Planting and Establishment of Corn

Joseph Lemmons

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Figure 1. Corn Planting. Dekalb, Illinois. Year unknown.

Course Map

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Introduction

Management decisions which influence planting are critical to agronomic success. Climate, crop rotations, soil conditions, equipment, and seed options influence the planting decisions. Each variable must be addressed to meet the goals of the operation.

Objectives:

- Understand the key variables involved with planting decisions
- Understand the effect the decisions have on emergence and establishment of the crop
- Quantify the effects these decisions have on potential yield

Figure 2. Corn Harvest. Illinois

Hybrid Selection

There are four components to hybrid selection.

1. Potential Yield
2. Harvestability
3. End Use
4. Maturity

Potential yield is "…maximum yield that could be reached by a crop in given environments, as determined, for example, by simulation models with plausible physiological and agronomic assumptions" (Evans and Fischer, 1999). Potential yield is measured by research trials in specific soil-water regimes. Seed companies test hybrids across multiple environments before a hybrid is commercially released. The hybrid must have sustained or stable high performance over several years of testing to show that they are adapted to an environment and can maximize yields under various agronomic practices such as tillage, fertility, and planting date.

Seed catalogs commonly characterize the hybrid yield in the seed catalog. It is important to get unbiased yield information when selecting hybrids. Unbiased information is available from sources such as University variety trials, and on-farm variety trials (such as F.I.R.S.T).

Hybrid Selection

The following factors can be used to characterize hybrid performance.

1. Plant-environment response (GxE)
2. Maturity
3. Dry-down potential
4. Physical characteristics that affect growth and harvest (lodging, ear drop, stalk breakage)
5. Insect and disease tolerance

Observations are made in research trials across the corn belt. These observations help researchers to place hybrids in the regions that they are adapted to.

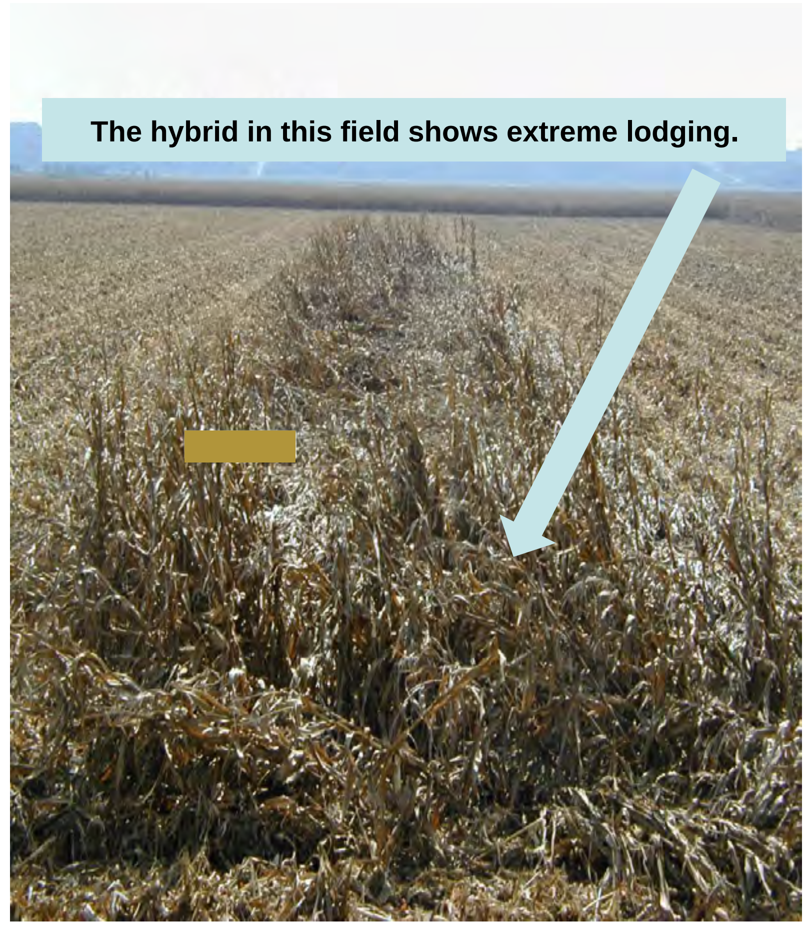

Figure 3. Down corn at research location. Hybrid ID and location has been obscured. 2007

Hybrid Selection

Time required to harvest, ear drop, ears left on plants, tightness of husk, stalk lodging, dry down, and plant intactness influence harvestability (Jugenheimer, 1985).

Stalk lodging is the breakage of the stalk below the ear. Environmental conditions, such as flooding and drought, can weaken stalks. Lodged corn results in increased harvest losses, slower harvest equipment speeds, and increased drying cost. Yield losses from stalk lodging range from 5 to 25 percent nationwide (North Dakota State University ProCrop, 2009). Ear drop refers to the propensity to lose the ear at the shank. Tightness of husk and dry down refer to the hybrids ability to dry to expected moisture levels after physiological maturity.

Hybrid Selection – Organic Certified

Some transgenic hybrids offer protection from insects. For example, some genetically enhanced hybrids have insect protection genes that have been incorporated in them to protect against corn rootworm, European corn borer, western bean cutworm and black cutworm.

Certified organic refers to agricultural products that have been grown and processed according to uniform standards. Standards are verified by independent state or private organizations accredited by the USDA. All products sold as "organic" must be certified. Certification includes annual submission of an organic system plan and inspection of farm fields and processing facilities.

Organic foods are minimally processed to maintain the integrity of food without artificial ingredients or preservatives. Certified organic requires the rejection of synthetic agrochemicals, irradiation, and genetically engineered plants.

A detailed recordkeeping system that tracks all products from the field to point of sale; and maintenance of buffer zones to prevent inadvertent contamination by synthetic farm chemicals from adjacent conventional fields must be kept and available for investigation.

For more information on Organic Certification visit www.CCOF.org

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Hybrid Selection - Maturity

A full season hybrid uses the entire available growing season to reach physiological maturity before killing frost or cool temperatures end the growing season. This will exploit the potential to attain maximum dry weight.

A linear correlation between Growing degree units (GDUs) and plant development help to characterize hybrid maturity (Nielsen et al, 2002 and Bonhomme,1994).

GDUs, which are the same as growing degree day (GDD), are measured as accumulated heat units based on cardinal daily temperatures. GDUs reflect the relationship between growth stage and climate; specifically temperature. Hybrid lines vary for cumulative GDUs from planting to physiological maturity (Nielsen et al, 2002).

Short season hybrids require fewer GDUs to reach maturity than full season hybrids when planted in optimal conditions.

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Hybrid Selection - Maturity

Hybrid selection is a function of temperature expectations, precipitation averages, and growing season length Plant hybrids whose GDU ratings compare most closely to your location, planting date, and the date two weeks prior to the average first killing frost.   A mix of 25% short season, 50% medium season, and 25% full season hybrids should be used to avoid weather risk and manage harvest timing. A 200 GDU range should separate short season and full season (Carter, 2006).

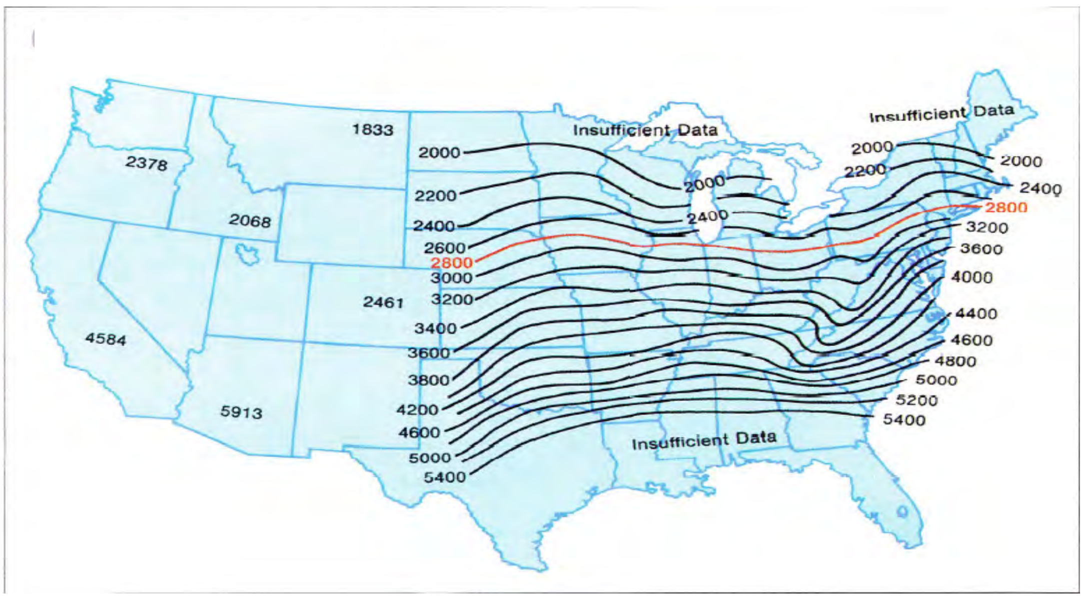

Figure 4. Growing Degree Unit Summary Map. MCSP 2000

Hybrid Selection - Seed Treatments

Seed treatments include fungicides and insecticides applied to seed before planting. Fungicides are used to control diseases of seeds and seedlings; insecticides are used to control insect pests.

Most fungicidal seed treatments do not control bacterial pathogens and most will not control all types of fungal diseases. It is important to carefully choose the treatment that provides the best control of the disease organisms of concern in the area.

There are five benefits to seed treatments:

1. Prevents spread of plant diseases.
2. Protects seed from seed rot and seedling blights
3. Improves germination
4. Provides protection from storage insects
5. Controls soil insects

Hybrid Selection - Seed Treatments

There are three types of seed treatments (Ohio State University Extension Bulletin 638).

1. Seed Disinfection: Seed disinfection refers to the suppression of fungal spores that have become established within the seed coat, or more deep-seated tissues. For effective control, the fungicidal treatment must penetrate the seed in order to kill the fungus that is present.

2. Seed Disinfestations: Seed disinfestations refers to the destruction of surface-borne organisms that have contaminated, but not infected, the seed surface.

3. Seed Protection: The purpose of seed protection is to protect the seed and young seedling from organisms in the soil that might cause decay of the seed prior to germination or during emergence

Seed Quality

Physical seed quality is generally expressed on the seed label.

1. Pure seed percentage – seed percentage based on weight of hybrid on label
2. Other variety percentages – seed percentage based on weight of other hybrid lines present in lot. Informational on purity
3. Other crop percentages – Percentage based on weight of other crop seed
4. Noxious weed seed percentage – Percentage based on weight of weed seeds
5. Inert matter – Inert matter such as of bee wings, cob material, and harvest trash
6. Germination – Percent germination of warm test.
7. Hard seed – Percentage of seed that is considered hard, or needing mechanical scarification to germinate

High quality seed is characterized by a high percentage of pure seed, high germination; low percentage of inert matter, weeds seed, other crops, or other hybrids.

Seed Quality Assurance

Quality assurance tests are conducted during and after seed conditioning. These tests are designed to provide information on seed vigor. These tests are designed to place specific environmental stresses on the seed. The cold test defines the lowest emergence that would be expected from a seed lot when planted under reasonably satisfactory field conditions, while the germination test represents the highest emergence potential that could be expected.

1. Standard Germination/Warm Test – This test is conducted to provide an idea of what field germination would be under ideal conditions (75-85F). Results are expressed as a percentage of plants that germinated in a given time period, usually several days.
2. Accelerated Aging Test – This test exposes seed to environmental variables that cause rapid seed deterioration. Artificial stress is placed on the seed for 96 hours; 41C, and 100% humidity. These conditions can estimate the storability of seed. Good potential storability is a sign of vigor.
3. Cold Test – Kernels are left in a sand/soil mix for 10 days at low temperatures (~10C). Afterwards the kernels are allowed to germinate at ideal temperatures. Seeds with good vigor produce normal seedlings. This test is used to simulate the adverse conditions that seeds might encounter in an early spring planting.

Planting Practices

Six factors impact germination and emergence.

•Temperature
•Moisture
•Depth
•Planting date
•Seeding rate
•Row spacing

The emerging crop should germinate at the same rate and emerge at roughly the same time. Delayed emergence increases the risk of insect and pathogen damage. Maximizing light interception throughout the growing season increases the potential for higher yields. Practices that allow the crop to escape stressors, such as limited moisture, can increase the potential yield.

Planting Practices – Soil Temperature

Corn germinates between 50F and 86F with a significant decrease in germination outside these cardinal temperatures (Coffman, 1923). The highest rate of germination and emergence occurs around 89F. The higher the soil temperature the higher the rate of germination and emergence (Blacklow, 1972). The current trend is for earlier planting when soil temperatures are around 50F. At 50F germination and emergence are slow. Slow germination and emergence increases the risk of soil borne pathogens and/or insects attacking and damaging the seed.

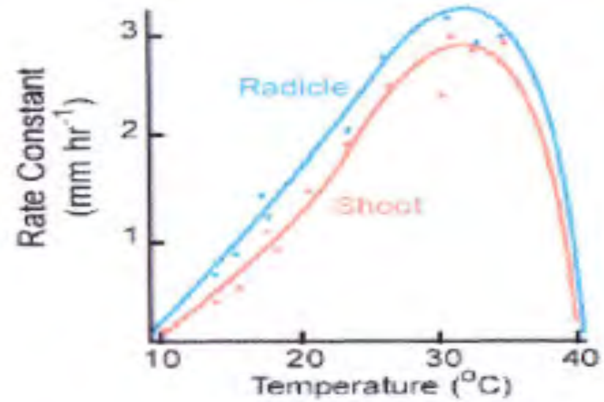

Figure 5. Radicle and shoot growth. Blacklow 1972

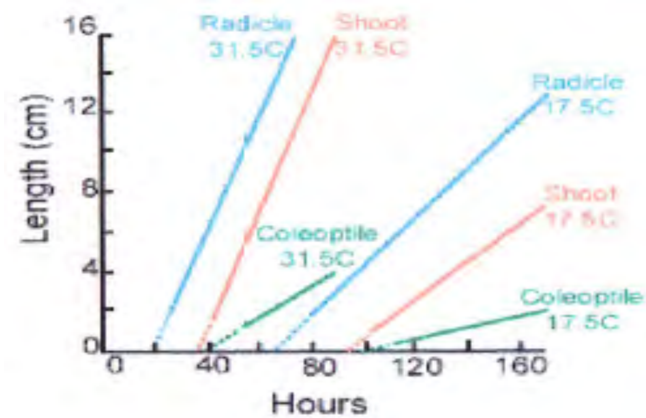

Figure 6. Radicle and shoot growth with temperature . Blacklow 1972

Planting Practices – Low Soil Temperature Effects

Planting in cool soils can result in a reduction in plant height and total leaf area (Bollero et al, 1996).   Morphological delays can continue into the season. As late as V5, plants may fail to recover, leading to reduced yield levels.   Mederski and Jones (1963) found a 5 day lag in tasseling between corn planted at 50F and 86F. Yield levels were reduced in the 50F planting.

Soil temperature testing should be done at two times in the day. The lowest daily temperature reading is typically an hour after sunrise. Place a thermometer at seeding depth, 1.5 to 2 inches. Record and compared this to the temperature at around 1:00 in the afternoon, the typical daily high temperature period (Hoeft et al, 2000). If temperatures are around 50 in the morning and 55 in the afternoon then it is safe to plant. This is due to the fact that for at least several hours through the day the cardinal temperature of >=50 degrees had been reached.

Planting Practices – Soil Temperature

It is not unusual for soil temperatures to warm rapidly in the spring, then turn cool again. Attention to the projected forecast for the period between planting and emergence is important. Frost damage to young corn is possible or soil temperatures may slow germination.

Figure 6. Frozen scenery. Post planting spring ice storm. Date unknown.

Planting Practices – Soil Temperature

After approx.65-120 GDU, the crop should have emerged. If not, sampling is required to determine what conditions are preventing emergence.

A visual inspection of the seed may reveal the source of the problem. Emergence problems may be due to insects, disease, non-viable seed, or slowed growth.

The picture to the right depicts kernels that were dug from a cold soil. Dead radicle tips, rotted kernels, and corkscrewed mesocotyls are indicators of cold soils.

Figure 7. Cold soils can cause corkscrewed mesocotyls or dead root tips (inset) Corn and Soybean Field Guide. Bob Nielsen, Purdue University 2008.

Planting Practices – Soil Temperature

Emergence problems may be caused by fungal pathogens. The most common soil-borne fungi in corn production include: *Diplodia, Fusarium, Penicillium, Pythium, and Rhizoctonia.* These pathogens are more prevalent in cold, wet and poorly drained soils when soil temperatures are less than 55F (Nielsen, 2005).

Specific symptoms from these pathogens vary but include rotted seed or seedlings, pitted scar tissue, water soaked regions, chlorotic tissue; coloring ranging from yellowish-to-red, and stunting. Accurate field analysis to determine specific pathogens are not always possible as many symptoms mimic multiple disease complexes that often require laboratory analysis for positive identification.

Planting Practices – Soil Temperature

Correct identification of emergence problems may only be possible with specialized equipment and procedures. For example, nematodes are too small to be seen with the naked eye; samples must be analyzed in nematology laboratories.

Local soils labs, professional scouting services, regional Extension Educators, University campus specialists, and/or county inspectors can aid in sample identification.

Correct identification relies on rapid receipt of fresh representative samples with observed symptoms.

The following information should be available.

1. What field this comes from
2. Field conditions at planting
3. Field conditions post-plant
4. Soil nutrient amendments, including fertilizers and pesticides
5. Seed source
6. Pesticide program

Planting Practices – Soil Moisture

Phillips (1968) concluded that 0.088g of water per seed kernel was required for germination on a Zanesville Silt Loam soil. Blacklow (1972) conducted a study that predicted germination with temperature. More soil moisture is required at lower temperatures than at higher temperatures. The table defines the change in moisture need as temperature increases from 50F to 86F.

	Moisture Required per kernel weight
Shoot initiation	-13%
Radicle initiation	-18%

Table 1. Moisture requirement for initiation.

For the average producer it is not possible to test the soils to this degree of precision.

Planting Practices – Soil Moisture

A physical test for moisture can be done in the field with the hand feel and soil appearance method. This method requires field experience in estimating soil moisture. A handful of soil is kneaded and evaluated on the characteristics as defined in the table below. The soil shape, moisture traces left on your hand, and consistency of the soil are significantly different among different soil textures. For most soils any degree of moisture at or above 50-25% is adequate for planting.

Soil Moisture Remaining (Field Capacity)	Moderately Coarse Texture	Medium Texture	Fine and Very Fine Texture
100%	No free water appears on soil but outline of ball is left on hand.		
100-75%	Forms a weak ball. Easily broken when bounced on hand	Very pliable. Easily forms a ball	Ribbons easily between fingers
75-50%	Forms a ball but separates upon contact	Forms a ball easily. Slicks with moderate pressure	Ribbons easily. Ball formation is easy and stable
50-25%	Appears to be mostly dry. Moderate pressure can't form a ball	Holds together with pressure but crumbles with minor disruption	Less pliable. Moderate pressure needed to ball soil
25-0%	No apparent moisture. Flows easily through fingers. No balling.	Easily crumbled. Will not hold together	No pliability. Hard and inflexible. Not easy to break up

Table 2. Adapted from USDA NRCS Publication 1619, NE Cooperative Extension Publication G84-690-A 1998

Planting Practices – Soil Moisture

The average rainfall across the Iowa area is between 18 and 24 inches between April and September. Timing of rainfall events can influence germination and emergence through flooded or dry soil conditions.

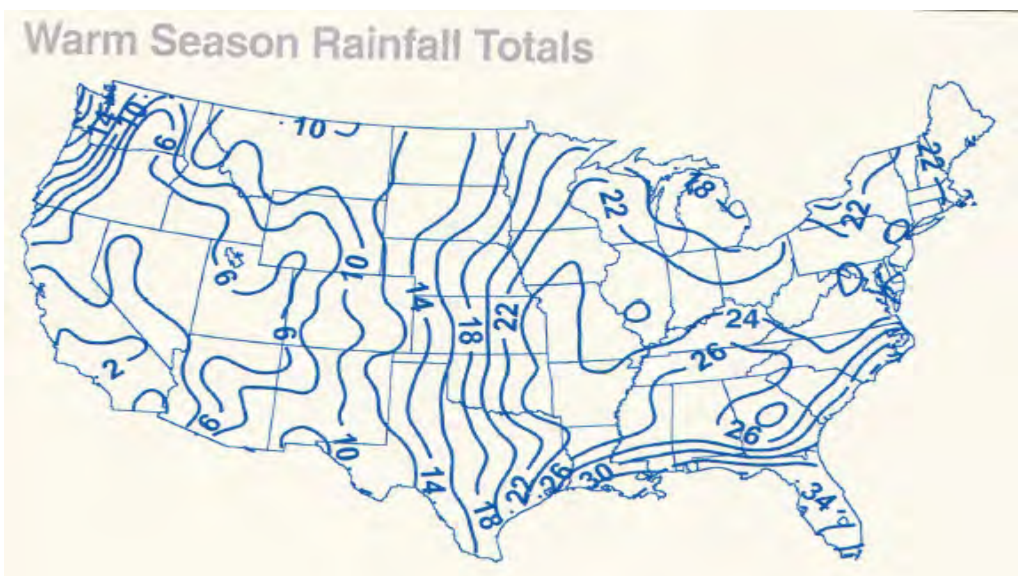

Figure 8. MCSP 2000. Data source from Midwest Regional Climate Center

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Planting Practices – Soil Moisture

Hypoxia is a concern in saturated soils. Hypoxia occurs when excessive moisture displaces oxygen and slows the diffusion of oxygen into the soil. Oxygen is required for respiration in the germinating and growing seedlings. Reduced vegetative growth and yield are common effects of planting into wet soils.

Fausey and McDonald (1985) concluded that emergence was reduced 50% at 48 hours of flooding, and reduced to 8% from 48 hours to 96 hours of flooding.

Disease incidences may also be higher in post-flooded corn stands. Diseases such as *Phytophthora, Pythium*, ear smut, and crazy top are quite common after a flooding event.

Figure 9. Flooded field conditions in Illinois - late spring. Date unknown.

Course Map

Planting Practices – Soil Moisture

Planting when the soil is dry is an acceptable management tactic if irrigation or rainfall is in the immediate future. Plant the seed at the proper depth and wait for moisture levels to increase. Be aware of future rainfall potential. The following are possible effect of prolonged exposure to dry conditions.

- Poor seed placement. Extremely dry soil may blow away and expose the kernel. Exposed kernels may fail to germinate.

- Low matric potential restricts water movement. Water will remain in micropores within the soil and will not move to the seed. Seed may begin to swell but fail to germinate as water becomes limiting. This could lead to failed germination, uneven emergence, and restricted radicle growth.

Planting Practices – Planting Depth

Corn should be planted between 1.5 and 2.0 inches deep. Deeper planting (depths >2.0 inches) may result in slow emergence. As planting depth increases, time to emergence increases (Gupta and Schneider, 1988) .

In dry soil it may become necessary to plant deeper. Plant up to 3-3.5 inches deep on clays, 4-4.5 inches deep on silts, and up to 6 inches deep in sands to reach adequate moisture (Nafzinger, et al, 2000).

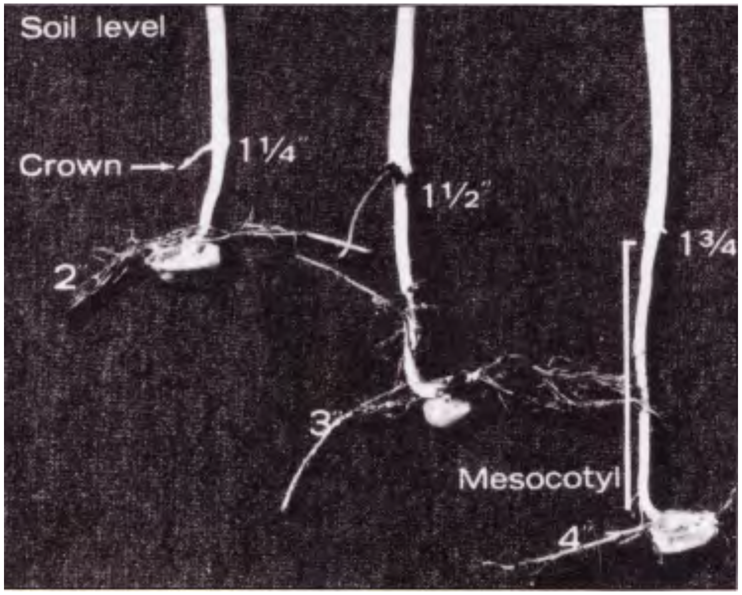

Figure 10. This picture shows the length of the mesocotyl at the 2 inch, 3 inch, and 4 inch planting depth. MCSP 2000

Planting Practices – Planting Date

Planting dates are regional and vary across the US due to climate and length of the growing season (Bruns, 2003).

Planting should be delayed until temperature and moisture conditions are acceptable as stated earlier.

Target planting to begin two weeks prior to the regionally accepted optimum planting date. Historically, as displayed to the right, 80% of the corn has been planted between the 7th of May and the 21st of May.

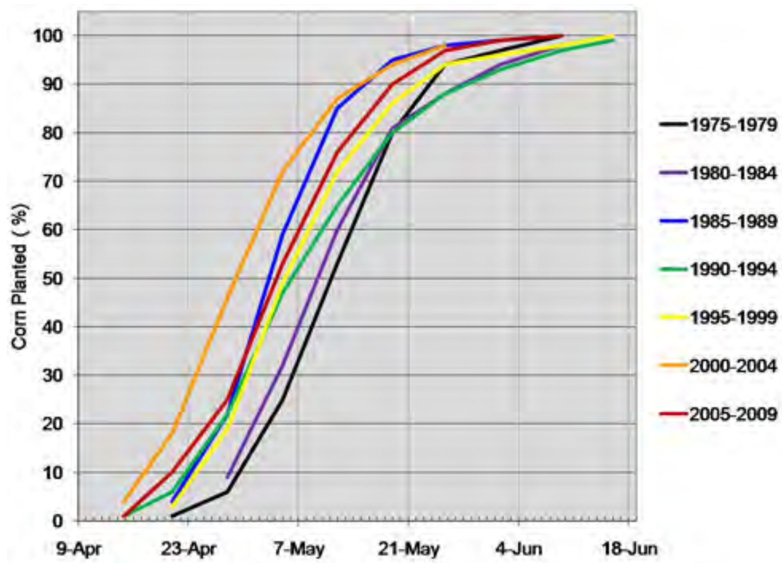

Figure 11. Iowa State University Iowa corn planting progress, 1975-2009.

Planting Practices – Planting Date

As planting is delayed the potential yield percentage is reduced. Full season hybrids generally yield better than short season hybrids across all planting dates (Norwood, 2001 and Sindelar et al, 2010).

In IA, late April to early May plantings result in the highest yields with significant yield loss occurring with early June planting.

Corn yield response to planting date.*

Date	Relative yield potential (percent)
April 20–May 5	100
May 13–19	99
May 26–June 1	90
June 10–16	68
June 24–28	52

* Average of three locations (Nashua, Ames, and Lewis) and three years (1998-2000).

Table 3. Iowa Corn Planting Guide PM1885 (2001)

Planting Practices – Effects of Delayed Planting

When planting is delayed beyond May 10, GDUs from planting to black layer decreases approximately 0.8 GDUs per day (Nielsen and Thomison, 2002) . The reduced time to maturity results in in yield reduction with the rate of loss increasing as calendar date increases.

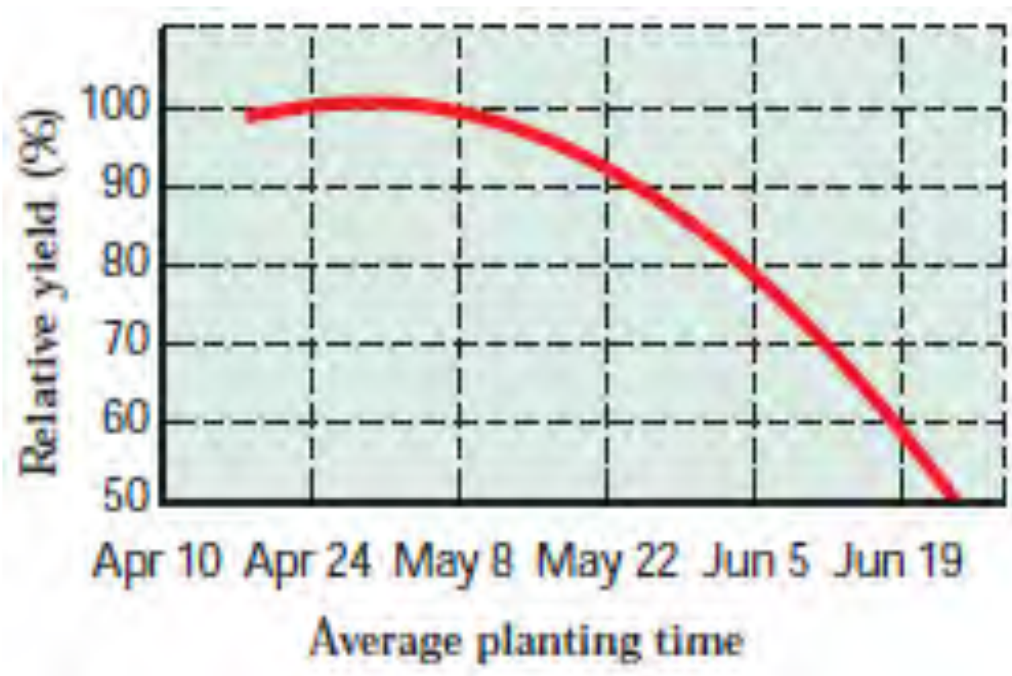

Figure 12. Iowa Corn Planting Guide PM1885 (2001)

Planting Practices – Effects of Delayed Planting

If planting is delayed until May 25, select a hybrid that matures 5 days earlier than a full season hybrid.

If planting is delayed another 7-10 days (June 2-5) then select a hybrid that matures 10 days earlier than the full season selection.

After June 10-15 the potential for loss due to freeze increases. Selection of the earliest adapted hybrid is best or a switch to a different crop may be required.

Figure 13. Photograph of early planted corn field located near Plattsmouth NE. 2008

Planting Practices – Effect of Early Planting

Maturation earlier in the season may reduce costs of drying by taking advantage of warmer fall temperatures.

The graph shows the percent moisture, at harvest, of corn planted on three different dates. The early May planting was drier at harvest.

In high stress environments early maturing hybrids, when planted early, can produce yields comparable to full season hybrid's (Sindelar et al, 2010). Early planting may allow the crop to escape stress, such as moisture stress around pollination or grain fill. Planting early may also promote early pollination before high July temperatures impact pollen viability.

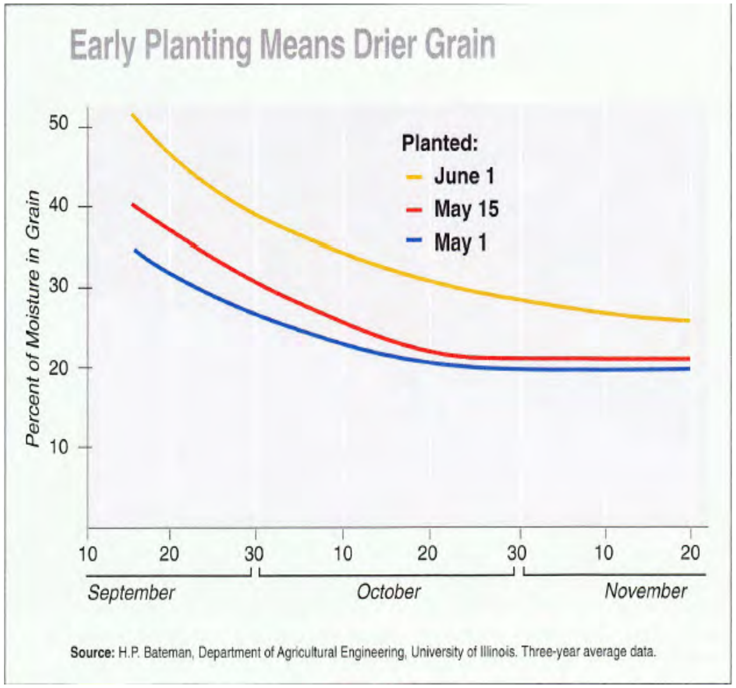

Figure 14. This chart shows the percentage moisture in the grain at the given date. Note that early plantings dried faster. MCSP 2000

Planting Practices – Planting Date

Early planting and emergence takes advantage of a longer season to maximize dry matter production. Corn planted in early May yielded 30% higher than corn planted in late May (Lauer and Carter, 1999).

Lauer and Carter (1999) concluded that 14 days after the optimal planting date, corn lost between 0.3 and 3% yield per day. This was attributed to fewer growing days and exposure to stressful conditions that decreased the potential yield of the hybrid.

A common practice when planting early is to increase the planted population by 1000-2000 kernels to compensate for seed that emerges slowly or dies.

Planting Practices – Seeding Rate

As population density increases the yield per plant generally decreases as the yield per unit area increases (Duncan, 1958). With an increase from 16,000 plants to 38,000 plants per acre there is loss in height of tassel (short plants) and a decrease in ear weights. High population results in increased lodging (Sprague, 1988). Dry matter accumulation in the stem decreases due to remobilization of materials from the stem to the grain (Nielsen and Colville, ___).

Planting Practices – Seeding Rate

With increased population density, single ear hybrids show a linear yield response to a plant density range of 36,000 to 48,500 plants per acre (Hashemi et al, 2005).

There are three components of corn yield.

•Kernels per ear
•Ears per area
•Kernel weight

As population increases, beyond 38,000 plants per acre, yield is reduced as each component is reduced (Tetio-kagho and Gardner, 1988).

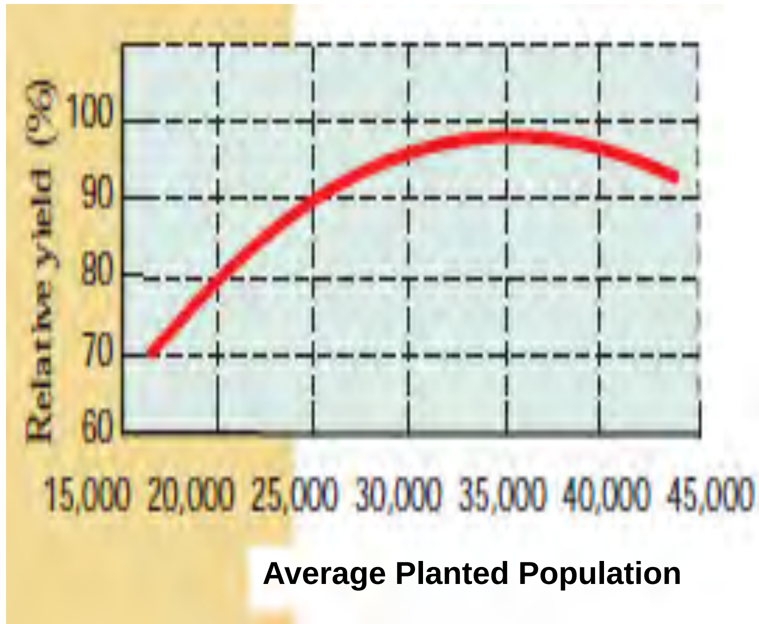

Figure 15. Population effect on yield potential. Iowa Corn Planting Guide PM1885 (2001)

Planting Practices – Row Spacing

Spacing of corn rows affects plant distribution within the row. Plants compete for nutrients, light, and moisture. Spacing plants more equidistantly should reasonably provide less competition for these factors and maximize potential yield. Reduced row spacing has been proposed to provide the following effects (Sprague, 1988):

•Decreased row spacing increases light energy available for photosynthesis by 15-20% (Coleville, 1968). Decreased row spacing increases light interception which can increase the energy available for photosynthesis. However, the closer plants are spaced in the field the more opportunity there is for interplant competition. It is therefore important to balance inter-row spacing, intra-row plant spacing, and production environment to minimize interplant competition while optimizing light interception.

•Decreased row spacing reduces energy available at the soil surface through increased shading. Evaporation is reduced.

•Decreased row spacing increases transpiration (Sprague, 1988). By intercepting more light in the canopy, more light energy is available to heat the leaf surface resulting in higher transpiration rates.

•Decreased row spacing increases soil water use (Rumawas, 1971). Soil water use is increased as transpiration is increased. This may result in yield loss under moisture stress. When moisture is not limiting, there may be an increase in yield as higher rates of transpiration result in more water availability for growth processes.

Planting Practices - Row Spacing

Several studies have been conducted to determine if there is a population density x row spacing effect and row spacing x hybrid effect. These studies have been largely inconsistent (Farnham, 2001). Various interactions with hybrid, different growing conditions, and management practices such as tillage, fertility, and planting date result in wide differences in yields reported.

It is believed that early maturing hybrids react favorably to narrow row spacing, Early hybrids tend to be smaller and less leafy. This may allow early hybrids to benefit from narrow row spacing because of the decreased competition for light. Data indicates that this is not consistent. Maturity had no significant effect on row spacing yields in several studies (Farnham, 2001). There are no definitive row spacing recommendations from investigators.

Summary

The potential yield and maturity need to be considered in selecting the proper hybrid. Maturity must be matched to the regional GDU average. The hybrid must be adapted to the region to compete more successfully with pathogens and climate conditions.

Better management decisions can be made with an understanding of how soil temperature and moisture affect germination and emergence. Planting date, population, depth, and row spacing are cultural practices that must be considered when planting. Knowing how each effects germination and emergence is important to make the correct planting decisions.

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SAMPLE TEST

1. The following is not a key component in hybrid selection:
   - Yield potential and stability
   - Harvestability
   - Maturity
   - Brand

Correct: Brand

2. Harvestability does not include characteristics such as:
   - Time to harvest
   - Ear drop
   - Lodging
   - Kernel depth

Correct: Kernel depth

Course Map

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SAMPLE TEST

3. Organic programs allow planting of seed that is:
   - Treated with synthetic chemicals
   - Transgenic
   - Irradiated
   - Non-GMO

Correct: Non-GMO

4. GDU/GDD is more reflective of maturity than relative maturity because:
   - Based on cardinal temperatures and accumulated heat units
   - Related to calendar date when planted
   - Ensures that a 110 day hybrid will be harvest ready 110 days after planting
   - GDU defines growth diameter of radicle

Correct: Based on cardinal temperatures and accumulated heat units

SAMPLE TEST

5. Shorter season hybrids should always be planted in Iowa because
   - Allows producers to make better use of equipment
   - Allows harvest to finish before Halloween
   - Allows planting until the first of June when temperatures are better
   - Shorter season hybrids should only be planted when climate, equipment or labor restrict full season hybrids from being planted

Correct: Shorter season hybrids should only be planted when climate, equipment or labor restrict full season hybrids from being planted

6. Seed treatments do not benefit by:
   - Preventing disease spread
   - Protecting seed from rots and blights at germination
   - Control soil insects
   - Guarantee 100% germination

Correct: Guarantee 100% germination

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SAMPLE TEST

7. The following is not a goal of planting
   - Establish a uniform stand
   - Provide the highest potential for light interception
   - Best utilize the natural resources available
   - Plant the most seeds per acre possible

Correct: Plant the most seeds per acre possible

8. Corn germinates best above
   - 35 degrees F
   - 40 degrees F
   - 45 degrees F
   - 50 degrees F

Correct: 50 degrees F

Course Map

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SAMPLE TEST

9. When soil temperatures are low, _______ moisture is needed for root and shoot initiation
   - More
   - Less
   - No more or less

Correct: More

10. In overly wet soils, _____ is a potential problem because _____ is limited
    - Seed to soil contact, down pressure
    - Hypoxia, oxygen
    - Emergence, light resources
    - Germination, temperature

Correct: Hypoxia, oxygen

Course Map

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SAMPLE TEST

11. Extremely dry soils are not characterized by
    - Potential poor seed placement
    - Low matric potential
    - Low fertility
    - Potentially low germination, uneven emergence, restricted radicle growth

    Correct: Low fertility

12. When planting into cold soils, as depth ______, time to emergence _______.
    - Increases, decreases
    - Increases, increases
    - Decreases, increases
    - Decreases, decreases

Correct: Increases, increases

Course Map

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SAMPLE TEST

13. Target your planting date to end about ____ weeks prior to the regionally accepted norm for 90% completion.
    - 1
    - 2
    - 3
    - 4

Correct: 2

14. After 14 days past the accepted regional completion date, there is an _____ in relative yield potential.
    - Increase
    - Decrease
    - Insignificant

Correct: Decrease

Course Map

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SAMPLE TEST

15. If there is a severe delay in planting, 7-10 days past May 25, then select a hybrid that is
    - 10 days earlier than a full season hybrid
    - 5 days earlier than a full season hybrid
    - Full season
    - Adapted to northern Minnesota, to compensate for the later planting.

Correct: 10 days earlier than a full season hybrid

16. As population ______, yield per plant _____.
    - Increases, decreases
    - Decreases, remains unchanged
    - Decreases, decreases
    - Increases, remains unchanged

Correct: Increases, decreases

Course Map

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SAMPLE TEST

17. Always target a seeding rate that is
    - Higher than suggested, to compensate for insect damage
    - Lower than suggested, to keep costs down
    - Suggested by unbiased research or indicated on the bag/tag

Correct: Suggested by unbiased research or indicated on the bag/tag

18. Narrow row planting is always suggested because it
    - Yields more
    - Allows more plants per acre
    - Plants fewer plants per acre, thus keeping costs down
    - Narrow row planting is not always justified for all operations

Correct: Narrow row planting is not always justified for all operations

Course Map

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SAMPLE TEST

19. Which of the following is usually the most important when determining when to plant
    - Soil pH
    - Seeding rate
    - Soil aeration
    - Soil moisture

Correct: Soil moisture

20. Which is a likely result of planting too early
    - Poor emergence
    - Rapid germination
    - Less seedling disease
    - More lodging

Correct: Poor emergence

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SAMPLE TEST

21. Which of the following would be a good reason to increase seeding rate
    - Narrow row planting
    - Optimum soil moisture
    - Early planting into cool soils
    - Ridge-till planting

Correct: Early planting into cool soils

22. Of the following, which would most likely cause a decrease in germination
    - Soil temperatures of 65 degrees F
    - Planting into adequate moisture
    - Severely dry soil
    - Oxygen concentration of 18%

Correct: Severely dry soil

Course Map