



# Considerations for selecting corn hybrids in Pennsylvania

Selecting the best corn hybrids can be a significant factor in the profitability of a corn production enterprise. The differences in performance among commercially available corn hybrids of the same maturity generally exceed 15 bushels per acre and frequently reach 50 bushels per acre. As a result, improving corn yields by an average of 5 to 10 bushels per acre through careful attention to hybrid selection is not unrealistic.

## CHARACTERISTICS TO CONSIDER

An effective hybrid selection strategy involves considering a number of hybrid characteristics that are important for performance under your system and then using various sources of information to choose the most appropriate hybrids.

### MATURITY

Maturity is of primary importance in the hybrid selection process because it is critical to choose hybrids that can use as much of the available growing season and still have a minimal risk of being frosted before maturity. Hybrids that are too early will have a reduced yield potential and those that are too late may result in poor quality grain or silage. Corn hybrids are rated in one of two systems: the relative maturity system and/or the growing degree day system.

Of the two systems, the relative maturity system is more popular. In the relative maturity (RM) system, hybrids are assigned a days-to-maturity rating based on the grain moisture at harvest compared to other hybrids. As a result, a hybrid with a lower RM rating should have lower grain moisture levels at time of harvest than one with a higher RM rating. The rating is not a measure of the actual days required for maturity, since it is not uncommon for a 105-day hybrid to require 150 days from the date it is planted to reach maturity. The ratings also vary somewhat among companies; this makes comparisons of maturity more difficult. One way to overcome the differences among the companies is to compare moisture contents of specific hybrids in performance trials where they appeared together—lower moisture contents translate into an earlier rating.

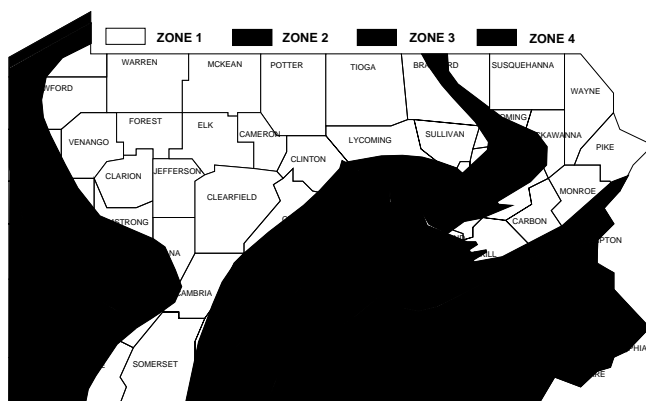
The second system is the growing degree day system. In this system, the number of growing degree days is calculated between dates of planting and black layer or maturity. The advantage of the growing degree day system is that it provides a link between hybrid maturity and local weather information. Disadvantages of this system are: 1) GDD ratings are not necessarily indicative of differences in grain moisture, because hybrids may differ in dry-down rates after black layer, and 2) growing degree day requirements of hybrids may change somewhat with location and season. Hybrids in Pennsylvania frequently do not require as many growing degree days as they will use in the Midwest states. Also, growing degree day requirements of specific hybrids may be lower in cool seasons and late plantings.

A good rule of thumb is that corn for grain should reach maturity one to two weeks before the first killing frost in the fall. Other factors, such as harvest method, marketing plans, and timeliness considerations may also have a bearing on maturity selection. The need for a field dry-down period with ear corn and dry shelled corn means that maturity should not be pushed with these systems. Where high-moisture corn harvest is planned, slightly longer season hybrids can be used. Even longer season (5 to 10 days) hybrids can be utilized for silage production provided wet soils will not interfere with harvest. Earlier hybrids may provide some advantages for early corn markets or more timely harvesting. If you consider this approach, be sure to monitor yields of these earlier maturing hybrids to make sure this strategy is economical for your system.

A key to managing maturities in an area as diverse as Pennsylvania is to monitor crop development each year and use this information in selecting hybrid maturities for future years.

Appropriate maturities for grain production in Pennsylvania are shown in Figure 1 and Table 1 on page 2.

**Figure 1. Pennsylvania corn maturity zones.**



### DISEASE RESISTANCE

Hybrid selection is the main avenue for control of the the most predominant corn diseases in Pennsylvania. Stalk rot, one of the most serious and common corn diseases, is favored by environments where stress occurs during August. If stalk rot appears to be a persistent problem in your system, consider placing more importance on standability and stalk rot resistance in your hybrid selection. Gray leaf spot, northern leaf spot, and northern leaf blight are also common in Pennsylvania.

Gray leaf spot is most severe in those fields of continuous, no-till corn where air drainage is poor. Fields that are along creeks and rivers are particularly vulnerable to gray leaf spot because of the extended periods of dew. The symptoms of the disease resemble a paper match—gray, rectangular shaped lesions that are restricted by the leaf veins. Where this disease is serious, gray leaf spot resistance should be a primary consideration in your hybrid selection.

Both northern leaf spot and northern leaf blight occur most frequently in valley areas where heavy dews and early morning fog or mist are common. Northern leaf spot (race 3) symptoms are tan to brownish, linear, chain-like lesions. The northern leaf blight symptoms are elliptical, grayish green streaks that develop on the leaves and may extend the length of the leaves. Under severe infection, all leaves may die. Both diseases can cause early plant death. Resistant hybrids are the best means of control.

Learn to identify the major corn diseases in your area and select hybrids with specific resistance to these diseases. Be wary of hybrids advertised as having “good disease resistance”—instead ask your dealer about specific resistance to diseases that you know are common on your farm.

### STANDABILITY

Standability is an especially important hybrid characteristic in Pennsylvania, where the corn harvest often continues late into the fall. Poor standability is primarily due to stalk rot, but can also be caused by weak stalks or root systems

**Table 1. Approximate season length and growing degree days (GDDs) available for Pennsylvania corn maturity zones.**

MATURITY ZONE	SEASON LENGTH (DAYS)	APPROXIMATE AVAILABLE GDDS	PLANTING DATES
1	90–95	1600–1824	5/15–25
	96–100	1825–2024	
2	101–105	2025–2274	5/1–15
	106–110	2275–2499	
3	111–115	2500–2724	4/25–5/7
	116–120	2725–2949	
4	121–125	2950–3174	4/15–5/1
	126–130	3175 or >	

as well as insect damage. Standability should be an important consideration for fields where a shelled grain or ear corn harvest is planned, and especially for those that will be harvested late. Considerable progress has been made in improving standability, but important differences still remain in commercial hybrids.

### YIELD PERFORMANCE

Hybrid yield performance is a critical factor in hybrid selection. The range in yield potential among commercial hybrids frequently is greater than 40 bushels per acre (Table 2). It is essential that performance information be based on the results of several trials and not just one test. Average performance from a number of sites in your region is often a better indicator of future performance than the results of a single test on your farm. Also consider moisture differences between hybrids when evaluating for yield. At a drying cost of \$0.04/point/bushel and a corn price of \$2.50 per bushel, every 1% moisture difference between two hybrids yielding 125 bushels per acres is worth 2 bushels per acre. This is especially important for corn that will be shelled and dried.

When interpreting yield performance tests grown over a wide region, consider only those hybrids with a maturity adapted to your farm, even though later hybrids in these tests may have higher yields. When grown under your conditions, these later hybrids may not yield as well, and they will have higher moisture levels and an increased risk of frost before maturity. Yield performance can be best estimated by actual harvest-time measurements of grain production. Visual estimates of yield based on ear size, kernel rows, or kernel depth are not reliable enough to use for hybrid comparisons.

When evaluating hybrids for silage production, it is best to base decisions on silage yield performance data if possible. Where this information is not available, a tall, leafy, hybrid with a good grain yield potential would likely be a good choice for silage.

**Table 2. Two-year average and range in yields and moisture for hybrids entered in both 1990 and 1991 Pennsylvania Commercial Hybrid Corn Tests.**

MATURITY ZONE	YIELD AVERAGE (BU/A)	YIELD RANGE (BU/A)	MOISTURE AVERAGE (%)	MOISTURE RANGE (%)
1	120	88-136	21.3	18.9-23.2
2	118	90-136	25.2	20.3-27.2
3	126	81-139	23.0	19.4-25.1
4	147	122-170	23.5	20.4-24.7

#### SPECIAL CHARACTERISTICS

A number of other special hybrid characteristics should be considered in selection for specific situations. The importance of these characteristics depends on the specific situation. Generally, they should have a major impact in hybrid selection only if they will have an impact on the yield and quality of the final product. These characteristics include harvestability as ear corn, seedling vigor, test weight, tight husk cover for bird resistance, stay-green potential, and grain or silage quality.

Harvestability of a hybrid can be particularly important for ear corn producers. Some hybrids have the tendency to lose kernels from the ear during the picking process, lowering the yield and quality of the ear corn. On other hybrids, husk removal is sometimes difficult, which contributes to reduced airflow in the bin and increases the potential for spoilage.

Differences in seedling vigor do exist between hybrids and can have an effect on stand establishment in stressful situations, such as early planted no-till corn or corn planted into heavier, wetter soils. The importance of seedling vigor under most other situations, however, is probably secondary compared to maturity, disease resistance, and yield performance.

Test weight differences also exist between hybrids and these should be considered if higher test weight is an advantage from a marketing standpoint. Studies have shown that test weight is not a good indicator of feed value, so there is likely to be little advantage from feeding high-test-weight hybrids.

For growers who frequently experience serious losses from bird damage when corn is in the milk stage, husk tightness and coverage may be important considerations.

Many of the new hybrids being developed possess increased levels of what is known as stay-green, or the ability to retain leaf color past physiological maturity. This characteristic appears to improve late season plant health and to increase the grain dry-down rate. This characteristic may also help to extend the harvest window for silage production by reducing the whole-plant dry-down rate.

Grain and silage quality differences should also be considered, since feed quality differences do exist among hybrids. However, you should monitor the economics of

growing hybrids with improved quality traits. Frequently, quality differences among hybrids are small and the yield differences among comparative hybrids are much greater. You usually can't afford to give up very much in yield performance to get the improved quality. In hybrid testing trials, quality differences among groups of hybrids have been shown to range up to 1 percentage point in grain protein and 2 to 3 percentage points in silage digestibility. Recent advances in biotechnology may allow a wider range of hybrid quality differences in the future.

#### MANAGEMENT INTERACTIONS

The idea that hybrids differ in their adaptation to different management practices such as tillage systems, nitrogen rates, populations, and soil productivity levels remains an area of great debate. One group in this debate contends that hybrid differences under these practices are small and difficult to predict. On the average, this group suggests using hybrids that have performed well under a wide range of conditions. The other group contends that hybrids respond consistently different to some of these changes and that these responses should be incorporated into your plan of placing hybrids in different fields on your farm. Recent research results are beginning to clarify some of these differences.

Recent studies have shown that the best hybrids in conventional tillage are also usually the best in reduced tillage systems. One notable exception to this would be the need for higher gray leaf spot resistance where this disease is a problem. Another consideration may be to put added emphasis on seedling vigor in early season no-till plantings. On the whole, however, tillage practice should not have a large impact on your hybrid selection.

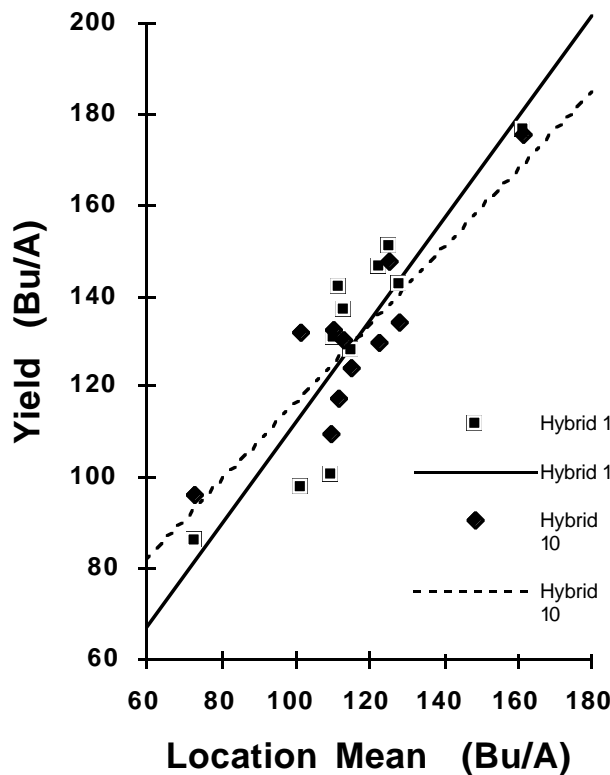
In controlled situations in the greenhouse or laboratory, some researchers have shown differences in how hybrids respond to different forms and timings of N applications. When others have tried to document this in the field, however, they have generally been unable to consistently show the same type of differences. In general, research has shown that different hybrid responses due to the growing seasons are much greater than any differences from N form or timing. As a result, there appears to be little basis for selecting hybrids differently based on the N fertilization program, or for fertilizing hybrids differently.

Hybrid differences in response to population are frequently described as a hybrid's ability to "flex" its ears and produce a larger ear in response to lower populations. Prolific or double-eared hybrids have been promoted as having the ability to produce better at lower populations. Hybrids with these characteristics should be ideally suited to less productive sites, where lower populations may be used or where there may be a greater risk of poor stands. The idea behind this would be that these hybrids could produce a larger ear in response to favorable conditions or reduced populations. Studies in Iowa, Wisconsin, and Ohio, however, have indicated optimum populations do not differ greatly among commercial hybrids. These studies have also

shown the best hybrids at low populations are generally the best at high populations. Based on this research, it appears that population response should not be an important factor in hybrid selection.

Another interaction which has received attention is the adaption of hybrids to high or low yield situations. The question in this issue is whether different hybrids should be selected for high yield and low yield situations. Plant breeders have documented differences among different hybrids in their yield response to different situations (yield stability), and some hybrid testing programs have confirmed these differences. This is best shown using a stability graph, such as Figure 2, where the yield of two top yielding hybrids is plotted against the average yield of all hybrids tested. In this figure, both hybrids had similar average yields, but hybrid 10 generally performed better in the low yielding sites and hybrid 1 performed better in the high yielding sites. This indicates that differences among hybrids do exist and that there is potential for these differences to be exploited by selecting some hybrids for higher yielding conditions and other hybrids for the lower

**Figure 2. Stability analysis graph for two hybrids tested in the 1985 Pennsylvania Commercial Hybrid Corn Tests for Maturity Zone 1. The average yields of both hybrids across locations were similar.**



yield potential situations. Based on this, there appears to be some basis for placing hybrids on the farm differently depending on the anticipated yield level of a field. In Pennsylvania, one of the main causes of low yield potential is drought stress associated with shallow soils. Thus, a consideration of the yield stability of a hybrid may be important when selecting for such high and low yield situations. Unfortunately, only limited data exist on the yield stability of available hybrids, although the seed industry is making an effort to characterize hybrids in this fashion.

#### SOURCES OF INFORMATION

##### Seed suppliers

Commercial seed companies should be able to supply much of the detailed information on hybrid characteristics. Seed suppliers who have worked with these hybrids in your area should have a basic understanding of many of the hybrid traits that are important in your crop production system. They also have access to performance data collected from their own evaluation trials conducted in the region. These data are best used for comparing hybrids within a company because competitive hybrids often are not included in these trials.

##### University hybrid trials

Hybrid performance trials are conducted annually by the Department of Agronomy at Penn State. In this testing program, hybrid evaluations are conducted at five sites in each of the four corn maturity zones in Pennsylvania. An average of 50 to 60 hybrids are evaluated for grain production in each zone. Data are also collected on moisture, lodging, plant height, ear height, and some diseases. The results are published in the Pennsylvania Commercial Hybrid Corn Tests Report which is available at local extension offices. These trials provide a source of independent information on hybrid performance. Hybrid testing reports are also available from most of the states surrounding Pennsylvania.

##### Strip trials

Many strip trials are conducted annually across Pennsylvania by seed suppliers, growers, and extension agents. Nonreplicated strip trials can provide excellent yield performance data when the results of at least several trials are combined together. The results of individual trials should be interpreted cautiously. Individual strip trials are best used to evaluate very repeatable traits of hybrids such as harvestability, height, and maturity.

Producers who grow sizeable acreages of corn should consider evaluating promising hybrids on an annual basis in a strip plot. These are particularly useful for comparing promising new hybrids to those hybrids already in use.

### On-farm Records

Another valuable but often overlooked source of information for hybrid evaluation is on-farm records. Growers who are able to devise a harvest and record keeping system that allows them to collect yield information from individual fields or groups of fields planted to the same hybrids can usually estimate performance of hybrids quite well. Fields that were planted late or unusually stressed should be deleted from any comparisons.

This evaluation system works best where a large number of similarly managed fields are being compared. By comparing hybrid performance on different soils, you may be able to detect differences in hybrid stability or stress tolerance.

### DEVELOPING A STRATEGY

Another important part of hybrid selection is developing a strategy on how to pick and place corn hybrids on your farm. Part of your strategy should include some diversification—use a group of hybrids, perhaps 5 to 10, rather than relying on just a few. These hybrids should have some differences in maturity, even if differences are relatively small. This helps to reduce the risk of weather related stress on your corn crop. Mixtures of about 20 per cent short-season, 60 per cent medium-season, and 20 per cent full-season (a 10-day range in relative maturity) hybrid maturities are good compromises to avoid weather risks and allow for timely harvesting. The need for diversity in hybrid choices is probably greater in areas where drought stress is common. Another consideration should be use of new hybrids. Generally, new hybrids are best used on a

limited acreage until you become confident with their performance on your farm. As you gain confidence with a hybrid, use it for more of your acreage. After a hybrid becomes four to five years old, evaluate its performance carefully, because newer hybrids with improved performance often have been developed by this time.

A final consideration in your strategy should be to try to place hybrids on the farm as best as you can. Use some secondary characteristics of the hybrids. This is especially important if you have different soil types or tillage systems. Use hybrids with greater stability or drought tolerance on shallow soils and hybrids with high yield potential under ideal conditions on the best soils. In no-till fields, you may want to consider hybrids with better gray leaf spot resistance or early season vigor.

### SUMMARY

The process of selecting hybrids is integral to profitable corn production. A key component of the process is identifying characteristics that are important in your particular situation. Pay attention to details in observing the crop during the season. Learn to identify corn diseases, note the maturity and other characteristics of the hybrid, and take some time to make yield comparisons. Collect any appropriate information you can on available hybrids from industry, university trials, neighbors, or other sources. Using this information, make informed hybrid choices based as much as possible on performance data. Plant the hybrids you have chosen in situations where they are best adapted. Finally, during the season, spend some time evaluating your choices.

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