Planting Depth Effects on Corn

Early corn planting recommendations in most Corn Belt areas are to plant 1.5 to 2 inches deep to ensure adequate moisture uptake and seed-to-soil contact. Deeper planting may be recommended as the season progresses and soils become warmer and drier. Planting shallower than 1.5 inches is almost never recommended at any planting date or in any soil type.

Growers who plant at depths less than 1.5 inches expect that seed will emerge more rapidly due to warmer soil temperatures closer to the surface. This is an important consideration, as corn growers across the Corn Belt are planting earlier to complete planting before yield potential begins to decrease after the first week of May. Particularly in soils that crust, speed of emergence is critical to establish plant stands before heavy rainfalls "seal" the soil surface.

When corn is planted 1.5 to 2 inches deep, the nodal roots develop about 0.75 inches below the soil surface. However at planting depths less than 1 inch, the nodal roots develop at or just below the soil surface (Figure 1). Such excessively shallow planting can cause slow, uneven emergence due to soil moisture variation; and rootless corn ("floppy corn syndrome") later in the season when hot, dry weather inhibits nodal root development (Figure 2).

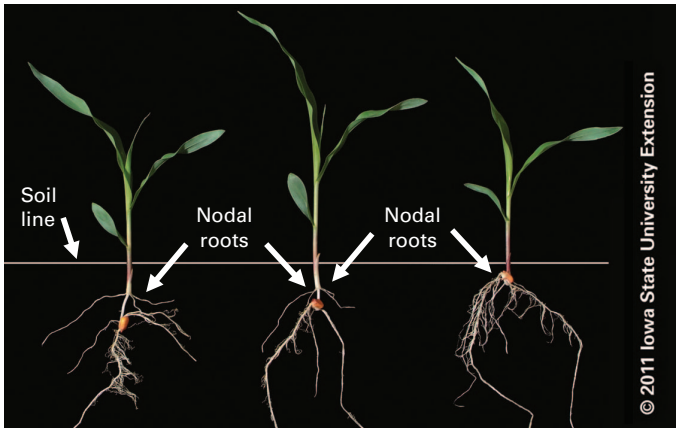

Figure 1. Planting depth (2.5" on left to 0.5" on right) determines the placement of nodal roots, which are developing too near the soil surface in shallow-planted corn plant at right.

Study Justification and Objectives

Well-documented effects of shallow planting on root development has led to the assumption that planting depth may play a role in managing the drought susceptibility of a hybrid. According to some agronomists, shallow plantings increase stress and result in less developed roots, smaller stalk diameters, smaller ears and reduced yields. However, data substantiating such claims are limited.

Although previous research has generally documented faster emergence rates with shallower planting depths, the comparisons have often included deeper planting depths than the recommended ranges, and results are highly influenced by temperature and rainfall in the given season. Recent studies comparing planting depths that are within the depth ranges commonly used by growers are limited, and none have attempted to compare hybrid differences between planting depths.

Figure 2. Rootless corn syndrome caused by shallow planting and dry soils conditions.

DuPont Pioneer has worked to introduce hybrids with improved drought tolerance to provide more yield stability on variable and droughty soils. Hybrids with higher levels of drought tolerance may provide improved yield stability in shallow-planted situations while also providing improved performance at normal planting depths, though this has not been documented. Improving our understanding of newer hybrid responses to planting depth across planting dates and over different soil types may help improve our understanding of hybrid management and positioning. Incorporation of differing planting dates and soil types will allow a more robust analysis of the impact of temperature, soil water holding capacity and crusting potential over the course of the study.

The objectives of this research study were:

- to evaluate the effect of planting depth on stand establishment of Pioneer® brand corn products
- to evaluate the grain yield response of corn products with different drought tolerance ratings to varying planting depths
- to assess if planting depth effects varied across growing environments that differed by soil type and planting date.

Study Description

Locations - This study was conducted by Dr. Peter Thomison in conjunction with the 2011 Ohio State University Ohio Corn Performance Test (OCPT) and established at 10 locations (Hebron, Washington Court House, S. Charleston, Greensville, Van Wert, Hoytville, Upper Sandusky, Bucyrus, Wooster and Beloit).

Plot Design - The experiment was replicated three times in a randomized complete block arranged in split-plot layout. The main plot was planting depth and subplot was hybrid. Plot size was 4 30-inch rows 25 feet in length. Force® 3G soil insecticide was applied in a T-band to all plots.

Hybrids and Planting Depth Treatments - Three Pioneer® brand corn products, Pioneer® P0965AM1™ brand corn (AM1, LL, RR2, 108 CRM), Pioneer® P0891AM1™ brand corn (AM1, LL, RR2, 109 CRM) and Pioneer® hybrid 35H42 (HX1, LL, RR2, 107 CRM) were planted at three planting depths (0.5, 1.5, and 2.5 to 3 inches). The drought scores for the three products were 8, 7 and 6, respectively. The Pioneer drought rating scale is from 1 to 9 (9 = best).

Seeding Rate, Measurements - Seeding rate was 34,000 seeds/acre. Measurements during the growing season included early stand, late emergers ("runts"), stalk diameter, final stand, ear weight, "nubbins", grain yield, stalk and root lodging, and test weight. Weather data were recorded at each site.

Applied Questions

How did planting depth affect corn yields?

2011 - Grain yields, averaged across locations and hybrids, were 13% and 15% greater for the 1.5- and 3-inch planting depths, respectively, than the 0.5-inch planting depth (Figure 3).

- At 8 of the 10 sites, yields of the 3-inch planting depth treatment exceeded those of the 0.5-inch planting depth treatment (data not shown).
- At 5 of the 10 sites, yields of the 1.5- and 3-inch treatments were similar; the 1.5-inch treatment out-yielded the 3-inch treatment at 1 site (data not shown).

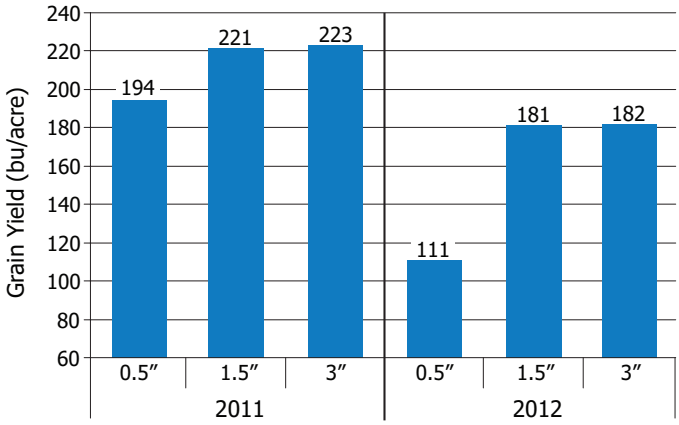

Figure 3. Corn yield response to planting depth in 2011 and 2012.

2012 - Grain yields averaged across locations and hybrids were 40% greater for the 1.5- and 3-inch planting depths than the 0.5-inch planting depth (Figure 3).

- At 9 of the 10 sites, yields of the 1.5-inch and 3-inch planting depth treatments were greater than those of the 0.5-inch planting depth (data not shown).
- At 6 of the 10 sites, yields of the 1.5-inch and 3-inch treatments were similar (data not shown).

Did planting depth affect stand establishment, and was this associated with yield effects?

2011 - The lower yield of the shallow planting treatment in Figure 3 was associated with a reduced final stand – 27,200 plants/acre for the 0.5-inch depth vs. 34,200 and 34,000 for the 1.5-inch and 3-inch planting depths, respectively (Figure 4).

- The lower yield was also associated with many more "runts" – 28% for the 0.5-in. depth vs. 5% and 4% for the 1.5-inch and 3-inch depths, respectively (data not shown).

2012 - The lower yield of the shallow planting treatment was associated with a lower final stand – 19,500 plants/acre for the 0.5-inch depth vs. 32,000 and 30,900 plants/acre for the 1.5-inch and 3-inch planting depths, respectively (Figure 4).

- The lower yield was also associated with many more "runts" – 31% for the 0.5-inch depth vs. 6% and 3% for the 1.5-inch and 3-inch planting depths, respectively.

Please see the following page for trademark information.

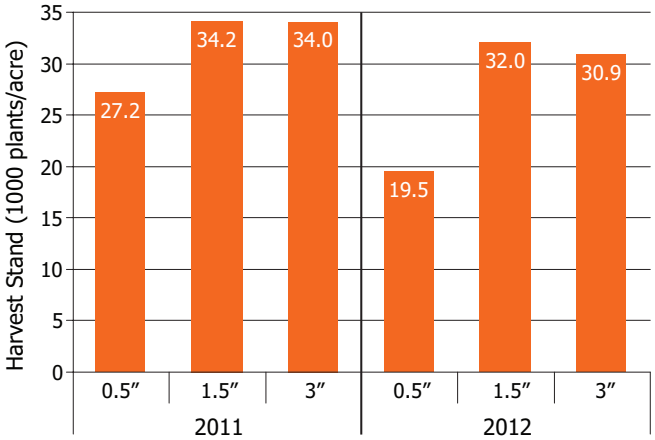

Figure 4. Harvest stand response to planting depth in 2011 and 2012.

Did corn products differ in their yield response to planting depth?

Although differences in yield were evident among hybrids, the three hybrids exhibited similar yield responses to varying planting depth (Figure 5).

- Averaged across locations, the yield of P0965AM1™ exceeded that of the other 2 hybrids by about 11 to 15 bu/acre at each planting depth.

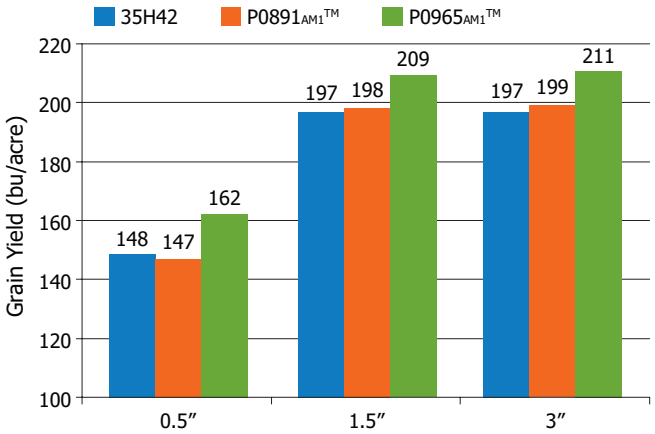

Figure 5. Corn product yield response to planting depth in 2011 - 2012.

Did differences in hybrid drought tolerance ratings affect yield response to planting depth?

Drought tolerance rating effects could not be separated from hybrid genetic effects in this study. However, similar to the prior question, there was no evidence that differences in hybrid drought tolerance ratings among the hybrids affected response to planting depth (Figure 5).

- P0965AM1™, the hybrid with the highest drought tolerance score, was consistently higher yielding than the other two hybrids at all planting depths.

Do not use these or any other data from a limited number of trials as a significant factor in product selection. Product responses are variable and subject to a variety of environmental, disease, and pest pressures. Individual results may vary.

AM1 - Contains the Optimum® AcreMax® 1 Insect Protection System with an integrated corn rootworm refuge solution includes HXX, LL, RR2. Optimum AcreMax 1 products contain the LibertyLink® gene and can be sprayed with Liberty® herbicide. The required corn borer refuge can be planted up to half a mile away.

LL - Contains the LibertyLink® gene for resistance to Liberty® herbicide. Liberty®, LibertyLink® and the Water Droplet Design are trademarks of Bayer.

RR2 - Contains the Roundup Ready® Corn 2 gene that provides crop safety for over-the-top applications of labeled glyphosate herbicides when applied according to label directions.

HX1 - Contains the Herculex® I Insect Protection gene which provides protection against European corn borer, southwestern corn borer, black cutworm, fall armyworm, western bean cutworm, lesser corn stalk borer, southern corn stalk borer, and sugarcane borer; and suppresses corn earworm.

HXX - Herculex® XTRA contains the Herculex I and Herculex RW genes.

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