A3265

Selecting Corn Hybrids

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ONE OF THE MOST IMPORTANT management decisions corn growers make each year is selecting corn hybrids. The following specific attributes strongly affect top performance: maturity, yield potential and consistency, standability, disease and insect resistance, ear and kernel qualities, type of cross, seed size and quality, hybrid response to management, and specific uses.

Maturity

Corn is **physiologically mature** when kernels reach maximum dry weight and are safe from frost. All milky fluid disappears from the kernel, and the **black layer**, a dark layer of cells, forms near the tip of mature kernels. Most hybrids adapted to Wisconsin reach this stage when kernel moisture decreases to 30–32%, but it may not occur until moisture content decreases to 28% for some early hybrids. **Harvest maturity** depends on the intended use of the corn and on the harvest and storage methods of each farm. Corn for silage or high-moisture grain is ready to harvest about 10 days before physiological maturity. Corn that is field-shelled and dried or picked and cribbed does not reach harvest maturity until kernel moisture content reaches 23–28%.

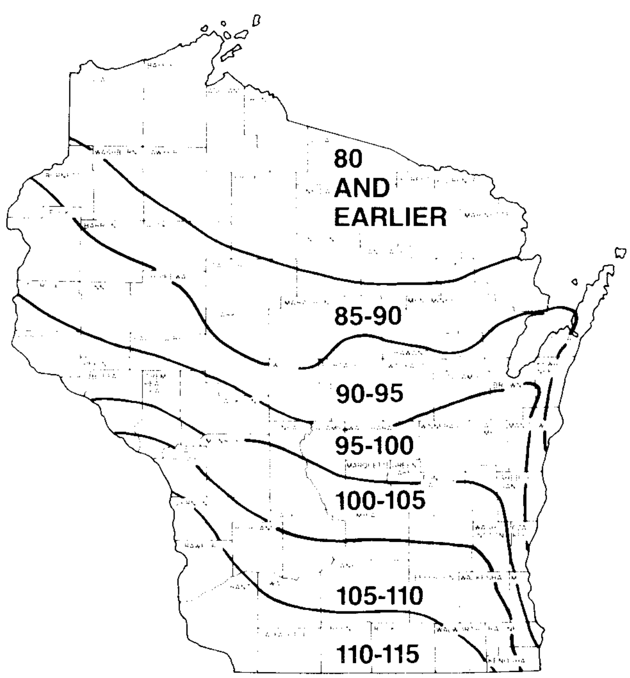

Figure 1. Relative Maturity (RM) belts for early-planted, full-season corn hybrids.

Companies that produce hybrid seed use different systems to classify maturity, which makes it difficult to compare hybrids from different companies and to choose hybrids appropriate for specific farms. The two most common classification systems are Relative Maturity and Growing Degree Days. The Relative Maturity (RM) System ranks hybrids in relative order of maturity using grain moisture percentage at harvest to evaluate the hybrids against check hybrids. This system does not give the absolute days to maturity. A 95-day RM hybrid planted May 5 in central Wisconsin may take 130 days to reach physiological maturity in a warm year and 150 days in a cool year. Figure 1 is a general guide to maximum RM for corn planted early in Wisconsin.

The Growing Degree Days (GDD) or heat unit system classifies hybrids according to the effective heat required from planting to physiological maturity. Table 1 shows the approximate RM and GDD equivalents for hybrid maturities commonly used in Wisconsin. The GDD accumulations change across the state depending on planting and maturity dates. Figure 2 shows how GDD varies with combinations of four planting dates and two physiological maturity dates. Plant hybrids whose GDD ratings compare most closely to those listed on the maps based on your location, planting date, and date of the

Table 1. Approximate relationship between maturity indices for corn hybrids.

Relative Maturity (days)	Growing Degree Days[a]
75–80	1800–1900
80–85	1900–2000
85–90	2000–2100
90–95	2100–2200
95–100	2200–2300
100–105	2300–2400
105–110	2400–2500
110–115	2500–2600

[a]Growing Degree Days = [(maximum temperature+minimum temperature)/2]-50 summed for each day from planting to physiological maturity. Daily maximum temperatures greater than 86°F result in use of 86°F in formula; minimum temperatures less than 50°F result in use of 50°F.

average end of season. For dry-grain production, select hybrids that reach physiological maturity at least two weeks before the average first killing frost.

To select hybrids with the proper maturities, review comparisons of grain moisture percentage, like those in the annual *Wisconsin Hybrid Corn Performance* reports that are published each December in weekly agricultural newspapers and are available at county Extension offices. Researchers plant all hybrids at a given location on the same day in spring, harvest them at the same time in fall, and then rank them in order of grain moisture percentage. Lower kernel moisture percentage for a particular hybrid compared with another indicates earlier maturity and/or more rapid dry-down rate.

Another consideration when comparing hybrid maturities is the economic tradeoff between yielding ability and drying costs. Although farmers generally get the greatest average yields by planting full-season hybrids early, many short-season hybrids are drier at harvest and produce yields competitive with the best full-season hybrids. Also, earlier hybrids are ready for harvest sooner, which promises more favorable weather conditions and allows more time for fall tillage. Planting several hybrid maturities each year spreads the harvest season and reduces the risk of losses from moisture stress at pollination time or early frost. A hybrid maturity mix of 25% short-season, 50% medium-season, and 25% full-season hybrids (with a 10-day range in RM from short-season to full-season) is optimum for avoidance of weather risk and for timely harvest management.

Yield Potential and Performance Consistency

Yields of commercially available hybrids with the same RM rating can vary in university test plots by 50–70 bu/a. The only way to compare hybrid yields is by comparing actual measurements of grain production per acre at a standard grain moisture percentage. Grain yield potential of average hybrids is consistently 10–15% lower than for the highest yielding group of hybrids on the market. Simply choosing a hybrid because it has big ears, many rows of kernels, big or deep kernels, or more than one ear per plant will not guarantee high yields. Finally, some hybrids perform at consistently high levels over many sites, while others may not perform equally well under variable conditions. Superior hybrid performance over several locations and years is the best prediction of superior future performance.

Standability

The ability of corn hybrids to withstand root and stalk lodging at optimum plant populations is vital to obtaining high harvestable yields. Stalk and root rots are the primary cause of weak stalks and roots, which may result in toppled plants during windy fall weather. Corn hybrids with strong stalks and extensive root systems can resist these diseases if they are planted on time, at recommended populations, and in soil with optimum fertility, and if weeds and insects are controlled. Harvest lodging percentages of many commercial hybrids appear in the *Wisconsin Hybrid Corn Performance* publications.

Disease and Insect Resistance

The best way to control major corn diseases effectively and economically is to plant resistant or tolerant hybrids. Be wary of hybrids described generally as disease-resistant hybrids, however. No hybrid is resistant to all diseases that infect a crop. Stalk rot, rust, northern leaf spot, smut, Gibberella ear rot, northern corn leaf blight, southern corn leaf blight, yellow leaf blight, Goss' wilt, and eyespot all occur in Wisconsin. Ask your seed dealer about reactions to the specific diseases that have given you problems.

Although corn breeders have expended considerable effort to develop corn hybrids with resistance to the two major Wisconsin corn insects, corn rootworm and European corn borer, cultural and chemical methods are still necessary for consistent, effective control. Hybrids vary in resistance to European corn borer, particularly the first generation, but some high-yielding hybrids that are relatively susceptible to European corn borer consistently out-yield more-resistant hybrids.

Ear and Kernel Qualities

Corn hybrids that you harvest with a combine and dry at high temperatures should retain their ears, have uniform cob and ear sizes, be easily shelled, and resist kernel breakage. Kernels with a high proportion of soft starch endosperm are susceptible to cracking during harvest and handling, which increases field and storage losses and reduces grain quality. Researchers currently are developing breakage testers to rate kernel durability of hybrids.

Despite little relationship between test weight and kernel breakage or nutritional value, test weight is used to indicate market quality. Do not compare test weights of hybrids that differ widely in kernel moisture percentage, because the drier hybrid has an unfair advantage in that comparison. Generally, test weight increases as kernel moisture decreases unless corn is immature, severely combine-damaged, or dried at extremely high temperatures. Hybrids of similar maturity may have a 2–4% difference in kernel moisture percentage during the harvest period because loose husks, thin seed coats, and small cobs may contribute to variations in dry-down rates.

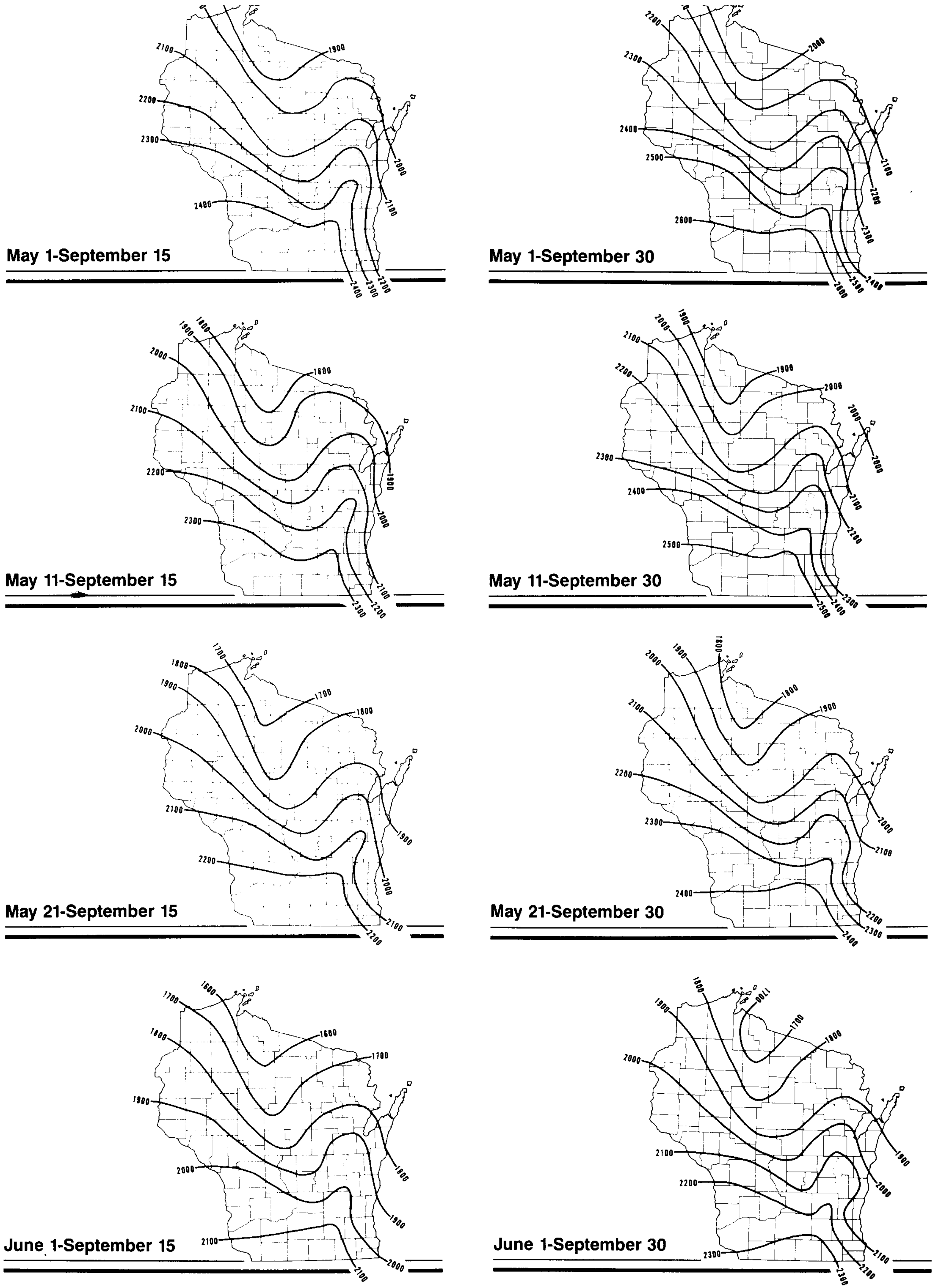

Figure 2. Maps of average Growing Degree Days accumulated between various spring (planting) and fall (physiological maturity) dates in Wisconsin (1954–1970).

Type of Cross

Breeders produce corn hybrids by crossing inbreds. Inbred lines result from several generations of inbreeding and selection to discard undesirable characteristics. Growth vigor lost during inbreeding is increased greatly when an inbred is crossed with another unrelated inbred. This response is called hybrid vigor.

Breeders can make hybrids by single crosses, three-way crosses, or double crosses—meaning that breeders use two, three, or four inbreds, respectively. The crosses are as follows:

Single cross (AB)

Seed parent (inbred A) **x** Pollen parent (inbred B)

Three-way cross (ABC)

Seed parent (single cross AB) **x** Pollen parent (inbred C)

Double cross (ABCD)

Seed parent (single cross AB) **x** Pollen parent (single cross CD)

Breeders initially used double-cross hybrids in commercial hybrid seed production even though they recognized that single crosses resulted in maximum hybrid vigor. The low seed yields of the first inbred lines made the cost of single-cross hybrid seed prohibitive. Breeders can now produce seed from single crosses economically because of increased seed yields, but prices still are higher than for double-cross seed. Corn breeders have developed modifications such as three-way crosses and modified single crosses ("sister-line crosses") to increase seed yields, and thus reduce seed prices, while maintaining hybrid vigor close to that of single crosses.

Because of the identical genetic makeup of the plants, single-cross hybrids are uniform in plant and ear height, ear size, and disease tolerance. Double crosses are the most variable for all traits. Single crosses have the maximum hybrid vigor, and thus the greatest yield potential, followed by modified single crosses, three-way crosses, and double crosses. Although some double crosses may yield better than some single crosses under certain circumstances, most modern single crosses can outperform double crosses even under unfavorable growing conditions, and few double-cross hybrids are currently available.

Always select a hybrid for its performance and price, not because it is a particular type of cross.

Seed Size and Quality

Hybrid seed corn is separated by the seed industry into sizes and shapes based on kernel width, thickness, and length. Variation in seed sizes and shapes result from attributes of seed parents, weather during kernel filling, and position on the ear: single crosses generally produce smaller seed than three-way or double cross hybrids; dry weather will reduce kernel size and may increase the number of round kernels; small round seed originates toward the ear tip, flat seed from the middle portion, and large round seed from the ear base. Cost per thousand seeds is usually lower for small seeds and plateless seed classifications. Planting small seed with appropriate planters will not lower yields, provided the seed is of high quality.

State and federal seed laws require the seed industry to furnish seed quality information on the label, including percentages of weed seed, inert matter, pure seed, and other crop seed, the percentage of viable seed, and the calendar month and year in which the viability (germination) test was completed. **Viability** is measured by the standard germination test under favorable laboratory conditions. However, **vigor** tests (such as cold germination tests) relate better to field performance under a wide range of conditions. Although seed can vary substantially in vigor at a high level of viability, there is no government or industry standard test for seed vigor. Growers therefore must depend on "in-house" vigor testing and the reputation of seed companies to be sure that they purchase high-vigor seedlots. Finally, corn hybrids vary genetically in the ability to germinate and grow rapidly under cool, stressful conditions, but differences in seed vigor due to quality differences within lots of genetically similar hybrids can be greater than genetic differences.

Producers of hybrid seed corn plant more than needed for sale each year as protection against unfavorable weather conditions. When widespread frost or drought reduces seed yields and quality, more "carry-over" seed (produced in earlier years and carefully stored) is sold. Corn seed loses little germination or vigor potential when stored properly and carried from one year to the next. Wisconsin research indicates that planting low vigor seedlots reduced field emergence percentage by about 5% and yields at constant final stands by 4% compared to high-vigor lots.

Hybrid Response to Management

Many seed companies suggest in their commercial literature that the corn hybrids they sell vary in adaptation to growers' management practices. In particular, they emphasize hybrid responses to soil type, plant population, conservation tillage, soil fertility, herbicides, crop rotation, and irrigation. While subtle differences do occur in relative corn hybrid performance under various cultural practices, superior hybrids are generally the same regardless of cropping systems or practices. Hybrid responses to weather (rain amount and distribution and seasonal temperature patterns) have the greatest influence on relative hybrid performance.

Soil type

Soil texture and drainage characteristics may influence soil temperatures and planting dates, which could alter corn hybrid maturity adaptations within a farm. For example, within a maturity zone a full-season hybrid generally does better on well-drained sand than on poorly-drained clay soils. Within hybrid maturities, superior hybrids are generally similar regardless of soil type.

Plant population

The relative stalk strength (standability) of the hybrids primarily determines the recommended harvest plant population, with lower final plant populations suggested for hybrids that tend to have weak stalks. Some companies also suggest that hybrids vary greatly in their ability to adjust ear size or number per plant with changes in plant population ("fixed" versus "flex" ear types). University of Wisconsin research has shown only small differences in plant-population response among commercially available hybrids.

Conservation tillage

The best hybrids under conventional tillage are also superior hybrids with conservation tillage. Some farmers practicing no-till with heavy previous-crop residue cover must plant hybrids with RM ratings several days shorter than those they plant under conventional tillage, because cold no-till soils result in slow early corn growth, which delays silking and maturity.

Soil fertility

Hybrid differences in response to soil fertility or different nutrient sources are infrequent and tend to occur only with severe nutrient deficiencies. Supplying appropriate nutrient sources (manure, legume nitrogen, fertilizer) is more effective than hybrid selection in alleviating such problems. Follow soil test recommendations to be certain that soil fertility does not limit achievement of desired yields.

Herbicides

Although hybrids may differ in injury potential with some herbicides, most hybrids are consistently tolerant of herbicides labelled for use on corn. Occasionally herbicide labels indicate that use is not recommended for specific corn hybrids. Some seed companies have information regarding herbicide tolerance of hybrids they sell, although willingness to share this information with producers varies among companies.

Seed companies are using special genetic techniques to "insert" resistance to certain herbicides into existing corn hybrids. This process does not appear to reduce yield potential of resistant types compared to the original susceptible hybrid, but resistant types may have slightly lower yield potential than other "brand-new" hybrids. Growers must weigh the severity of their weed-management problems against this lower yield potential before choosing herbicide-resistant hybrids.

Crop rotation

Some hybrids may be particularly sensitive to continuous corn production, especially with no-till, and will perform much better when grown in crop rotations. However, hybrids selected for consistent performance over many environments will be superior hybrids both in rotation and in continuous cropping.

Irrigation

Profitable production of irrigated corn depends on high-intensity management. This requires hybrids with excellent standability at high plant densities, resistance to leaf diseases under high humidity, and top yield potential. Evaluations of corn hybrids under irrigation at Spooner and Hancock appear annually in the Wisconsin *Hybrid Corn Performance* reports.

Specific Uses

Silage

Top-performing grain hybrids generally will be good choices for whole-plant silage as well. Additionally, corn hybrids that are too late in RM for grain production in northern Wisconsin may produce superior silage yields of acceptable whole-plant harvest moistures for proper fermentation in storage.

Both high stover digestibility and high grain content are important for high whole-plant digestibility. Wisconsin research has found 1–3 percentage units differences in whole-plant digestibility and 2–4 percentage units ranges in neutral detergent fiber (NDF) concentration among the best grain-yielding hybrids. Whole-plant crude protein can vary by 1–2 percentage units, but hybrids with highest protein concentrations are often relatively low in both grain and whole-plant yield potential. The economic value of these small differences in digestibility, NDF concentration, and crude protein will depend on the proportion of corn silage fed in different dairy and livestock systems. Some seed companies provide ratings of the relative whole-plant nutritive value of hybrids they sell, but these can only be used to evaluate potential silage quality within, not between, companies.

Some seed companies produce hybrid mixtures or blends and sell them for use as silage corn. These blends may be mixed deliberately for planting on limited acreages where maturity or risk need to be spread out. However, such blends also may be mixtures of leftover seed and should be priced accordingly. Before purchasing blends or mixtures, check with seed dealers to find out what they are selling.

Special corn types

Some Wisconsin farmers are interested in two corn types other than normal yellow dent corn: waxy corn and high-lysine corn. White or yellow dent food-grade corn for human consumption is also increasingly popular. While these products sometimes command premium prices, the market is limited. You should carefully investigate sales potential before planting. Also, food-grade corn may require additional care to meet rigid quality specifications.

Waxy corn hybrids. Because they contain the waxy gene, waxy corn hybrids produce a different starch content than regular corn. The starch in waxy corn is 100% amylopectin (branched chain glucose molecules), while starch in normal corn is 75% amylopectin and 25% amylose (straight chain). Other chemical constituents, such as protein, are similar in waxy and normal corn, as are grain texture, hardness, drying rates, and plant characteristics. Because corn hybrids have often been on the market for several years before seed companies change the genetic make-up of normal hybrids to include the waxy gene, many waxy hybrids are older than the newest normal hybrids and consequently may have lower yield potential. Growers must isolate fields to prevent pollen contamination from normal corn.

Some feeding trials suggest that finishing lambs, pigs, and beef have slightly greater feed efficiencies and average daily weight gains when they eat waxy rather than normal corn grain. Most feeding trials, however, have found no such differences. Some seed companies have also promoted the value of waxy corn grain and silage for dairy cows. Testimonials indicate that cows fed waxy corn increase milk production and butterfat percentage. Currently, there is no research with dairy cows either to confirm or to dispel these claims. Laboratory forage-quality measurements do not indicate any differences between waxy and normal corn forage nutritive value.

Some buyers may pay a premium for waxy corn purchased for use by the wet milling industry and for export. Before planting waxy corn, growers interested in this market should contact buyers to learn about potential premiums.

High-lysine corn hybrids. Because they contain the opaque-2 gene, high-lysine corn hybrids have increased levels of the amino acids lysine and tryptophan in the grain protein. Ruminants synthesize these amino acids, but nonruminants do not have this ability. Farmers must add lysine and tryptophan when they feed normal corn grain to nonruminants such as pigs, because normal corn has insufficient dietary levels of these amino acids. Feeding high-lysine corn enables farmers to reduce or eliminate these supplements.

Wisconsin trials indicate that silage from high-lysine corn may be of lower quality than silage form normal hybrids. High-lysine hybrids also must be isolated to avoid pollen contamination. The first hybrids with the opaque-2 gene had lower yields, dried down more slowly, lodged more, and had softer kernels than normal hybrids. Some new high-lysine hybrids nearly equal normal corn in these respects.

When deciding whether to grow or purchase high-lysine corn, a swine producer must consider the price of corn, the lysine content of the corn, and the price of soybean meal (an alternative source of these amino acids). Lysine content can vary with different high-lysine hybrids and soil nitrogen levels. A lysine analysis is necessary to ensure sufficient lysine in the pigs' diet.

Food-grade corn hybrids. A few growers in southern Wisconsin have received premiums for producing white corn or white-cob, yellow food-grade corn for human consumption. White corn is used primarily in Mexican foods (tortillas, chips) and traditional meal and grits products, while yellow "food corn" is used to make snack foods and cereals. Yield potential of white corn hybrids adapted to Wisconsin is generally lower than yellow hybrids because breeders have not emphasized white corn hybrids. Buyers set stringent criteria regarding approved hybrids' maturity, cob color, kernel color and texture, and grain quality (harvest moisture, drying conditions, test weight, kernel integrity and damage, etc.) before contracting with producers to pay premiums for food-grade corn. Results of annual yield trials evaluating white and yellow food-corn hybrids are available from the Department of Agronomy, University of Wisconsin-Madison.

Information for Selecting Hybrids

Hybrid selection is an annual process because of the continuous improvement in available corn hybrids. When selecting hybrids, many Wisconsin farmers rely primarily on previous years' field performance, personal relationships with dealers, company and dealer notoriety, seed size/shape, and price. A general relationship between seed price and hybrid performance does exist within hybrids sold by a particular company, but growers may find top-performing hybrids at a relatively low price. Comparative performance among hybrids provides the only realistic assessment of the relative value of hybrids differing in seed price. Hybrids should never be purchased without consulting performance data. You can get trustworthy information on corn hybrid performance from university evaluation trials, commercial seed company tests, local demonstration plots, and on-farm tests.

University evaluation trials

Because weather conditions are unpredictable, **the most reliable way to choose hybrids with the greatest chance to perform best next year on your**

farm is to consider performance last year and this year over a wide range of locations and climatic conditions. The annual *Wisconsin Hybrid Corn Performance* report is published each December in weekly agricultural newspapers and is also available at your county Extension office. The report compares over 300 commercial hybrids and provides information on yield, harvest moisture percentage, and percent lodging for two years at thirteen locations throughout Wisconsin. Guidelines are provided in the report to help you use the results to select consistent, top-performing hybrids for next year. A recent study conducted on more than 60 Wisconsin farms found that superior hybrids selected from two-year, multi-location *Wisconsin Hybrid Corn Performance* results performed similar to or better than the farmers' top choice in 78% of the comparisons.

After choosing hybrids based on university trial results, observe their relative performance in several other reliable, unbiased trials and be wary of any with inconsistent performance. You might consider planting your own test plot, primarily to evaluate the way your chosen hybrids stand after maturity, dry-down rate, grain quality, and ease of combine-shelling or picking. Be careful not to base hybrid decisions only on yield results from your test plot. You are taking a tremendous gamble if you make hybrid selection decisions based on one year's yield comparisons in only one or two local test plots.

Corn Hybrid Genetic Diversity

Maintaining genetic diversity among corn hybrids may help avoid major disease outbreaks or environmental disasters. This section outlines how corn hybrids are produced, describes some methods used to compare hybrid genetics, and provides guidelines for selecting hybrids with different genetic backgrounds.

University Trials versus Strip Tests

Many corn producers conduct their own on-farm strip tests, often questioning the value of small-plot university trials conducted as much as 50 miles from their farm. The comparison below lists positive (+) and negative (-) features of the two testing methods.

Wisconsin Hybrid Corn Performance Trials	Single-Location Strip Tests
(+) High level of objectivity	(-) Tendency for bias (particularly if conducted by seed companies)
(+) Most "new" hybrids evaluated	(-) Few available hybrids included
(+) 50 seed companies represented	(-) Often "stacked" with one seed company's hybrids
(+) Plot design accounts for soil variability • randomized • replicated	(-) Soil variability often influences results • seldom randomized • seldom replicated
(+) Good potential to predict future performance • all hybrids evaluated over multi-locations and/or years (can measure repeatability)	(-) Limited predictive potential • Usually single location, year comparisons (no measure of repeatability)
(+) Staff trained in field-plot design techniques	(-) Producers and crop advisors often have limited/variable field-plot design training
(+) Staff evaluated based on quality of data obtained	(-) Producers evaluated based on farm operation; seed sales staff evaluated based on bags sold
(+) Data provided to growers without monetary or time cost	(-) Competes with producers' time during critical periods (planting, harvest)
(-) Limited evaluation of characteristics besides grain yield and moisture	(+) Producer can evaluate harvest ease, appearance, dry-down, grain quality
(-) Potential for inter-plot competition (border effect)	(+) Small border effect
(+) Conducted under management similar to producers'	(+) Conducted under producers' management
(+) High producer credibility	(+) High producer credibility

Corn hybrid production

As indicated above, a hybrid is the offspring of genetically dissimilar parents. For corn, hybrid seed is produced by crossing genetically unique parents, which are called inbreds. These inbreds are developed over a period of years to be genetically pure and to contain desired traits. Inbreds have low growth vigor, but the cross of two unrelated inbreds results in hybrid vigor.

Inbred line development is crucial to the seed corn industry. Line development takes years of labor, large amounts of capital, and a highly trained professional staff. Only a few large seed companies have the resources to develop their own inbred lines. Additionally, the breeding efforts of public land-grant institutions have declined in the past 20 years. Most inbred lines used by small seed companies are developed by specialized foundation seed companies. Foundation companies sell or lease the inbreds to seed companies, who then cross the inbreds in their production fields to produce hybrids for sale.

Methods for comparing hybrid genetics

Absolute proof of hybrid genetics usually is not possible to obtain. Fairly reliable comparisons are possible, however, using laboratory techniques such as gel electrophoresis, high-performance liquid chromatography (HPLC), and restriction fragment length polymorphism (RFLP) analysis. For all practical purposes, these methods are not available to producers at the present time.

Less-complicated and less-expensive methods of differentiating hybrids include observations of appearance in side-by-side trials and attempting to get seed companies to reveal the pedigree. Neither method is likely to be helpful to most producers. Hybrids may appear very similar but differ significantly in genetic make-up. Seed companies typically do not make pedigree information public, although some persistent producers have discovered commonly used inbreds.

Establishing hybrid diversity

It is unlikely that producers will be able to determine the actual genetic parentage of hybrids they plant. The following two methods of ensuring genetic diversity more reliably spread the risk of yield loss. However, growers should not sacrifice hybrid performance just to diversify hybrid genetics.

1. *Plant a range of hybrid maturities*. This will ensure that at least one parent in the cross is different. An 8–10 day spread in hybrid maturity minimizes the risk of weather problems during a particular growth stage (particularly pollination/silking) and of early frost before maturity. It also improves the workload during harvest. Growers should plant 50% of their corn acreage to hybrids in the middle of the maturity range, and 25% each on the early and late end of the range.

2. *Purchase seed from one company*. Seed companies are unlikely to handle genetically-identical hybrids in their lineup.

Price, service, and quality vary from company to company, even if genetics do not. Differences in quality control standards among companies can result in genetically identical hybrids performing differently. Genetically identical hybrids may vary in price, which may or may not reflect differences in seed quality and company dependability, reliability, or service. Generally, companies with more-extensive breeding programs and larger marketing or customer service programs need to charge more for their seed to cover these other expenses. Even so, there are good and bad companies of all sizes and types. Growers should be wary of companies selling mail-order seed and/or those with hybrids not entered in objective performance trials.

The genetic similarity of corn hybrids being sold and the secrecy concerning hybrid pedigrees may seem frustrating, but a restricted range of competitive germplasm contributes to top field performance. Thus it is not surprising that the genetic base narrows as breeders strive to isolate the limited elite hybrids. The present system has resulted in rapid and widespread introduction of hybrids to many producers, rather than concentration in the hands of a few insiders.

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R-06-92-2M-60-E