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Best Management Practices for Corn Production in South Dakota: Corn Hybrid Selection

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CHAPTER 2
Corn Hybrid Selection

Selecting a hybrid is one of the most important decisions a producer makes. Hybrid selection should consider yield, maturity, resistance to disease and insect pests, and other traits important to individual production systems (Table 2.1).

Table 2.1. Common traits for evaluating a hybrid

- Hybrid maturity
- Yield potential
- Yield stability
- Lodging resistance
- Ear retention
- Disease resistance
- Insect resistance
- Herbicide tolerance
- Seed quality
- Dry-down rate
- Test weight

Hybrid Maturity

Growing-season length varies within South Dakota. Growers are encouraged to select hybrids that will reach physiological maturity, or "black layer," about 1 to 2 weeks before the average first killing frost. Comparing the maturity rating systems of different seed companies is difficult because the respective ratings systems are estimated and reported differently. One commonly used system is the Minnesota Relative Maturity (MRM) system. In the MRM system the hybrid is field tested for 3 years and compared to a group of standard hybrids with known relative maturities (RM). Hybrids with relative maturity ratings ranging from 75 to 115 days are suitable for South Dakota.

Another approach for selecting hybrids relies on accumulated "growing degree days" (GDD) or "growing degree units" (GDU). The base temperature used for calculating GDUs will vary by crop. The base temperature for corn is 50°F (corn growth is minimal below this temperature). The maximum temperature used also varies by crop; for corn it is set at 86°F (corn growth declines when the temperature exceeds 86°F). GDUs are calculated using the equation in Table 2.2. Accumulation of GDUs can be tracked with a thermometer during the growing season or is available for specific South Dakota sites at http://climate.sdstate.edu/climate_site/current_weather.htm.

When using GDUs to select hybrids, base the maturity selection on accumulated GDUs from planting to first fall frost (minus the adjustment value of GDUs to allow for grain dry-down). However, if the crop is to be harvested for silage, an allowance for grain dry-down is not needed. If planting is delayed, an earlier-maturing hybrid may be appropriate. Average accumulated GDUs for selected spring planting dates is provided by location in Table 2.3.

Table 2.2. Calculation of growing degree units (GDUs)

$$^{1}\text{GDU} = \left(\frac{(\text{MDH} + \text{MDL})}{2}\right) - 50$$

GDU[2] = growing degree units
MDH[3] = maximum daily high temperature (degrees Fahrenheit [°F])
MDL[4] = minimum daily low temperature (degrees Fahrenheit [°F])

[1]When selecting hybrid maturity based on GDUs, unless crop is to be harvested for silage, subtract accumulated GDUs for 10 days prior to first fall frost to allow for grain dry-down.
[2]GDU = growing degree day (GDD)
[3]MDH cannot be greater than 86°F; if MDH > 86°F then MDH = 86°F
[4]MDL cannot be less than 50°F; if MDL <50°F then MDL = 50°F.

Table 2.3. Average accumulated growing degree units (*GDUs)
"Years of data" range from 24 to 36 years (from 1970 to 2006) by location.

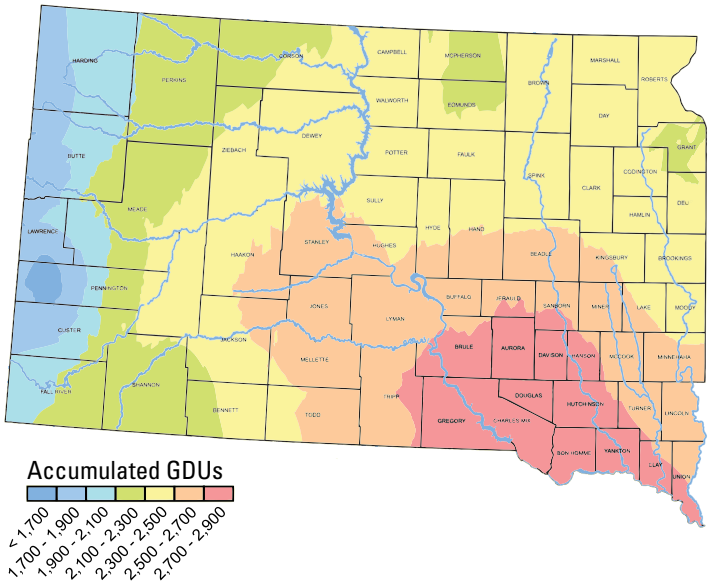
Weather Station	Years of data	Spring planting date						Adjustment for grain dry-down	Average date of first fall frost	
		May 1	May 11	May 21	May 31	June 10	June 20			
		average GDUs† to first fall frost of 32°F						GDUs‡	32°F	28°F
Aberdeen Arprt	36	2,389	2,305	2,195	2,072	1,928	1,763	163	Sep 22	Oct 1
Armour	32	2,832	2,730	2,599	2,458	2,296	2,104	330	Sep 30	Oct 21
Bison	29	2,326	2,243	2,143	2,038	1,906	1,756	199	Sep 25	Oct 15
Bridgewater	29	2,720	2,627	2,507	2,365	2,202	2,010	278	Oct 1	Oct 22
Britton	35	2,523	2,427	2,308	2,176	2,021	1,847	192	Sep 24	Oct 10
Brookings 2 NE**	36	2,220	2,149	2,052	1,938	1,803	1,644	143	Sep 21	Oct 11
Canton 4 WNW	31	2,687	2,589	2,458	2,316	2,153	1,960	250	Sep 27	Oct 16
Centerville 6 SE	36	2,554	2,464	2,348	2,213	2,054	1,868	212	Sep 24	Oct 18
Clark	35	2,441	2,363	2,259	2,142	2,002	1,839	224	Sep 30	Oct 15
Clear Lake	34	2,390	2,308	2,203	2,083	1,944	1,777	218	Sep 29	Oct 17
De Smet	33	2,572	2,485	2,376	2,254	2,105	1,930	250	Sep 30	Oct 17
Eureka	36	2,299	2,218	2,114	1,996	1,859	1,704	162	Sep 22	Oct 9
Faith	30	2,503	2,416	2,307	2,191	2,052	1,894	268	Sep 28	Oct 16
Faulkton 1 NW	33	2,454	2,368	2,264	2,143	1,996	1,834	213	Sep 25	Oct 10
Flandreau	34	2,332	2,254	2,152	2,031	1,889	1,724	199	Sep 26	Oct 14
Gettysburg	33	2,320	2,245	2,144	2,044	1,913	1,758	237	Sep 28	Oct 15
Gregory	35	2,682	2,586	2,464	2,336	2,180	2,000	273	Sep 29	Oct 19
Highmore 1 W	30	2,531	2,440	2,322	2,195	2,043	1,870	207	Sep 24	Oct 12
Huron Arprt	36	2,564	2,475	2,363	2,235	2,084	1,907	237	Sep 27	Oct 18
Ipswich	35	2,327	2,242	2,131	2,010	1,869	1,708	158	Sep 22	Oct 8
Kennebec	35	2,754	2,650	2,520	2,382	2,215	2,025	230	Sep 24	Oct 11
Madison 2 SE	36	2,427	2,348	2,242	2,119	1,973	1,805	214	Sep 27	Oct 19
Mellette	31	2,381	2,299	2,192	2,077	1,933	1,766	187	Sep 24	Oct 10
Menno	35	2,802	2,697	2,566	2,418	2,247	2,050	271	Sep 27	Oct 19
Milbank 2 SSW	28	2,426	2,344	2,233	2,108	1,956	1,789	220	Sep 27	Oct 17
Miller	35	2,596	2,507	2,393	2,270	2,120	1,947	266	Oct 1	Oct 15
Mission	35	2,439	2,362	2,261	2,148	2,012	1,850	236	Sep 26	Oct 13
Mitchell 2 N	29	2,718	2,627	2,509	2,377	2,217	2,030	287	Oct 1	Oct 22
Newell	35	2,337	2,265	2,170	2,056	1,927	1,778	229	Sep 26	Oct 14
Oelrichs	35	2,447	2,360	2,252	2,134	1,994	1,834	220	Sep 24	Oct 11
Onida 4 NW	34	2,573	2,480	2,363	2,236	2,085	1,916	246	Sep 27	Oct 15
Pollock	31	2,470	2,379	2,265	2,136	1,985	1,821	225	Sep 26	Oct 7
Rapid City 4 NW	29	2,340	2,268	2,171	2,069	1,941	1,793	247	Sep 30	Oct 24
Redfield 2 NE	26	2,399	2,312	2,204	2,080	1,935	1,770	196	Sep 23	Oct 11
Selby	35	2,323	2,247	2,144	2,030	1,896	1,738	188	Sep 25	Oct 11
Sioux Falls Arprt	35	2,592	2,501	2,387	2,254	2,098	1,912	245	Sep 28	Oct 20
Sisseton	35	2,456	2,369	2,256	2,132	1,983	1,814	237	Sep 29	Oct 18
Timber Lake	36	2,411	2,328	2,222	2,105	1,193	1,803	252	Sep 29	Oct 13
Tyndall	34	2,859	2,760	2,636	2,493	2,328	2,132	334	Oct 3	Oct 22
Vermillion 2 SE	27	2,895	2,796	2,646	2,496	2,318	2,114	327	Sep 29	Oct 24
Wagner	36	2,974	2,863	2,728	2,576	2,400	2,200	363	Oct 3	Oct 25
Watertown Arprt	32	2,344	2,266	2,163	2,046	1,904	1,741	155	Sep 23	Oct 11
Webster	34	2,415	2,333	2,227	2,105	1,964	1,804	214	Sep 29	Oct 14
Wessington Springs	34	2,814	2,729	2,612	2,475	2,314	2,129	366	Oct 5	Oct 27
Winner	35	2,906	2,800	2,668	2,529	2,362	2,170	385	Oct 3	Oct 23

* GDUs – based on a daily maximum and minimum of 86°F and 50°F, respectively, and a base temperature of 50° F (Table 2.2).
** Indicates Brookings 2 NE is located 2 miles northeast of the Brookings Post Office.
‡ GDUs that must be subtracted from any May 1 to June 20 date to allow for 10 days of dry-down before 32°F.
† Averages are based on "years of data" column or from 1976-2006. Averages are based on a range of values that are less and greater than the average; therefore, values lower or higher than average should be expected.
Adapted from Todey, D. and C. Shukla. 2007. South Dakota Climate & Weather. South Dakota State University.

The map in figure 2.1 shows the 30-year average accumulated GDUs (50°F basis) across the state during an "average" growing season (taking into account the probabilities of the last spring and first fall frost dates).

A third approach to hybrid maturity selection is the Comparative Relative Maturity (CRM) method. With this method, RM and GDUs are compared. No matter which method is selected, the most important factor for achieving the full genetic yield potential is to choose hybrids that are suited to local conditions. Hybrids that have either too long or short maturity may not reach their full yield potential. Growers are advised to consult their local county Extension educator or crop advisor to assist them in hybrid selection.

Figure 2.1. Thirty-year average accumulated GDUs (50°F basis)



This map was created from daily reporting National Weather Service Cooperative Observer Stations, considering the 50th percentile date of last spring frost and first fall frost for each reporting station between 1977 and 2006.

Yield Potential and Stability

Regardless of climate, fertility, pest, or weed problems, different hybrids have different yield potentials. Hybrids that are more resistant to stress have more stable yields. When considering a hybrid, yield data and climate conditions for the past 3 years should be considered. Hybrids with consistent yields under varying climate conditions are more desirable than hybrids with variable yields.

Another approach is to plant 15, 35, and 50% of acres with hybrids having 1, 2, and 3 years of yield data, respectively. This allows a producer to take advantage of a new hybrid without exceptional risk.

Corn yield trials are conducted annually by the South Dakota State University Crop Performance Testing Program. Results from those yield trials are available at http://plantsci.sdstate.edu/varietytrials/.

Agronomic Traits

Agronomic traits represent the base genetics of the hybrid. Seed companies commonly rate the hybrid's yield, stalk strength, drought tolerance, and disease-resistance traits. One trait may be more important to a producer than another.

Emergence and seedling vigor indicate the ability of the plant to deal with stress early in the season. Hybrids that emerge quicker and have a greater early season vigor may be able to better cope with cool temperatures. This is especially important in high-residue no-tillage systems.

Harvestability is related to traits that impact dry-down rate, root and stalk strength, "stay-green," ear retention, and husk cover. Lodging and ear-drop can reduce yield simply by making it difficult to harvest the crop. Plants that stay green later into the season are likely to have

Table 2.4. Agronomic traits

Plant Development
- drought tolerance
- emergence
- seedling vigor

Yield & Harvestability
- root strength
- stalk strength
- plant height
- ear height
- kernels per row
- husk cover
- ear retention
- ear flex
- stay-green
- grain dry-down

increased stalk strength and reduced lodging. Ear retention indicates how strongly the plant holds the ear and resists ear-drop.

Although a hybrid might have a good genetic package for plant standability, there is no guarantee that it will not lodge or break. All hybrids are susceptible to stalk lodging, snapping, or breakage during periods of rapid stalk growth. Hybrids prone to stalk breakage have a longer period of susceptibility or exhibit a greater degree of damage during rapid growth. Strong winds, hail, insect damage, and stalk rots (exacerbated by insect damage and/or drought) can cause stalk breakage. Growth-regulator herbicides like 2,4-D and dicamba can affect a hybrid's ability to resist stalk problems.

Insect and Disease Resistance and Genetically Modified Crops

If disease or insect problems exist or are expected, resistance traits for that particular pest are important. To identify resistance to specific problems, check with your seed dealer.

Genetically modified crops (GMC) have become popular for managing insect and weed pests. Insects that present a threat to the crop (such as European corn borer, corn rootworm, and western bean cutworm) can be controlled by planting a hybrid genetically engineered to kill those insects. Genetically engineered hybrids that are tolerant to broad-spectrum herbicides can simplify weed control programs. It is recommended that the technology cost and marketability of the crop be considered prior to committing to a GMC. Information regarding GMC-approval status is available from the National Corn Growers Association (NCGA) online at http://www.ncga.com/biotechnology/main/index.asp.

Seed Quality

Prior to planting, seed should be checked for germination rates and weed seeds. Weed seed is generally not a problem, due to the large seed size and ease of weed seed removal with mechanical seed-conditioning equipment. All hybrid seed must have germination test results on the label. Cold test germination values of 85% or higher are desirable if planting in soil with temperatures less than 50°F. Most hybrid seed is treated with a fungicide. Seed should be inspected for nicks or cracks, as these conditions lower seed quality (thus increasing vulnerability to disease infection). Broken or cracked seeds may not germinate; poor quality seed should be returned to the dealer.

Additional Information and References

Hall, R.G. and K.K. Kirby. 2007 (revised annually). Precision planted corn performance trials. South Dakota State University, South Dakota Cooperative Extension Service, Brookings, SD. http://agbiopubs.sdstate.edu.

Todey, D. and C. Shukla. 2007. South Dakota climate and weather. South Dakota State University. http://climate.sdstate.edu/climate.

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