Crop Solutions that Work

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August 2016

Your August 2016 issue

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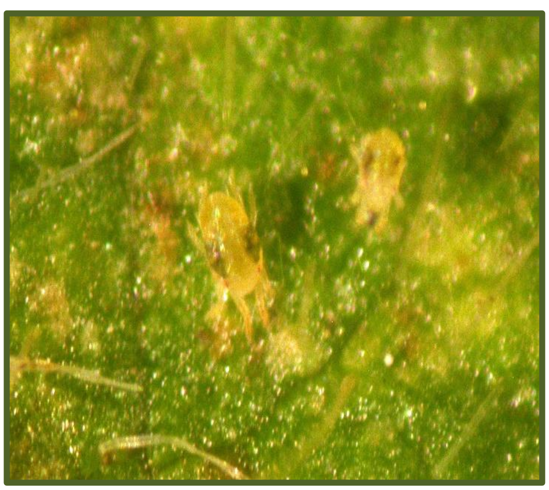
Sap-feeding pests may benefit from hot water

During hot, dry weather, the composition of plant sap often changes. Amino acid concentration may go up, along with sugars, as water content goes down. This can be of benefit to certain sap-feeding pests in field crops. Increased amino acid content of plant sap is especially important for most of these pests. The pests which most often benefit under these conditions include mites, aphids, leafhoppers, thrips and whiteflies.

Hot, dry weather also reduces the activity of certain beneficial fungi that attack some of the pests mentioned above. To a lesser degree, hot, dry weather may also reduce the reproductive rate of certain beneficial insects that feed on these pests. The net result of all this is that some pests benefit greatly from hot, dry weather.

We have received reports of two-spotted spider mites being found in soybeans in some dry areas. Spider mites have phenomenal reproductive potential so this is a pest that we should watch for over the next few weeks. Although spider mites are not as common in corn, outbreaks do occur. This is particularly true near, and west of, the Missouri River.



Two-spotted spider mites on soybean leaf

It is expected that recent hot weather could also result in increasing populations of potato leafhoppers in alfalfa and dry beans. The presence of nymphs in sweep net samples is a good indicator that leafhopper reproduction is taking place and that rapid population increases could occur.

Aphids are another pest that could benefit from hot, dry weather. We need to watch for increasing populations of soybean aphids in soybeans, as well as various aphids in corn. The corn aphid most likely to become a problem in hot, dry weather is the corn leaf aphid. For most effective control, corn leaf aphids need to be scouted and detected during late whorl stage corn growth.

Thrips are an insect that is generally not regarded as being of great pest significance. These insects do benefit from hot, dry weather and may be of more importance than we had earlier considered. There has also been some recent evidence that thrips may transmit soybean diseases, like soybean vein necrosis virus and tobacco streak virus.

Whiteflies are another insect that is not widely regarded as a serious pest in field crops. However, in some years we see an unusually high number of greenhouse whiteflies in soybeans. Like the other pests mentioned here, whiteflies are sap feeders. There has also been speculation that whiteflies may transmit virus diseases.

Spider mite damage in soybeans

Whitefly adults and soybean aphid on soybean leaf

Soybean defoliation

Soybean defoliation can be observed throughout the growing season from emergence to harvest. A wide array of insects feed on soybean foliage, including japanese beetle, bean leaf beetle, grasshoppers, green cloverworm, miscellaneous lepidopteran caterpillars, longhorn weevils, and others. Often more than one species is present at the same time and feeding in different parts of the canopy, and in this situation our scouting focus shifts to look at total per cent defoliation, rather than individual species-specific scouting thresholds.

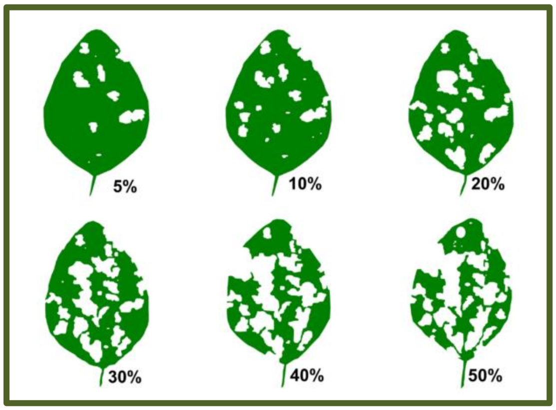
Defoliation can cause yield losses and should not be ignored in the management system. The key yield determinant is light interception in the canopy, with yield losses occurring when light interception falls below 90 per cent. Other defoliation yield factors include the growth stage of the bean, the environmental growing conditions, and the overall size of the leaf canopy. Soybeans in vegetative growth stages are very resilient and can tolerate extensive defoliation up to 30 per cent without economic yield loss. Soybeans in reproductive growth stages, particularly R4 pod formation, are considerably more sensitive to defoliation, with the threshold dropping to 20 per cent.

Japanese beetles on soybean – provided by Tim Laatsch
Reference: Managing Soybean Defoliators (University of Nebraska-Lincoln)
http://extensionpublications.unl.edu/assets/pdf/g2259.pdf

Soybeans with larger canopies and growing under ideal conditions can tolerate higher levels of defoliation than beans with smaller canopies or beans under stress conditions. These additional factors may skew the thresholds as much as 5-10 per cent up or down, so the crop specialist must rely on good judgment to make the final call.

Defoliation is visually alarming and is often over-estimated, so it's important to be systematic in your approach to eliminate emotion from the decision. When scouting a field location, sample ten plants and collect trifoliate leaves from the upper, middle, and lower canopy. Evaluate these leaves against the defoliation guide in Figure 1 and determine average per cent defoliation. Evaluate additional field locations in the same fashion to get a representation of the whole field.

A wide array of broad-spectrum foliar fungicides are labeled for control of soybean defoliation insects. Reference the FS Crop Protection Handbook or Chembook application for guidelines on products and rates for control of specific insects. If using a product containing a contact insecticide, be sure to pick a nozzle that ensures good coverage, spray at higher volumes, and use a surfactant. Spraying insecticides at high temperature can reduce efficacy due to evaporation of droplets before they reach the canopy. Adjustments will have to be made to increase droplet size to compensate for extreme temperatures. Always be conscious of pollinator best management practices and time your applications accordingly. Always read and follow label directions.



(Figure 1): Soybean defoliation guide. (University of Nebraska-Lincoln)

Corn pollination summary

The tassel is usually fully emerged and open before any pollen is shed. The length of pollen shed for each plant varies, but is usually five to eight days with the peak production coming about the third day. It is estimated that each tassel will produce between two million and 25 million pollen grains. (Unfortunately, no one has counted them to confirm this.) Pollen shed usually begins at the center of the tassel and proceeds up, down, and outward on the branches.

Silks are the female part of the flowers. Every potential kernel (ovule) on an ear develops its own silk that must be pollinated in order for the ovary to be fertilized and develop into a kernel. Typically, up to 1000 ovules form per ear, even though we typically harvest only 400 to 600 actual kernels per ear. (Bob Nielsen, Purdue University)

Silking is delayed more than tasseling when the corn plant is under moisture stress. Literature often indicates that first silks typically will emerge about three days after pollen shed begins but many hybrids now show silks much earlier, sometimes before pollen shed starts. Under extreme drought conditions, the silks grow slowly and may not emerge from the husks before the pollen is shed. Emergence of silks after pollen has been shed is commonly referred to as "missing the nick" and results in poor to complete lack of kernel set.

Silks emerge from kernels at the tip of the ear last and are least likely to be fertilized if the plant is under stress. Kernels at the tip may abort following fertilization if the plant becomes stressed during grain fill. High daily temperatures, especially with low humidity, are often responsible for this, although an extended period of cloudy weather may also cause problems. Even warm nighttime temperatures can inhibit kernel set and fill.

Silks will take two to seven days to emerge. With adequate moisture, the silks will grow one to one and a half inches each day and continue to grow until fertilized. The ability of the silk to receive pollen generally exists up to ten days after silk emergence. After ten days, the ability of the silk to receive pollen decreases rapidly. Silk elongation continues until pollination is successful, although elongation eventually ceases as unfertilized silks senesce.

Scout fields for silk clipping. Silk clipping by insects not only removes viable silk tissue, but also injures a certain length of the remaining silk. Generally, silks should extend at least 1/2 inch beyond the husk to ensure that a sufficient length of uninjured silk tissue is exposed to capture viable pollen. Fields that pollinate relatively late are often targets of large numbers of silk-feeding insects.

Pollen shed is not a continuous process. The release of pollen will stop when the tassel is either too wet or too dry and starts again when moisture and temperature conditions are favourable. Peak pollen shed usually occurs between 9:00 and 11:00 in the morning, but there may be a second daily surge of pollen shed. While individual plants may shed pollen for a few days, field-wide pollen shed often lasts for up to about two weeks.

Pollen is not likely to be washed off of silks during a rain. Pollen that is shed prior to a rain usually attaches itself to the silks so quickly that it is not likely to be washed off.

Pollen grain germination occurs within minutes after a pollen grain lands on a receptive silk. A pollen tube, containing the male genetic material, develops and grows inside the silk and fertilizes the ovary within 24 hours. Pollen grains can land and germinate anywhere along the length of an exposed silk. Under hot, dry conditions, the silks dry rapidly and may not contain enough moisture to support pollen grain germination or pollen tube growth. (Bob Nielsen, Purdue University)

Pollen can dry up within a few minutes following release from anthers when hot, dry conditions occur, but pollen shed usually occurs when conditions are more favourable. Viable pollen can sometimes travel ½ mile or more under favourable conditions. However, tests show that most pollen falls within the field where it originates, within about 60 feet from where it is shed.

Moisture stress during any period of corn development can impact yield potential. Stress during early vegetative development has less effect on yield than similar stress during the pollination period.

The table below lists the estimated loss in yield potential at various stages when corn plants show severe wilting for four consecutive days.

Wilting at tassel emergence……………………yield reduction of 10 to 25 per cent
Wilting at silk emergence and pollen shed…...yield reduction of 40 to 50 per cent
Wilting at the blister stage………………………yield reduction of 30 to 40 per cent
Wilting at the dough stage……………………...yield reduction of 20 to 30 per cent

Check pollination in the field. Each potential kernel has a corresponding silk. About two days after pollination, the silk will detach from the developing kernel. Carefully remove the husks and gently shake the developing ear. Silks that remain attached indicate that those embryos have not been pollinated.

Seven days of silk growth

Anthurs (pollen bearing structures) on corn tassel

Soybean midseason growth facts

Row spacing – Narrow row spacing is preferable for late-planted or replanted soybeans. The closer spacing of these shorter plants in narrow rows allows for better utilization of sunlight and also helps promote higher positioning of the lowest seed-bearing node.

Plant population – With normal planting dates, research has shown that soybean populations as low as 90,000 plants per acre can provide near maximum yields. However, with late planting, populations should be increased 10-20 per cent above average for each additional week of planting delay. This helps ensure that there is an adequate number of flowering nodes available to produce a respectable yield.

Flowering and day length – Flowering in soybeans is triggered by daily hours of darkness. Since nights (at the time of the summer solstice) actually are longer as you go south, moving a variety south from its adapted zone may cause it to bloom earlier. This is why we recommend staying close to adapted maturities, even with late planting or double-crop soybean production. In many cases, with late planting recommendations, a slightly fuller season variety is suggested.

When flowering starts – Flowering will normally begin at about the V6 to V10 growth stage but may begin as early as V4. The first blooms are usually noted at the third to sixth stem node.

Stress effects on flowering – A period of stress may cause flowering of indeterminate and semi-determinate soybean varieties to slow or stop. On occasion, we have seen these soybeans renew both vegetative and reproductive growth with the return of favourable conditions. Although this demonstrates the adaptability of some of our modern varieties, the presence of both dry beans and “butter beans” on the same plant makes for difficult harvest and often results in lower grain quality.

Duration of bloom production – With most soybean varieties adapted to Midwest growing conditions, blooming (that results in viable pods) can occur over 30+ days.

Numbers of flowers versus yield – Some soybean varieties are known to produce enough flowers to theoretically produce 250 bushel yields. While this unrealized yield potential is often a concern of soybean breeders, most recognize that this is simply a useful trait that helps the soybean tolerate periods of stress while maintaining a base reproductive potential.

Most vulnerable growth stage for defoliation – At the R2 (full bloom) growth stage, insect damage or a hailstorm can be devastating. Fifty per cent defoliation at this stage can reduce yields by sixty per cent.

Seed size is related to planting date, according to Purdue University research. Larger seed is produced with soybeans planted in May and early June. The number of stem nodes is maximized with early planting, and decreases significantly after early May.

Soybean pod at the R5 growth stage

Temperature and seed set – Soybean seed set is affected by temperature. Seed set is most consistent when warm nights (21°C) are followed by warm days (at least 27°C). Night temperatures of 15°C or less and daytime temperatures of 35°C or above may adversely affect seed set. The ideal temperature for seed development is 30°C.

Soybean bloom

Maximum above-ground growth – The growth period midway between R5 and R6 is important. This is when the soybean plant reaches its maximum height, has developed the maximum leaf area, has the most stem nodes, and peaks in nitrogen fixation (followed by a rapid decrease in N-fixation). Root growth is complete by about R6 to R7.

Soybean nutrient uptake – Soybeans can respond to a favourable growing environment relatively late into the growing season. They take up most of their needed primary nutrients after flower initiation. The following information is interpreted from the Iowa State University publication "How a Soybean Plant Develops."

This is a summary of how much nitrogen and potassium are assimilated by the soybean plant during the 'R' Stages:

Flowering………10 to 15 per cent of total needs.
Pod set…………30 to 35 per cent of total needs.
Seed set………..40 to 45 per cent of total needs.

Implications of early corn wilting

Although a recent storm pattern has doused many areas, localized hot, dry weather has resulted in some cornfields experiencing daytime leaf rolling or wilting. As long as the corn returns to its normal appearance when air temperatures go down in the evening, there should be little lasting harm. This does suggest, however, that a review may be in order of what to look for when evaluating the impact of hot, dry weather on the corn crop.

Some of the wilted corn we have seen recently is in fields that were wet earlier. Wet soils early in the season promote shallow rooting. The sudden shift to hot, dry weather is now pulling more moisture from the leaves and stalk than the shallow roots can resupply.

Temporary, or transient, leaf rolling in corn does not necessarily result in yield loss, but this wilting is still a warning of a crop experiencing a moisture deficit. Many agronomists will point out that the rolling of the corn leaf helps reduce further loss of moisture from leaves, and this is true. However, unrelieved leaf rolling or wilting takes a toll over time. At what point does the wilting become harmful, and how can we evaluate these field situations to learn from them and be ready to advise on suitable management practices?

In order of severity, the general levels of drought injury are as follows:

LIGHT – Corn wilts in the afternoon but returns to normal appearance overnight.

MODERATE – Corn wilting starts in the morning, continues through the day, but returns to normal appearance overnight.

SEVERE – Corn is continuously wilted around the clock.

Severe drought stress in corn

Whether corn wilts just in the heat of the day, or over an extended time period, here are some things to check:

Soil moisture and rainfall patterns – Recent rainfall has been hit-or-miss. Some fields have received too much rain, while others have received too little. Corn will use about 0.25 inches of water per day during vegetative growth, and about 0.35 inches of water per day during reproductive growth. Use a soil probe or spade to evaluate moisture in the top soil profile. Note: Ironically, low soil oxygen in wet or compacted soils will prevent corn from taking up both water and nutrients through the roots, resulting in wilting and leaf rolling.

Air temperature – Corn is capable of cooling itself and withstanding high air temperatures (up to about 44°C) as long as soil moisture is adequate and the corn is healthy. Remember that corn growth rate slows at temperatures above 30 degrees Celsius. Also, relatively cool nights allow the corn to convert products of photosynthesis into stored carbohydrates, while relatively warm nights result in loss of carbon as CO_2 with excessive nighttime respiration.

Relative humidity – evaporation and transpiration is fastest at lower humidity levels and provides an efficient cooling mechanism for corn. However, where "evapotranspiration" removes water faster than the roots can resupply it, wilting will occur.

Corn growth stage – Stress, at any time, can impact corn physiological processes building up to the harvest yield. The time period from about two weeks before pollination to two weeks following pollination is critical. Yield losses from severe moisture deficits during this time period can range from three to eight per cent, with highest potential losses during silking and pollen shed. Note: severe stress can delay silk emergence and growth, resulting in poor filling of ears.

Corn root growth and apparent root growth restrictions – A rapid shift to hot weather can catch corn with a small or shallow root system that cannot replenish needed moisture fast enough to compensate for evaporative losses, and therefore, leaf rolling or wilting results. Given a chance, corn will often compensate with new root growth. Soil compaction, insect feeding, and diseases can reduce root growth and efficiency. Use the spade to compare root growth from problem areas to root growth from good areas of the field.

Soil condition and drainage – A healthy soil should permit roots to grow and expand in the soil profile, where these roots can access moisture and nutrients. Soils should be well drained, but not excessively well drained. Soils having compaction layers, intermittent ponding, hilltops or slopes with excessive surface drainage, are all at risk for eventual problems from heat and drought. Use the soil probe or spade to check soil texture, drainage, and aeration.

Soil nutrient levels – Check the soil test for the wilted corn field. Adequate nutrient levels improve water use efficiency in corn. In particular, adequate potassium levels are often linked with efficient water use and stomata function in corn leaves.

Weeds, pests and diseases active in the field – Weeds can compete for soil moisture and nutrients. Pests and diseases may affect roots or the vascular system of the corn plant. Check carefully to see if weeds, pests, or diseases are contributing to corn wilting and leaf rolling.

Corn genetic factors – Corn hybrid genetics can have a significant influence on the ability of the plant to tolerate hot, dry weather. In fact, many seedcorn suppliers are selecting and breeding for hybrid lines that are drought tolerant. Normal corn hybrids vary greatly in drought tolerance. This is not necessarily good or bad, but the hybrid genetics should be considered when evaluating wilted corn.

For more information or discussion on any of the topics in this newsletter, please contact your local County Farm Centre FS crop specialist.

County Farm Centre