MISSISSIPPI STATE UNIVERSITY
EXTENSION SERVICE

Grain Crops Update

March 12, 2010 Dr. Erick Larson

How to Plant Corn for Higher Yields

High yield management starts at planting – Early planting is a well-known component of successful corn production, since environmental stress normally increases during the summer, reducing yield potential of late-planted corn. However, rushing the process often instigates major problems that overwhelm the benefits of early planting. Southern growers often hurry to get their crop planted, because rainfall restricts days suitable for fieldwork during prime planting time. Although corn is an amazingly productive plant, it will not tolerate problems at any growth stage without suffering some magnitude of yield reduction, because of its determinate growth habit. Many troubles developing related to ill-timed or haphazard planting cause serious irreparable corn yield reduction.

Figure 1. Corn yields are likely affected by planting performance more than any other row crop.

What are appropriate conditions for planting corn? – Historically, the primary factor limiting corn planting in Mississippi is wet soils. However, you should also be aware that soil temperature is very critical to successful corn germination, emergence and early growth. Soil temperature is the primary factor regulating germination rate, which can affect stand success and plant growth uniformity, both of which are paramount to high corn productivity. Corn seed germination requires a minimal temperature of about 50 degrees F and germination rate increases substantially as soil temperature rises. Thus, the standard guideline for determining earliest planting date is when morning soil temperature at a 2-inch soil depth is 55 degrees F and/or 50 degrees F at a 6-inch soil depth. These levels generally ensure emergence within two weeks. Although early planting is a critical component of successful corn production, planting corn very early will not generally produce the highest yields. This is not only due to the problems noted previously, but extraordinarily early planting enhances maturity very little and is not generally favorable for optimal vegetative development, because corn growth rate is correlated to temperature, and heat unit accumulation (GDD 50) is historically very low during early March. Our rainy springs not only encourage you to plant quickly, but also tempt you to plant marginally wet fields, particularly when planting intentions are high. This compacts soil, especially in the seed-furrow, which restricts root growth and often cause severe corn root development problems. These hard, compacted seed furrow walls restrict and/or even prohibit nodal root penetration in some cases, causing rootless corn syndrome, poor nutrient and water uptake and exacerbate root lodging at maturity. Also, some soils shrink when they dry, causing the seed furrow to open and expose the nodal roots - just like shallow planting. I believe that dry weather in 2007, promoted much better root growth than normal and was a primary factor contributing to the exceptional corn grain yields produced in 2007, compared to 2008 and 2009.

Figure 1. You should measure soil temperature to make sure it is adequate and conducive to rapid corn germination and emergence. Soil temperature should be measured early in the morning to determine minimum temperature. This morning's soil temperature was still below suitable for corn germination and planting, despite spring-like conditions this week.

Continuous corn expectations and management – Corn growers in the Mid-south have traditionally planted corn in rotation with other primary crops, such as cotton and soybeans. Thus, the value of rotation to our corn production systems is very under-appreciated. Research consistently shows corn productivity at least 15% lower when grown continuously, compared to a crop rotation. This effect is probably more significant than any other management input (within normal production parameters) on corn profitability. Furthermore, continuous cropping also substantially increases the likelihood of disease infection, weed competition and insect infestation which will cut yield level or increase management expenses. Thus, I strongly discourage growing corn in the same field for more than two consecutive years in Mississippi. If you chose to plant continuous corn, my primary suggestion is to select hybrids with resistance to specific foliar diseases which thrive when corn follows corn. One expression which grossly over-simplifies this issue is "disease package." There are a number of specific diseases which survive on corn residue, including Northern corn leaf blight, Southern corn leaf blight and Gray leaf spot that could be problematic in continuous corn. Hybrid disease resistance normally varies for each of these specific diseases. Thus, you need to closely analyze as much data as you can to select suited hybrids and spread your risk. A third-party source of this data is the "2009 MSU Corn Demonstration Program Results."

Stand and growth uniformity – Root systems and uniform stands are the foundation of "plant health" and high corn yields. Healthy root systems and plants are both directly affected by planter performance. Variable plant spacing and plant emergence are common stand problems that can affect corn yield potential as much, or more than actual plant population. Corn plants are extremely sensitive to variable plant spacing because they do not tiller or produce branches to adjust their plant size, and only produce one fruit-bearing organ per plant, unlike most other crops. Crowded plants produce small, variable-sized ears due to intense competition for light, water and nutrients with adjacent plants. Late-emerging corn plants experience permanent developmental disparity which drastically reduces grain yield because these runts poorly utilize resources. Planter meter system tune-up and proper calibration can certainly improve planter performance, but performance also depends a lot upon operator input in the field. I believe the most prevalent cause of seed distribution problems is excessive planter speed. Corn yield champions are fanatical regarding planter precision and often plant their contest corn at 2-4 mph. The standard maximum planter speed for corn is 5.0 mph or less. Speeds exceeding these values will usually cause much poorer seed spacing, increased double-drops, and less seed depth uniformity because seeds may roll and/or bounce in the seed furrow. These factors reduce yield potential by increasing plant competition for available resources or by causing permanent physiological disparity.

Planting depth - Many "new" corn producers may plant corn the same depth as soybeans or even cotton. This insufficient depth can produce substantial seasonal root development problems. Corn seed should normally be planted 1 ½ - 2 inches deep. Planting depth should be set in the field during planting. This is important because soil texture, seedbed condition and soil moisture will influence optimal seeding depth. Corn seed's inherent energy and germination process ensure emergence from a 3-inch depth or more. However, the initiation point of the nodal root system (near the crown of the stem) is moved upward when corn seed is not planted deep enough or seedbeds settle substantially after planting. Corn seed placed less than 1-inch deep will develop nodal roots near or even above the soil surface. This potentially exposes these roots to factors such as hot, dry soil, herbicide injury, and insect predation which can significant impede root development. This often leads to standability problems, nutrient deficiencies and even drought stress throughout the year. Birds may also cause stand loss by extracting shallow planted corn seeds or entire, small plants.

Figure 3. Planting in wet soil will create seed-furrow compaction (1st photo) which will reduce crop productivity by severely restricting corn root development and promoting rootless corn syndrome (2nd photo).

Starter fertilizer – Many corn growers use starter fertilizer to supplement their corn fertility program. Starter fertilizer promotes earlier maturity, enhances plant vigor, and often improves grain yield, especially in minimum or no-tillage systems. Starter fertilizer works by providing a concentrated phosphorus supply directly in the root zone of young plants, which is particularly beneficial when soils are cold and wet. Phosphorus placement is very important to young plants with small root systems because phosphorus doesn't move in the soil. Even though nitrogen is an important part of starter fertilizer, it can move in the soil. That's why nitrogen placement is not as important to corn uptake, especially since corn has a fibrous root system with lots of lateral growth. Thus, nitrogen fertilizers alone are not very valuable as starter fertilizers. The industry benchmark starter fertilizer source is ammonium polyphosphate (10-34-0 or 11-37-0). Many brands of orthophosphate fertilizers are readily available. But they are much more expensive, have lower nutrient analyses, and routinely show no yield difference compared to polyphosphate fertilizers in field trials. When you apply starter fertilizer in the seed furrow, use no more than 4 gallons of ammonium polyphosphate per acre in 38 to 40-inch rows or 5 gallons per acre in 30-inch rows. Otherwise, you may cause salting injury to seedlings. Corn Belt growers often use coulter rigs that band starter fertilizer to the side and below the seed. These systems are efficient, safe for the plant, and effective.

Zinc application – Corn is a sensitive crop to zinc availability, particularly at high production levels. Like phosphorus, zinc is relatively immobile in soils. Therefore, if you desire to apply zinc in a band, it is best to apply it near the row in a starter fertilizer. Conversely, zinc will not be utilized very well when sidedressed with nitrogen fertilizer. Broadcast zinc should be incorporated into the soil with tillage prior to planting.

Figure 4. Starter fertilizers promote early vigor, crop maturity and yield potential of corn, especially in minimum tillage systems. They are also an effective method to apply zinc.

Seeding Rate Suggestions – Corn growers should generally strive for a goal of 24,000 to 32,000 plants per acre. Seeding rates should exceed the desired plant population about 5 to 10% depending upon planting conditions, seedbed preparation, and seed germination. However, the optimum plant population may vary considerably from these guidelines, depending upon several factors. Dryland producers should moderate their goals, because they are dependent upon mid-season rainfall to realize potential. Therefore, I generally recommend 24,000-28,000 plants per acre for dryland production. Obviously, irrigation helps alleviate potential water deficit allowing you to maximize plant population where the "plant factory" controls productivity. However, when light interception is nearly complete, corn response to higher population ceases. Many factors affect corn light interception, including hybrid characteristics, planting date and planting configuration, so you should integrate these factors into planting decisions. Early-maturing hybrids often have less leaf canopy than later hybrids, meaning they may be more responsive to higher seeding rates. Ultra-early planted corn (soil temperature 50-55 degrees F) should be seeded about 10% thicker than normal because cool spring conditions usually promote higher seedling mortality and smaller plants with less leaf area at tassel, meaning more plants are needed to intercept available light. Conversely, growers should reduce seeding rate at later planting dates since warm temperatures enhance seedling establishment and produce taller, leafier plants, but are more likely to expose the crop to late-season stress, decreasing grain yield potential. Narrow rows substantially improve plant spacing geometry which improves light interception and decreases plant competition for nutrients and water, so potential productivity and corresponding plant population is higher. Thus, optimum plant population in wide rows is generally around 2,000 - 4,000 plants/acre less than narrow rows. Twin wide rows should be planted at rates similar to 30-inch rows.

Table 1. Irrigated corn seeding rate suggestions. These suggestions vary depending upon planter row width, anticipated stand establishment, and relative planting date.

Seeding Rate	Seed Spacing (inches)			Final Stand	
	30" rows	38" rows	40" rows	5% loss	10% loss
24000	8.7	6.9	6.5	22800	21600
26000	8.0	6.3	6.0	24700	23400
28000	7.5	5.9	5.6	26600	25200
30000	7.0	5.5	5.2	28500	27000
32000	6.5	5.2	4.9	30400	28800
34000	6.1	4.9	4.6	32300	30600
36000	5.8	4.6	4.4	34200	32400

Suggestion for:

- Late Planting Dates
- Optimum Planting Dates
- Ultra-Early Dates

Table 2. Dryland corn seeding rate suggestions. These suggestions vary depending upon planter row width, anticipated stand establishment, and relative planting date.

Seeding Rate	Seed Spacing (inches)			Final Stand		Suggestion for:
	30" rows	38" rows	40" rows	5% loss	10% loss	
24000	8.7	6.9	6.5	22800	21600	Late Planting Dates
26000	8.0	6.3	6.0	24700	23400	
28000	7.5	5.9	5.6	26600	25200	Optimum Planting Dates
30000	7.0	5.5	5.2	28500	27000	
32000	6.5	5.2	4.9	30400	28800	Ultra-Early Dates
34000	6.1	4.9	4.6	32300	30600	
36000	5.8	4.6	4.4	34200	32400	

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