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Corn & Soybean Science Group Newsletter

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Cooperating Departments: Agricultural Economics, Biosystems and Agricultural Engineering, Entomology, Plant and Soil Sciences, Plant Pathology
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1. Potassium Deficiency Widespread

Greg Schwab, Lloyd Murdock, and John Grove, Plant and Soil Sciences

This year we have seen a higher number of corn and soybean fields exhibiting potassium deficiency symptoms. It is generally appears first on the lower leaves of corn. The leaf edges turn yellow from the tip and eventually lead to necrosis (tissue death) beginning with the leaf tip. In soybeans, you will also see chlorosis followed by necrosis of the leaf edge. On young soybean plants, it occurs on leaves lower in the canopy, but can appear on upper leaves if the plants are stressed later in the season.

The primary cause of K deficiency is low levels of available soil K. If you are doing a good job at routine soil testing, and applying the proper amount of fertilizer, soil test K should not be an issue. However, the high price of K fertilizer this spring might have caused many producers to apply less than the recommended rate. In a normal year, skimping on K fertilizer might not have been a problem, but this year has not been normal. The K deficiency we have observed this year is probably a result of several factors.

First, soil test levels might not be as high as you think. Keep in mind that the past two seasons produced exceptional yields in many parts of the state, and K removal increases as the yield increases. Therefore, it might have been a mistake to use soil test information that was more than a couple of years old. Also, keep in mind that fields testing adequate can have small areas that are deficient. In some cases one sample represents 80 or more acres and deficiencies are only present in parts of the field. Samples should not represent more than 20 acres and should represent similar soil types and past management histories.

A compounding factor is anything that restricts or slows root development. An example is soil compaction, which can cause K deficiency symptoms to appear first in wet areas of fields. Because of the rooting restriction, additional K fertilizer in these areas may not help. There is still time this season to assess soil compaction in areas showing K deficiency. If you determine that compaction is the culprit, you may want to consider deep tillage this fall (depending on the size of the area and severity), and you should definitely try to limit future compaction.

This year however, dry soils might also be a contributing culprit. Potassium is carried to the plant root with the soil water. Droughty soils are less able to supply K and compacted droughty soils will further limit root acquisition of K. A secondary factor under any form of conservation/shallow tillage soil management system is that much of the available K is in the surface few inches of soil. As K is not that mobile within the soil, K availability is further reduced when this surface layer dries. Surface waster loss can be minimized by maintaining as much soil coverage with crop residue as possible. Shallow surface tillage encourages degradation of crop resides and should be avoided. Additional rain will benefit both root growth and soil K mobility.

While these areas look bad now, it is impossible to determine how much (if any) yield reduction will be associated with midseason K deficiency. Nevertheless, such symptoms demonstrate the importance of routine soil testing, and give you an indication of problem fields where soil sampling this fall is essential.

2. Feast or Famine - How Much Rain is Enough?

Dennis B. Egli, Plant and Soil Sciences

After two "feast" years in Kentucky are we looking at a "famine" year in 2005? Lots of rain in 2003 and 2004 produced record or near-record corn and soybean yields, but this year is not off to a good start. Rainfall in May and June was below normal, but there may be some grounds for optimism after Hurricane Dennis brought good rains in mid-July. Dry periods that reduce yields often occur in Kentucky in spite of the fact that we have a humid climate with between 45 and 50 inches of rain in an average year[†]. With so much rain, it's surprising that the most common factor limiting yields is probably water.

How much rain do we need? More than you might think because crops use a lot of water – a field of corn or soybean with enough leaves to completely cover the soil surface will use 0.20 to 0.25 inches or more on a warm sunny day in July if plenty of water is available. That amounts to 1.00 inch (27,000 gallons per acre) every four or five days which totals roughly 15 to 25 inches for the crop (depending on weather, planting date and variety or hybrid maturity). The water moves into the roots and evaporates from the leaves (through pores called stomata). The rate of evaporation depends on the weather and the amount of water in the soil. Evaporation will be higher on warm sunny days with low relative humidity and the wind blowing and lower on cloudy humid days. Evaporation will decrease as the soil dries.

Crops use water every day, but it only rains occasionally, so the water stored in the soil must provide the buffer to match the intermittent water supply with the constant use. When most of the soil water is gone, plants are stressed and yields reduced. The amount of water stored in the soil is very important – crops growing in a soil that stores a lot of water are less likely to be stressed than those in soils with little storage. Many soils in Kentucky hold about 5 to 6 inches of water, which is less than the deep loess soils in Iowa and Illinois (one of the reasons why their yields are usually higher than ours), but more than shallow sandy soils in some southern states. Erosion on hillsides reduces soil depth and water holding capacity, while soils in bottom areas may be deeper and hold more water. The water holding capacity of a soil helps define its yield potential. Kentucky's soils are not the best in this respect, but we can be thankful that they are not the worst either.

We depend upon rain to keep water in the soil reservoir. When it rains is almost as important as how much it rains. Too much rain at one time will fill the soil to overflowing and the extra water will drain out the bottom and be lost as far as the crop is concerned. Too much time between rains and the soil reservoir will empty, the plants will be stressed and yield may be reduced. It will take 20 days to empty the soil if your soil holds 5 inches of water and the crop is using 0.25 inches per day. Unfortunately, the crop will probably be stressed before all of the water is used, so you don't have 20 days to get the next rain. In a perfect world we would get a nice rain (1 to 1.5 inches) every week, and crop yields would always be high. We are often far from this perfect world in Kentucky as we are seeing so far this year.

Average summer rainfall in Kentucky is probably not enough for maximum corn and soybean yields – but a lot depends on your soil and when it rains. High yields in Kentucky (2003 for example) are often associated with above-average summer rainfall (Table 1), but we can get good yields with near-average rainfall (e.g., 2004) if it occurs at the right time. Below-average rainfall is definitely bad news (e.g., 1999).

Rain is more valuable if it falls after the crop starts flowering. Water stress during flowering or seed filling causes larger yield losses than stress during vegetative growth. Low rainfall or a poor distribution before flowering may not reduce yield (but it's always a matter of degree, if it's too dry early, yield will be reduced), but near-perfect amounts and distribution after flowering are the key to high yields.

What is going to happen this summer? We are not off to a good start, but the remnants of the hurricanes have been a big help in July. No one knows for sure what the rest of the summer will bring – we can only hope that the rain will be enough for good yields. Check the University of Kentucky Agricultural Weather Center website (wwwagwx.ca.uky.edu/) to keep abreast of the rainfall and drought situation in Kentucky. This year, as always, corn and soybean yields will depend, in large part, upon when it rains, how much it rains and the water holding capacity of the soil. All we can do now is watch the Weather Channel and worry.

† Hill, Jerry. 2005. Kentucky Weather. The University Press of Kentucky. Lexington, KY. 198 pp.

Table 1. **Corn and soybean yields and rainfall in Western Kentucky, 1999 to 2004.**

Year	Soybean	Corn	Summer Rainfall (in.)[2]	Deviation from Average (in.)[3]
	Yield[1] (Bu/Acre)			
2004	43.2	155	11.57	+ 0.50
2003	43.3	140	13.52	+ 2.44
2002	33.0	106	7.39	- 3.69
2001	39.3	146	12.77	+ 1.70
2000	38.0	131	9.55	- 1.52
1999	21.4	111	9.55	- 1.52

[1] Average yields for western Kentucky (crop reporting districts 1 and 2).
[2] Total rainfall for June, July and August (western climatological district).
[3] Amount above (+) or below (-) the 20 year-average rainfall.

3. Drought Impact on Corn Yields

Chad Lee, Plant and Soil Sciences

The drought conditions faced earlier this growing season in Kentucky have certainly impacted the corn crop across the state. The real question is how much yield was lost due to the drought stress? The answer is: it varies, depending on crop growth stage at the time of drought stress, and duration of the drought.

Drought Stress at Pollination

Dry conditions will have the greatest impact on corn that was tassling and pollinating during the drought. Pollination requires the release of pollen from the tassels and capture of that pollen by the silks. The pollen then travels down each silk to fertilize the ovule. Dry weather will reduce pollination in a couple of ways. First, dry weather will delay silking and could result in pollen dropping before silks are exposed. Second, dry weather will cause the silks to dry out quicker and reduce the ability of the silks to capture and move pollen to the ovules. Nothing can be done to regain unfertilized ovules after pollination. Adequate moisture following poor pollination will help the fertilized ovules develop kernels, but yield losses are certain with poorly pollinated corn. Yield losses from a drought during pollination can be as high as 100% but more often the yield losses are much less.

A quick way to determine how many ovules are fertilized within about 10 days after pollination is with the ear shake method. With this method, use a sharp knife to cut through the husk, but not the cob, from the base of the ear to the tip. Gently remove the husk from the ear, taking care to not remove any silks. Once all husks are removed, gently shake the ear. The silks of fertilized ovules should fall off. If an ovule was not fertilized, then the silk will remain on the ear. Repeat this method several more times at different areas in the field to determine how well the field of corn pollinated.

By about two weeks after pollination, the corn should reach the blister stage and fertilized kernels should be visible. From the blister stage on, pollination success can be determined by examining the number of developing kernels on each ear.

Drought Stress Before Pollination

Corn undergoing drought stress prior to pollination still has many chances to regain most of the yield potential. Ear size, kernel rows and potential ovule numbers are starting to be determined by leaf stage V9 through V12. Drought stress can reduce these components. However, if adequate moisture occurs by pollination, the corn plant probably will recover and yield losses can be as little as 5 or 10%.

Drought Stress After Pollination

Fertilized ovules develop into kernels and the first stage of this development following pollination is the blister stage. Dry conditions during this stage could result in aborted kernels. Aborted kernels are shrunken and white compared to plump, developing kernels. Kernels at the tip of the ear are most susceptible to abortion.

The developing kernels will progress through the blister, dough and dent stages before reaching physiological maturity. The kernels are gaining weight during the dough and dent stages. Water is a key component to kernel weight gain. Dry weather during the dough and/or dent stages will reduce final kernel weight and reduce yields. Dry weather will reduce yields more during the dough stage than during the dent stage.

Yield Reductions

The rains that came with and followed Hurricane Dennis certainly have alleviated some of the water stress. Corn that survived the dry weather will recover, but specific yield loss levels are difficult to determine because the final yield depends so much on the amount and timing of stress. Water stress is never good but stress closer to pollination will result in the greatest yield losses, compared with water stress at other growth stages. Reductions in ear length, kernel row and/or kernel numbers can be offset by adequate moisture during seed fill, resulting in larger kernels. However, larger kernels cannot compensate fully for large losses in kernel number. Stress during seed fill will reduce seed size but typically will not reduce yields as much as stress occurring during pollination.

Resources:

Nielsen, R.L. 2002. A Fast & Accurate Pregnancy Test for Corn. Chat 'n Chew Cafe. URL: http://www.kingcorn.org/news/articles.02/Pregnancy_Test-0717.html

Ritchie, S.W., J.J. Hanway, G.O. Benson, and J.C. Herman. 1993. How a Corn Plant Develops. Special Report No. 48. Iowa State University Press. URL: http://maize.agron.iastate.edu/corngrows.html

4. Does Flower Abortion Limit Soybean Yield?

Dennis B. Egli, Department of Plant and Soil Sciences

Anyone watching a soybean crop closely will notice that many of the flowers abort – they do not develop into mature pods containing seeds. Agronomists believed for many years that flower and pod abortion limited yield. Some researchers looked for a miracle spray that would prevent abortion because surely that would increase yield.

It was easy to conclude that flower abortion was bad; after all, flowers produce the pods that contain the seeds we harvest. It just seems logical that more pods should equal higher yield, and this logic is borne out in the field where high yields are almost always associated with more pods and seeds on plants than when yields are low. The fallacy in this logic is that more pods and high yields do not necessarily mean less flower abortion. Plants in high yield environments grow faster and are larger with more nodes and more flowers; so, with more flowers, abortion levels do not have to go down to produce more pods. We have measured - by counting flowers and pods– 50% abortion when yield was 60 bushels per acre. Most would agree that 60 bushel is a pretty good yield, but half of the flowers failed to produce mature pods.

The soybean plant seems to be an eternal optimist; it always produces more flowers than it needs. Flower and pod abortion (most abortion seems to occur as flowers or small pods) is always a part of soybean production. Producing too many flowers is actually an advantage because it means that yield will not be limited by a lack of flowers, as can happen when corn is grown at low populations. There is no danger that a soybean plant will produce only enough flowers for a 40 bushel yield in an 80 bushel environment. Taking this viewpoint, flower abortion is not bad; it simply represents the plant's adjustment to its environment.

Drought during flowering and pod set can cause large reductions in yield and it may increase flower and pod abortion. But, in this case, flower and pod abortion is not really the problem; the problem is the drought that reduces photosynthesis and plant growth. Abortion is just a symptom. So don't worry about abortion – pray for rain or do a rain dance, depending on your inclination.

Would a magic spray that stopped abortion increase yield? If it worked there would be more pods on the plants, but most research indicates that there would be no more yield. Yield is determined by the variety and the environment – soil fertility, rainfall, temperature, sunlight, pests – which determines how fast the plants can grow. Simply adding more pods without changing the growth rate will probably not increase yield. The mostly likely result will be the same yield but smaller seeds.

It is true that high soybean yields require a lot of pods and seeds, but it is not true that flower and pod abortion must be reduced to get high yields. It is no secret that the key to high yield is good management and lots of rain after flowering – flower and pod abortion are just part of the process.

5. Kentucky Corn Production Contest

Chad Lee, Plant and Soil Sciences

The rules and forms for the 2005 Kentucky Extension Corn Production Contest are available online and at your County Extension Office. The online address for the contest rules is: http://www.uky.edu/Ag/GrainCrops/, which is also the University of Kentucky Extension Grain Crops home page. The rules for eligibility, classes, awards and harvesting are similar to the rules in previous contests. There will be three non-irrigated classes: 1) conventional or minimum till, 2) no-till and 3) white corn. There is one division for irrigated corn. Deadline for submission of entries is December 9, 2005. Contact your County Extension Agent for more information.

Chad D. Lee, Grain Crops Extension Specialist

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY
College of Agriculture

Cooperative Extension Service
University of Kentucky
Plant and Soil Sciences Department
Ag. Distribution Center
229 Stadium View Road
Lexington KY 40546-0229

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