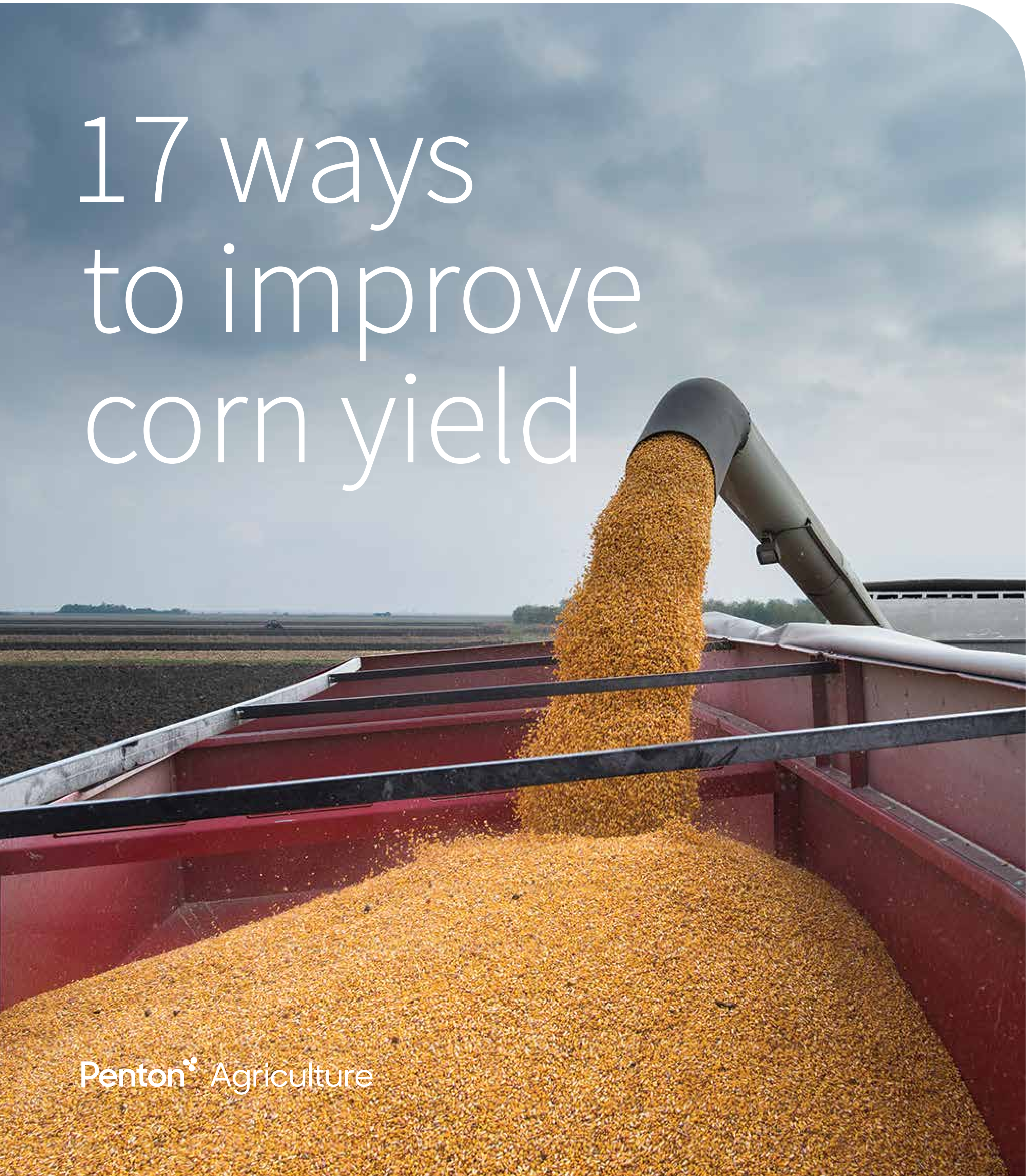
17 ways to improve corn yield



Penton Agriculture

Back in 2011, agronomists agreed that averaging 300 bushels of corn per acre by 2030 was out of line, even though some short-term trend lines indicated such corn yield gains were possible.

Those same agronomists also advise thoughtful consideration of short-term trend lines. In order to get an average of 300-bushel corn by 2030, you would have to gain 6 bushels a year. There's no evidence that can happen short of a miracle.

However, the genetic potential to get those kinds of yields is available. We've got the genetics in the bag; all you have to do is identify what is holding you back.

Before you finish getting the planter ready to roll, check out these 17 tips that could help you boost corn yield. If it's too late to implement some of these suggestions this year, consider some for next year.

1. Plant alternate strips of two hybrids two to three days different in pollen shed when possible

This may give a striped pattern to your field if you have aerial images flown during the season to check on plant health. That's not a concern, and the possible advantage is spreading the pollination period. That could be extremely important if it turns hot when corn is pollinating. In the future, a twin-hybrid planter (also called multiple-hybrid planters) may be helpful on any type of soil provided the hybrids are similar in height, maturity, disease tolerance and harvestability.

2. Use narrower rows or twin rows

This may be best considered if you're thinking about upgrading planters. This technique is most likely to pay off with shorter hybrids with more upright leaves and increased tolerance to higher populations, drought and stress.

In the early 1900s, when the primary power source for farmers was the horse, corn row spacing commonly ranged from 38 to 40 inches to accommodate the animal's wider girth. While tractors eventually replaced the arguably more temperamental horses, row spacing didn't change much until research in the 1960s showed narrowing it to 30 inches could increase corn yields by 5% or more. Over the ensuing years, many growers gravitated to narrower row spacing, making 30 inches the predominant planter configuration.

Coinciding with the decrease in row width, plant populations began to increase. Consider that, while average seeding rate for corn in the 1940s was around 10,000 plants per acre, many growers this year will be dropping 35,000 to 40,000 seeds per acre. That represents a 250% to 300% increase. The trend is to increase populations each year by about 400 plants per acre.

Plant populations are likely to continue increasing yearly with further stress-tolerant hybrids and the future promise of biotech "high-yield" genes.

In theory, many advantages exist with narrower row widths:

- Can use same planter for corn and soybeans;
- Increase the utilization of light;
- Have more even plant-to-plant spacing and less in-row crowding;
- Reduce weed competition; and
- Have earlier canopy closure and soil shading.

These advantages could allow plants to intercept more sunlight and nutrients and endure less stress, thus increasing yield.

In twin-row corn planting, two rows about 7 to 8 inches apart are placed on 30-inch centers. Besides the same potential advantages as other narrow-row systems, twin-rows have other theoretical advantages. Among them, growers may not have to make major modifications to sprayers and corn heads, and planter units place the seed more accurately because each is planting half as many seeds per acre.

Growers who use the twin-row system say that “theoretical” doesn’t always translate into “real.” A few of the twin-row challenges they have experienced are keeping equipment running true on side hills, harvesting lodged corn, watching ears flying off plants being pulled violently sideways 4 inches into the snap rolls, and keeping sprayers off the row. However, these row-spacing pioneers also say they feel the benefits offset these challenges, and they plan to continue with their twin-row systems.

3. Match seeding rates

Match the right population to the right hybrid. Don't plant all hybrids at one population. If possible, vary seeding rate on-the-go to match soil types.

Challenging growing environments may reduce corn plant populations below optimum levels. These conditions can occur when planting into no-till or high-residue seedbeds, or cloddy or compacted soils. Soilborne diseases and soil insects can also diminish stands. All these factors can interact to challenge stand establishment, and effects are magnified when planting early into cold, wet soils. Thus, consider the following points when choosing your seeding rate.

- In general, plan to drop 5% more seeds than the target population to account for germination or seeding loss.

- Boost target seeding rates by an additional 5% for extreme or challenging environments.

- In areas with perennial drought stress, seeding rate targets are lower. Base your seeding rate on the specific hybrid population response at the historical yield level of the field.

With farms becoming more reliant on GPS technology, the opportunities to more precisely apply crop inputs are expanding. What started out as only variable-rate lime and fertilizer application by a commercial applicator has now evolved to the farmer having the capabilities to adjust nitrogen product rates and planting populations on the fly or from variable-rate prescription files.

Variable-rate planting can maximize a field’s yield potential while managing the in-field variability during a tough growing season. By planting the correct rate, issues with moisture, lodging, disease and weeds are minimized through ideal inter-plant spacing and competition.

Even on the most uniform fields, there are places where drainage or soil fertility does not allow that area to match the productivity of the rest of the field. Being able to adjust planting rates allows you to manage those areas as well as take advantage of the more productive areas that should be pushed to the limit.

Think of what the crop needs to grow and make bushels. Mitigating moisture stress and equalizing inter-plant competition are keys to calculating what population an area will support. For corn, lighter soils that have low moisture-holding capacity are more likely to have stalk lodging issues and smaller ear size. Darker soils with higher organic matter content have a high capacity to hold moisture in late-summer drought situations, but have high weed pressure as well.

In lighter soils, a grower is better served by lowering the corn planting rate to 28,000 to 30,000 seeds per acre to reduce the risk of stalk lodging due to moisture stress while still maintaining yield. On darker soils, higher planting populations (35,000 to 37,000 seeds per acre) maximize yields and keep weed pressure to a minimum.

4. Move up plant populations gradually

Your goal may be increasing populations per acre over time, depending on where you are now. Do it by pushing seeding rates up gradually over time. Yield comes from (number ears per acre) x (number kernels per ear) x (kernel weight).

When weighing plant population options growers may want to consider varying planting rates based on field and hybrid. While it seems logical to plant more seeds on the best soil, there are exceptions.

There is a limit on how many kernels we can put on a single cob and the weight of each kernel. Thus, the only way to keep increasing yields is by increasing the number of ears per acre.

Over time, we can get in the same routine of just planting the same population across all our acres. Take the time to experiment with population in a small field. Talk with your seed supplier and find out which corn hybrids respond to different population. Even increasing 2,500 to 4,500 plants per acre on a side-by-side field test will provide data for yield differences.

The ideal plant population varies by region and is constantly changing with new varieties and practices. But whatever level is ideal for your farm, the number of ears per acre should be within 1,000 to 1,500 of the number of plants per acre.

If it's not, a possible explanation is too many skips or doubles in the field. Skips could be an equipment problem. It could also result from poor seedbed preparation, poor germination or excessive planter speed.

Another problem is doubles. One or all of the plants growing too close together may be barren. Planter speed and equipment problems are the main cause of doubles.

5. Soil test your acres

The 2015 crop had rough growing conditions. Excessive rainfall had an effect on soils as well. Did crops have "enough" nitrogen to reach their full yield potential? How about P and K? If there is a year that soil testing can help us make bottom line decisions, the time is now. With the amount of rainfall this past year, there will be many fields requiring different recommendations.

A couple years ago, it was so dry that some farmers postponed taking soil samples. Some that were taken produced results that were suspect due to the dry conditions. So besides the normal rotation of fields that you test every third year, every other year or every year, depending on how intense your soil sampling program is, you may have acres from last year that you want to test again this year.

You may do your own testing or hire a soils consultant to test for you. Either way, it's important to understand what goes into getting a good soil test that provides reliable results. That should give you more confidence in making and following recommendations for applying fertilizer based upon those tests.

Instead of being too dry, if rains continue or if late fall turns wet, the problem this fall could be finding a time when soils are dry enough to get a good test. Remember that if you normally test in the fall, test results will be most accurate if you always test in the fall, rather than taking some tests in the fall and some in the spring.

Take 20 to 30 cores with a probe to form one sample. Mix all cores together and pull a sample from the entire set of cores.

While one sample can represent 20 acres, it's customary to divide that into smaller areas to sample today. The less uniform the ground, the smaller the areas you may want one sample to represent.

If fertilizer is banded when applied, take more cores than you would if fertilizer was broadcast across the field.

Take soil samples to 8 inches deep in tilled fields. It's important to make sure you sample at exactly the same depth each time. Many consultants mark probes so they're getting the same depth each time.

In long-term no-till fields, you may want to sample at 0-4 inches and 4-8 inches separately. Certain factors, such as pH, tend to change faster and closer to the surface in no-till systems.

Sample lighter soils or sandy soils more often, say every one to two years even if you typically sample average soils every three years. These soils have lower nutrient holding capacity.

6. Buy an electronic scale

You can find one for about $100 at most office supply stores, count out 250 kernels and weigh them. Then, project the number kernels it will take to weigh 56 pounds.

If it takes 75,000 to 90,000 kernels to equal 56 pounds, kernel weight is in the normal range. If it takes more than 90,000 kernels to reach 56 pounds, you need to determine why your kernels are lighter than normal, and if there's anything you can do about it. Kernel weight is largely determined late in the year, usually by the weather, and/or late-season plant health.

Producing heavier kernels may mean planting earlier, planting hybrids that mature earlier, or doing both.

The other half of the yield equation — kernel number — is something that you have more control over. The number of kernels produced per acre is a function of the girth and length of the ears, the number of plants per acre and the number of ears per acre.

Girth is a function of plant breeding. Whether the plant is able to fill out the ear depends on the weather, soil conditions and available nutrients in the soil.

A clue to whether you have reached maximum yield potential is at the kernel tip. If the ear is large and is filled all the way to the end, you probably wasted resources. If there's about ¾ inch of tipback at the end of the ear, the plant used all the resources available.

7. Fertilizer mistakes

Not having enough fertilizer to fully develop and fill out ears is another problem. Often, adequate fertilizer isn't available at the time corn plants need it.

It is a bigger challenge the earlier you plant, or if the weather cools after emergence. Corn establishes its maximum yield potential from emergence to the V12 stage of growth. If a plant runs short of nutrition in the first weeks of growth, yield potential will be reduced.

Placing the correct fertilizers with the seed or in a 2-by-2 placement next to the seed are possible ways to provide good early nutrition.

Be a good detective. You can't afford to buy all the possible solutions — better hybrids, a new planter, more fertilizer, different tillage tools, etc. You have to narrow it down. There is no substitution for doing homework in your own fields.

Follow these areas that can add bushels to the crop. First, there are crucial prerequisites. Drainage, weeds, pests, pH, and levels of phosphorus and potassium must be right. But if you have met the prerequisites, go ahead and check out the other 7 factors:

> **Weather:** Favorable weather conditions can add as much as 70 bushels an acre.
>
> **Nitrogen:** It's high on the list because it controls the factors below it. However, without good weather, nitrogen may not help.
>
> **Hybrids:** Biotechnology has made that decision tougher. However, the Bt trait has not only added control for insects like rootworm, but also created enhanced root systems that allow the plant to take up more nitrogen as it grows.
>
> **Previous crop:** Following a rotation can enhance yields by up to 25 bushels.
>
> **Plant population:** Getting a stand that enables maximum interaction with sunlight is crucial.
>
> **Tillage:** Too much tillage is not good for soil structure.
>
> **Growth regulators:** Growth regulators found in fungicides can add up to 10 bushels an acre. If you use them wrong, however, it will go the other way.

Consider these tips to ensure your corn has enough nitrogen to grow.

First, estimate nitrogen needs now. Highly variable weather conditions make it difficult to accurately estimate optimum nitrogen rates, so get a handle on it before your application window closes. Options include:

N-rate calculator: Crop advisors in top corn-producing states embrace the Maximum Return to N approach, using regional N-rate recommendations based on a database network of multiyear and multi-location N-rate field trials.

Soil test: Test at least 12 inches deep to indicate nitrogen currently available to plants.

Field scouting: Check low areas of fields where water may have been standing. If temperatures are cooler for 10 days and the soil is 55 to 60 degrees, applied N losses of up to 25% can occur. At soil temps of 75 to 80 degrees, nitrogen losses can climb to 96%.

Optical sensors: Sensors mounted on N-application equipment measure "crop greenness" which correlates with the plant chlorophyll content. Estimated chlorophyll content also estimates crop nitrogen status.

Aerial infrared: If the computerized service is available, infrared imaging can easily spot N-deficient areas. Even normal visual surveillance can spot areas that are more yellow than others.

Ideally, split-N application is the best way to reduce N-loss risks. That allows rate adjustment based on weather variations.

While in-season applications can supply N near the time of maximum plant uptake, wet conditions can delay sidedress applications beyond the optimum application date. Very dry conditions can result in a delay in availability of sidedressed nitrogen to the plant.

Be prepared to apply sidedress nitrogen as quickly as possible when that window of opportunity appears. Finally, a backup plan should be in place for in-season application to help avert a significant N deficiency and yield loss in case of weather issues.

Some farmers have switched to growing corn continuously in recent years, but have been seeing unusually high yield reductions.

Although corn can be cropped continuously, it is widely accepted that there is a yield reduction compared to corn rotated with soybean. This difference is referred to as the continuous corn yield penalty, which is generally in the range of 20 to 30 bushels per acre.

The 2012 growing season marked the third consecutive year of unusually high CCYP values in the U.S. Midwest, often with corn yields that were 30 to 50 bushels per acre less than corn following soybean.

The researchers conducted the experiment from 2005 to 2010 in east-central Illinois, beginning with corn produced in a third-year CC system or a CS rotation, at six N fertilizer rates. The study investigated: 1) how the yield penalty changed with time in CC, 2) under what conditions increasing the nitrogen fertilizer rate reduced the penalty, and 3) what causes the penalty?

Each year, they determined an "agronomically optimum N rate" and corresponding yield value for each rotation (CC and CS). On average, corn yield at the agronomically optimum N rate for CC was 167 bushels, compared to 192 bushels per acre for CS – a CCYP of 25 bushels per acre. CCYP values ranged yearly from 9 to 42 bushels per acre.

Study authors said to explore the causes of the CCYP, a number of different weather- and yield-related measurements were tested for their relationships with the CCYP. With just three predictors, the CCYP could be estimated with almost 100% accuracy.

The predictors were: 1) unfertilized CC yield, 2) years in CC, and 3) the difference between CC and CS delta yields.

The researchers found that the best predictor of the CCYP was unfertilized CC yield. In years when unfertilized CC yields were relatively high, the yield penalty was low, and vice versa. Unfertilized CC yield is an indicator of how much N the soil is supplying to the corn crop, either from residual fertilizer N or from decomposition of previous crop residues and other organic matter (N mineralization).

The second predictor of the CCYP, years in CC, was also strongly correlated with the CCYP. CCYP got worse with each additional year in the CC system through the seventh year, when the study was terminated.

This conclusion is at odds with the claims of many Corn Belt farmers who argue that corn yields in CC eventually attain the same level as CS rotations. On average, the CCYP in this study increased by 186% from third-year CC to fifth-year CC and 268% from third-year CC to seventh-year CC.

Additionally, researchers said corn residues from continuous corn production introduce a host of physical, chemical, and biological effects that negatively influence corn yields.

Effects of accumulated corn residues include reduced soil temperature, increased soil moisture, reduced N fertilizer availability, and production of autotoxic chemicals, all of which can negatively affect growth and future corn crop development.

The final predictor of the CCYP, difference in CC and CS delta yields (the difference between the yield where no N was applied and the maximum yield under non-N limiting conditions), is probably a function of weather conditions, particularly during critical growth periods such as ovule determination and grain fill. Drought and heat can disproportionately reduce yields of the CC system relative to the CS system. This principle was demonstrated during the 2012 drought, when farmers reported yield reductions as large as 50 bushels per acre for CC systems compared to CS.

Based on this study, the authors concluded that the CCYP persists for at least seven years. However, during very favorable growing seasons, increased N rates can overcome the CCYP. Unfortunately, higher N rates do not eliminate the CCYP during average or poor growing seasons. This study concluded that the primary causes of the CCYP are: N availability, corn stover accumulation, and unfavorable weather.

Authors said given that weather cannot be controlled, and the optimum N fertilizer rate can be determined only after crop harvest, managing corn stover has the greatest potential for reducing the CCYP.

Sulfur may be another option to maximize corn yields, especially on highly eroded, low organic matter soils. Approximately 95% to 98% of sulfur in soils is found in organic matter. Different soils release different amounts of SO4-S (the plant-available form of sulfur) through a process called mineralization.

This process releases very small amounts of SO4-S from sandy soils, while heavy or fine textured soils release increased amounts of SO4-S. Mineralization also can be slowed by cooler soil temps. This effect causes concerns because of the large amount of residue left on the soil in continuous corn and reduced-tillage environments.

It may be beneficial to consider sulfur applications in high-residue situations. Heavy crop residues insulate soils, leading to reduced overall soil temperatures, which ultimately could reduce the amount of SO4-S available from soil mineralization.

A marked reduction in the sulfur content of coal used in power plants and other industrial processes, as well as gasoline and diesel fuel, has reduced the amount of SO4-S available to crops from rainfall.

Rainfall absorbs sulfur dioxide (SO2) from these sources and it then reaches the soil as SO4-S. This loss of SO4-S affects a very broad production area.

Application rates of sulfur vary based on soil OM levels. On extremely low OM soils it may be necessary to band as much as 25 pounds per acre. However, common broadcast rates of 10 to 15 pounds generally are high enough to achieve profitable crop responses on the majority of soils.

Many sources of sulfur are available to growers. Some more common sources, which can be applied in dry fertilizer applications, include ammonium sulfate and gypsum, as well as 90% elemental sulfur. Ammonium thiosulfate is a widely used liquid sulfur source commonly added to liquid nitrogen blends. While banded sulfur can be used effectively, high rates of some fertilizer sources placed with the seed as a pop-up starter can lower or delay germination, so consider alternative placements.

As production levels increase and farming practices evolve, it becomes increasingly critical to continually reevaluate soil tests and adjust fertility programs.

8. Know your hybrids before you plant

Selecting the right hybrids for your farm is one of the most important decisions you will make for meeting your yield goals. Hopefully, you and your seed specialist have already done a good job of selecting the best hybrids for your farm. Here are some factors to keep in mind:

Drought, heat and stress tolerance for lighter ground
Seed companies have been working for years to develop hybrids with good stress tolerance. There are some excellent hybrids already available with good heat and drought tolerance. If they are new hybrids, make sure to plant a few acres and compare them with hybrids that have performed well on your farm in the past.

Hybrid maturity
Generally, full-season hybrids for your area will have the highest yield potential. Planting 70% full-season maturity, 20% medium-maturity and 10% early-maturity hybrids will maximize corn yields.

Soil-type response
Is the soil sandy, loam or clay with high organic matter content? What are the cation exchange capacity and pH values? Hybrids differ in their response to different soil types.

No-till, minimum till or conventional till
Hybrids for no-till should have good seedling vigor and strong disease tolerance.

Row width
Are you in 15-inch, 20-inch, 30-inch or twin rows? Make sure your hybrids have upright leaves if you are using narrow rows. Also, shorter hybrids may be better for narrow rows.

Previous crop
Certain hybrids aren't suited for corn after corn. If you must plant corn after corn in some fields, you need an excellent disease package and good seedling vigor.

Previous herbicide used
Did you use conventional herbicides, glyphosate or glufosinate? Is there potential for carryover? Do you need to rotate herbicide chemistries? Most seed companies have detailed information on how various hybrids tolerate certain herbicides.

Herbicide to be used this year
If you're planning on using glyphosate or glufosinate, make sure your hybrid has the gene for resistance to the particular chemical that you choose. Determine how you are going to mark fields so you know exactly where hybrids with tolerance to various chemistries are planted. You may also want to check with your neighbors to avoid the risk of drift to or from their direction.

Disease resistance
If you know which diseases are prevalent, it is easier and cheaper to look for hybrids with tolerance to those pathogens than using fungicides later to control those diseases. If a disease is

caused by bacteria or virus, foliar fungicides won't help. Late-season health and stay-green power extend the grain-fill period of a hybrid.

Insect resistance
If you know which insects are problems in your area, there are excellent hybrids available with built-in trait resistance. However, you don't need to invest in traits for resistance to insects that aren't prevalent in your area.

Agronomic characteristics
Seedling vigor; plant and ear height; floppy or up-right leaves; growing degree days to pollen-shed and silking; girthy or flex ears; root and stalk strength; yield-to-moisture ratio

Ear-shank development
Attachment of the ear shank to the stalk is very important for ear retention. In drought years, poor shank development under stress can cause considerable ear drop in some hybrids.

Soil adaptability
If soil types are different, match hybrids to soil types in each field. Knowing whether a hybrid is a racehorse or workhorse will help in matching hybrids to fields.

9. Get the most from your yield maps

As you sit down at your desk with a stack of GPS yield maps, remember that colorful maps are not the same as useful knowledge.

For these tools to be of real value, the information must be accurate. It must be organized and presented in a meaningful way. It must aid your management decisions.

Accurate data collection begins with careful yield monitor calibration for each type of grain harvested. Do not skimp on this step.

Yield data often contains errors arising from field features or combine operations. For example, changes in combine speed or swath width can distort the data. If you do not clean up these errors, you can end up with misleading maps. Data collected from field headlands, point rows, overlaps and outliers should be removed, as well as places where you had to stop the combine.

Most yield mapping software has a function that automatically cleans up your data by removing unrealistic values. These functions do a fairly good job, but on occasion they can mask problems, like insect or disease hot spots or wet spots. It is recommended that you clean up the yield data manually. This takes more time, but it will also give you deeper insight.

Think about what you want the map to show. How you group yield data has a big effect on the appearance of your yield map — and its usefulness.

Most mapping software offers several ways to aggregate data, such as grouping by quartiles, equal yield ranges or natural breaks. Each method has advantages and drawbacks. Try several methods to see what they reveal.

The number of yield ranges also affects your map's appearance. There is no magic number of ranges — it depends on your goals. As a general rule, using too few ranges will cause meaningful variations to disappear.

However, many growers err in the opposite direction, setting too many ranges. That makes it hard to see the whole picture clearly. Don't get too caught up in details.

There are many types of maps you can generate with your harvest data. One of the most useful is a normalized yield map, which expresses yields as a percentage of the field average.

These maps are especially good for comparing multiple years and different crops. You can see which parts of the field consistently yield above average and which are consistently below average. Normalized yield maps are also a good way to see if your management is reducing field variability.

A yield map only documents variations — it doesn't explain why they happened. Variability may be caused by any number or combination of management practices and natural variations. You have to play detective.

Bring in additional tools, such as your GPS-referenced planting, spraying and soil nutrient maps; scouting notes; soil surveys; topographic and drainage maps; weather records; and your own detailed knowledge of the field's history. Each of these requires a different approach. In stable, low-yielding areas, for example, there might be an opportunity to correct a problem, such as poor drainage, or to reduce inputs and lower costs.

Many growers don't have the time or expertise to delve deeply into yield map analysis and interpretation. That is why it's advised to work with a precision agriculture consultant.

Anecdotal reports of yield help gauge what is happening in an area, but shouldn't be used as an information end-all for selecting next year's varieties. To select the right hybrid to maximize yield, look at company yield plots carefully.

•If they included competitors, was it the competitor's top hybrids, or just middle-of-the-road hybrids so they could say they competed against that company?

•Were plots you see data from replicated? Were the hybrids repeated? Or were they simply strip trials? If they were strip trials, was a checker hybrid used and corrections made back to the checker hybrid?

•Were results corrected back to 15.5% moisture? Most are today, but it doesn't hurt to check and make sure.

•What is the cost for the previous year? You want high yield potential and quality seed, but cost must be a factor at some point. Be wary of answers such as 'will be comparable to our competitors.' That basically means yields haven't been decided yet by that company.

•How many different locations were included in reports? Were some hybrids in similar plots for more than one year? You need this information to know if the hybrid can perform well in different weather and soil conditions.

•Look for unbiased plot results. Tell the seedsman you are waiting to see how his hybrid did in university plots. If it is not in any university plots, press him to find out why it wasn't.

10. Planting date vs corn yields

Corn growth is a function of temperature, sunlight availability, nutrients, water and carbon dioxide. For example, take a hypothetical field planted in the Corn Belt around April 1 that tasseled June 6. Pollination of this early-planted corn likely took place in relatively cool weather, because it should have finished by June 21.

The maximum amount of light is available from May 21 to July 21. Since June 21 is the longest day of the year, if plant canopy is fully extended by May 21, it should capture the maximum amount of solar radiation possible.

Temperatures during grain fill should be cooler, too. That is more conducive to photosynthesis. Corn plants live longer during cooler weather. That longevity results in more productive time that contributes to higher yield.

How about corn planted May 1 to May 10? All leaves weren't fully extended by May 21, which limits potential for trapping maximum solar energy. But it should still do very well.

What about corn planted in late May or early June? It missed the boat for trapping maximum energy. Expect fewer leaves because these plants need to hurry up to produce fully mature seeds. With a shorter life span, later-planted corn utilizes every minute to ensure viable progeny.

It has been proven that corn planted late requires fewer days to maturity. They say interaction among many factors may explain how late-planted corn knows to hurry things along. However, less sunlight and higher temps seem to be important. It is also possible that shorter day length for later-planted corn, plus a difference in the angle of the sun's rays, signals that its life span will be shorter.

The message corn gets is to pollinate quickly and produce mature seeds. If you do not believe it, find the same hybrid in plots planted weeks apart and notice the difference.

If everything else is equal, early-planted corn should yield very well, and be drier at harvest.

Does that mean you should plant all corn April 1? No. If you can plant during early April, consider spreading risks for pollination, rain and temperature variations by also planting some corn later in April and in early May.

Soil conditions can be the best ever during the first week of April. But the question is, should you plant corn early when the soil is still cold? Yes, but with a few cautions.

Another caution is to plant early only when seedbed conditions stay favorable; if it rains or is still wet, growers should not try to get back in the fields too soon.

It requires about 110 to 120 growing degree days for corn to emerge. With highs in the mid-60s and lows in the 40s to low 50s, less than 10 GDD per days are accumulated, so it can easily take two to three weeks for the crop to emerge.

Typically, this isn't a problem. But it is a long time, and problems can develop to hinder emergence. Early-planted corn should be watched carefully, especially when GDD accumulations pick up and the crop approaches emergence.

Low soil temperatures are not the major risk factor that planted corn faces. Instead, heavy rainfall soon after planting, with seeds or seedlings dying from lack of oxygen, is the major cause of replanting. Chances of this happening are no higher for early than for later planting.

Planting into cooler soils may even improve chances for emergence following rainfall. Seeds are not triggered to germinate and emerge as rapidly in cool soils, so they often survive longer in cool, wet soils than in warm, wet soils. There is some risk of damage from frost after plants have emerged, but that is fairly rare.

Many farmers report that their best yields come from early-planted corn. Often, that's corn planted in April, but many factors besides early planting play into corn yield potential in any given year.

According to previous University of Illinois and Purdue University studies on average corn yields vs. planting date there is a relationship between the two but it is far weaker than most people would think.

In fact, the correlation is only about 12% at best. What that means is there are a lot of other factors that affect yield besides planting date. Planting early may favor high yields, but it certainly doesn't guarantee it. Conversely, planting in near-mud conditions just to get a crop in once soils begin to dry out almost guarantees problems from the very start.

What is so difficult to determine is that not only are there so many other factors that affect yield over time, they can all be different in any given year. It is often impossible to tell ahead of time what those factors might be in most cases.

For example, if your yield potential was 200 and you have a late planting date but many other factors fall in the crop's favor, the yield might wind up at 190 bushels per acre vs. 200 bushels per acre due to delayed planting into mid-May or later.

However, if other factors combine to drop potential to 160 bushels per acre before planting date is considered, then the yield might drop from 160 maximum to 150 bushels per acre.

In short, don't panic and give up hope, or be tempted to mud things in during a late planting year. Do not go into a frenzy trying to find shorter-season hybrids to plant, either – time for those decisions may come; it just depends on the weather in a given growing season.

If it's early May and cool, wet weather is sticking around, planting will be delayed for many growers and prompt questions about switching to earlier season hybrids.

Long-term research at several universities shows that adapted, full-season corn hybrids usually offer the best yield and profit advantage when planting delays are not extreme. Studies by seed companies also agree with that advice.

Iowa State University studies show hybrids reached 100% yield potential in trials when planted between April 20 and May 5, and 99% of their yield potential for planting dates up to May 20. Yield potential will slowly decrease throughout the month of May, regardless of hybrid maturity. Switching hybrid maturities will not resolve this issue.

Full-season hybrids typically make full use of a growing season. Even when planted late, these hybrids often outperform early maturing hybrids, adjusting their growth and development to reach maturity in a shortened growing season. That's why even if you are considering an early hybrid switch, it is important to weigh your decision carefully. If you switch to a shorter season hybrid too soon, you are giving up higher yield potential and profits.

Hybrid changes should be based on expected grower returns including yield, drying costs and test weight discounts. Early maturity hybrids should be planted only when you have extreme late-planting or replant situations.

Long-term studies by both seed companies and universities which included a range of hybrid maturities across planting dates extending from April through June have shown a clear yield and profit advantage for full-season hybrids.

University research shows that full-season hybrids adjust to late planting with a reduction in their growing degree unit, or GDU, requirement of up to six units per day of planting delay. For example, hybrids planted May 20 may require 150 fewer heat units to reach maturity than the same hybrids planted April 25. This adjustment reduces the risk of fall frost damage to these hybrids.

Soil conditions permitting, April planting also is recommended in the north-central Corn Belt. Growers are encouraged to plant full-season hybrids (103 to 110 CRM) until the last week of May in this region, too.

Maturity planning is most critical in northernmost states because of the risk of cool weather or early frost. Pioneer recommends producers in northern Corn Belt areas (central Minnesota and north-central Wisconsin) stick with full-season hybrids (98-105 CRM) until approximately May 27. This recommendation also carries into far-northern areas (northern Minnesota, North Dakota and Quebec, Canada) for hybrids that are full-season there (97 to 100 CRM).

11. Corn planting depth

Seeding depths of around 2 inches are optimum for most conditions. Two root systems exist in corn, the first helping to establish the young seedling and the second carrying it through the entire season. The seminal roots emerge from the seed while the nodal roots emerge above these, at the junction of the mesocotyl and coleoptile. Planting too shallow results in shallow nodal root formation. The nodal roots form at a relatively consistent soil depth of ¾ of an inch regardless of planting depth. This is triggered by light interception as the seedling grows toward the soil surface. Planting too shallow results in a very short mesocotyl and, as a result, very little distance between the seminal and nodal root systems.

All of this may spell trouble. Although soil temperatures at the soil surface warm up faster than deeper in the profile, it also dries faster. Seed planted into dry soils may not germinate, or worse, may imbibe moisture and then die if rain is not forthcoming. Corn absorbs 30% to 35% of its weight in water before germination begins; soybean absorbs 50%. When planted into dry soils, whether shallow or not, corn emerges more erratically than soybeans. Planting corn shallow also exposes seedlings to more potential damage from either pre-plant or pre-emergence herbicides as well as fertilizer injury.

Shallow nodal root formation often shows up as rootless corn syndrome. Even later during the growing season, plants are more susceptible to root lodging if planted shallow due to inadequate root formation below and above ground.

In addition to all of these plant responses to shallow planting, it is good to remember that planter closing wheels are designed for 2 inch planting depths. In ideal conditions, the best seed-to-soil contact occurs at 2 inches.

On average, a 2-inch planting depth ensures the best root formation and potential for uniform emergence. Planting deeper delays emergence. Nevertheless, the best planting depth varies a bit with soil conditions and with current and impending weather. For example, in cool, early spring soils, planting at 1½ inch deep may work well. Yet in dry conditions, the planting depth may need to be deeper than 2 inches to tap into consistent moisture. Never plant corn shallower than 1½ inches.

Don't forget to check planter depth settings every time you enter a new field or plant in different conditions.

12. Critical weed control timing

Weeds may emerge with the corn in many fields due to the lack of a preemergence herbicide. In some cases farmers rely totally on postemergence application.

In other cases, weeds emerge with the corn due to weather conditions.

The term "critical period" is used to define how long weeds can be allowed to compete with the crop before yields are impacted. To get maximum yield from the crop, weeds must be controlled before the critical period is reached.

The difficulty in relying on total postemergence programs is the variability in the critical period, making it impossible to predict the optimum time to apply postemergence herbicides. The critical period is influenced by many factors, including weed density, relative time of emergence of weeds and corn, weed species and cultural and environmental factors.

A multi-state research project evaluated the effect of time of weed removal in glyphosate resistant corn. In the 35 experiments, the average yield loss was 2% when the initial glyphosate application was made to 2.5 inch weeds.

Delaying the application until weeds were 5 inches tall doubled the yield loss. The variability in the critical period can be seen by looking at the yield response at the sites with the least competitive environments and the most competitive environments.

At sites with low levels of competition, corn yield loss was not affected when application was delayed until the weeds were 7.5 inches tall. At the other end of the spectrum, corn yields were reduced 13% when weeds were only 2.5 inches at locations with heavy weed competition.

It is wise to act conservatively when you determine when to apply postemergence herbicides because weed density is probably the most important factor that influences the critical period, and fields with heavy infestations should be treated as quickly as possible after weed emergence.

The smaller the weed, the better. Proper timing of the application of postemergence herbicides provides the corn crop with the best opportunity to express its full genetic yield potential.

Allowing weeds to compete with the crop for too long reduces its seed yield. Yield losses can accumulate very rapidly, and the associated costs can far exceed the cost of an integrated weed management program that includes a properly timed application of a postemergence herbicide.

The problem is the longer weeds are allowed to remain with the crop, the greater the likelihood of crop yield loss, but we don't know the specific day after planting or emergence when weed interference begins to reduce corn yield.

This critical time is influenced by many factors, including the weed spectrum, density of species, and available soil moisture. Weed scientists generally suggest an interval, based upon either weed size (in inches) or days after crop/weed emergence, during which postemergence herbicides should be applied to prevent weed interference from causing crop yield loss. They often recommend removing weeds in corn before they are more than 2 inches tall.

Another reason to apply postemergence herbicides to small weeds is that they are generally easier to control than larger weeds. Application rates of postemergence herbicides are often based on weed size, with higher rates often recommended to control larger weeds.

To be effective, the postemergence herbicide has to be taken into the plant (usually by absorption through the leaves) and then moved to its target site. Younger plant leaves often absorb herbicides more rapidly and completely than older leaves. High relative humidity, adequate soil moisture, and moderate to warm air temperatures also favor enhanced herbicide absorption.

Waterhemp plants with resistance to one or more herbicide sites-of-action challenge the effectiveness of many postemergence herbicides depending on the resistance mechanism, these plants may not demonstrate much injury or a reduced rate of growth following a herbicide application.

A follow-up or "rescue" herbicide application to control resistant plants is more likely to be successful if the initial application is made when plants are 3 inches tall or smaller than it would be if they are 6 inches tall or larger.

The choice of foliar-applied corn herbicides could be affected by prior application of soil insecticides. Specifically, using an organophosphate insecticide at planting or after corn emergence could restrict the use of herbicides that inhibit either the ALS or HPPD enzymes. Be sure to consult the most current product labels.

Labels of most postemergence corn herbicides allow applications at various crop growth stages, but almost all product labels indicate a maximum growth stage after which broadcast applications should not be made. A few specify a minimum growth stage before which applications should not be made. These growth stages are usually indicated as a particular plant height or leaf stage; sometimes both are listed.

For product labels that indicate a specific corn height and growth state, be sure to follow the more restrictive of the two. Application restrictions exist for several reasons, but of particular importance is the increased likelihood of crop injury if applications are made outside a specified growth stage or range.

13. Tiny corn-yield robbing pests

Weeds aren't the only yield robbers.

There are at least eight different nematodes that can damage corn. The management is different depending on the type.

The nematode types include needle, dagger, sting and stunt, which feed on roots from the outside; and stubby root, lance and lesion, which feed inside corn roots. Each has a stylet, or hollow, spearlike tongue, which punctures and damages roots.

All are microscopic, but vary in size. Needle nematodes are the largest. They are also invisible without a microscope and have clear, uncolored bodies.

According to Jackson, a prevailing myth is that corn nematodes only occur on sandy soils. But while the needle and sting nematodes prefer sandy soils, others can live in any soil type.

Since there are corn nematodes in every soil type in every field and diagnosis is very difficult, farmers need to become more knowledgeable about the problem.

Rotating out of corn is one suggestion for controlling corn nematodes, although some of the nematodes can feed on soybeans.

Since nematodes also like grass, it won't do you any good to rotate to soybeans if grass weeds, including foxtail or sandbur along field borders, aren't controlled.

While it won't control nematodes, good management of nitrogen and irrigation water will lessen stress on corn plants.

The European corn borer, once regarded as a major and consistent insect pest, is now only rarely observed in most commercial cornfields across the Corn Belt.

In 1939, European corn borers were first reported in Illinois and by 1942 the pest could be found in all counties within the state.

In 2013, transgenic corn hybrids (includes Bt hybrids, stacked hybrids [Bt and herbicide tolerant], and herbicide tolerant only) were used on 90% of corn acres.

The widespread use of highly effective Bt hybrids on lepidopterous insect pests such as the European corn borer has had a significant area-wide population suppression effect on this once prominent species. In evening drives around the state of Illinois the past few years, the first or second flights of European corn borers have been barely noticeable. Many will recall what these spring and summer evening drives did to our windshields.

Depending on the accumulation of heat units, the first flight of European corn borers generally lasts from mid-May through mid-June. Moths emerge from corn residue and seek out areas of dense vegetation found in ditch banks, fence rows, and grass waterways. Females emit a sex pheromone in these "action sites" very late in the evening that attracts males and mating ensues. Females depart action sites after sundown and begin laying egg masses in nearby cornfields — typically two egg masses per night for upwards of 10 days. Action sites near cornfields are ideal for the largest aggregation of moths as described by Dr. Tom Sappington in an Environmental Entomology (2005) journal article.

Are too few survivors emerging from Bt fields to sustain the continuing efficacy of Bt hybrids against European corn borers? So far, no field-selected Bt resistant strains of European corn borers have been documented.

Is the added cost of Bt hybrids worth the investment for this insect pest in light of very low densities of the European corn borer and the less than favorable current and projected commodity prices?

If the use of Bt hybrids declined, would producers have sufficient time to scout large commercial cornfields, utilize economic thresholds, and apply rescue treatments as needed?

Time will tell if this once very significant insect pest will return as a consistent threat.

14. Limit stress during corn pollination

The impact of stress on corn depends on the timing of two critical events: pollen shed and silking.

Pollen Shed and Silking: Stress during the pollination and silking period often reduces yield potential. Water stress is the worst stress factor although high temperatures, defoliation – from hail, insects, etc. -

and extremely high plant populations, among others, reduce yield during this critical time especially when coupled with drought stress. During flowering, plants use more water (0.35 to 0.40 inches per day) than at any other time.

Anthesis – Silk Interval: One of the best indicators of how plants respond to stress during flowering is the Anthesis – Silk Interval or ASI.

ASI measures the time in days between pollen shed and silk emergence. Agronomists also are concerned about 'nick,' referring to the overlap of these two critical developmental stages.

The ASI for older corn hybrids in good condition might have been 2 to 3 days with a range up to a week or more.

These reductions in ASI over the decades helped stabilize modern corn yields in stressed environments. In situations where water is limited, silk emergence and elongation slows. Pollen shed remains constant or accelerates. In older hybrids, water stress often resulted in a loss of nick; thus when silks emerged, there was no pollen source.

Barren plants or ears with fewer kernels per ear resulted. By condensing the window of time between tassel and silk emergence, we are more assured of having good pollination with modern hybrids. This is true even if the silks are delayed a couple days or more due to water stress.

Pollen shed occurs over a 5 to 8 day period and silks are viable and receptive to pollen up to 7 to 10 days. Smaller ASI values means a greater chance of successful seed set, increased kernel numbers and increased yield.

In the long-run, the impact of stress conditions during this time will determine yield.

15. Yields depend on kernel size, fill

Superb grain fill during pollination depends upon putting as many kernels on each ear as possible, and making those kernels heavy.

Harvesting more kernels per ear stems primarily from less kernel abortion. A longer grain-fill period tends to be desirable.

Cool weather makes for a longer grain-fill period, and that's a plus. On the other hand, when it's warmer, you get more dry matter produced per day. That's also desirable. But in cases of cool summers, the longer grain-fill period seems to win out.

What's not a plus is stress at pollination. For example, drought stress commonly delays silk emergence and hastens onset of pollen shed. Sometimes the two do not coincide. That's when poor kernel set can result. Instead, cool temperatures and ample soil moisture favor prolonged, rapid silk elongation.

The goal of the plant is to make as many babies as possible. The plant wants progeny. When outside stresses tell it that it can't handle as many progeny as it thought, it cuts back, hoping to produce as many good seeds as possible.

Any kind of stress at the blister stage can lead to kernel abortion. Drought stress is one of the most common. Other stresses that can cause kernel abortion include severe nutrient deficiencies, severe leaf disease symptoms, leaf loss following hail and severe tunneling by European corn borers.

Excessively warm nights or consecutive cloudy days during or shortly after pollination also can trigger aborted kernels.

Kernels may wind up small if conditions go sour, but they won't be completely absent. Once you get to the dough stage, it's harder for the ear to abort kernels.

The more starch that goes into kernels, the heavier the kernels. The heavier each kernel becomes, the better the odds for higher yields.

The same factors that can abort kernels at the blister stage can affect the weight of kernels once corn reaches the early dough stage. Besides the factors mentioned already, stalk rots and an early killing frost come into play, especially if the crop was planted late. Those two factors trimmed back yields in certain sections of corn-growing states last fall.

Otherwise, the plant creates dry matter as long as it can, and kernels grow heavy. Without photosynthetic stress, the process continues. Those are the situations where fields are set up for big yields.

Heavier kernels contribute to higher yields, but the test weight concept is very difficult to explain, and even harder to understand. Test weight is the amount of grain that fits into a standard measure. Size and shape of kernel, not just weight, influence how many kernels fit into the cup.

Low test weight doesn't always indicate poor quality. It depends on what caused low test weight. For example, if it's dry and you get low test weight, protein was likely laid down first in the kernel, then starch. When it came time for starch, there weren't enough resources to go around.

16. Estimate corn yield before harvest

Planning ahead will help you handle your corn efficiently. You may not be dead-on with your corn yield estimate, but getting close enough for planning purposes is the goal. That's assuming you check yield at several spots per field.

To estimate yield:

> Step 1: Mark off one one-thousandth of an acre at each yield-check spot. For 30-inch rows, that's 17 feet, 5 inches. In 20-inch rows, mark off 26 feet, 2 inches.
>
> Step 2: Count harvestable ears per one one-thousandth of an acre.
>
> Step 3: Pull back the husks on every fifth ear. Count the number of complete kernel rows around the ear, and the number of kernels per row. Multiply the number of rows by the number of kernels to determine the number of kernels per ear.
>
> Step 4: Calculate the average number of kernels per ear by adding the numbers for all sampled ears and dividing by the number of ears sampled.
>
> Step 5: Estimate yield with this formula: First multiply number of ears per one one-thousandth of an acre by the average number of kernels per ear to get total kernel count. Divide that by 90, a conversion factor based on the average number of kernels per bushel. The result is the estimated yield per acre.
>
> Step 6: Repeat yield checks at as many locations as is practical for you.

17. Check planter settings

If you've got a vacuum planter and you've been using 17 or 18 pounds per square inch of pressure, you may need to use 22 with large rounds. If you don't make changes, singulation of kernels can drop off dramatically.

Without some proper maintenance to the frame of the planter you're just sitting in the field.

Proper tire pressure is important. Under or over inflated drive tires influence the accuracy of your planter. It can affect not just how your planter feels and moves, but also all your settings for seed placement. Start with a sound frame: Planter maintenance before planting should include checking air pressure in planter tires and whether or not the planter is level from front to back.

Unequal tire pressure causes the drive wheel with the lowest pressure to do all the driving, therefore it increases the planting rate due to smaller circumference of the tire. Daily pressure checks in the field are ideal, but not always on our minds. Start off right and check as often as possible.

Depth control wheels should be firmly on the ground when the planter is down. If you can easily turn the wheels by hand, it indicates that units are not fully down and you are not planting as deep as you want. This will also cause a variance in seed depth across your field. Increase the down pressure until you achieve good contact.

Check your frame height and also that the frame is level. Measure the front and back bar from the ground. Be sure that your parallel arm bushings aren't worn and are tight. Adjust the tongue height to be sure the planter is running level front to back.

Whether you use your markers or not, keep them maintained and adjusted. Blades should point out and be adjusted at a slight angle. You want to be able to see your mark when needed, but not dig a trench that will affect the seed planted in the next round.

Pivot pins and cables need to be checked and replaced if worn. Bent blades and marker arms can lead to uneven row spacing as well as crooked rows.

As always, be sure to check your planter's manual for specific frame requirements and maintenance.