Corn & Soybean News

August 2023
Volume 5, Issue 8

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

Southern Rust in Corn: A Late Season Confirmation

Southern rust of corn, caused by the fungus *Puccinia polysora*, was confirmed in Kentucky on August 8, in Todd County. As of August 8, we have only confirmed the disease in Todd County, but with our current weather conducive for disease development, it will not be surprising to see additional confirmations across the state. Southern rust is typically confirmed in mid-July in Kentucky, so this is a later than normal confirmation, and much of the corn in Kentucky, particularly western KY, is likely past the growth stage where there will be a positive economic benefit of a fungicide application. Previous research from southern states indicates that fungicides may be needed to protect yield while corn is in the tasseling through milk (VT-R3) growth stages. Once corn is past milk (R3), fungicides are likely not needed to manage the disease. If fields have already received a fungicide application this year at tasseling/silking (VT/R1), they are not likely to need a second application of fungicide. Fields that were sprayed pre-tassel (V10-V14) should be scouted carefully to determine disease presence and progression and determine if an additional fungicide application is needed.

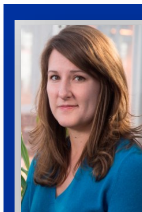
Very late planted fields of high-value corn that is still pre-tassel should be scouted to determine if the disease is present before deciding on a fungicide application. Fungicide application may be beneficial in certain fields of late-planted corn, but this should be determined on a case-by-case basis.

More information on timing of fungicide applications for southern rust can be found in Table 2 of the Crop Protection Network publication “Southern Rust” which can be read here: https://cropprotectionnetwork.org/encyclopedia/southern-rust-of-corn. The efficacy of specific fungicide products for southern rust are described in the updated fungicide efficacy table for management of corn diseases, which is developed by the national Corn Disease Working Group, and posted on the Crop Protection Network website: https://cropprotectionnetwork.org/publications/fungicide-efficacy-for-control-of-corn-diseases

It will be important to scout and monitor fields over the next few weeks and submit samples to the Plant Disease Diagnostic Laboratory (PDDL) through local County Extension Agents if you suspect you have southern rust in a field.

Southern rust is first observed as raised, dusty orange pustules on the upper surface of the leaf (Fig. 1). Pustules will typically be present only on the upper surface of the leaf. The disease is easily confused with common rust, which produces pustules on both sides of the leaf. Common rust (*Puccinia sorghi*), can be found sporadically in Kentucky corn fields and is not economically important to manage, so it is important to distinguish between the two diseases before applying fungicide. If southern rust is suspected, the fastest way to get a diagnosis through the PDDL is to submit samples through County Agents. Confirmations of southern rust will be posted on the cornipmpipe website here: https://corn.ipmpipe.org/southerncornrust/. On the map, red counties/parishes indicate that southern rust has been confirmed by university/Extension personnel.

Figure 1. Southern rust on corn (photo by Kiersten Wise)



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Flooding Effect on Corn and Soybeans in 2023

- For corn and soybean plants that survived flooding, compromised roots and stalks are the greatest concerns going forward.
- Fertilizers and fungicides will not rescue flood-damaged crops. There may be certain reasons to apply them once survival is certain, but again, they will not rescue a crop.

Corn and soybean fields were flooded in western Kentucky on July 19, 2023, when areas received anywhere from 7 to more than 11 inches of rainfall in less than 24 hours. By now (July 28, 2023), corn and soybeans in some of those fields are flashing yellow leaves and other plants are visibly dying.

Either corn or soybean fully submerged more than 24 hours in these temperatures likely died. Plants in fields flooded for about 48 hours or more - even with plants exposed - likely will die. Generally, the area of plant death is larger than we initially estimate. If the water was over the ears for about 24 hours, then the ears are lost. They very likely have started to rot by now.

For fields where flooding drained rapidly, but the soils are saturated, the root hairs died quickly. They will not grow new root hairs until about 3 days after oxygen re-enters the root profile. Oxygen starts to re-enter the soil profile when a person can walk into the field without sinking into it. Oxygen is fully in the soil profile when a person can safely drive on the field without making ruts.

Root hair death from the saturated soils is the major concern for the plants. Root hair death will cause a flash in nutrient deficiency and will weaken the stalks. Some yield loss will occur on these plants and chasing these lower yields with additional fertilizer or fungicides will not increase those lost yields.

Plants with dead root hairs cannot take up nutrients. The leaves are still conducting photosynthesis and still trying to grow. Because no new nutrients are being taken up, the plants will rob nutrients from the stalks and lower leaves. If the root hairs remain dead long enough, the plants will begin to flash nutrient deficiencies. Nitrogen deficiency is the most obvious deficiency, but other nutrients will be deficient as well. The corn and soybean plants will stay deficient until about 5 to 7 days after oxygen re-enters the root profile. Applying nitrogen to the field will not help immediately. Root hairs are needed to take up the nitrogen. Many farmers consider foliar applications. The plant can only take up about 1 pound of a nutrient per acre through the leaves with any foliar application. If a farmer really wanted to supplement with foliar nutrients, the farmer would need to apply every day until the root hairs are fully functional. A foliar fertilizer will not help and applying one every day for about 8 days is not economical.

Some nitrogen losses can occur but normally from the saturated soils. In fields where plants survive, the nitrogen losses are minimal, especially on corn that is in seed fill. Corn and soybean yields are hurt because they grew for about a week or so while the roots were choked out. There is no need to apply fertilizer nitrogen until the farmer is certain that the corn or soybeans will survive.

This is a poor analogy, but may help explain what the plants are experiencing. Imagine being locked away from food but having to conduct a 4-hour workout (or 10-mile run) every day plus do your normal duties. You will move a little slower the longer you are locked away from the food. About 3 days after oxygen moves back into the root zone, it is like a key unlocking the door to the food. If we stop the analogy right here, you get a since of what is happening to the plants in a saturated field.

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Many farmers are tempted to apply fungicides to protect the crops. Do not apply a fungicide to help plants recover, even if it is an inexpensive product. Fungicides will not help recover yield that has been lost. Consider potential yield loss and other economic factors before applying fungicides for disease control in fields that have been impacted. In other words, assess if the remaining yield potential is still worth the investment of a fungicide application for disease control. If the crop is dying due to standing water or flooding, then there is no point to apply fungicides.

Many farmers are tempted to apply fungicides to protect the crops. Do not apply a fungicide to help plants recover, even if it is an inexpensive product. Fungicides will not help recover yield that has been lost. Consider potential yield loss and other economic factors before applying fungicides for disease control in fields that have been impacted. In other words, assess if the remaining yield potential is still worth the investment of a fungicide application for disease control. If the crop is dying due to standing water or flooding, then there is no point to apply fungicides.

If plants are covered in mud, they will have less photosynthetic capability and could have some higher pathogen risks. Theses plants needed another inch of rain as soon as possible to wash off the mud. The longer the mud stays on the crops, the greater the yield losses will be. Since soybeans are shorter, there will be more fields in the area with muddy soybeans. Expect some large yield losses in those fields.

On upright plants that recover, the roots are compromised and weaker stalks, especially in corn, are expected. Corn fields probably need to be harvested sooner and farmers should expect to dry grain. Soybean roots are compromised as well but they do not have the stand issues late in the season like corn does. There could be more lodging, but a grain table can capture those easier than a corn head can capture downed corn.

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Do Smoky Skies Reduce Crop Yield?

Smoke from forest fires in Canada recently produced hazy conditions in parts of the Midwest, the East and the Mid-South. Smoke and haze reduce the solar radiation reaching the earth's surface. Will this reduction reduce crop yields? This is a logical question given that photosynthesis produces yield and the energy to drive photosynthesis comes from solar radiation. Reducing solar radiation should reduce yield – right? It's not that simple.

Yes, the reduction in solar radiation will reduce photosynthesis, but that doesn't automatically translate into lower yield. First, the relationship between solar radiation levels and photosynthesis is not a straight-line relationship (to put it another way, the relationship curves over as solar radiation increases), so the decrease in photosynthesis is less than the decrease in solar radiation. For example, in a field experiment with soybean, 63% shade (much much greater than reductions from smoke and haze) from planting to maturity only reduced the yield by 50%. The solar radiation – photosynthesis relationship in corn is closer to a straight line, but still the reduction in photosynthesis from a 20% reduction in solar radiation, for example, would by less than 20%.

Secondly, smoky conditions increase the proportion of solar radiation that is diffuse (as opposed to direct radiation). Diffuse radiation occurs when the radiation from the sun bounces off the dust, smoke particulate matter, and other pollutants in the air and arrives at the surface from all directions (direct radiation comes in a straight line from the sun). Diffuse radiation penetrates farther into the plant canopy resulting in a more even distribution of radiation over the leaves and higher photosynthesis. The benefits of diffuse radiation may be larger on the relative compact soybean canopy compared with the more upright leaves in the corn canopy.

Finally, reduced solar radiation will reduce water use (evapotranspiration, ET), which could be a positive effect for fields experiencing drought stress. The first step in the ET process is the conversion of water from a liquid to vapor which requires energy from the sun, so reducing solar radiation could reduce ET. Any reduction in ET would probably be relatively small and may be important only in marginal situations when the crop is just beginning to experience drought stress.

Reductions in photosynthesis during vegetative growth rarely carry over to yield unless there are large reductions in plant size. Lower photosynthesis during vegetative growth will reduce plant size and leaf area; if this reduction is large enough to reduce solar radiation interception during reproductive growth, yield will be reduced. If not, the smaller plants will not result in lower yield. When we shaded soybean communities (30 and 63% shade) in the field from planting to growth stage R1 (initial bloom), total plant dry weight at R1 was reduced by 20 (30% shade) and 42 (63% shade) %, but there was no effect on yield. The smaller plants still intercepted all of the solar radiation, so size did not affect yield.

The overall effect of smoky skies on crop yield is the result of one negative effect (less solar radiation and less photosynthesis), one positive effect (more diffusive radiation and higher photosynthesis)

Martin-Gatton
College of Agriculture,
Food and Environment

Aug 31, 2023
8:00 am to 2 pm
(sign in @ 7:30)

KATS
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Field Crop Pest Workshop

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KENTUCKY Small Grain GROWERS' ASSOCIATION and one possible positive indirect effect (reduction in drought stress). The combined effect on yield is hard to predict as it depends on how much smoke and haze is in the sky (how much the solar radiation is reduced and the proportion of diffuse radiation is increased), the water status of the crop and how long and when (before or after flowering) the smoke and the reduction in photosynthesis occurs.

At this point in the growing season, most of the smoky days occurred during vegetative growth, so, my best guess is that yield potential of corn and soybean has not been affected. I don't think smoke is worth worrying about unless we get a lot more smoke later this summer and, even then, its usually better not to worry too much about things we can't control. Practicing up on your rain dance might be a better strategy this year if you are going for maximum yield.

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Yield Monitor Maps for P and K Fertilizer Rate Prescription Maps??

Developing a field's variable rate fertilizer prescription map can be costly, including the time in taking plant tissue and/or soil samples, sample analysis costs, and later map development time. Soil sample analysis is particularly important to phosphorus (P), potassium (K) and soil acidity (pH) management. Soil sampling time may be in short supply when crop harvest is to be followed by establishment of a succeeding crop. Soil test results are not always timely, further delaying prescription map development. Due to the expense, grid or zone sampling is often done only every 2 to 4 years, which raises the question of how much fertilizer is to be applied in other years.

Other precision technologies, especially yield maps, are being used to reduce the time crunch. Fertilizer prescription maps based on nutrient removal can be developed directly from a yield map by multiplying the yield by grain P or K concentration values taken from published tables. Intuitively, nutrients would be applied to replace nutrients removed by the previous crop. A random sample of the grain could be analyzed if values from published tables were thought inappropriate.

There are potential problems with this approach. Limiting factors other than nutrient deficiency, especially water stress (both too little and too much), can drive field yield patterns. Should this year's insect/disease pressure or weed competition patterns drive fertilizer P and K application? If a low soil test P limits crop yield in one area, should that area then be fertilized according to the low P removal found with the low yielding, P deficient, crop? The yield monitor map might improve fertilizer prescriptions, but how does it compare with other options?

We compared four approaches to generating field-scale fertilizer rate prescriptions: a) the "grid", based on (expensive) grid soil sampling a field on a 180 x 200 ft grid (about 1 sample per 0.83 acre) and spatial analysis of the soil test results; b) the "composite", based on a single average soil test value from all grid soil samples taken in the field; c) "yield map nutrient removal-tabular", based on the field's yield map, a single published grain P concentration value, and spatial analysis of the calculated nutrient removal values; and d) "yield map nutrient removal-local composite", based on the field's yield map, a single grain P concentration value determined on a composite grain sample taken from that field, and spatial analysis of calculated nutrient removal.

Two producer fields, designated 112 (51.4 ac) and 950 (43.4 ac), were chosen. The dominant soil in both fields was a well-drained Crider silt loam, but there were sizeable areas of only moderately well drained soil (Lowell, Nicholson or Tilsit silt loams). Field 112 had a history of chemical fertilizer applications and 950 had a history of swine manure and fertilizer N applications. Corn yield was determined with a calibrated yield monitor. Grain and soil samples were taken at the same grid point, shown in Figure 1A for field 950. A digital elevation map was determined for each field (also shown in Figure 1A for field 950). Soil test P was determined by the Mehlich III extraction procedure at the University of Kentucky's Division of Regulatory Services soil test laboratory. This lab also determined soil pH and organic matter on each soil sample. Grain tissue was analyzed for P by the University of Kentucky Plant and Soil Sciences Department's Analytical Services Laboratory.

Maps were generated for crop yield/nutrient removal and soil test P. The tabular value used to calculate nutrient removal maps was 0.326 % P = 0.353 lb P_2O_5/bu. Table 1 shows the fertilizer rate prescription as related to P removal or soil test P values.

Fertilizer Prescription (lb P_2O_5/ac)	Removal (lb/ac) (lb P_2O_5/ac)	Soil Test P (lb/ac)
0	0-15	> 60
30	15-45	42-60
60	45-75	28-42
90	75-105	14-28
120	105-135	0-14

Table 1. Fertilizer prescriptions as related to removal or soil test values

"Composite" soil test, grain yield and grain tissue P information for the two fields are given in Table 2. On average, field 950 was higher in soil test P and organic matter, but soil pH values were similar. Grain yield was lower, and more variable, in 112 than 950. For 950, grain P was close to the tabular value, and grain from 112 was lower than the tabular value.

Property	Field 950	Field 112
Soil Test P (lb/ac)	147 ± 64	54 ± 31
OM (%)	3.3 ± 0.6	2.6 ± 0.4
pH	6.4 ± 0.3	6.3 ± 0.6
Yield (bu/ac)	138 ± 22	130 ± 47
Grain P (%)	0.35 ± 0.03	0.29 ± 0.04

Table 2. Soil test, yield, and grain composition information for each field (mean ± one standard deviation).

Figures 1a and 1b show sample point locations, elevations, and yields in 950. We generally found that lower elevation, soil erosion and less than well-drained soil decreased corn yield in this moderately dry season. Considerable spatial variation in soil test P within 950 is shown in Figure 2a, but no fertilizer P would be recommended (Table 3) for the grid or composite soil test approaches because there were no areas with a soil test P value below 60 lb/acre. The nutrient removal-based fertilizer prescription map for 950 (Fig. 2b), using the yield map and the tabular grain P concentration, gave only two areas with rate prescription differences - due entirely to yield differences between these two areas (Fig. 1b). Comparing the four approaches to getting a fertilizer P prescription for 950, the nutrient removal-based fertilizer prescriptions always called for more fertilizer than the soil test-based prescriptions for this field (Table 3). In fact, areas in the removal-based map calling for a greater fertilizer P rate (Fig. 2b) were often those areas with higher soil test P (Fig.2a).

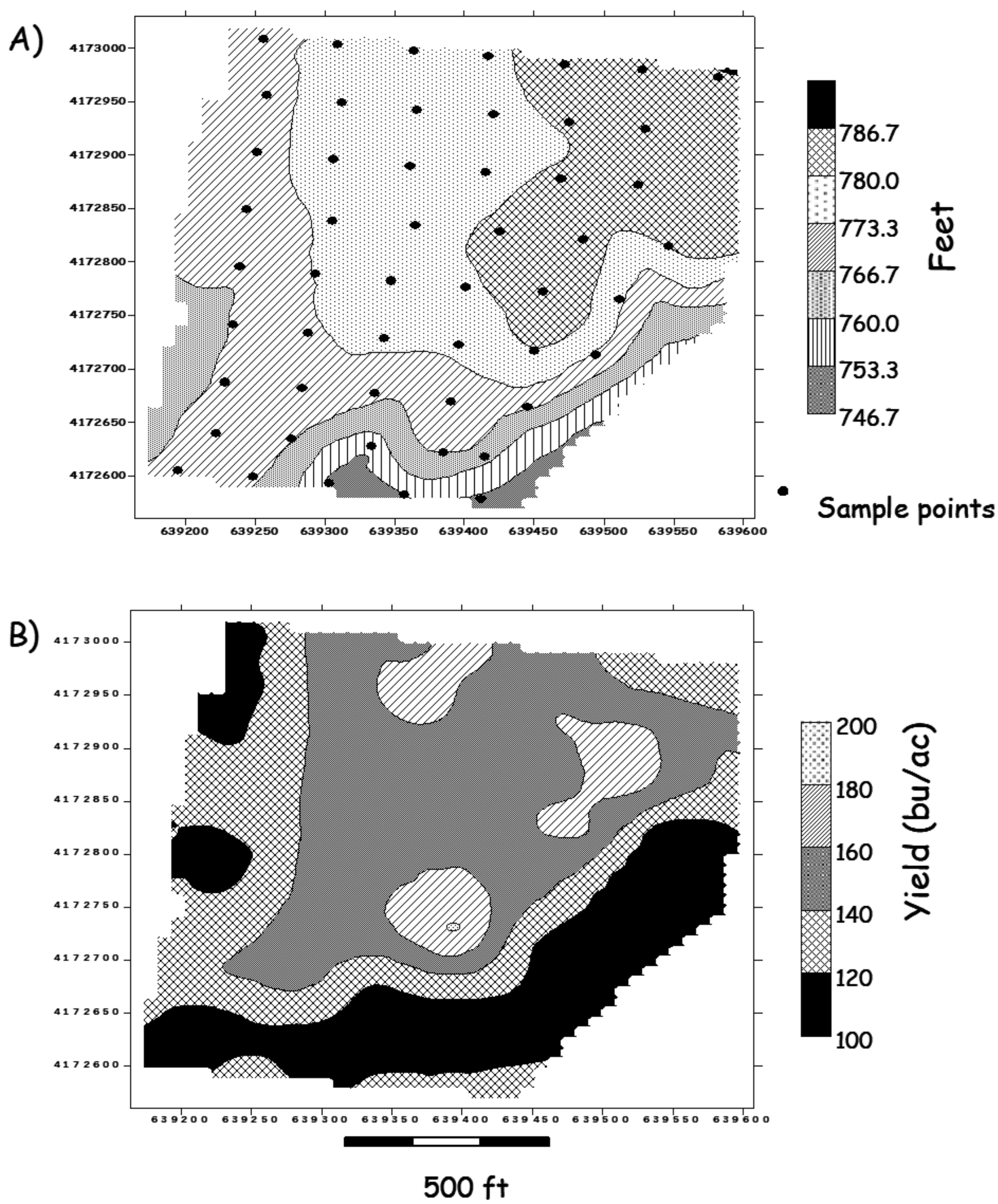

Figure 1. - Field 950 A) Elevation and sampling points; B) Interpolated yield map.

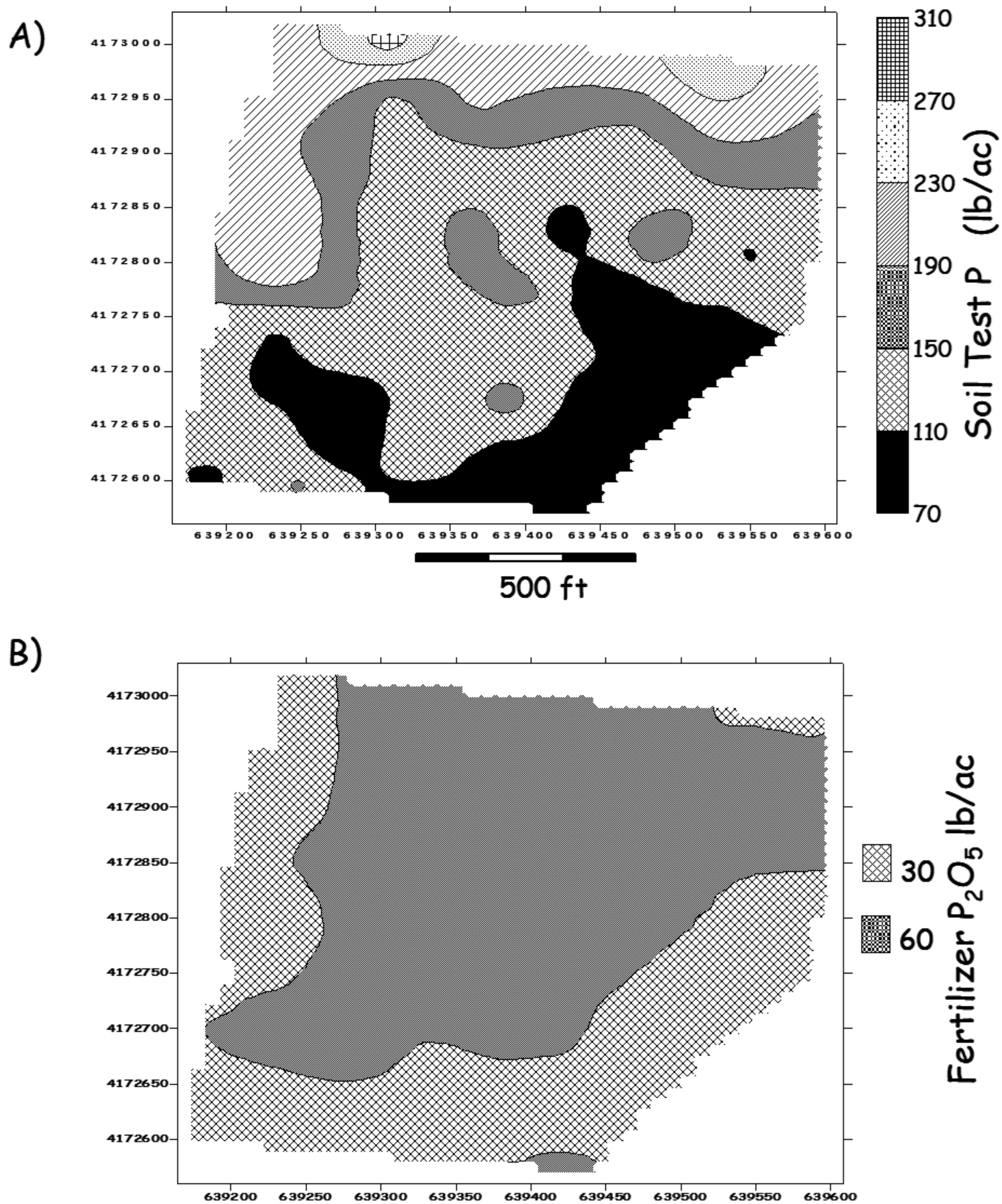

Figure 2. - Field 950 A) Map of soil test P; B) Fertilizer P prescription from P removal using yield map and tabulated grain P concentration

The soil test P map for field 112 (not shown) also showed considerable spatial variation. Comparing prescription approaches for this field, fertilizer P is over-prescribed, relative to that recommended by “grid” sampling, by both nutrient removal approaches (Table 4). In 112, the greater difference between the grain P concentration value for grain taken from the field and the value taken from the table caused the removal-based fertilizer P prescriptions to differ. The “composite” soil analysis recommended a uniform rate of 30 lb P2O5 per acre for field 112.

Relative to grid soil sampling, the "composite" P rate prescription was appropriate for a third of the field, over-fertilized a third of the field, and under-fertilized a third of the field (Table 4).

Fertilizer Prescription ($lb\ P_2O_5/ac$)	**Grid Soil Test P (%)**	**Composite Soil Test P (%)**	**Removal Tabular Grain P (%)**	**Removal-Local Composite Grain P (%)**
0	100	100	0	0
30	0	0	38.4	23.3
60	0	0	61.7	76.7
90	0	0	0	0
120	0	0	0	0

Table 3. Portion (in %) of field 950 receiving each fertilizer P rate, according to the prescription method.

Fertilizer Prescription ($lb\ P_2O_5/ac$)	**Grid Soil Test P (%)**	**Composite Soil Test P (%)**	**Removal Tabular Grain P (%)**	**Removal-Local Composite Grain P (%)**
0	30.5	0	0	0
30	36.0	100	43.1	74.1
60	31.7	0	56.5	25.9
90	1.7	0	0.5	0
120	0	0	0	0

Table 4. Portion (in %) of field 112 receiving each fertilizer P rate, according to the prescription method

We concluded that composite soil sampling was not always inferior to grid soil sampling in terms of the resulting fertilizer P or K prescriptions, especially when both approaches confirmed that no fertilizer was needed. In general, using yield-nutrient removal maps to derive fertilizer prescription maps resulted in greater prescribed P and K fertilizer rates than either soil test approach. We also observed that as the tabular grain P concentration value deviated from the field grain P concentration there was more of a difference in the nutrient removal-based fertilizer P prescription. Our results indicate that using yield monitor maps and grain P or K concentration information to develop variable rate fertilizer P and K rate prescription maps rests upon an assumption that was often not valid. We found P and K removal by the most recently harvested crop is not better related to the need for fertilizer P and K for the next crop than current soil test P and K values.

That said, our experience indicates that yield maps can be used, along with soil, topographic and other spatial information (satellite imagery) to divide a field into “management zones” that better capture crop production differences than simple square/rectangular grids. These zones, likely fewer, would then be soil sampled for nutrient management information.

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Martin-Gatton College of Agriculture, Food and Environment

Yield Improvement and Yield Components: Corn vs. Soybean

Corn and soybean yields have increased steadily during agriculture's high-input era (~ 1950 to the present). The increase in yield was associated with more seeds per unit area in both crops. The higher yields are attributed to genetic improvement, better management practices, and, possibly, changes in the environment, although the contribution of each is hotly debated. There has been, however, less discussion of how the plant changed to produce more seeds per unit area.

I collected data from field experiments in the referred literature to evaluate how corn and soybean plants changed to accommodate the increase in seeds per unit area as yield increased. My data set contained 172 observations (1919 to 2018) for soybean and 231 observations (1906 to 2019) for corn with the bulk of the observations for both species occurring after 1940. Yield per plant was calculated by dividing yield by plant population.

Soybean plant population did not change from 1919 to 2018 (averaged 121,000 plants/acre), but corn population increased steadily from 6500 to 36,000 plants/acre. Yield per plant of soybean increased steadily over the interval as a result of the increasing yield and a constant population (Fig. 1A). In contrast, yield per plant for corn did not change as a result of increases in both yield and population (Fig. 1B).

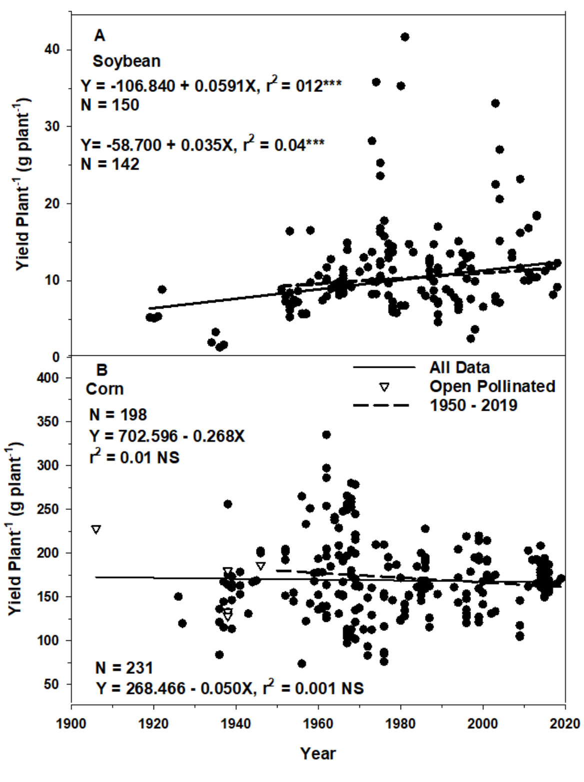


Fig.1. Time trend of yield per plant of corn and soybean from the early 1900s to the present . Calculated from yield and plant population. Soybean yields greater than 20 g plant-1 were not included in the regressions. Adapted from Egli (2023).

The response of corn and soybean plants to yield improvement was completely different. The corn plant was not flexible; it did not increase yield (Fig. 1B) or kernels per plant as yield increased nearly six-fold (41 to 225 bushels/acre). The increase in seeds per acre associated with higher yield came entirely from more plants per acre. The soybean plant, on the other hand, was flexible; yield (Fig. 1A) and seeds per plant increased as yield increased from 26 to 64 bushels/acre with no change in plant population.

The increase in seeds per acre came entirely from more seeds per plant. The increase in seeds per plant for soybean could come from more nodes per plant, more flowers per node and/or a decrease in flower and pod abortion. I don't know which components changed, but the literature suggests that flowers per node is a good candidate.

Interestingly, corn plants can also flex – they can produce more than one ear on the main stem (there are ear primordia at every node below the ear node) and they can produce ear-bearing tillers - but most modern hybrids produce only a single ear at normal populations. Apparently, flexibility was not emphasized during hybrid improvement in the U.S.

Flexibility does not seem to have anything to do with yield improvement. The relative rate (% per year) of yield increase in the U.S. is the same for corn and soybean (based on national yields reported by the National Ag Statistics Service).

Flexibility does, however, have a huge effect on crop management. Since the corn plant is not flexible, the increase in seeds per area that was associated with higher yields had to come from an increase in population. Maximum corn yields depend upon selecting the correct population which is determined by the yield level (only an approximate level is known prior to planting) and the reproductive characteristics of the hybrid [kernel size (weight per kernel or kernels per bushel) and ear size (potential kernels per ear)]. If the population is too low, yield will be limited by the number of kernels the plant can produce. Yield may also be reduced if the population is too high.

One important implication of the dependence of corn yield on population is that the higher yields of the future will require rows narrower than 30 inches to accommodate the higher populations that will be needed. After all, there is a limit to how many plants can be grown in a foot of a 30-inch row.

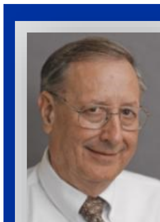
The corn plant's lack of flexibility also explains why corn yield is sensitive to variation in the spacing of plants in the row or the time of emergence of individual seedlings. The dominant corn plant (one with a wider spacing or earlier emergence) cannot increase seed number enough in response to the more favorable environment to compensate for the loss of seeds on dominated plants (closely spaced or late emerging). If seed number of the dominant plants cannot compensate, yield will be reduced.

The flexibility of the soybean plant allows it to produce the same yield over a range of populations. The soybean producer's only concern is that the population is above the minimum level needed for maximum yield. Its flexibility also insulates it from any affect of un-even spacing or time of emergence on yield.

The need to hit a fairly specific target population with uniform spacing and emergence makes managing corn for maximum yield more complicated than simply exceeding the minimum population without worrying about spacing or time of emergence in soybean. Selecting a population is complicated by the fact that the producer can only select the planting rate – the population is determined by the number of seeds that germinate and emerge from the soil, a function of soil conditions (primarily temperature and moisture) and the quality(germination and vigor) of the planted seed.

When management is complicated, it is less likely that it will be done correctly which can result in lower yields.

Adapted from Egli, D.B. 2023. Yield Improvement and Yield Components: A comparison of corn and soybean. Crop Science 63: 1019-1029.



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University of Kentucky presents 2023 Fall Crop Protection Webinar Series

Beginning Nov. 2, 2023, the University of Kentucky Martin-Gatton College of Agriculture, Food and Environment will present a series of four webinars covering field crop protection. Hosted through the Southern Integrated Pest Management Center, the webinars will feature UK extension pest management specialists discussing weed science, plant pathology and entomology topics. Continuing education credits for Kentucky pesticide applicators and Certified Crop Advisors will be available.

The Thursday morning webinars will take place via Zoom at 10 a.m. EST/ 9 a.m. CST, and preregistration is required for each webinar. The webinars are open to agriculture and natural resource County extension agents, crop consultants, farmers, industry professionals, and others, whether they reside or work in Kentucky or outside the state.

Dr. Kiersten A. Wise
Webinar #1:
November 2, 2023
Registration: https://zoom.us/webinar/register/WN_CfQFt0dQSnq5ifdnaSre7A

Dr. Carl Bradley
Webinar #2:
November 9, 2023
Registration: https://zoom.us/webinar/register/WN_3SvKPhEDSSWcYhnUnLrvsQ

Dr. Travis Legleiter
Webinar #3:
November 16, 2023
Registration: https://zoom.us/webinar/register/WN_SIOzGyibQiOk4A6pTRHGmw

Dr. Raul Villanueva
Webinar #4:
November 30, 2023
Registration: https://zoom.us/webinar/register/WN_AqvCh08TQGCAJXvKxqdwFA

Martin-Gatton College of Agriculture, Food and Environment University of Kentucky.

Hosted by Southern IPM Center

UPCOMING EVENTS

KATS Field Crop Pest Workshop

August 31, 2023

2023 Fall Crop Protection Webinar Series

November 2nd, 9th, 16th, & 30th

Kentucky Crop Health Conference

February 8, 2024

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