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Outbreak of Corn Leaf Aphids was Extensive Affecting Kentucky & Neighbor States

Dr. Raul Villanueva, UK Extension Entomologist

Description of Aphid

Population outbreaks of the corn leaf aphid, *Rhopalosiphum maidis* (Hemiptera: Aphididae) have oc-curred for some years, but they have hardly caused significant damage to corn, sorghum, or pastures. This aphid species is a native insect of North America and present across the entire United States, Canada, and Mexico. This aphid feeds on corn, sorghum, small grains, and several grasses. In small grains, high populations can occur in fall or early spring; it is a vector of the barley yellow dwarf virus.

Corn leaf aphid coloration varies from bluish grey to green and can occur in very dense clusters in the whorl (Figure 1). Aphids in these clusters are composed of wingless specimens, but under heavy ag-gregation, winged individuals develop to move and colonize new fields.

Figure 1. Corn leaf aphids on the whorl of sorghum. (Photo by Raul Villanueva)

Past and Current Situation

On July 19, 2024, Dr. Lagos-Kutz (USDA-ARS, IL) noticed the presence of this aphid in suction traps and in fields in Illinois. I noticed the presence of winged corn leaf aphids landing on grasses and corn on July 24. During that week, communications with extension specialists from Ohio, Illinois, Michigan, Wisconsin, and Ontario, Canada indicated that the presence of corn leaf aphids occurred in those states and this outbreak seems to be a widespread event. However, extension specialists from Florida and Delaware did not observe this outbreak.

Surprisingly, Dr. Bailey (Tobacco specialist at UK-REC, Princeton) noticed that this species was landing on tobacco leaves the next day, July 25 (Figure 2). Similar observations were made by tobacco farmers in western Kentucky as reported by Dr. Bailey and Dr. Pearce in Lexington. Their presence on tobacco may be due to the large tobacco leaves, dark-green coloration of leaves, or other unknown reasons. Tobacco farmers seeing corn leaf aphids on tobacco, might be worried and want to treat their fields; however, this aphid will not thrive on tobacco or feed on these plants as tobacco is not a host, tobacco was not treated with insecticides for this pest species. However, there was a potential that winged aphids, also called foundress, that landed in corn, sorghum, or grasses may lay nymphs and outbreaks may occur in nearby corn, soybeans, or pastures.

Figure 2. Corn leaf aphids on a tobacco leaf. (Photo by Andy Bailey)

Scouting during theweek-end and Monday (July 29), showed that aphid numbers were reduced in corn (2 to 3 winged aphids were observed). Most aphids may have been washed away, and few dead winged aphids remained on leaves after rains on Friday and Saturday (27th and 28th of July).

After this event, corn leaf aphids might be affected by natural enemies or entomopathogens that stop further growth of populations.

Management

Corn leaf aphid rarely causes economic losses, as they are controlled by several natural enemies (lady beetles, syrphid fly larvae, parasitoids, entomopathogens, lacewing adults and larvae) or environmental conditions, such as heavy rains. However, county Extension agents, scouting personnel, farmers, and consultants need to be aware of the presence of this aphid and check for its abundance. Insecticides are usually not necessary unless huge numbers are observed. If insecticides are necessary, consult with the county Extension agent.

As mentioned above, observations from July 26 to July 29 showed high mortalities of aphids in corn and sorghum in Princeton, although this was a localized event and personal observation; this might have occurred in Kentucky and adjacent states as many other extension entomologist colleagues did not report any outbreaks or recommend sprays to control this aphid. Several factors may have contributed to this mortality including lady bugs and *Orius* spp., observed in fields, rains that occurred since the outbreak, and an unknown entomopathogen that may cause this mortality (Figure 3).

Figure 3. Dead winged and wingless corn leaf aphids on a corn leaf. (Photo by Raul Villanueva)

More information:

[Corn Leaf Aphid](), University of Kentucky

[Corn Leaf Aphid on Field Corn](), PennState Extension

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Multiple Corn Diseases Confirmed in Kentucky

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In western Kentucky, corn is rapidly approaching maturity, and plans for harvest are underway. High-value late-planted corn and re-planted corn may still require some scouting and management in parts of the state, particularly central Kentucky. Multiple foliar diseases have been observed over the past month. Some of these diseases are familiar and annually important diseases like gray leaf spot and southern rust, but newer diseases are also present in several areas of the state.

Tar spot on corn, caused by *Phyllachora maydis,* has been confirmed by the University of Kentucky Plant Disease Diagnostic Laboratory (PDDL) from samples collected in Hardin, Henderson, Meade and Union counties (Figure 1). Crop scouts will likely continue to find tar spot as the season progresses, but the impact of the disease in each field is still to be determined.

Figure 1. Tar spot on corn (photo by Kiersten Wise)

In areas where the disease is confirmed, infections likely occurred a month or so ago. The fungus that causes tar spot has a very long latent period (the time between infection and symptom expression) under optimal conditions, but in our Kentucky environment, that exact time period is unknown. Recent research has suggested that it could be 19-41 days between infection and when symptoms are observed. This could explain why we are finding it now, even though conditions through July were mostly hot and humid.

The Crop Protection Network has recently put together a fungicide decision table (Table 1) that shows the benefit of spraying fungicide for tar spot based on when symptoms are first observed. This is similar to our fungicide decision table for southern rust and will aid in making decisions of if/ when to spray for tar spot based on disease detection. Remember, fields that do not have tar spot do not need a fungicide application to manage tar spot.

Research has shown that a single fungicide application at VT/R1 is effective at preventing yield loss from tar spot and is also the best chance of seeing a positive ROI. If fields have already been sprayed for southern rust or other diseases, the decision to make a second application should be made on a case-by-case basis.

Table 1. Possible benefits (by growth stage) from applying fungicides to protect against tar spot in corn.

Crop Stage When Tar Spot is First Detected	Possible Benefit From Spraying	Comment
Late Vegetative	Rarely, consult extension specialists before spraying	Scout fields and monitor disease progress; may need a second spray
VT/R1 (Tasseling/Silking)	Yes	May need a second spray
R2 (blister)	Yes	Less likely to need a second spray
R3 (milk)	Yes	No second spray needed
R4 (dough)	Maybe, with severe disease pressure	No second spray needed
R5 (dent)	No	No second spray needed
R6 (black layer)	No	

In addition to tar spot, we are also seeing another new disease on corn in Kentucky (Figure 2). This Crop Protection Network article describes the symptoms of the new disease. This disease is not yet named but has been present in the state since 2020. It is easily confused with other foliar diseases like Curvularia leaf spot. There has not been confirmed yield loss associated with this disease yet, but like tar spot, it is important to scout and identify the disease through the PDDL so we can learn about its spread and impact in Kentucky.

Figure 2. New disease on corn in Kentucky (photo by Kiersten Wise)

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Time to Consider a Corn Stalk Nitrate Test

Dr. John Grove, UK Extension Soil Specialist
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The current corn crop is starting to mature. And given prospects for both corn grain and fertilizer N prices, you may wonder whether your current corn nitrogen (N) program is working. You may have some fields where you tried some alternative N management ideas, but this year's weather might confound the grain yield comparison. The corn stalk nitrate test (CSNT) is another way of checking whether the crop generally experienced adequate N availability.

The CSNT is based on the observation that corn depletes stalk N levels when under N stress, maintains stalk N when N nutrition is adequate, and raises stalk N concentrations when N availability is greater than needed. The CSNT is useful when a corn grower wants to understand whether their 'standard' corn N management program is working well with a new hybrid that is being tried for the first time. In farm operations where the corn fields experienced a wide range of planting dates and seasonal weather, the CSNT can assist producer understanding N management adequacy across those fields.

Taking the Stalk Sample

The CSNT is a lab measurement of the nitrate-N concentration in a sample of stalk segments that were taken just after corn physiological maturity. Starting 6 inches above the soil and ending 14 inches above the soil, to give an 8 inch segment length, you need 15 stalk segments to well represent a uniform field area. A representative sample is important. CSNT results can exhibit considerable spatial variability (Maresma et al., 2019). Cooperative Extension publication AGR-180 (https://publications.ca.uky.edu/agr-180) describes stalk sampling and you can see the sampling process in this video (https://youtu.be/N7wBn3dIG-w). Finally, cut the 8-inch segments into 2-inch segments (Figure 1) and put into a paper bag before sending your sample to the lab.

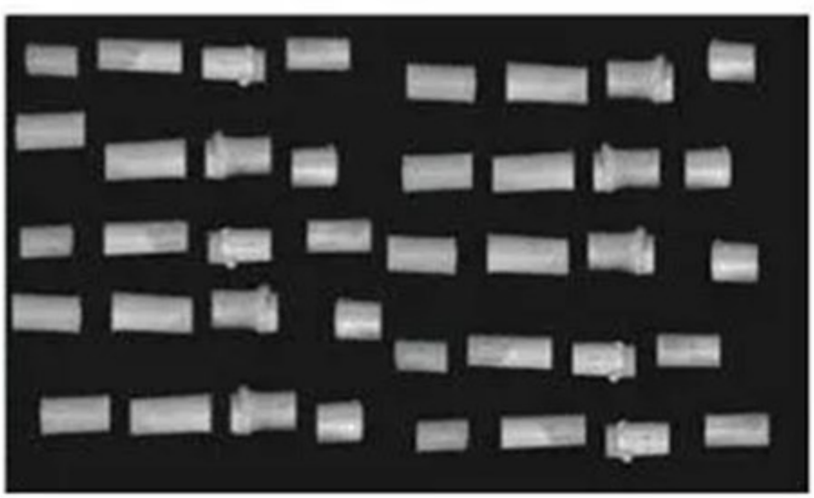

Figure 1. From Beegle and Rotz (2009).

Interpreting the CSNT Lab Result

The relationship between relative corn yield and the CSNT test result is shown in Figure 2. Relative yield was used because of the wide range in maximum yield values observed in the research. The response pattern shown in Figure 2 was the same as that found in Kentucky (Murdock and Schwab, 2004). There is a wide range in both relative corn yield and CSNT values. Note that the relationship breaks quite sharply as the CSNT value decreases – yield falls very dramatically at the lower CSNT values. This 'drop off' causes the range in CSNT values associated with each interpretation 'level' to be narrow at lower CSNT values and wide at higher CSNT values.

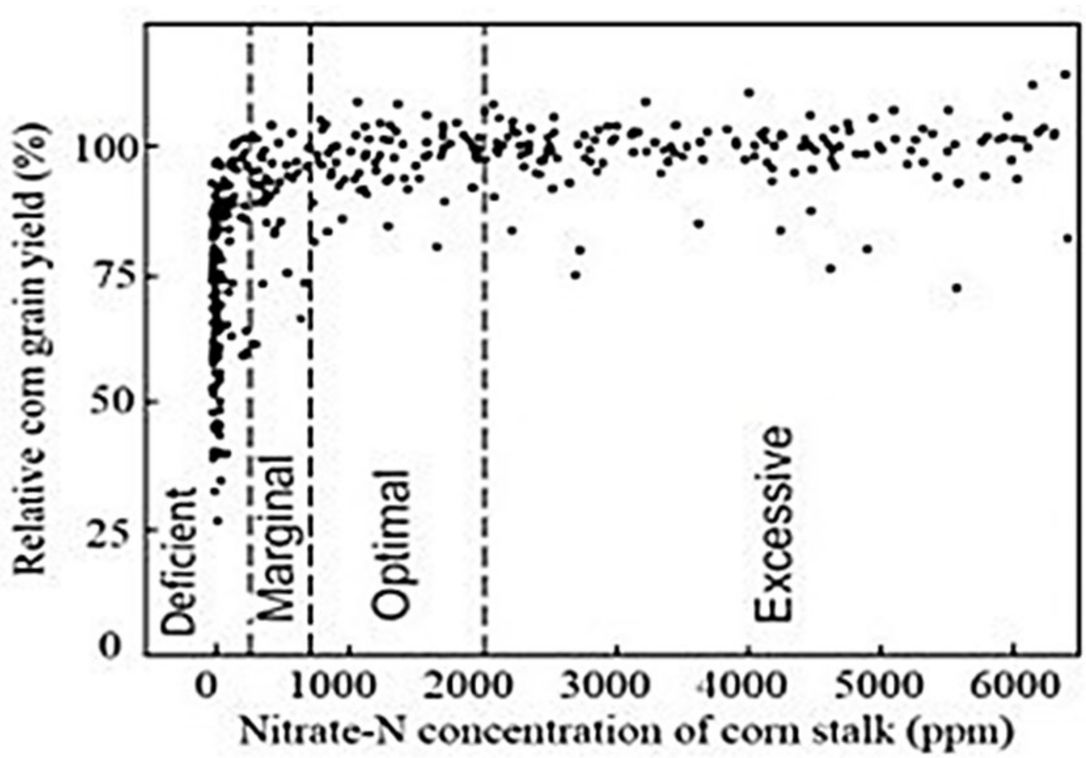

Figure 2. Relative corn yield versus CSNT value (adapted from Tao and Pan, 2019; Sawyer and Mallarino, 2018). Relative yield = 100 x (observed plot yield/average site yield across all plots where additional N did not increase yield).

The interpretation categories, based on UK research, are given below (Table 1). Growers can benefit from this information but should be mindful of interpretive limitations. First, the test does not indicate the amount of N over or under applied if the result is 'excessive' or 'low/deficient', respectively. Second, the test result is affected by seasonal weather – is higher in dry years and lower in wet years. Over time, the most economical N rate will result in lower CSNT values at the end of a wet season and higher CSNT values after a dry year. Third, early season N stress may limit corn yield in a way that is not indicated by a low CSNT value, and especially if N is applied later – too late to alleviate that early N stress. Fourth, 'optimal' CSNT values for irrigated corn may need to start at values higher than 700 ppm N (≈ 1000 ppm N) due to greater crop N demand and greater potential for N loss from the soil (Tao and Pan, 2019).

Table 1. Interpretation of CSNT lab results (adapted from Murdock and Schwab, 2004).

Plant Nitrogen Status	CSNT Nitrate-N (ppm N)	Interpretation
Low/Deficient	Less than 250	High probability that N is deficient. Visual signs of N deficiency are usually apparent.
Marginal	250-700	N availability is close to "optimal" but could result in lower yields that will cause economic losses.
Optimal	700-2000	High probability that yields are not limited by N availability. Visual signs of N deficiency on lower leaves are often observed in this range.
Excessive	More than 2000	High probability that N is greater than needed for maximum yields.

The ability of any N management scheme (rate, timing, placement and source) to meet corn's N need depends upon both field soil and seasonal weather conditions (and soil by weather interactions on N availability). Don't base next year's N management on a single year's CSNT values. CSNT data collected over several years, combined with seasonal weather information and fertilizer, manure, prior crop and tillage management histories, will help better inform future N management decisions.

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Temperature and Water Use by Crops

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Summer is when farmers stress about the weather – when will it rain, when will it cool off? This obsession is not surprising - rain is the key to high crop yields (unless you can irrigate) and high temperatures increase water use, making rain less effective.

Crops use enormous amounts of water – a well-watered corn or soybean crop can use 0.25 inches (6788 gallons per acre) or more in a day. That is an inch every 4 days that must be supplied by rain, by irrigation or by water stored in the soil to avoid stress. High temperatures make this challenging situation worse.

Let's review the processes that control water use by crops to help us understand the effect of temperature. Transpiration is the movement of water vapor out of leaves through stomata, which are tiny pores in the leaf. Transpiration accounts for most of the water used by crops. Water is also lost by evaporation from the soil, which is usually less than transpiration, especially when the soil surface is dry or when crop leaves completely cover the soil. The combined loss is called evapotranspiration (ET).

Transpiration occurs when water in the leaf evaporates, and the vapor moves out of the leaf by diffusion. The rate of diffusion depends upon the amount of water vapor in the air inside the leaf vs. the amount in the air surrounding the leaf. Diffusion occurs only when there is a gradient in water vapor concentration between the air inside the leaf and the outside air.

Air inside the leaf is saturated with water vapor, but the atmosphere is usually not saturated (relative humidity < 100%) providing the gradient that drives transpiration. The larger the gradient, the higher the rate of transpiration. Transpiration will be higher if the air is dry (low relative humidity - larger gradient) than if the relative humidity is high (smaller gradient).

Temperature affects transpiration by changing the gradient from inside the leaf to the atmosphere. Increasing temperature increases the gradient and transpiration. The same logic applies to evaporation from the soil.

The temperature effect is significant – increasing the temperature from 68 to 86°F increases the gradient by 1.8 times or more depending on changes in relative humidity of the air surrounding the leaf. A further increase in temperature to 104°F increases the gradient by 1.7 to 2.4 times over the gradient at 86°F. Increasing the temperature from 86°F, a fairly normal summer temperature, to 104°F would roughly double the gradient and significantly increase the rate of transpiration if plenty of water is available to the crop.

Wind also affects transpiration by influencing the water vapor gradient between the leaf and the air. In still air, the water vapor that diffuses out of the leaf increases the water vapor content of the air next to the leaf which reduces the gradient and reduces transpiration. Wind sweeps the water vapor away from the leaf, maintaining the gradient and the rate of transpiration.

It takes a lot of energy to evaporate water (585 calories per g) – which is why transpiration is so effective in cooling the plant. When a lack of water limits ET, some of the energy that would have been used to evaporate water heats the plant and the air. Air and plant temperatures are usually higher during a drought. Plants in a desert can actually be cooled below air temperature by high transpiration rates resulting from the dry air and the large gradient.

Climate change and the resulting higher temperatures will increase water use by crops which will, in turn, cause a more rapid depletion of the soil moisture reservoir causing stress. High temperatures increase ET, deplete the soil water reservoir faster, and the lack of water makes it hotter. Isn't that a kick in the head?

The size of the soil moisture reservoir plays a critical role in matching the intermittent supply of water (rain + irrigation) with the relentless daily demand from ET. It is not surprising that soils that store large amounts of water often produce the highest yields. The increasing temperatures associated with climate change will increase ET making the size of the soil moisture reservoir even more important.

"Human vanity can best be served by a reminder that, whatever his accomplishments , his sophistication, man owes his very existence to a six-inch layer of topsoil – and the fact that it rains." (Richard L. Evans, 1906 – 1971, author and radio personality).

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Personal Observations of an Entomologist in Brazil on the Use of Genetically Modified Soybeans

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In countries like Brazil, Argentina and Uruguay several genetically engineered (modified - GMO) soybean cultivars are commercially available, providing tolerance to one or more herbicides and protection against caterpillars. In this article, we will share basic information and personal experience on how these technologies work and the recommended measures to avoid the loss of efficacy of these technologies in the long term. This information is based on the experience of the author acquired during years of work in the Cerrado region in Brazil. The expansion of soybean crops to the Brazilian Cerrado occurred mainly from the 80's and today is the region with the highest production and productivity of the crop in the country.

Figure 1: Cerrado Region in Brazil (image from https://matoecia.blogspot.com). More than 772,204 square miles (23% of Brazilian territory) where most of the 114 million acres of cultivated soybeans are planted in Brazil.

The first available biotechnology providing protection against caterpillars was the "**Intacta**" technology, which contains *Bacillus thuringiensis* (*Bt*) genes that expresses the crystal protein Cry1Ac. The Cry1Ac is a protein resulted from the bacterium sporulation process and it is known to display insecticidal activity against specific groups of insects.

The Cry proteins have multi-step toxicity process, which demands ingestion, activation at specific pH and binding to specific receptors, so the crystals are toxic to very specific groups of insects.

The soybean cultivars expressing the *Bt* protein Cry1Ac are known as the first generation of "*Bt* soybean" (Intacta RR2 Pro® - IPRO) in Brazil and are commercially available there since 2013. The Intacta technology provides protection to the soybean plants against velvetbean caterpillar (*Anticarsia* *gemmatalis*), soybean looper (*Chrysodeixis includes*), bean shoot moth (*Crocidosema aporema*) and the tobacco budworm (*Chloridea virescens*). An evolution of the Intacta technology was presented in 2022, by the addition of genes to express two more Bt proteins, the Cry1A.105 and Cry2Ab2, besides the Cry1Ac already present in Intacta Technology. This evolution of Intacta was called "**Intacta 2 Xtend (I2X)**", which provides protection against Old World Bollworm (*Helicoverpa armigera*), black armyworm (*Spodoptera cosmioides*), besides all other species managed with the Intacta/Cry1Ac.

In 2021, another technology called "**Conkesta E3®**" was also launched in Brazil. The soybean cultivars with the Conkesta Technology express genes for Cry1Ac and Cry1F proteins, which provide protection against velvetbean caterpillar (*Anticarsia gemmatalis*), soybean looper (*Chrysodeixis includes*), tobacco budworm (*Chloridea virescens*), lesser cornstalk borer (*Elasmopalpus lignosellus*) and the old world bollworm (*Helicoverpa armigera*).

All these technologies are helpful, effective and provide more flexibility for the management of weeds and pests and require less use of pesticides. However, a plant expressing a toxic protein to caterpillars means that pests are exposed to the toxin 24 hours per day during the whole cycle of the crop, which implies a high selection pressure for resistance. In order to delay the evolution of resistance by the pests in GMO crops it is extremely important to keep refuge areas, which are a percentage of the area that should be planted with non-GMO crops; in Soybeans in Brazil this is at least 20%. The refuge allows the maintenance of susceptible (nonresistant) individuals in the area. When an eventual resistant individual breeds to a susceptible one, the next generation (heterozygous) will also be susceptible to the *Bt* crystal proteins (phenotypically). If the whole area is planted with a *Bt* soybean, the eventual resistant individuals that survive in the field will mate between themselves and have a whole resistant offspring with thousands of individuals able to grow and multiply in the area. In a few generations, the process results in a resistant population unaffected by the *Bt* crystals proteins anymore.

Figure 2: Soybean fields showing different stages of development in the Cerrado Region in Brazil. (Photo by Felipe Batista, Post Doc at UK-REC, Princeton)

Although these technologies are not available in soybeans in the U. S., they are in corn, with similar conditions for selection of resistant populations. Furthermore, knowledge and preventive measures may be helpful in case the *Bt* soybeans are approved and available in the U. S. in the future. It is extremely important to keep in mind the need for a conscious use of *Bt* crops, in order to extend the effectiveness of these technologies over time. The refuge area is the basis of resistance management on Bt crops and both companies and farmers should work together to ensure its implementation. Companies should invest in the education, awareness of refuge areas to farmers, extensionists and community. Great emphasis should be placed on the importance of the refuge areas and farmers should follow the recommended measures to avoid selection of resistant populations. Losing the efficacy of such technologies means the farmers lose one tool for pest management and more sprayings are needed, which compromises the profit of farmers and promotes more contamination of the environment and people. It takes a lot of time and monetary investment to develop and register new technologies that can lose effectiveness after a few years if not used properly.

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