Kentucky Field Crops News

Spanning 5 departments and 120 counties

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Martin-Gatton College of Agriculture, Food and Environment | Grain and Forage Center of Excellence

UK Wheat Science Group
UK Corn & Soybean Science Group

Inside this issue:

Too Wet to Soil Sample but Ideal to Check for Soil Compaction

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We know producers are ready for the soil to dry out so they can start topdressing wheat with their first shot of nitrogen. This also makes us think about soil compaction, which is simply compressing a given volume of soil into a smaller volume. Compaction can occur in different places in the field and can be due to different reasons. The main reason for soil compaction in row crop production comes down to doing some operation when the soil is too wet. Soil compaction reduces the soil pore space, the amount of air and water a soil can hold, and the pore space continuity that supports air and water exchange/movement in the soil. Compacted soil also has higher densities that restrict root proliferation and water infiltration - and these can reduce crop yield. Further, if compacted areas are found on sloping fields, reduced infiltration can promote surface water runoff and thus soil erosion.

The main types of compaction we deal with in Kentucky are due to traffic, tillage, and planting (sidewall). The ideal soil moisture for a compaction event is at or near the soil's field capacity (Figure 1). Field capacity in Figure 1 is around 0.20 to 0.25 g water per gram of soil (20 to 25 % moisture). Field capacity is when free water ceases to drain due to gravity. This is roughly when the soil first dries enough to traffic it without leaving ruts. When soil is wetter than field capacity, ruts will form. This is another issue to contend with and though definitely not desirable, is really not the same as compaction. We can see in Figure 1 that as the soil moisture levels increase the soil bulk density (another measure of compaction) also increases, up to a point, then it decreases. The reason the soil bulk density decreases after it peaks is because you can't compact water. This is where ruts would be formed if trafficked in the field.

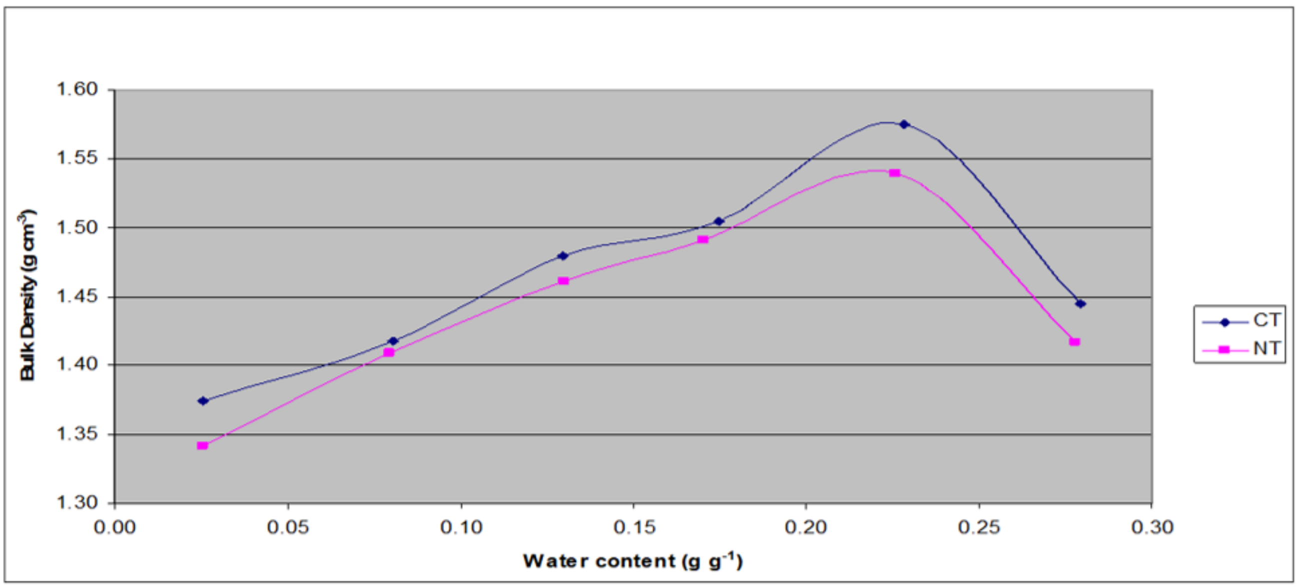

Figure 1. Soil compaction as influenced by soil moisture and previous tillage. NT (no-tillage) and CT (plow tillage) soil organic matter contents were 3.2 and 2.7%, respectively.

Tillage pans can form when tillage operations are conducted to the same depth year after year. The bottom edge of the tillage tool can cause dense pans to form. Other tillage compaction occurs when a tillage operation is executed when the soil is too wet. These "tillage pans" reduce water infiltration and accelerate erosion on sloping land. Soil erosion is a long-term detriment to field productivity, removing the topsoil and the soil nutrients contained there, reducing overall soil depth that plant roots can explore for water and nutrients. This loss in soil productivity can be exacerbated as even more soil is lost and even less water can infiltrate and refresh the soil profile.

A couple of tillage compaction examples come to mind. First, using a disc when the soil is too wet can create a compacted zone at the lower operating edge of the disc blades, regardless whether the operational element is a traditional curved blade or a less traditional vertical blade. This is one of the most effective ways to create soil compaction. Another example is from multiple passes of a shallow tillage tool used for seedbed preparation (e.g. vertical tillage) when the soil is too wet. All these tillage tools will dry out the soil above the lower depth of operation but can effectively create compaction at that lower operating depth.

Sidewall compaction occurs when planting into wet soil. The sidewalls of the planter furrow are smeared/compacted, usually by the row opener, and plant roots can have difficulty growing outside the furrow/through the furrow sidewall. Of course, if sidewall compaction is occurring, then traffic compaction is probably also a concern. This is especially evident when tractor/and planter traffic patterns cause planted crop rows to be bounded on each side by a tire compacted interrow area. This is often called 'pinch-row' compaction – crop growth in the affected row appears stunted or pinched by the compaction found on each side.

Traffic compaction is due to field traffic when the soil is too wet. The degree of compaction is influenced by soil type, soil wetness, tire pressure, load pressure, and the number of traffic events over a given area. Most of the time the entire field area is not compacted rather areas within a field that are wetter than the rest of the field and/or subject to greater traffic. Larger tractors, combines, grain carts, manure spreaders/injectors and other equipment weigh more than before and often have greater axial load, though less of the field area may be trafficked. Paths where grain carts travel or areas where trucks are parked/loaded can be confined, limiting overall compaction. With this in mind we want to discuss some approaches to identifying and dealing with soil compaction.

A standard soil probe in the hands of a skilled agronomist can indicate a lot about soil structure and density in the amount of resistance encountered when collecting a soil sample. Note the amount of pressure it takes to stick the probe in the ground, and if greater pressure occurs at a similar depth across a field. This is a good preliminary diagnostic for identifying soil compaction, but a more detailed approach is done with a soil penetrometer.

A soil penetrometer is a more accurate tool for determining the extent and depth of compaction. A soil penetrometer measures penetration resistance (PR), the amount of force needed to insert the penetrometer into the soil. A soil penetrometer has a pointed tip attached to the end of a rod that is connected to a load cell showing the amount of force needed as the rod tip move into and through the soil, proportional to the resistance encountered. Penetrometers usually have a dial facing the user so that PR values/thresholds can be viewed as the penetrometer is inserted into the soil (Figure 2).

Figure 2. A closeup of a penetrometer face, showing the amount/thresholds of resistance.

The caveat to properly using a soil penetrometer is that soil moisture content matters. This is the purpose of this newsletter – NOW is a great time to check for compaction. It is generally agreed that a soil over 300 psi (lb/in^2) is considered compacted, but a non-compacted soil can easily read over 300 psi in summer when soils are dry. If PR is determined when the soil is dry, or dry at a certain depth, then the information can be misleading. You want the differences in PR to be due to differences in soil density, not differences in soil moisture. The best time to take soil PR measurements is when the soil is thoroughly wetted throughout the entire soil profile, like now and for the next few weeks.

Soil compaction can be "mapped" with a penetrometer, by location and depth. Most penetrometers have marks every 3 to 4 inches on the shaft. Insert the penetrometer into the soil at a constant speed (Figure 3). Watch the PSI as the shaft is pushed into the soil and note the depth where a high PR resistance is observed. Do this in multiple field areas to determine if corrective action is needed. Field edges and other high traffic areas are usually the most prone to compaction. Other areas to check include areas that are/have been trafficked at greater soil moisture levels than the rest of the field, areas with stunted plants, or areas that have standing water for longer periods of time. Mapping the compacted area will allow a producer to focus on specific field areas to address, rather than treating the entire field. Remember that the entire field area is being evaluated, one PR reading > 300 psi does not mean that the entire field needs to be treated. Look for areas where there are multiple high PR readings and treat those areas appropriately. Consult ID-53 for additional information for assessing soil compaction.

Figure 3. A soil penetrometer being used to diagnose soil compaction in a wheat field.

There are several ways to deal with soil compaction, depending on the extent and depth encountered. The first method might be to do nothing. Freezing and thawing will help to remedy shallow soil compaction. We don't get the same amount of freezing and thawing as more northern states, but still enough to help in some years. Also, plant roots can penetrate moderately compacted soils with adequate moisture and additional management might not be needed. The next approach is to do something when compaction is severe enough to warrant some additional management operation.

The additional management is usually going to include some sort of tillage operation. This is where the time spent mapping the soil compaction can pay off. A chisel plow works well at breaking up shallow compaction. Make sure the depth of operation is below the lower depth of the compacted zone. A chisel plow is usually going to require less energy to pull than other tillage tools used to deal with compaction, like a subsoiler. Use a subsoiler for compacted layers deeper than a chisel plow can address. Again, set the operating depth below the depth of the compacted layer. In both instances a focused approach can be used to target only compacted areas in the field. This will save time and fuel and reduce costs. The best time to break up soil compaction is when the soil is dry, and remember the reason that compaction occurred - likely due to trafficking soil when the soil was too wet. Make sure that the soil moisture conditions are on the dry side of ideal for compaction breaking tillage. Don't create additional compaction while trying to alleviate compaction.

In summary, the best thing to do about compaction is to avoid causing it. Don't traffic soil when soil is too wet – wait for the soi to dry. This is not always possible and sometimes management operations must be done in less than ideal soil moisture conditions – leading to compaction. When suspected, try to diagnose compaction by soil probe, plant and/or root growth, ponded water, or a soil penetrometer. Most of the time an entire field is not compacted, certain areas can be targeted so as to save time and money. Remember that a good time to detect and identify compaction is also a really good time to create compaction, so if you think a field is too wet to traffic then it is probably a good time to check for soil compaction.

Additional resources:

AGR-161, Soil Compaction in Kentucky (agr161.pdf (SECURED))

AGR 197, Compaction, Tillage Method, and Subsoiling Effects on Crop Production (agr197.pdf (SECURED))

ID-153, Assessing and Preventing Soil Compaction in Kentucky (id153.pdf (SECURED))

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Winter Wheat in February

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Most winter wheat survived well during the previous cold weather. While the air temperatures dropped near zero most soil temperatures at 2 inches below the surface remained above freezing (Kentucky Mesonet). In the January USDA NASS Kentucky Crop Progress & Condition Report, 80% of the wheat was rated good or excellent. Wheat from last December to now is mostly at Feekes 3, which is in the tillering phase of growth. At tillering, air temperatures need to get well below freezing before injury is expected.

Soil temperatures can vary across a landscape. Normally, we expect colder temperatures at lower elevations. However, in Lexington, we observed the coldest temperatures at the top of the slope. These varying temperatures could result in localized damage to some plants. But even at the temperatures reported in the two charts in Figure 2, no or very minimal damage is expected in the wheat.

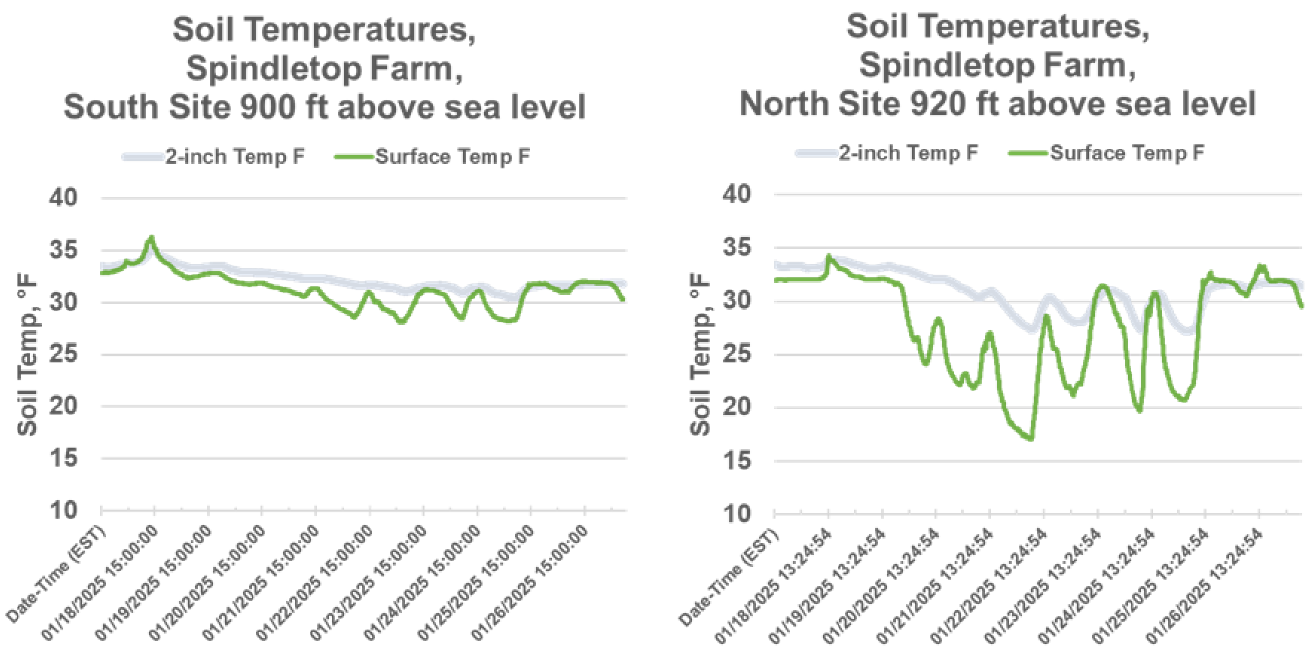

Figure 1. Soil temperatures at surface (green line) and 2 inches below the surface (gray line) for two locations at Spindletop Farm, Lexington, Kentucky from January 18 to January 26, 2025.

Scout for tiller counts to determine the February nitrogen (N) rate. Tillers should be between 70 to 100 tillers per square feet (630 to 900 square yard). If tillers are within this range, then 30 to 40 pounds N per acre should be applied. If tiller counts are below this range, then increase the N rate to 50 to 60 pounds per acre. If tiller counts are above this range, then no nitrogen should be applied in February. Total February and March applications should be about 90 to 120 pounds N per acre.

While counting tillers, you also can scout for aphids and any other irregularities such as gaps in stands and any other issues. As of this writing, even though much of Kentucky has abnormally cold temperatures in January, farmers and crop scouts can proceed normally with wheat management.

Soil temperature conditions can be monitored at the Kentucky Mesonet site by clicking on “Data” and in the dropdown menu selecting “Soil”. Once the new screen opens, on the left side, you can select the location, then select soil temperature and finally select if you want to see the chart for 1 week, 2 weeks, etc.

References

Kentucky Mesonet. https://www.kymesonet.org/

Lee, C. and J. Herbek. Co-editors. A Comprehensive Guide to Wheat Management in Kentucky. ID-125. Kentucky Cooperative Extension Service. Lexington. https://publications.ca.uky.edu/sites/publications.ca.uky.edu/files/ID125.pdf

USDA NASS Kentucky Crop Progress and Conditions. https://www.nass.usda.gov/Statistics_by_State/Kentucky/Publications/Crop_Progress_&_Condition/index.php

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Corn Yield Recovery with At-Tasseling/ Early Silking N Application

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In the past decade, over 50 % of the years have given corn growers some difficulty with wet early season conditions. These conditions can complicate corn nitrogen (N) management. Sustained wetness can delay/prevent N application, resulting in uncertainty in corn's N status at-tasseling/early silking (VT/R1), when ear development commences. Even with unlimited N availability, corn geneticists and physiologists have found that corn N uptake might be only 75% complete at VT/R1 (Figure 1).

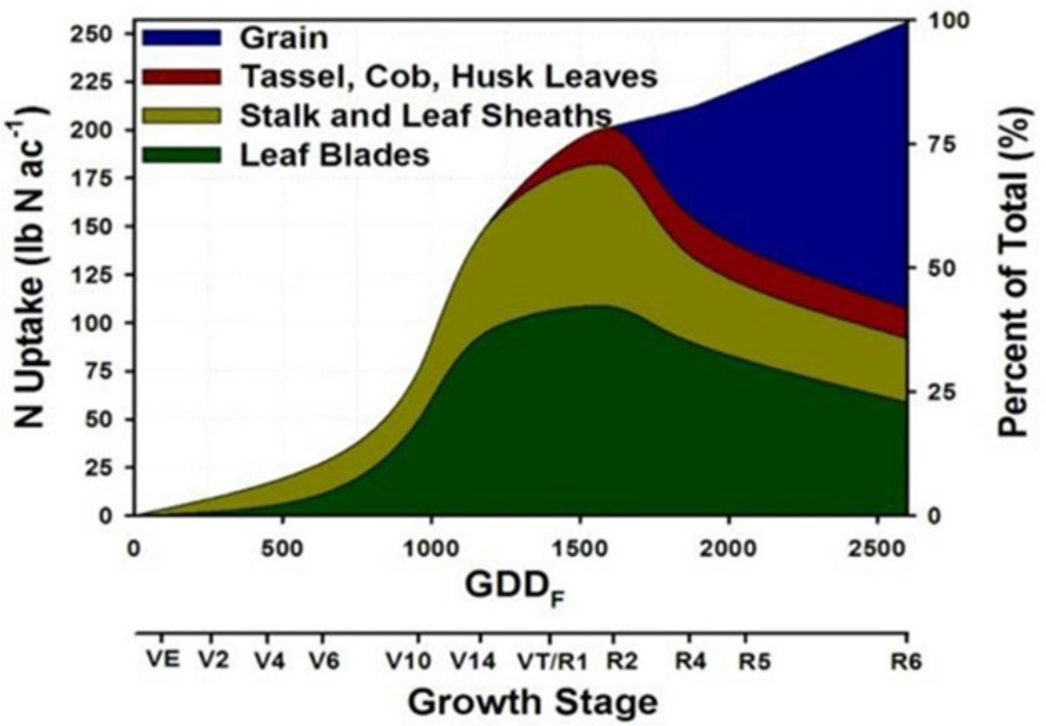

Figure 1. Seasonal nitrogen uptake in corn. Graph courtesy of R. Bender at the University of Illinois Crop Physiology Lab.

During ear formation about 60% of final total N uptake is allocated to corn grain. Of that 60%, a bit more than half may be remobilized from leaves, leaf blades and stalks. The rest comes from soil organic matter mineralization and earlier N fertilizer applications. When the corn producer suspects that these N sources are going to be inadequate, the stage is set for a needed VT/R1 fertilizer N application. But a question remains – can an N application made this late recover lost yield potential?

With support from the Kentucky Corn Growers Association, we researched this question at 13 different locations in 2023 and 2024. We created different levels of early season N availability and consequent corn N nutrition across Kentucky, achieving a range in N nutrition, corn planting dates, and seasonal weather (Table 1). We cooperated with the Corn Variety Testing Program (Cam Kenimer) to get five locations and with Wheat Tech Research (Brad Wilks) to get eight locations. In 2023, corn planting began in April and ended in May. In 2024, all locations were planted in April (Table 1).

Table 1. Site Information.

Year	Site	County – Soil Series	Corn Hybrid	Planting Date
2023	1	Christian – Pembroke	DeKalb C65-95	11 April
2023	2	Warren – Crider	DeKalb C65-95	12 April
2023	3	Logan – Pembroke	DeKalb C65-95	15 April
2023	4	Nelson – Elk	DeKalb C65-95	20 April
2023	5	Woodford – Bluegrass Maury	Pioneer 1464VYHR	25 April
2023	6	Caldwell – Crider	Pioneer 1464VYHR	2 May
2024	7	Christian – Pembroke	DeKalb C65-95	6 April
2024	8	Christian – Pembroke	DeKalb C65-95	16 April
2024	9	Caldwell – Crider	Partners Brand 8105 AA	22 April
2024	10	Warren – Crider-Pembroke	DeKalb C65-95	22 April
2024	11	Woodford – Bluegrass Maury	Pioneer 1464VYHR	25 April
2024	12	Fayette – Dunning	Pioneer 1464VYHR	25 April
2024	13	Nelson – Pembroke-Trappist	DeKalb C65-95	29 April

At each location we had 3 rates of early N (75, 150 and 225 lb N/A) applied at V4, at each of 2 rates of late N (0 and 75 lb N/A) applied at VT/R1. The six treatments were replicated four times. The N source was Super U – urea co-prilled with both a urease inhibitor (NBPT) and a nitrification inhibitor (DCD). The urea was hand broadcast to each plot, at each application time. Leaf tissue samples were taken at R1, grain yield was determined by combine harvest, and samples were taken from harvested grain at the eight locations planted to DeKalb C65-95. Only yield will be discussed here.

Average site grain yield varied quite widely, from 86 to 262 bu/A (Table 2). As we begin to look at the data in Table 2, there are some things to take note of. First, in 2023, there were no differences among any of the treatments at sites 5 and 6, and in 2024 there was little difference among the treatments at site 10 (yellow highlighted columns). At the other ten sites, the treatment with a single application of 75 lb N/A at V4 did not give the highest yield, indicating that treatment did not supply sufficient N nutrition and yield was impaired (Table 2). Additionally, in 2024, yields at three sites, 9, 11 and 12, were hurt to varying degrees by drought.

Looking more specifically at Table 2's second and third data rows, where the 75(V4) + 75(VT/R1) and 150(V4) treatments are compared, at eight sites (highlighted in green) the additional 75 lb N/A at VT/R1 raised yield to a level equal to or exceeding that found with all 150 lb N/A at V4 (Table 2). Two sites, 4 and 12 (highlighted in red), exhibited the opposite trend.

At higher N rates, only sites 1, 2 and 3 gave significant yield increases to N applications totaling more than 150 lb N/A (Table 2). For these three sites, in the fourth and fifth data rows where the 150(V4) + 75(VT/R1) and 225(V4) treatments are compared, the additional 75 lb N/A at VT/R1 increased yield to a level equal to or exceeding the yield observed with 225 lb N/A at V4 (highlighted in blue, Table 2).

In summary, this study indicates that a late VT/R1 N application could generally reduce corn N deficiency to the point that yield potential (at a particular total N rate) was fully recovered. That said, it should be noted that all this corn received at least 75 lb N/A at V4, so there was no instance of severe

N deficiency. In fact, there was little to no further response to additional N at three of the thirteen sites. Further, VT/R1 application may involve specialized ground equipment or aerial application to get over the crop, incurring additional cost to this application timing. But if needed, this late N timing can be beneficial.

Table 2. Grain Yield Response – By Trial Site.

Treatment: V4	VT/R1 --lb N/A	1	2	3	4	5	6	7	8	9	10	11	12	13
		---grain yield, bu/A, by site---												
75	0	224c†	201d	223c	254bc	208a	206a	185d	210c	157c	248b	131c	69b	196c
75	75	246b	236bc	263b	250c	211a	214a	238ab	248ab	181a	258ab	160ab	73b	231a
150	0	246b	230c	266b	273a	218a	216a	224bc	240b	170abc	255ab	138bc	91a	223ab
150	75	267a	233bc	270ab	257b	207a	205a	228b	245b	166bc	250ab	175a	96a	231a
225	0	252ab	240ab	269b	265abc	211a	208a	213c	241b	172ab	258ab	158ab	89a	218b
225	75	257ab	250a	281a	266ab	208a	212a	242a	259a	177ab	262a	156ab	96a	222ab
Site Ave.		249	233	262	261	211	210	222	240	170	254	153	86	220

‡For any site, treatment yield values followed by the same letter are not significantly different at the 90 % level of confidence.

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What Limits Yield – The Source or the Sink? Does it Matter?

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Crop Physiologists often analyze the yield production process in grain crops by dividing the process into two components – the source and the sink. The source is the photosynthetic machinery that supplies the raw materials and energy for plant growth. The sink is the seed that utilizes simple sugars from the source to grow. This simple division helps us understand a very complex system and makes it easier to determine what is limiting yield. If yield is limited by the source (photosynthesis), efforts to increase yield should focus on increasing photosynthesis. If the size of the sink (number of seeds per acre) is limiting, increasing photosynthesis will do no good – the number of seeds must be increased.

Source vs sink seems like a simple system – its either one or the other. Unfortunately, it is not nearly as simple as it seems. Analysis of plant growth and yield production is rarely simple.

Generally speaking, yield is source limited. The size of the sink (seeds per acre) is determined during flowering and seed set by the supply of simple sugars from photosynthesis (the source). Matching seed number to source activity adjusts the reproductive output of the crop to the productivity of the environment and usually prevents a sink limitation. This adjustment occurs between growth stages R1 (initial bloom) and R5 (beginning seed fill) in soybean and from roughly 10 to 15 days before to 20 days after silking in corn.

High photosynthesis during this period usually results in a large number of seeds and high yield, while low photosynthesis results in fewer seeds and lower yield. The source is in control during this period. The crop can usually tolerate some stress during vegetative growth, but stress that reduces photosynthesis during the critical period will reduce sink size (seed number) and yield.

As promised, there are exceptions to this simple source limitation. If your corn population is too low, there will not be enough flowers on the ear(s) to handle all of the simple sugars from photosynthesis and the crop will be sink limited. The source could support more seeds, but there are not enough flowers. The number of seeds limits yield.

Soybean is not sink limited during flowering and seed set. The soybean plant is flexible, it responds to the supply of simple sugars from photosynthesis by producing branches with more nodes and more flowers increasing sink size. Fifty percent flower and small pod abortion in high-yielding soybean crops shows that the potential sink size is much larger than the actual sink size. There is no sink limitation.

Corn is sink limited at low populations because corn lacks the flexibility to increase the number of flowers to match the supply of simple sugars. Over the years breeders favored single-ear hybrids which reduced corn's flexibility and made it susceptible to sink limitations. Corn producers increase the number of flowers per acre to avoid sink limitations by increasing population. The plant does the adjusting for soybean producers.

Corn populations increased steadily since the beginning of the high input era (~1940) to avoid sink limitations as productivity increased. Soybean populations, in comparison, stayed constant and, in recent years, declined, as the plant increased flower number to avoid a sink limitation. This difference is due to the flexibility of the plant or the lack thereof.

Most corn producers prize ears that are filled to the tip at maturity. Completely filled ears (there was no flower or small seed abortion) can indicate high yield or they can indicate a sink limitation (population was too low) with yield left in the field because there were not enough flowers. Unfortunately, there is no uncomplicated way to determine if well-filled ears are good news or bad news.

Crops are normally source limited (assuming adequate corn populations) during the critical period for seed number determination, but what about seed filling? Determining seed number is only the first part of the yield production process – the seeds still have to grow to their mature size. Source-sink relationships during seed filling often depend upon changes in the environment.

Seed number will be in balance with the capacity of the crop to fill the seeds if the environment doesn't change from the critical period for seed number determination through seed filling. A productive environment that is maintained until maturity will produce large numbers of seeds and fill them to their normal size.

What if the environment changes after seed number is fixed? If the environment deteriorates (i.e., (the rains stop, for example, and source activity is reduced), there will not be enough simple sugars to fill the seeds and the seeds will be smaller and yield will be reduced. Sink size was set too large for the deteriorating source during seed filling. In other words, plants don't always get it right because they can't predict the weather.

What if the environment improves after seed number is fixed(i.e., rains come after a dry critical period)? Now the source is larger than the sink and the capacity of the individual seed to respond to the larger supply of simple sugars will determine what happens to yield. The crop will be sink limited if the seed cannot respond to the increase in the supply from the source. If the crop cannot convert the increase in source activity during seed filling into higher yield, yield will be sink limited. Corn seeds often fall into this category.

If the seed can respond to the increase in source activity during seed filling, seeds will be larger, and yield will be increased. Soybean seeds fit into this category; improved conditions during seed filling often result in larger seeds and higher yields (i.e., the crop is source limited).

The response to improved environmental conditions during seed filling is always limited by the physical characteristics of the seed and pod. All seeds have a maximum potential size – after all you can't expect to find a golf ball in a soybean pod, so there is a limit to how much yield can be recovered when the environment improves after stress reduces seed number.

But as often happens in life, there is no downside limit – there is no limit to how much stress during seed filling can reduce seed size and yield in both corn and soybean.

Thinking about sources and sinks helps us better understand the yield production process. It provides us with insights into the response of crop productivity to the environment, the effect of population on crop yield and many other aspects of crop yield. These insights lead to more informed management decisions that ultimately improve the bottom line.

“Flix qui potuit rerun cognoscere causes” (Fortunate is he who understands the cause of things) (Virgil, Italian poet, 70 – 19 BC).

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Follow the Basics to Maintain Yields and Manage Costs

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An economist was overheard saying that there were 5 ways to increase profits in any production system: cut costs, cut costs, cut costs, cut costs, and increase yields. This was somewhat a joke but has a solid underlying basis. Let's delve a little deeper into this strategy with some specific examples and practices to follow.

Yields are influenced by soil and weather conditions, soil pH and nutrient fertility status, and by pests (insects, diseases and weeds). The number one yield limiting factor for most Kentucky row crop producers is water, either too much or not enough. Water management is more of a long-term production decision regarding installation of irrigation and/or drainage systems that we will leave to the engineers.

Controlling insect, disease and weed pests is another management practice that can have a huge impact on final yield and profitability for any given year. For now, we will also assume producers are using good pest management strategies and following IPM practices/thresholds to make spray decisions.

As soil scientists, we'd like to discuss soil pH and nutrient availability. Both of these concerns can be addressed by proper soil sampling and testing. A standard soil probe is capable of making (or saving) a producer many dollars per acre when used correctly. A properly collected soil sample will provide a producer, or their consultant, with the current fertility status of the sampled fields. Knowing this for a field is paramount to knowing the right amount of lime, phosphorus, or potassium to add to that field, if any is actually needed. Remember that there are two ways to lose money in your soil fertility program; adding something you don't need (wasted input costs) or not adding something that you do need (reduced yield due to poor soil fertility). Soil sampling and testing can help avoid both of these perils as you manage your soil fertility program.

A good soil sampling and testing routine should be the basis of any soil fertility program. The first step is to properly identify the area of interest, typically no more than 10 to 20 acres in size (depending on field uniformity), sampling to 4 inches in no-till fields and 6 inches in tilled fields, and making sure to avoid anomalies within that area that might greatly affect test results. Submit the samples to a lab with a good reputation that uses soil test procedures appropriate for soils of the of the area/region. Soil extractants are developed to provide an estimate/index of nutrient availability for crop use in the coming growing season. These extractants can vary with region as native soil conditions can vary considerably (e.g. acid, alkaline, saline, etc.). In Kentucky, we are best served by using the Mehlich 3 extractant that was developed for acid to neutral soils in the southeastern U.S.. There may be several soil test labs in the area that use the same extractant but be aware that they might report results differently. The two most common reporting methods are lb nutrient/acre or ppm nutrient in the sample. The conversion between the two is simple, multiply ppm by 2 to convert to lb per acre, or divide lb per acre by 2 to get ppm. Make sure you understand the unit your chosen lab is using.

Spring soil samples will differ slightly from fall soil samples. For continuity of interpretation, be sure to collect soil samples at the same time of the year. This allows a producer to compare the historical soil samples with the current ones and make changes as necessary. Comparing the soil samples over time, along with good fertilizer application records, will allow the producer to make adjustments for individual fields as needed.

Once good soil samples are collected, and then analyzed in a good laboratory, the next thing is to evaluate the results for individual fields. Follow soil test recommendations for the individual field. Don't average soil test values across multiple fields – apply what is needed to the field that needs it. Generally, the best bang for the soil fertility buck is going to be soil pH management. Row crops perform best at a pH around 6.5. Maintaining a pH in this range optimizes availability of phosphorus and micronutrients, promotes good root growth and health and can positively influence the activity of certain herbicides.

How do you decide what nutrients or soil amendments should be added if the budget is limited? Liebig's Law of the Minimum is a good rule to remember when deciding which nutrient(s) to add. It states that crop yield is proportional to the amount of the most limiting essential nutrient. In other words, the addition of a non-limiting nutrient will not maximize yield if the limiting nutrient is not addressed. Adding potassium to a phosphorus deficient soil will not remedy phosphorus deficiency or vice versa. Adding phosphorus to a soil with a pH of 5.3 is not going to be as effective for improving yield as liming the field and increasing the soil pH.

In very tight times with limited fertilizer budgets, rates might need to be cut in order to get several needed nutrients on the field. At what point is yield being lost due to a reduction in fertilizer additions? In these instances it would still pay to address soil pH. Work from The University of Tennessee showed that a half rate of limestone was almost as effective in neutralizing soil acidity as the full recommended rate - the benefit just didn't last as long. You can cut lime some, but acidity will eventually have to be addressed. Soil test values in the high range don't call for a fertilizer addition. Crops growing on soils testing in the 'medium' range are less likely to respond to fertilizer additions, especially when at the higher end of the medium range. The soils testing in the 'low' range for available nutrients are most likely to limit crop growth and are most likely to profitably respond to fertilizer addition. These are the fields to address first, followed by fields testing in the low end of the medium range.

One thing to avoid is using a "miracle product" that claims to replace conventional fertilizers at a fraction of the cost and nutrient rate. There are plenty of products available that have remarkable claims about reducing overall soil fertility needs. Be skeptical of products with claims like, two quarts per acre replaces X pounds of dry fertilizer. A pound of fertilizer is a pound of fertilizer regardless of the form. For example, a gallon of ammonium polyphosphate (APP, 10-34-0) weighs about 11.7 lb and contains about 4 lb P_2O_5. To obtain 50 lb P_2O_5/acre using APP will require 146 lb or 12.5 gallons APP/acre. To get the same 50 lb P_2O_5/acre with DAP (18-46-0) requires 109 lb DAP/acre. This 50 lb P_2O_5/acre will not be replaced by a product at a use rate of 1-2 quarts per acre, regardless of their claims. Don't spend $5 to $20/acre on these types of products in hopes of replacing a proven lime or fertilizer product – the money is better spent on proven products.

Maybe the opening paragraph should read "make well informed decisions and don't waste money where it isn't needed" rather than cut costs, cut costs, but that wasn't as catchy. We didn't really tell you anything special or new, we just promoted that you use good basic agronomic principles. Maintaining good yields and watching the budget comes down to following basic crop production principles. If you can manage costs wisely while maintaining good yield potential in your fields, then you are in a better position for the seasonal weather to give you a nice profit. Take good soil samples and submit them to a reputable lab using appropriate soil test procedures. Evaluate all fertilizer and lime recommendations carefully, with an eye towards controlling costs. Soil sample analysis cost ranges from $0 (free) to about $10 per sample. What other important management practices can be completed at such a low cost? Address soil pH when it falls below 6.0 to 6.2. Match fertility applications to soil sample recommendations. Don't average fertilizer rates over several fields – apply what is needed where needed. When budgets are tight, address low testing nutrients first, then those at the low end of the medium test range. The lower the soil test value the greater the chance for a profitable crop response. Don't spend money on miracle products that merely claim to replace proven fertilizer products – go with what works.

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Nitrogen Management Strategies in Winter Canola

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Canola is a nitrogen-intensive crop and nitrogen (N) management is a key factor to consider for successful production. Researchers at K-State University and Canola Council of Canada stated that canola requires 2.5–3.5 lb/ac available nitrogen (N) per bushel of seed produced. Ensuring sufficient N availability is crucial for achieving competitive yields. In AGR-1, the Lime and Fertilizer Guide for Kentucky, N recommendations include no more than 30 lb N/acre in the fall and up to 120 lb N/acre in February and March for Canola following corn, soybeans, small grains or fallow land. If Canola is following a perennial sod or legume, then the total nitrogen can be reduced to 90 lb N/acre.

Recent research in Kansas, on different soils and in a drier climate, follows a different nitrogen guideline. Because several Canola resources reference this method, we are going to explain that method here. This method uses a yield goal approach, and factors soil organic matter (SOM) into the equation.

In soil with 2% organic matter, Kansas State research suggests applying at least 2.5 lb of N/acre per expected bushel of canola using the following formula:

$$N\left(\frac{lb}{ac}\right) = 2.5\ x\ Expected\ Yield\ \left(\frac{bu}{ac}\right)$$

$$Fall\ N\left(\frac{lb}{ac}\right) = \frac{Total\ N\left(\frac{lb}{ac}\right)}{3} - Soil\ N\ \left(\frac{lb}{ac}\right)$$

Soil organic matter (SOM) influences N availability and should be considered when determining N application rates. If the SOM is 3%, 15 lb less N/acre should be applied, whereas if the SOM is only 1%, increasing the N rate by 15 lb is beneficial.

For example, if the expected yield target is 60 bushels/ acre in soil with 2% organic matter, the total N requirement is 150 lb N per acre. If SOM is 3%, then 135 lb N/acre is suggested. In this system, the farmer would apply up to 30 lb N/acre in the fall, 52.5 lb N/acre in February and 52.5 lb N/acre in March. For the example of 150 lb N/acre as a total application, the schedule would be 30 lb N/acre in fall, 60 lb N/acre in winter, and 60 lb N/acre in spring. (Note: These total N rate recommendations based on calculations end up very near the range suggested by the University of Kentucky). Since N application is split between fall, winter, and spring, farmers should always subtract soil N from the fall application amount to avoid excessive early growth. For example, if the total N requirement is 150 lb/acre and the soil nitrate test from 1-foot soil cores shows 20 lb N/acre (10 ppm N), then only 130 lb N needs to be applied through fertilization.

Early-planted canola requires only a small portion of its total N in the fall as suggested earlier—typically one-third to one-fourth of the total N requirement—since it has sufficient time for growth before winter. Applying excessive N in the fall can lead to excessive vegetative growth, reducing winter survivability. On the other hand, later-planted canola should receive a higher fall N application—up to 40% of the total N requirement—to promote rapid growth and ensure plants reach the rosette stage before winter dormancy. Therefore, a balanced N distribution ensures optimal crop development and maximizes yield potential.

While growers use various sources of N fertilizer, such as chicken or poultry litter (which contains 34 -72 lb N per ton), caution is necessary to avoid over-application. For example, applying two tons of chicken litter could supply over half of canola's total N needs, potentially leading to winter kill. Nevertheless, the N mineralization rate in chicken/poultry litter varies due to factors such as weather conditions, application methods, and soil properties. Therefore, exercise due diligence and consult with your extension agent or your supplier to understand the nutrient availability and appropriate application strategies for chicken or poultry litter.

For chemical fertilizers, ammoniated phosphorus sources, such as and DAP (18-46-0, commonly sold in Kentucky) and MAP (11-52-0, sold in Kentucky to a lesser extent), provide N without causing damage to small seeds and seedlings. N supplied through MAP and DAP should be considered as part of the total N. Furthermore, Kansas State University often observed yield increases to fertilizer sulfur (S) applications. The climate and soils in Kansas are very different than the soils in Kentucky. During winter and spring, Kansas State recommends applying N fertilizers in combination with S. They calculate 20 lb of S per one seventh of total N. For winter application, fertilizers like ammonium thiosulfate (21-0-0-26) or ammonium sulfate (12-0-0-24) provide both N and S, helping to support canola growth. In spring, avoid topdressing ammonium thiosulfate directly on tissues. Regardless of the specific product, the total amount of S should be applied in winter and spring, as fall application of S offers little benefit for canola.

As winter application time approaches, farmers should be aware of the possibility of freezing temperatures in mid-February. Winter N applications are recommended when the average temperature exceeds 40°F. Winter N application ensures that N is readily available for the plant's bolting process.

Before applying N, it is highly recommended to monitor your canola closely and seek expert advice. Start by assessing whether your canola has survived the winter. Look for green leaves at the growing point and feel the growing point with your fingers. A fleshy growing point indicates a dead plant, whereas a firm growing point suggests the plant is still alive.

An extreme lower limit for plant survival is two plants per square foot. If you find that your canola won't meet this threshold, applying N may be a waste of money, and it might be best to consider switching to another crop.

The spring N application should be made about one month after the winter application, but it should be timed early enough to avoid delaying canola flowering and maturity. A delayed application could delay maturity, which would in turn push back soybean planting.

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2025 Integrated Pest Management Training School Meeting

The 2025 Integrated Pest Management (IPM) Training School will be entirely held via Zoom on March 12 from 8:00 AM to 4:00 PM CST. Twelve CAFE professors and an extension associate along with a guest speaker, Dr. David Owens, from the University of Delaware, will discuss relevant topics related to the major pest problems and best strategies for healthier crops and pest management. Dr. Owens will share his experience with gray garden and marsh slugs in Delaware including factors that promote slug damage, natural enemies, scouting and management tactics. To address some concerns about the influence of changes of weather patterns on insect pests, Dr. Nick Teets will discuss basic principles of insect responses to climate change.

The program includes two sessions: Field Crops (Morning) and Horticulture (Afternoon), each session will offer CEUs to pesticide applicators and certified crop advisers. For more detailed information, please see the attached flyer.

Registration, currently available at this link, is mandatory to attend the meeting.

Martin-Gatton College of Agriculture, Food and Environment

Virtual IPM Training School

March 12th, 2025
Zoom 8:00 AM – 4:00 AM

8:00-8:15 Welcome Dr. Ric Bessin

Morning: Field Crops

8:15	Updating Nitrogen, Phosphate and Potash Rate Recommendations (AGR-1) for Kentucky Grain Growers - **Dr. John Grove**
8:40	Fertilization Methods for Organic Crop Production **- Dr. Edwin Ritchey**
9:05	Improving ROI for Corn Fungicide Applications - **Dr. Kiersten Wise**
9:30	Management of Foliar Diseases of Soybean - **Dr. Carl Bradley**
9:55	**Coffee Break**
10:10	Slug Observations and Implications from Delaware - **Dr. David Owens**, Michael Crossley and Ben Sammarco, University of Delaware
10:35	Three Emergent Soybean Pests: Snails, Three-Cornered Alfalfa Hopper and Bean Leaf Beetles - **Dr. Raul Villanueva**
11:00	Potential Responses of Insect Pests to Climate Change - **Dr. Nick Teets**
11:25	Weed Control in 2025 and Beyond - **Dr. Travis Legleiter**
11:50	**Lunch Break**

Afternoon: Horticulture

1:00	Difficult Weeds and Management Strategies - **Dr. Shawn Wright**
1:25	Techniques for Managing Common Invasive Plants - **Dr. Ellen Croker**
1:50	Soil Solarization: An Alternative Management Method for Many Issues - **Dr. Rachel Rudolph**
2:15	**Coffee Break**
2:30	Nursery IPM Practices to Up Your Disease and Pest Management Game- **Ms. Tara Vaughn**
2:55	Spotting Trouble: Spotted Lanternfly and Kentucky - **Dr. Jonathan Larson**
3:20	An Overview of Cold Damage And Prevention For Fruit Crops - **Dr. Brent Arnoldussen**

Field Crops CEUs	**Pesticide Applicator-** Category 2, 3, 10: 1; Category 1A: 3 **Certified Crop Adviser-** Nutrient Management: 1; IPM: 3
Horticulture CEUs	**Pesticide Applicator-** Category 1A, 2, 3: 1 for each **Certified Crop Adviser-** IPM: 2; Crop Management: 1

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Italian Ryegrass Control Field Tour

Thursday, March 27, 2025
9 a.m. to 11:30 a.m. CDT

Please meet at the Caldwell County Extension Office

1025 U.S. Highway 62 West, Princeton, KY
Sign-in begins at 8:30 a.m. CDT

A caravan will proceed to the UKREC in Princeton for plot tours of Italian ryegrass research.

Click link or scan QR Code to register
https://uky.az1.qualtrics.com/jfe/form/SV_2c6KX2NmiqEp1TE

Presented by Dr. Travis Legleiter, UK Extension Associate Professor - Weed Science, this field tour will highlight the options available to Kentucky farmers for maximum control of this problematic weed in the fall and spring prior to corn and soybean planting. For more information about the field tour call (859) 562-2569.

Educational credits available:

CCA: 3 CEUs in IPM;
KY Applicator Credits: 3 CEUs for Category 1A (Ag Plant)

Upcoming Events

KATS Drone Sprayer Training	March 20, 2025
Italian Ryegrass Control Field Tour	March 27, 2025
KATS Soil Properties Workshop (Richmond, KY)	April 10, 2025
WHEAT FIELD DAY	May 13, 2025
KATS Crop Scouting Workshop	May 15, 2025
KATS Planter Clinic	June (TBD):
Pest Management Field Day	June 26, 2025
CORN, SOYBEAN & TOBACCO FIELD DAY	July 22, 2025
KY High School Crop Scouting Competition	July 24, 2025
KATS Field Crop Pest Management & Spray Clinic	August 28, 2025

To sign up & receive our latest newsletter(s),
click the link: KFCN NEWSLETTER or scan the QR code.