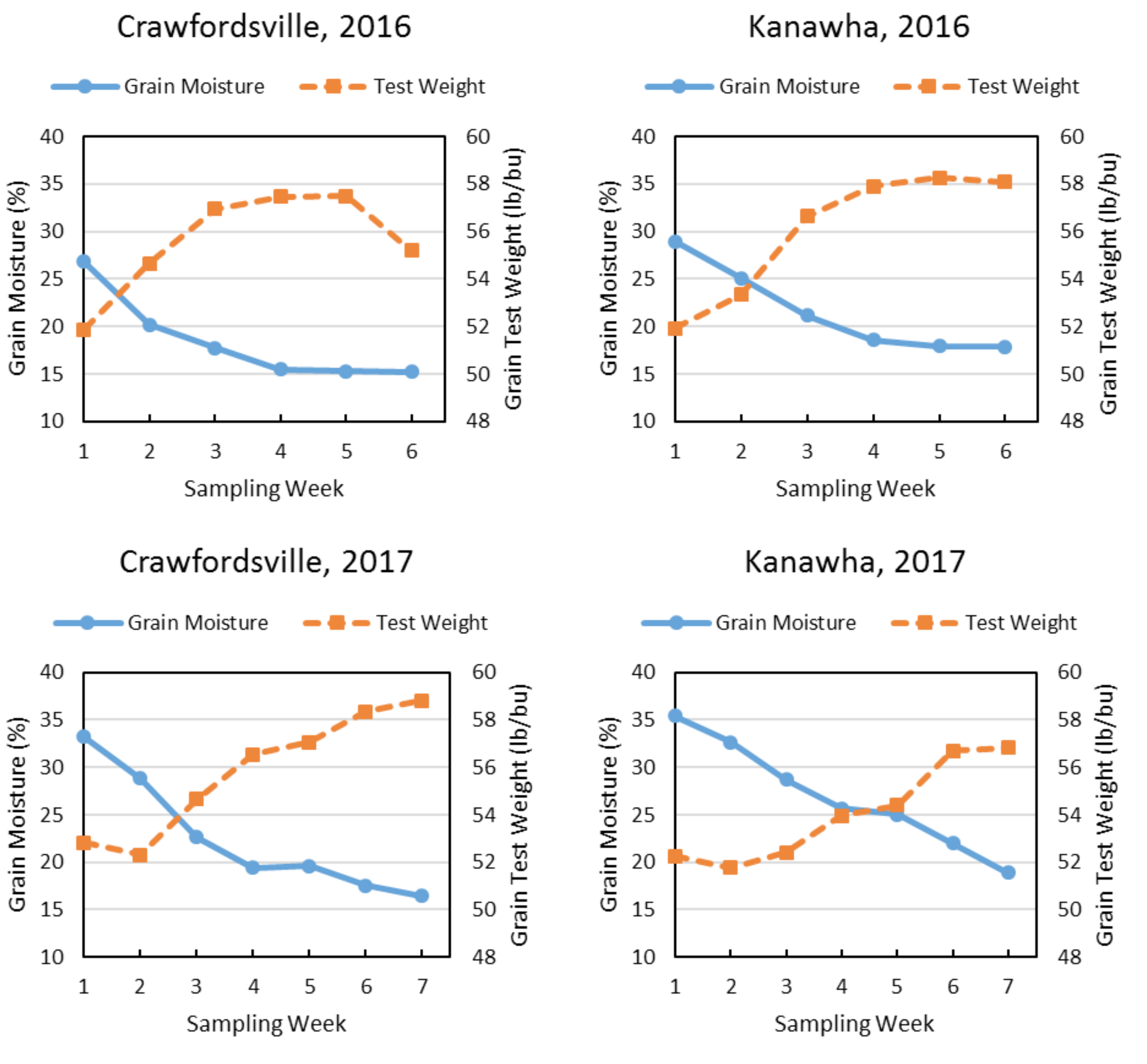

Figure 1. Corn grain harvest moisture content and grain test weight progression over the post physiological dry down period (September and October) for two planting dates and three hybrid maturities at Crawfordsville and Kanawha, Iowa in 2016 and 2017.

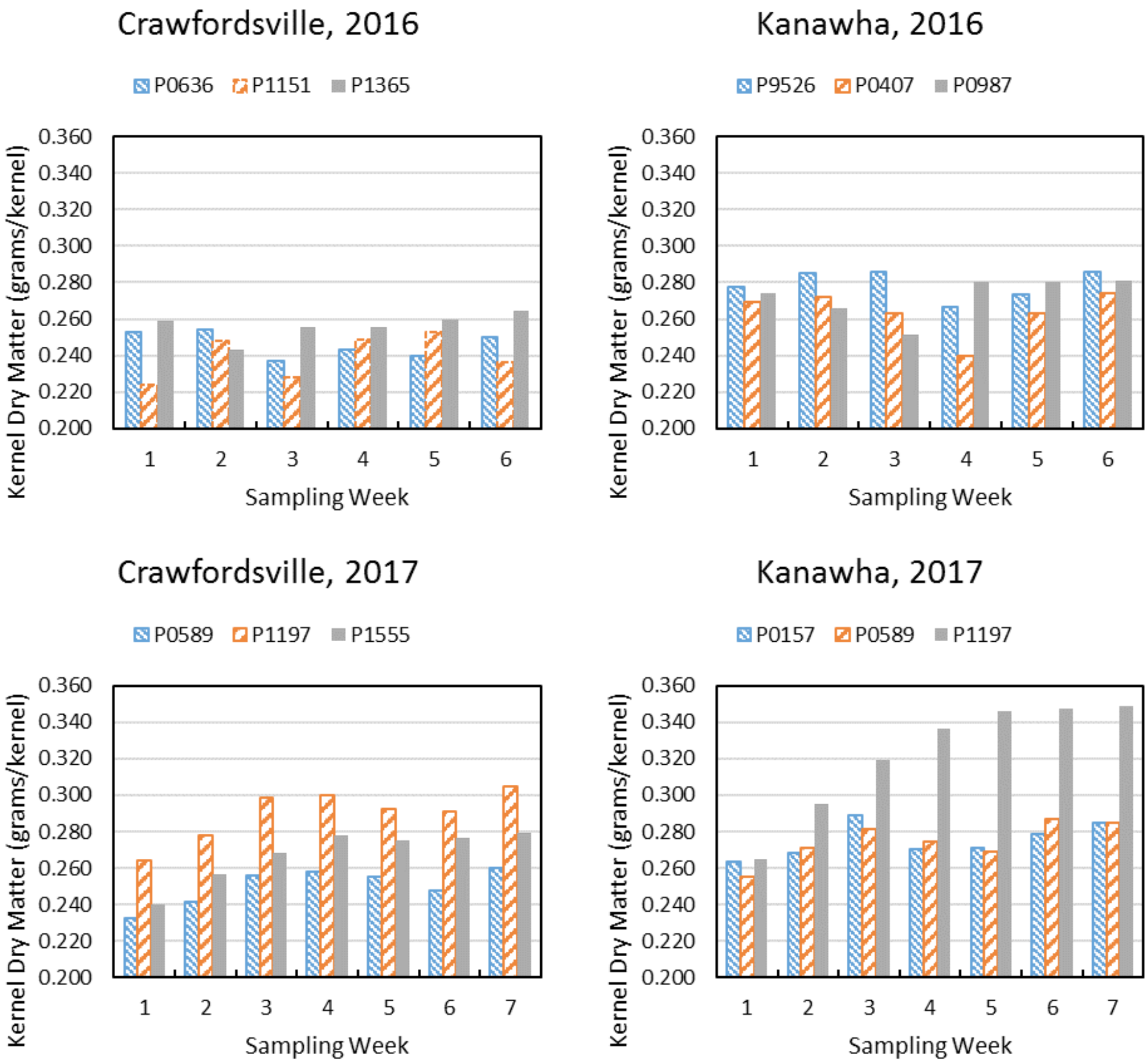

Figure 2. Corn kernel dry matter progression over the post physiological dry down period (September and October) for two planting dates at Crawfordsville and Kanawha, Iowa in 2016 and 2017.