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Planter Impacts on Seed Establishment and Plant Growth

H. Mark Hanna
Iowa State University, hmhanna@iastate.edu

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H. Mark Hanna, Extension Agricultural Engineer, Agricultural and Biosystems Engineering, Iowa State University

Tillage operations generally alter soil structure prior to planting. Soil manipulation by the planter represents the final opportunity to influence the soil physical environment in the seed zone for germination and early growth. Objectives for planter operation should be to:

- place seed at a uniform depth
- with good seed-to-soil contact
- and uniform seed spacing.

Soil-engaging parts of the planter such as seed openers, closing wheels or discs, and front mounted row cleaners or coulters should be maintained and adjusted along with seed metering systems.

Maintaining seed depth

Even with depth wheels set properly, every year seeds in some fields are planted too shallow because firm soil limits penetration of the seed opener. In this situation, depth wheels are not making firm contact on the ground. Unfortunately monitoring systems do not independently evaluate seed depth. Check seed depth and use adequate but not excessive down spring pressure to maintain depth wheel contact with the soil. Excessive pressure can create compaction in the seed zone and slightly lower actual seeding depth. On many planters, increased soil contact pressure of depth wheels is obtained by increasing down spring tension through parallel links attaching the planter row units to the toolbar frame. Some newer planters have a central adjustment for soil contact force with depth wheels.

Depending on soil conditions, a certain minimal amount of weight or down force is required to insert double-disc seed openers and other ground-engaging attachments into the soil. If many soil-engaging attachments are being used, the planter mainframe is light, or row spacing is narrow resulting in a large number of row units on a specific frame size, extra ballast may be needed on the planter for coulters, discs, etc. to obtain adequate operating depth. Manufacturers often design for 500 pounds or more of down force to be available to individual row units to help seed openers penetrate in hard soil conditions (e.g. dry, untilled). To help present a narrow profile for easier insertion into the soil, planters with evenly matched seed opener discs should be pinched together at the soil entry point. Planters with staggered discs should be slightly separated and maintain a narrow spacing between edges of the lead and following disc.

Conversely, if rainy periods cause soils to become wet during planting season, remember to lighten down spring force as necessary. As soil became wetter in many areas of Iowa during the 2007 planting season, some operators that omitted this adjustment discovered compaction problems later as initial crop roots attempted to explore surrounding soil.

Soil contact

The closing system should be properly aligned behind the opener. Pressure on wheels or covering discs should be adjusted as soil moisture changes to create soil contact with the seed without over compaction. Similar to down force on depth gauging wheels, if a rainy period re-wets soils at planting time, spring tension should be lightened to provide adequate seed-to-soil contact without over compaction in the seed zone.

Row cleaners or leading coulters

If row cleaners or coulters are used in front of the seed opener, height should be carefully adjusted, particularly for row cleaners. Research has shown faster early corn germination when row cleaners move primarily residue with minimal soil disturbance. Because their primary focus is moving surface residue away from the seed row zone, row cleaners are most beneficial in no-till planting situations with high amounts of residue or in cold, wet, poorly drained soil conditions if residue cover over the seed is slowing soil warm up. If a single, lead-coulter is used ahead of the row unit, research has shown that germination occurs more quickly if the bottom edge of the coulter is set about one-half inch above seed depth.

Make sure the planter frame is leveled, particularly if attachments are mounted ahead of the row unit. It will be very difficult if not impossible to properly adjust height of a leading coulter or row cleaners, or adjust ground contact pressure of closing wheels or discs if the main planter toolbar frame has not been leveled with the soil surface.

Metering system

Parts that help to singulate or meter seed wear over time and should be maintained. In particular, brushes, gaskets, seed discs, and air flow devices should be maintained in air systems. Depending on the mechanical system, brushes, springs, wear plates, and fingers should be maintained. In addition to pre-season maintenance, seed-metering areas should be inspected during the season as conditions warrant (e.g. number of acres planted, use of seed treatment, etc.).

Effect of soil contact pressure by planter depth wheels on seed placement and early plant growth

To assess affects of soil contact pressure by planter depth wheels, three row units of a four-row planter were modified by mounting a load cell between the depth adjustment and the upper contact point of the depth wheel assembly on the row unit. Load on the depth wheels was also altered somewhat on-the-go by a rotating swash plate on the parallel links operated by a controller to change down pressure spring tension in response to measured load readings. The controller attempted to keep real time loading on the depth wheels within a specific range. After planting, planted row sections with load ranges of 40 – 110 lbs (light), 110 – 200 lb (medium) and greater than 200 lb (heavy) were identified to evaluate effects on planted corn. Down pressure springs on the fourth row unit of the planter were set manually by checking that depth wheels were in firm contact with the soil surface without excessive over-tightening of springs for the soil conditions (i.e., row unit operation similar to a conventional planter or a "control" row unit).

Planting was done on three different dates in an attempt to assess planter depth wheel loading effects in wet, moist, and dry soil conditions. The first planting occurred at 17.5% soil moisture content (moist), the second planting at 20.8% soil moisture (wet), and the final plantings was at soil moisture content of 13.9% (dry).

Some measures of early corn growth and development were not able to be statistically related to load. For example it was not expected that average seed spacing or variability of seed spacing (standard deviation) would be related to contact load of the depth wheels. No relationship was observed between these variables and load on depth wheels.

Emergence rate index (ERI) is a measure of how quickly corn plants emerged. Corn plants emerging on an earlier date are more heavily weighted in the index than those emerging on later dates. ERI is a relative number for any single soil condition (planting date), but the greater the ERI the more quickly the corn stand emerges. ERI showed a significant effect with the varying load levels (Table 1). With good soil moisture or in wet conditions, corn emerged more rapidly with a low load. In dry soil conditions, corn emerged more rapidly with a heavy load. Corn planted in a "control" row without a defined surface loading did not emerge as rapidly as the optimal range of load for a given soil condition. Greater average ERI values for dry (and wet) soils were due to increased soil temperature present at the time of planting independent of the soil moisture condition (corn emerged more quickly during soil conditions with higher ambient temperatures).

Table 1. Emergence rate index and seed depth at different load levels of planter depth-gauge wheels on the soil surface.

	Emergence rate index			Seed depth, in.		
Load	**Moist**	**Wet**	**Dry**	**Moist**	**Wet**	**Dry**
Low	12.7	18.6	22.5	1.80	1.64	1.51
Medium	11.6	16.6	22.9	2.09	1.85	1.67
High	10.9	16.0	25.1	2.32	1.94	1.92
Control	10.9	16.0	21.0	2.24	1.94	1.23
$LSD_{0.05}$a	0.6	1.9	1.6	0.15	0.21	0.24

Significant differences in seed depth were also detected across down pressure levels (Table 1). Greater down pressure resulted in greater seed depths. This is a somewhat expected result, as more pressure exerted may have caused seed placement to be somewhat deeper than normal. Shallower planted seed emerged more quickly in the wetter soil conditions of the first two plantings (Table 1). With the same depth setting (relative position of depth wheels to bottom of double-disc seed opener) seeds were planted deeper (0.3 to 0.5 in.) when load was heavier on depth-gauging planter wheels.

Effects of depth wheel loads were most apparent in seed placement and early emergence. As the crop progressed, depth wheel load effects became less apparent. Plant dry matter weight was slightly increased at the V3 growth stage with low load levels in moist soils, but only at a reduced 85% statistical confidence level. Later measurements taken at growth stages V7 – V10 (including final stand, growth stage, and extended leaf height) did not differ statistically by load level on the depth wheels.