SDSU Extension

iGrow Corn

BEST MANAGEMENT PRACTICES

Chapter 10:
Selecting Corn Hybrids

Jonathan Kleinjan (Jonathan.Kleinjan@sdstate.edu)

Hybrid selection is one of the most important management decisions made by a corn producer because the genetic yield potential of different corn hybrids varies greatly and directly impacts yield and input costs. There are many factors to consider when selecting hybrids including: yield potential, maturity rating, drought resistance, nutrient efficiency, and pest resistance. Useful information about specific hybrids can be obtained from many sources including state and regional testing programs, on-farm strip trial testing, independent and company agronomists, seed company catalogs, and company demonstration trials (Fig. 10.1).

Figure 10.1 SDSU corn hybrid test plots (courtesy author).

Yield Potential

If a businessman were choosing a location to begin a new retail store, a real-estate agent would tell him that the three most important factors for choosing a successful site are "location, location, and location." In the same manner, a corn grower planning for next season should recognize that the three most important characteristics for selecting hybrids are "yield, yield, and yield." A hybrid with poor yield potential cannot be made into a "good" hybrid with better management. Examination of the 2013 corn hybrid trial results (100 days relative maturity rating or less) showed that at the SDSU Volga Research Farm, there was a 35-bushel per acre yield difference between the highest- and lowest-yielding hybrid. Assuming a long-term average corn price of $4/bu, this equates to an increase in gross income of $80 and $140 per acre, respectively.

Table 10.1 Tips for selecting corn hybrids (starting points):

1. Obtain reliable information on hybrid performance.
2. Identify the field problems. For example:
   a. Does it have a history of Goss's wilt.
   b. Is lodging a problem.
3. Identify a realistic yield goal and select appropriate hybrids. To achieve this goal select racehorse or defensive hybrids. Racehorse hybrids are designed to maximize yields under optimum conditions, whereas defensive varieties are designed to produce a "good" yield under less than optimum conditions.
4. Select a hybrid with an appropriate maturity rating.

There are many resources available for producers to evaluate hybrid performance. Information is available from the SDSU Extension Crop Performance Testing program (CPT) or F.I.R.S.T. trials. Additional information can be obtained by conducting side-by-side yield tests on your own farm or searching seed dealership or local agronomy company websites. Keep in mind that most side-by-side tests are one replication and therefore results may not be as reliable as a multiple replication test. When studying yield trial results, it is best to focus on hybrids that perform well over multiple locations and years. Consistent performance over multiple locations with different soil and weather conditions is important because of the variability in growing conditions between seasons.

When examining yield results, it is important to note not only the yield performance of a hybrid but also the LSD (Least Significant Difference) of the hybrid yield averages (Table 10.2). The LSD value is used to determine which hybrids are statistically different from one another. In Table 10.2 it is the last row in the table. Examination of Table 10.2 shows an $LSD_{0.05}$ value of 19.1 bu/acre. This value means all hybrids exhibiting yields within 19.1 bu/acre from one another are considered to be similar with 95% confidence. For example, a yield of 248 bu/acre is not significantly different from any hybrids with yields > 228.9 bu/acre.

Another important statistic is the coefficient of variation (CV). This statistic is 100 times the standard deviation divided by the mean value for the trait of interest (e.g. yield, test weight, etc.). The CV is an indicator of the repeatability and reliability of the measurements. The lower the CV the better. The CV value of 6% in Table 10.2 is considered excellent.

Table 10.2 An example of corn hybrid yield trial results from the South Dakota State University Crop Performance Testing program. For each hybrid, a number of measurements are collected. This information can be used to match the hybrid to specific problems. For example if the field has a history of lodging, hybrids with low lodging scores should be selected.

Brand	Hybrid	Relative maturity	Yield	Grain moisture	Test weight	Lodging	Final stand
			bu/acre	%	lbs/bu	%	*1000
Channel	197-68STX	97	248	21.0	55.9	0.8	27.9
Wensman	W80978VT3PRO	97	246	19.5	55.2	0	28.5
Renk	RK596SSTK	98	244	20.3	57.5	0	27.4
Channel	197-33STX	97	241	19.8	57.1	0	28
Hoegemeyer	HPT 7042 AMX-R	100	241	21.0	57	0	28.2
Trial average			227	19.1	56.7	0.08	27.4
LSD (0.05)			19.1	1.5	1.1	2.2	0.9
CV			6	5.6	1.4		2.4

Geographic Suitability and Stability

It is important to examine yield data from studies with climatic conditions similar to those observed on your farm. In drier areas, where yield potential may be < 100 bu/acre, producers may want to select defensive hybrids, whereas in areas with a high yield potential, (>200 bu/acre), racehorse hybrids might be the best choice. The average precipitation and growing degree map shown in Figures 10.2 and 10.3 describes regional variability. Care must be used in applying these maps because average conditions rarely occur. Standard deviation of the precipitation averages can be used to assess the expected variability. For example if the standard deviation is 5 inches and the average rainfall is 20 inches, then 68% of the time the area will receive between 15 and 25 inches of rainfall. This variability means that on average, the value of the testing site decreases with increasing distance from your farm.

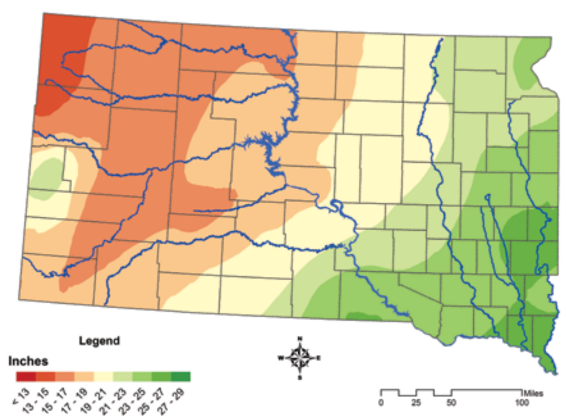

Figure 10.2 The South Dakota average annual precipitation in inches from 1977 to 2006 (Courtesy Kurtis D. Reitsma)

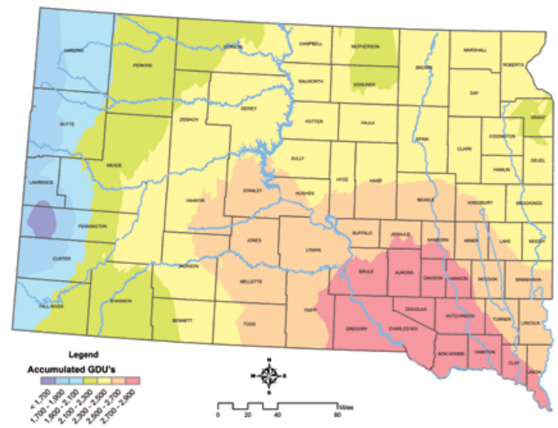

Figure 10.3 South Dakota 30-year average (1977 to 2006) accumulated of corn growing-degree days (GDDs) (50^{o}F basis). Sample calculations for growing-degree units (GDU) are provided in Example 10.1. Average GDDs for all weather stations in South Dakota are available at: http://climate.sdstate.edu/awdn/archive/degreedays.asp.

Maturity

Hybrids are rated based on their relative maturity (RM). Selecting an appropriate maturity rating is important because if the hybrid does not reach physiological maturity (black layer) before the first killing frost, yield and test weight may suffer. Black layer occurs when there is a layer of dark cells near the kernel tip. Images showing black layer are available in Chapter 5.

Hybrid maturity may have a significant impact on final grain yield, moisture content, and test weight. Drying grain costs money and reduces profits. Chapter 53 provides information on corn storage and drying. A rule of thumb is that 2 bushels of corn are needed to dry corn 1%.

Different classification systems can be used to characterize corn maturity ratings. A comparison between several systems is available in Chapter 5. One of the most widely used approaches is the number of growing-degree days (GDD) to reach maturity. GDD can also be reported as growing-degree units (GDU). An example of growing-degree day calculations are provided in Example 10.1. See Chapter 5 for additional information.

Example 10.1 Estimating corn growing-degree days (GDD) over a three-day period. In this calculation, the corn GDD base is 50^{o}F and the GDD max is 86^{o}F. These values mean that if the temperature is less than 50^{o}F use 50^{o}F (see day 1) or if the temperature is >86^{o}F use 86^{o}F (see day 3). The general equation is, $GDU=\frac{(\text{max temperture+minimum temperature})}{2}$ - lower base temperature. Additional discussion is in Chapter 5.

Table 10.3 Growing-degree days over a 3-day period.

Day	Minimum	Maximum
1	48	72
2	52	80
3	62	88
$GDU_{day\ 1}$	(50+72)/2 - 50 = 11	
$GDU_{day\ 2}$	(52+80)/2 - 50 = 16	
$GDU_{day\ 3}$	(62+86)/2 - 50 = 24	
$GDU_{accumulated}$	11+16+24 = 51	

The second approach for ranking corn maturity is the Comparative Relative Maturity (CRM). CRM assigns ranks to hybrids according to “days” of maturity. These ranks are related to the accumulated GDDs. When considering CRM it is important to consider that selecting a 90-day corn does not mean it will mature in 90 days. Two hybrids may reach physiological maturity at the same time but dry down at different rates, thus having identical GDD hybrid ratings but different CRM ratings. The two systems are related, and generally:

1. An 85-90 day hybrid requires 2000-2100 GDD.
2. A 90-95 day hybrid requires 2100-2250 GDD.
3. A 95-100 day hybrid requires 2250-2350 GDD.
4. A 100-105 day hybrids require 2350-2500 GDD.
5. A 105-110 day hybrids require 2500-2650 GDD.

It is important to choose hybrids suited to the environment where they will be grown. Most seed companies publish detailed information about corn hybrids, including the specific number of growing-degree days required to reach physiological maturity. As a rule of thumb, selected hybrids should reach maturity (black layer) at least 10 days before the first average killing frost (32°F). Keep in mind that production systems may affect maturity selection. For example, in cooler spring soil temperatures, no-till systems with heavy residue may slow plant maturity.

Some growers will also look closely at the silk CRM (GDUs to silking) of individual hybrids. Earlier-silking hybrids have been known to work well in droughty and hot environments because they may enter the reproductive growth stages prior to severe drought and heat stress.

Pest Resistance

In recent years, genetically modified (GM) traits in corn hybrids have been used to minimize the damage from pests. These GM corn hybrids provide increased crop resistance to insects and diseases, improved drought tolerance, and tolerance to broad-spectrum herbicides. Consideration of technology costs, the marketability of the crop, and the risk of developing weed or insect pest resistance should be considered when planting a GM crop. The starting point to obtain information about GM seed corn traits is from seed suppliers.

Transgenics are a type of genetic modification where genes (such insect resistance) are transferred from nonplant sources into plants. In corn, for example, the Bt (*Bacillus thuringiensis*) genes were obtained from soil bacteria *Bacillus thuringiensis*) and inserted in the corn plant to combat insect pests. One type of Bt gene provides resistance to corn rootworm while other Bt genes provide resistance to European corn borer, Southwestern corn borer, western bean cutworm, fall armyworm, corn earworm, and black cutworm.

Transgenic modifications have also provided crop tolerance to herbicides such as Roundup® and Liberty®. Stacked hybrids contain two or more genetic traits. For example, Monsanto’s Genuity® VT Triple Pro® RIB Complete® contains two separate genes for protection from aboveground insects such as corn borer and earworm, and a single gene for protection from belowground insects such as rootworm in addition to providing a 10% refuge (to combat insect resistance). Many hybrids have an integrated refuge in the bag (RIB) whereas others may require a separate corn borer and/or corn rootworm refuge for insect resistance management.

Insect and weed pests are becoming increasingly more resistant to chemical and genetic solutions. To slow the development of pest resistance the control strategies should be rotated. Tips to avoid problems include:

1. Know the terminology. For example: GT (Glyphosate Tolerant), LL (LibertyLink®), RR2 (Roundup Ready 2 Yield®).
2. Understand the trait biology.
3. Check seed bag tags to make sure what was ordered was delivered.
4. Check herbicide traits multiple times prior to herbicide application.
5. Save seed bag labels for your field records.

Other Agronomic Characteristics

Corn hybrids have a wide variety of agronomic characteristics relating to plant structure and health. Seed companies generally provide trait ratings for seedling vigor, stalk strength, and ear retention. Seedling vigor refers to the ability of a corn plant to cope with stress early in the growing season. Hybrids with good seedling vigor may perform better in cool, moist conditions. This may be important in no-till and high-residue production systems.

Good stalk strength can decrease lodging but there are no guarantees. All hybrids can lodge or break off if undesirable weather events or insect/disease infestations occur during periods of rapid stalk growth. Poor stalk strength can reduce yields by increasing harvest losses. If lodging and/or ear drop is an issue, select hybrids that provide protection against shank-boring insects, drought tolerance during pollination, and good ear retention. Harvest problems associated with lodging may be alleviated somewhat by adjusting the combine accordingly. Information on measuring and adjusting combines to reduce losses is available in Chapter 37.

Seed Corn Production

Corn hybrids are produced by crossing inbred lines that are developed over several seasons. Plant scientists select for specific traits by inbreeding (self-pollinating) corn plants and then discarding progeny that has undesirable characteristics. Plant vigor is often lost during the inbreeding process but it can be recovered by crossing with other inbred lines. Hybrids can be produced by crossing two (single-cross), three (three-way-cross), and four inbred lines (double-cross). If a single cross is used, then all plants within a field will have near uniform characteristics, whereas hybrids produced using double-crosses will have the most variability. Generally, single-cross hybrids have the highest hybrid vigor.

Use On-farm Testing to Verify the Best Hybrids

Different hybrids have characteristics that make them better-suited for one environment over another. An approach that can be used to examine hybrid performance is on-farm strip-trial testing. On-farm testing can be used to match hybrids to your conditions. Be sure to use a well-calibrated yield monitor and/or compare weights from strips using scales on grain carts for accurate harvest data when conducting on-farm strip trial testing. Understand that replication in strip trials is very important for determining which hybrids are actually better performers. Replicated, split-planter testing can help overcome many of the inherent variables that occur in agronomic testing.

Consider field-by-field hybrid placement to maximize yield of each hybrid. Many seed and data-mining companies are putting a lot of effort into analyzing large amounts of yield data to determine which hybrids perform better on individual soil types. This type of technology is still in the early stages but "prescription" hybrid selection based on soil type may become commonplace in the future. Consult with your local seed experts to match hybrids to your soil and environmental conditions.

Seed Quality

It is possible to purchase hybrids with specific seed-quality characteristics. For example, high-lysine, high-amyopectin (waxy corn), or white corn hybrids are available. High-lysine corn hybrids were created for feed for nonruminant animals, such as hogs, whereas waxy corn hybrids were created to increase milk production efficiency. White corn was created specifically for the food market (tortillas). Specialty corn hybrids may have specific management requirements that should be followed. Additional information on specialty corn hybrids are available in Dickerson (2003).

Summary

Selecting a genetically diverse lineup of locally adapted hybrids that vary in maturity and agronomic strengths can help growers lower their risk of crop loss. Spreading out maturities helps manage weather-related risk as well as spreading out the harvest interval so the crop is not all too dry or too wet at harvest. Hybrids should be considered/selected for the following key traits: yield, maturity, drought tolerance, standability, pest resistance, dry-down time, grain quality, and harvestability. Consulting with seed experts in your area to understand the agronomic characteristics of locally adapted hybrids is a good starting point.

References and Additional Information

Carter, P. Selecting corn hybrids. University of Wisconsin Extension, Madison WI, A3265.

Dickerson, G.W. 2003. Specialty corns. Guide H-232 New Mexico Cooperative Extension Service.

Hall, R.G., and K.D. Reitsma. 2009. Corn hybrid selection. pp. 9-12. In Clay, D.E., K.D. Reitsma, and S.A. Clay (eds). South Dakota State University, South Dakota Cooperative Extension Service, Brookings, SD.

Kleinjan, J.L., and K.K. Kirby. 2014. Precision planted corn performance trials. South Dakota State University, SDSU Extension, Brookings, SD.

Thomison, P. Specialty corns: Waxy, high amylose, high oil, high lysine corn. AGF-112-91, Ohio State University Extension,

Acknowledgements

Support for this document was provided by South Dakota State University, SDSU Extension, and the South Dakota Corn Utilization Council. Special thanks to Curt Hoffbeck and Keith Alverson for their helpful insights.

Kleinjan, J. 2016. Chapter 10: Selecting Corn Hybrids. In Clay, D.E., C.G. Carlson, S.A. Clay, and E. Byamukama (eds). iGrow Corn: Best Management Practices. South Dakota State University.