Integrated Pest & Crop Management

SDS and Other Late Season Soybean Diseases

by Laura Sweets

After a challenging start to the season with numerous reports of damping-off, seedling blights and root rots as well as herbicide injury, the soybean crop finally took off and looked good for much of the season. Now the overwhelming disease problem is sudden death syndrome or SDS. Several of the other late season diseases such as late season Phytophthora and Cercospora leaf spot and blight are making minor appearances. There have been more samples with stem canker than we typically see. And there have been a few samples with brown stem rot and one or two with charcoal rot. Foliage diseases were not widespread or severe for most of the season although some are making a last minute appearance. Septoria brown spot, downy mildew and bacterial blight may be evident on green leaves still in the upper canopy. Very early symptoms of soybean vein necrosis virus may also be evident on green leaves in the upper canopy. Losses from soybean cyst nematode continue to be a problem and this would be a good year to sample fields for SCN. This is also the time of year when anthracnose and pod and stem blight may show up on maturing soybean plants.

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Yield losses from these various late season diseases will vary depending on when symptoms began to occur, number of plants infected, severity of disease in infected plants and weather conditions from now to harvest.In some cases although yellowing of the upper canopy may be quite widespread and spectacular in a field, damage is limited to the uppermost leaves and pods so yield loss should be minimal. In other cases, especially with sudden death syndrome, the entire plant may have been killed prematurely. If large areas of a field are thus affected, yield losses will be greater. Although it is too late in the season to do much to control these diseases this year, management strategies to prevent or minimize these diseases next season are also given below.

Sudden Death Syndrome

Symptoms of sudden death syndrome (SDS), caused by a strain of *Fusarium virguliforme*, may appear several weeks before flowering but are more pronounced after flowering.Foliage symptoms begin as scattered yellow blotches in the interveinal leaf tissue. These yellow blotches may increase in size and merge to affect larger areas of leaf tissue. Yellow areas may turn brown but veins remain green giving the leaves a striking appearance. Severely affected leaflets may drop off the plant leaving the petiole attached or may curl upward and remain attached to the plant. Infected plants may die prematurely. Root systems may show deterioration and discoloration of lateral roots and taproot. When split open, internal tissues of the taproot and stem may show a light gray to light brown discoloration from the soil line several inches up the stem. If plants are carefully dug up, bluish-white, powdery masses of spores of the SDS fungus may be seen on the roots or taproot.

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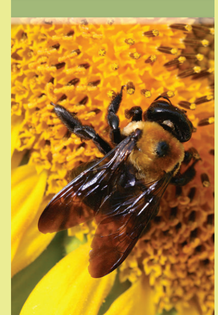


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Management options for SDS are somewhat limited but should include planting varieties which have performed well where SDS has been a problem, improving drainage in poorly drained fields, avoiding compaction, staggering planting dates, delaying planting until soils are warm and dry, avoiding continuous crop soybean, maintaining good crop vigor, avoiding crop stress including stress from soybean cyst nematode and harvesting fields with SDS in a timely fashion.

Figure 1. Foliage symptoms of SDS

Figure 2. Severe necrosis due to SDS

Figure 3. Defoliation at upper nodes due to SDS

Figure 4. Bluish mold growth on roots of plants with SDS

Figure 5. SDS causing widespread yellowing across field

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Late Season Phytophthora Root Rot

Wet conditions after planting regardless of planting date increase the likelihood of Phytophthora root rot. Phytophthora may cause seed decay and seedling blight but it can also cause symptoms later in the season as plants move into reproductive stages of growth. Infected older plants show reduced vigor through the growing season or die gradually over the season. Lower leaves may show a yellowing between the veins and along the margins. Upper leaves may yellow. The stems show a characteristic brown discoloration that extends from below the soil line upward and even out the side branches. Eventually the entire plant may wilt and die. Withered leaves remain attached even after the plant dies. Preventive measures are the main means for managing Phytophthora root rot. Select varieties with race-specific resistance, tolerance or a combination of the two, plant in good seedbed conditions, tile to improve drainage, take steps to reduce compaction, rotate crops and use an appropriate fungicide seed treatment.

Figure 6. Single plant showing yellowing and wilting due to Phytophthora root rot

Figure 7. Discoloration of stem and out side branches caused by Phytophthroa

Cercospora Leaf Spot, Leaf Blight and Purple Seed Stain

Cercospora kikuchii can infect soybean seeds, pods, stems and leaves but is most commonly found on the seed. However, this year we are seeing some cases of leaf spot caused by this fungus. Infection is primarily occurring on the uppermost leaves and begins as reddish purple to reddish brown, angular to somewhat circular lesions on the soybean leaves. These lesions may coalesce to kill larger areas of leaf tissue. The uppermost trifoliolate leaf and petiole may be blighted and brown. One striking symptom of this disease may be the premature yellowing and then blighting of the youngest, upper leaves over large areas of affected fields. In most fields, the symptoms have not progressed down the plants more than one to two nodes.Pods at the uppermost node may develop round, reddish purple to reddish brown lesions.

Initial symptoms of Cercospora blight may appear as plants are beginning to set seed. Upper leaves in the canopy that are exposed to sun start to show a pink to red to purple discoloration from the leaf tip extending back toward the base of the leaflet. The discoloration may darken and eventually cover the entire upper surface of the leaflet.Leaflets may have a leathery texture and a dark, reddish purple color highlighted with bronze.

This pathogen may also infect seed causing purple seed stain.Infected seed show a conspicuous discoloration ranging in color from pink to pale purple to dark purple. The discoloration may range from small specks to large blotches which cover the entire surface of the seed coat. Temperatures of 82-86°F with extended periods of high humidity favor disease development.

At this point in the season control of Cercospora leaf spot and purple seed stain is not feasible. It is important

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to remember that since this fungus can infect the seed, seed from heavily infected fields should not be used for seed.If infected seed must be planted, seed lots should be thoroughly cleaned and an appropriate seed treatment fungicide used.Rotating soybean with crops other than legumes will also help reduce Cercospora leaf spot and blight in future soybean crops.

Figure 8. Stem canker lesion on stem

Stem Canker

Although stem canker can occur in Missouri, this disease is usually not widespread or serious in the state.With the cooler than normal temperatures for much of the growing season, there have been scattered cases of stem canker this season. At first glance the affected plants might be mistaken for ones infected with Phytophthora as the plants are off-color or gray green and wilting. Examining the stems for the pattern of discoloration should help distinguish between the two diseases.

Initial symptoms of stem canker are small reddish brown lesions on stems near a leaf node. Over time the lesions expand to form larger, sunken cankers that are brown to black in color. Since the lesions tend to develop around leaf nodes, the discoloration of the stem is not continuous over the entire stem. The stem near the soil line may be green with bands of discolored tissue at infected leaf nodes separated by green healthy tissue at healthy nodes or intermodal regions of the stem.Foliage symptoms of yellowing or browning of leaf tissue may also develop.

Diaporthe phaseolina, the fungus that causes stem canker, survives in infested residues. Infection by the stem canker pathogen is favored by extended periods of rainy weather and cooler temperatures during early vegetative stages of soybean growth.However, symptoms may not be evident until later in the season.

Charcoal Rot

Symptoms typically begin to develop as plants move into reproductive stages of growth.Infected plants are less vigorous and have smaller leaves.Leaves may turn yellow and wilt.Leaves eventually turn brown and have a dry appearance. The taproot and lower stem develop a silvery gray to light-gray discoloration of the epidermis (outer layer of the soybean stem). The epidermis may flake or shred away from the stem, giving the stems a tattered appearance.Fine black specks or microsclerotia may be evident in tissues below the epidermis and eventually in epidermal tissues. Symptoms may develop on scattered plants, in circular to oval patches in a field, in drier areas of a field or across much of a field. Charcoal rot is favored by drought conditions so may not be a problem in much of Missouri this season. Management options for charcoal rot include rotating crops, maintaining good crop vigor to help reduce losses from charcoal rot and irrigating properly from just before bloom to pod fill.

Brown Stem Rot

Brown stem rot is another soybean disease which is not usually a problem in most of the state. When brown stem rot is found in Missouri soybeans it tends to be in the northern part of the state and in years with cooler temperatures through the growing season. Brown stem rot is caused by the fungus *Cadophora gregata* (formerly *Phialophora gregata*) which survives in infested crop residues and in the soil.

When foliage symptoms occur, they usually develop as plants are beginning to set pods. Light green to yellow blotches develop in the interveinal leaf tissue. The blotches may increase in size and merge to affect larger areas of leaf tissue. Over time, the yellow areas may turn brown with the veins typically staying green. These foliage symptoms resemble those of sudden death syndrome.

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Figure 9. Foliage symptoms that may occur with brown stem rot

Figure 10. Discoloration of center pith due to brown stem rot

Upper trifoliolates may become brown and dry out. Brown stem rot causes a brown discoloration of the vascular tissues and center pith of the soybean stem that is evident when the stem is split open. Initially the brown discoloration may be found in stem tissues close to the soil line and near nodes higher up on the plant. Later in the season, the brown discoloration may be almost continuous within the stem.

Development of brown stem rot is favored by temperatures in the range of 59-81 degrees F. As air temperatures increase above 81 degrees F, both incidence and severity of brown stem rot decrease. Leaf symptoms are most pronounced if cool weather occurs as the crop enters the reproductive stages of growth. Management of brown stem rot is primarily through the use of resistant varieties and crop rotation.

Soybean Vein Necrosis

In 2012, a relatively new virus disease of soybean, soybean vein necrosis, showed up in many soybean fields in various regions of the state. Initially, small light-green to yellow patches develop near main leaf veins. These patches then develop a mottled light green-yellow-brown pattern. The veins in these areas of the leaflet may become clear to almost translucent which is referred to as vein clearing. As the disease progresses these areas turn reddish-brown with a browning of the veins. The reddish-brown areas may have a scaly or scabby appearance. On more susceptible varieties the brown areas may expand killing larger areas of leaf tissue and giving a scorched appearance to the leaves.

The virus which causes soybean vein necrosis belongs to a group of viruses called tospoviruses which are spread by thrips. Under the drought conditions of 2012 thrips were present at high levels in many areas of the state and soybean vein necrosis virus was also widespread. With more normal conditions in 2013 and cooler conditions in 2014, this virus disease has not been nearly as prevalent.

At this point the disease is still a relatively new disease and there are more questions about it than answers. It appears that the virus is spread from soybean to soybean by thrips but which species(s) of thrips is unknown. Other hosts, especially weed hosts, have not been confirmed. And there are many questions related to the disease cycle, possible yield losses and appropriate management strategies. Varieties seem to vary in their susceptibility to this virus disease and symptoms may vary with varieties.

At this time there isn't enough known about the virus and disease to make effective management recommendations. As more information becomes available on this disease, management strategies can be formulated and recommendations made. Overall, disease symptoms of soybean vein necrosis have been low to moderate across fields in all states in which the disease has been reported this season. So for this season no control measures are recommended

Septoria Brown Spot

Septoria brown spot causes small brown spots on the unifoliolate and lower trifoliolate leaves. The individual spots may run together forming irregularly shaped brown blotches on the leaves. Infected leaves may yellow and drop prematurely. Brown spot usually starts on the lower

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portion of the plant. Under favorable weather conditions (warm, wet weather), the disease may move up through the plant. Brown spot was evident in many Missouri soybean fields earlier this season. But late season rains can trigger a reoccurrence of Septoria brown spot. Symptoms move up through the canopy of soybean plants. Lower leaves may show heavy spotting, yellowing and dropping prematurely. Upper leaves may also show spotting and yellowing. Some fields which have a yellow cast from the road may be showing symptoms of Septoria brown spot rather than SDS.

The fungus which causes this disease, *Septoria glycines*, survives in infested residues left on the soil surface. Fields with continuous soybean production are more likely to show damage. Planting disease-free, good quality seed of resistant varieties, rotating crops with at least one year between soybean crops and maintaining good plant vigor should reduce losses from Septoria brown spot.

Downy Mildew

Downy mildew, caused by the fungus *Peronospora manshurica*, is reported wherever soybeans are grown. The downy mildew fungus survives as oospores in infected leaf residues and on seeds. Spores produced in diseased areas on lower leaf surfaces are wind-blown and serve to infect additional leaves on that plant or other plants.

Initial symptoms of downy mildew are pale green to light yellow spots or blotches on the upper leaf surface of young leaves. These areas enlarge into pale to bright yellow blotches of indefinite size and shape. Eventually lesions turn grayish brown to dark brown with a yellow margin. During periods of heavy dew or wet weather, a gray to purple fuzz that is visible growth of the downy mildew fungus develops on the lower leaf surface beneath the diseased areas on the upper leaf surface. Severely infected leaves turn yellow and then brown. Downy mildew is favored by high humidity and temperatures of 68-72 degrees F.

Management options for downy mildew include planting disease-free seed and rotating crops with at least one year between soybean crops.

Bacterial Blight

Bacterial blight, caused by the bacterium *Pseudomnas savastanoi pv glycinea*, can occur on soybeans anywhere in the state and is common during cool, wet weather. The causal bacterium may be carried on the seed or can survive in crop residues. It is spread by wind driven rains or splashing rain.

Bacterial blight produces small, angular yellow lesions on the leaves. Lesions usually have a translucent or water-soaked appearance that may be more easily seen if the leaves are held up to the light. Lesions progress in color from yellow to light brown and eventually to a dark reddish brown. Older lesions have a dark center surrounded by a water-soaked margin and a yellow halo. In cool, rainy weather the small, angular lesions may enlarge and merge, producing large, irregular dead areas in the leaf. With wind and rain, these large dead areas drop out or tear away, giving the leaf a ragged appearance.

Symptoms typically occur several days after a rain with driving winds or a hailstorm. If there are alternating periods of wet and dry weather, plants may show bands of leaves with symptoms. Leaves that were expanding during wet periods show bacterial blight symptoms and leaves that expanded during dry periods are free of disease.

Bacterial blight is favored by cool, rainy weather. During early to midseason, disease outbreaks usually occur five to seven days after wind driven rain storms or hailstorms. Hot, dry weather checks disease development.

Soybean Cyst Nematode

Symptoms of soybean cyst nematode (SCN) range from no obvious symptoms to subtle differences in plant height and vigor or unexpected decreases in yield to severe stunting and discoloration of plants or dead plants. Foliage symptoms may include a yellowing of leaves from the margin inward or a general yellowing of leaves. But such foliage symptoms are also caused by a number of other factors including root rot diseases, nutrient deficiencies, herbicide injury and compaction, so foliage symptoms should not be used to diagnose SCN. Plants with SCN may have poorly developed root systems, if plants are carefully dug up, females may be evident on the roots. The females appear as tiny (smaller than nitrogen-fixing nodules), whitish to yellow to brownish, lemon-shaped structures on the roots. Symptom expression may be more severe if plants are subjected to other stresses such as moisture stress, nutrient deficiencies, herbicide injury, insect damage or other diseases.

It is important to periodically sample fields and have SCN egg counts done to know population levels in the field and to understand how management practices are influencing those levels. Variety selection is still an important tool in managing SCN. Rotating crops, maintaining good plant vigor and maintaining good weed control are also important. Recently several seed treatment materials which may aid in the management of SCN have become available.

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Figure 11. Anthracnose (large black spots) and pod & stem blight (small black specks)

Figure 12. Anthracnose and pod & stem blight

Anthracnose

Colletotrichum truncatum and several other *Colletotrichum* species cause anthracnose of soybean. Typically, anthracnose is a late season stem and pod disease of soybean. Symptoms occur on stems, pods and petioles as irregularly shaped, light to dark brown spots, streaks or lesions. Eventually black fungal structures may be evident in these lesions. Anthracnose may also cause tip blight. The tip blight phase of anthracnose causes a yellowing or browning of the uppermost leaves and pods. The blighted tips may dry up and die prematurely. Anthracnose is favored by warm, wet weather, and the tip blight phase of anthracnose is most likely to occur after a rainy period.

Again, at this point in the season control of anthracnose is not feasible. This fungus may also infect seed so seed from heavily infected fields should not be used for seed. If infected seed must be planted, seed lots should be thoroughly cleaned and an appropriate seed treatment fungicide used. Rotating crops with at least one year out of soybean will also help reduce anthracnose.

Pod and Stem Blight

Phomopsis longicolla and the other *Diaporthe* and *Phomopsis* species that cause pod and stem blight and Phomopsis seed decay can survive in infested crop residues, in the soil and in seed. Symptoms usually develop on stems of plants during later reproductive stages of growth.

Pod and stem blight infected plants may be stunted and their stems discolored. Black pycnidia or fruiting bodies of the cause fungi develop on the lower portion of the main stem, branches and pods as plants reach maturity. The pycnidia may be limited to small patches near the nodes or may cover dead stems and pods. On stems, pycnidia are usually arranged in linear rows while on pods they are scattered across the pods. The fungi may grow through the pod walls and infect the seed causing Phomopsis seed decay. Infected seed is usually oblong in shape, somewhat shrunken or shriveled and covered with a white mold growth.

Although prolonged periods of wet weather during flowering and pod fill favor the development of pod and stem blight, the rains since Labor Day have been enough to trigger low levels of this disease this year. If wet weather continues through harvest, levels of Phomopsis seed decay may increase.

At this point in the season control of pod and stem blight is not feasible. Management options include rotating crops with at least one year between soybean crops and planting disease-free seed. ■

Many Grass Pastures and Alfalfa Fields Infested with Fall Armyworm

by Wayne Bailey

Fall armyworm, *Spodoptera frugiperda* larval infestations continue to be found in grass and legume crops across Missouri. Although grass pastures and alfalfa fields are preferred hosts of this pest insect, it has a large host range of 60 different forage and field crops.

Numbers of fall armyworm larvae often peak in late summer and early fall resulting in substantial damage to grass and legume crops. Fall armyworm larvae tend to feed on all tender green plant tissues which give infested pastures the appearance of drought. If heavy feeding occurs, grass plants may become severely defoliated, stunted or killed. Damage may occur on 60 different hosts with tall fescue, and orchardgrass being favored as grass hosts and alfalfa as the favored legume host. Established alfalfa may be stripped of all leaf tissue, whereas newly seeded alfalfa stands are often completely destroyed when larval numbers are high. If plants are stripped of foliage in an established stand, the newly emerging buds should be closely monitored to make sure no fall armyworm larvae are feeding and restricting bud growth. If alfalfa bud growth is restricted, weed often take over the stand causing substantial completion for the recovering alfalfa plants. An insecticide application may be necessary to prevent alfalfa stand damage from any remaining fall armyworm larvae. Most often newly planted alfalfa stands are lost due to heavy feeding by larvae. An insecticide application may be necessary to control remaining larvae if the stand is to be replanted immediately. Grass stands usually recover from heavy fall armyworm infestations, although yield is often lost following pest feeding. Several insecticides are available for management of fall armyworm larval control in both legume and grass plantings.

Several generations of fall armyworm occur in Missouri each year. Larvae produced in spring and summer are often light in color ranging from light green to tan. Larvae produced during fall generations often are dark and may be completely black or gray in color. Both color phases of this insect will possess stripes running the length of the body. Identifying characteristics of the larvae include an inverted Y on the face of the insect, four black spots or bumps found on the top of each segment with those on the last segment of a worm arranged in a square pattern, and three white lines located on the back of the segment located just behind the head capsule. Sometimes the three white lines will extend to additional segments. Larvae typically grow through 6 "worm stages" often reaching a length of 1 ¼ to 1 ½ inches.

Damage in grass pastures often "just appears overnight" as growing larvae become large enough to consume substantial amounts of forage in short periods of time. Larvae are especially active both early and late in the day. Scouting is best accomplished during these periods to gain an accurate estimate of larval numbers. The economic threshold for this pest in grass pastures is to treat if 3 or more larvae are present per square foot. Insecticides labeled for use on this pest in grass pastures can be found in the following table. Best control is achieved if 10 to 20 gallons or more of formulated spray is applied per acre by ground equipment and 3 gallons by air. Be sure to follow all label precautions and restrictions.

Insecticides labeled for management of fall armyworm larvae in alfalfa and grasses are as follows:

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Recommended Insecticides for Fall Armyworm Larvae in Alfalfa

Chemical Name	Common Name	Rate of formulated material per acre	REI** Hrs	PHI *** Days
Beta-cyhalothrin	*Baythroid XL	1.6 to 2.8 fl oz	24	7 hay/graze
Flubendimide	*Belt SC	2 to 4 fl oz	12	0 hay/forage
Chlorpyrifos + lambda cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	24	21 hay/forage
Chlorpyrifos + gamma cyhalothrin	*Cobalt	19 to 38 fl oz	24	21 hay/forage
Alpha-cypermethrin	*Fastac EC	2.8 to 3.8 fl oz	12	3 hay/graze
Chlorpyrifos	*Lorsban Advanced	1 to 2 pts	24	7-21 days by rate
Chlorpyrifos	*Lorsban 4E	1 to 2 pts	24	7-21 days by rate
Chlorpyrifos	*numerous products	see specific labels	-	14 hay, 21 forage
Zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	12	3 hay/forage
Zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	12	3 hay/forage
chlorantraniliprole	*Prevathon	14 to 20 fl oz	4	0 hay/forage
Gamma-cyhalothrin	*Proaxis	2.56 to 3.84 fl oz	12	7 hay,1 forage
Carbaryl	Sevin 4F	1 - 1 1/2 qt	12	7 hay/forage
Carbaryl	Sevin XLR Plus	1 - 1 1/2 qt	12	7 hay/forage
Zeta-cypermethrin + chlorpyrifos	*Stallion	9.25 to 11.75 fl oz	24	7 hay/forage
Cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	12	7 hay/forage
Lambda-cyhalothrin	*Warrior II with ZT	1.28 to 1.92 fl oz	24	1 forage, 7 hay
Lambda-cyhalothrin	*Numerous products	see specific labels	24	1 forage, 7 hay

*Designates a restricted-use product.
**REI = Re-entry interval in hours before re-entering treated field.
***PHI = Interval in days before treated crop can be hayed or grazed.
Read and follow all label direction, precautions, and restrictions.

Recommended Insecticides for Fall Armyworm Larvae in Grass Pastures

Control: Treatment is justified when 3 or more larvae are present per square foot. Best to apply insecticide applications early or late in day when larvae are most active.

Common Name	Trade Name	Rate of formulated material per acre	REI** Hrs	PHI *** Days
beta-cyhalothrin	*Baythroid XL****	2.6 to 2.8 fl oz	12	0 hay/forage
zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	12	0 hay/forage
zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	12	0 forage/hay
Chlorantraniliprole	*Prevathon	14 to 20 fl oz	4	0 hay/forage
carbaryl	Sevin XLR Plus	1 to 1 1/2 quarts	12	7 hay/forage
lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	24	7 hay, 0 forage

*Designates a restricted-use pesticide. Use is restricted to certified applicators only.
**REI = Re-entry interval in hours before re-entering treated field.
***PHI = Preharvest interval for removing hay, forage,or seed from treated fields.
**** PHI for Baythroid XL applied to mixed alfalfa/grass stands is 7 days hay/forage.
For formulation selected, read the label to determine appropriated insecticide rates, directions, precautions, and restrictions.

Soybean Podworm (Corn Earworm) in Soybean

by Wayne Bailey

Economic damage from soybean podworm larvae is present in many Southwest Missouri soybean fields. Although soybean podworm infestations can occur in any soybean field, most at risk are late planted and double crop soybean. Conditions which favor the development of economic infestations of soybean podworm in late planted and double-crop soybean include:

1. Plant canopies which remain open after plant canopies of earlier planted soybean grow closed. Migrating corn earworm moths prefer open canopy soybean stands as egg laying sites. Approximately 6-8 weeks after egg laying occurs, soybean podworm larvae may reach economic levels in these late planted fields.
2. Elevated moth flights from within Missouri and from more Southern states 6-8 weeks prior to soybean pod production.
3. Reduced numbers of green cloverworm larvae in soybean fields. This may be due to weather conditions which limit green cloverworm populations or by the application of early season insecticide applications for earlier occuring.
4. Reduce the development of the fungal pathogen, Nomuraea rileyi which is the main biological control agent for soybean podworm in soybean. The levels of this beneficial fungus may be reduced by dry weather conditions or by applications of fungicides used to prevent fungal diseases in soybean.

Soybean podworm larvae are important pests of soybean in many southern and eastern states and traditionally have been a pest of soybean in Missouri counties bordering Arkansas, although in the past few years this pest has been found in higher numbers throughout the state of Missouri. Corn earworm larvae may feed on host plant foliage, but most often feed directly on the fruit of its cultivated hosts such as the tips of corn ears, grain sorghum seed heads, cotton squares and bolls, and soybean pods, seeds and occasionally flowers.

Although corn earworms overwinter as pupae in the soil in Missouri, additional moths migrate into Missouri each spring from more southern states. Moths are variable in color but tend to be tan with a yellow to light green tint. Moths are relatively large with approximately ½-inch wing spans. They may lay eggs throughout fields at sites where crop canopy has not yet closed. Eggs are laid singularly on a variety of field crops, although silks of late planted field corn and sweet corn are excellent hosts. Traditionally a pest during periods of hot, dry conditions when beneficial insect numbers are reduced, this pest may also flourish whenever field conditions and/or farming practices reduce beneficial insect numbers.

There are typically 3 generations of this insect produced in Missouri annually with the second and third generations being most damaging to soybean. Each female may lay an average of 1000 (500 to 3000) white to cream colored, dome shaped eggs which are laid singularly. Eggs display brown bands just prior to hatch with larvae emerging in 2-10 days depending on field temperatures. Once corn earworm eggs hatch in soybean, larvae initially feed on foliage, but prefer to feed on pod walls and consume seeds as larvae approach maturity (1-1/2-inch in length). Larvae grow through 5 or 6 worm stages and change in color with age. Newly hatched larvae are yellowish-white in color with second and third instar larvae changing to yellowish-green. Later instars found on feeding on soybean pods can range in color from green, yellow, and white to tan or reddish brown.

Regardless of color, they will generally display several dark longitudinal stripes running the length of their bodies and numerous black bumps with protruding hairs will be present on the top and sides of their bodies. The black bumps are most visible in very young larvae. In addition, this insect has 4 pairs of abdominal prolegs and 1 pair of anal prolegs. When disturbed, larvae often roll into a tight ball until the threat passes.

Late-planted or double-crop soybean are most at risk of attack by this pest. The preferred method of scouting for this pest is through the use of a shake cloth (drop cloth). Typically the cloth is laid between rows where 1-2 linear feet of each adjacent soybean row is vigorously shaken over the cloth. If an average of 1 or more corn earworm larvae are found per linear foot of row sampled, then the economic threshold has be reached. A less effective method of sampling for this pest is through the use of a 15-inch diameter sweepnet. If this method is used, be sure to angle the net opening upward as you sweep the upper 2/3 of the soybean plants in an upward motion. Each pass is considered a sweep with 25 sweeps per location at several locations in a field recommended. If you capture an average of 15 or more corn earworm larvae per 25 sweep sample, the economic threshold has been reached. Note that sweepnet samples tend to

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under estimate the number of larvae present. In soybean where neither sampling method can be used, treatment of the pest population is recommended if 5-10% or more of the soybean pods exhibit feeding damage from corn earworm larvae. This damage is generally seen as a hole chewed through the side of the pod to reach individual developing beans.

Several insecticides are labeled for corn earworm control in soybean and are listed below. Additionally, several beneficial insect species feed on corn earworm larvae and can help prevent the buildup of corn earworm larval populations in most years. Insecticide applications through the growing season should be used as a last resort as most insecticides substantially reduce both beneficial insect numbers. Pest alerts issued by the University of Missouri IPM Plant Protection Program use statewide pheromone traps to provide early warning of elevated corn earworm moth numbers by region. Additional information is available in University of Missouri Extension Guide Sheet G7110 "Corn Earworm in Missouri".

Excellent images of corn earworm are available in guide G7110 or at the Iowa State University entomology photo gallery (www.ent.iastate.edu/imagegal)

Treatment of corn earworm infestations in soybean are justified when 20% or more defoliation occurs during pod fill or 1 or more larvae are present per linear foot of row or if 5 to 10% or more of soybean pods are damaged. See the following table for insecticides labeled for control of this pest in soybean.

SOYBEAN POD WORM (Corn Earworm) ON SOYBEAN - Helicoverpa zea (Boddie)

Comments: Treat when defoliation reaches 30% prebloom or 20% from bloom to pod fill or when larval numbers exceed one per foot of row and 5% - 10% or more of pods are damaged. Heavy populations may cause excessive defoliation and pod loss.

Common Name	Trade Name	Rate of formulated material per acre	Placement	REI Hours	Pre-Harvest Interval Days
esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)Do not graze or feed
cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
flubendiamide	*Belt	2 to 3 fl oz	foliage	12	14 (grain) 3 (forage)
bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed
deltamethrin	*Delta Gold	1 to 1.5 fl oz	foliage	12	21 (grain) Do not graze or feed
lambda-cyhalothrin + thiamethoxam	*Endigo ZC	2.5 to 3.5 fl oz	foliage	24	30 (grain) Do not graze or feed
alpha-cypermethrin	*Fastac EC	2.8 to 3.8 fl oz	foliage	12	21 (grain) Do not fgraze, feed
zeta-cypermethrin + methomyl	*Hero *Lannate SP *Lannate LV	2.6 to 6.1 fl oz 1/4 to 1/2 lb 3/4 to 1 1/2 pt	foliage foliage -	12 48 -	21 (grain) Do not graze or feed 14 (grain) 3 (forage) 12 (hay)
Imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed
zeta-cypermethrin	*Mustang MAXX	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed
chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed
chlorantraniliprole	*Prevathon	14 to 20 fl oz	foliage	4	1 (grain)
carbaryl	Sevin 4F	1 to 3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
chlorpyrifos + gamma-cyhalothrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain)
spinosad	Tracer Naturalyte	1.5 to 2 fl oz	foliage	4	28 (grain) Do not graze or feed
cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed

*Designates a restricted-use pesticide. Use restricted to certified applicators only.
Read the label and follow all insecticide rate information, directions, precautions, and restrictions.

Weed of the month: Burcucumber (Sicyos angulatus), An Agronomic Pest on the Increase

by Kevin Bradley

Figure 1: Burcucumber grows as a vine; these vines are increasingly being found in agronomic fields, competing with and climbing soybean and corn.

Burcucumber, is a summer annual weed that resembles the cultivated cucumber. Currently, burcucumber can be found from the east coast to as far as west as Minnesota, Kansas, and Texas, and is becoming an increasing problem in agronomic crops. This climbing vine is recognized as a noxious weed in Delaware and Indiana, and in the latter state it is considered one of the 10 most difficult-to-control weeds in soybean[1].

Predominantly found in low-lying areas and near creeks and rivers, burcucumber can also become a problematic weed in agronomic crops. Burcucumbur seed can germinate in a range of soil temperatures (from 60 to 95°F[2]), and can germinate into the later months of the growing season, after herbicide applications are typically applied. Because the weed grows as a vine (Figure 1), the plant can compete with corn and soybean late in the season.

When grown in direct competition with soybean, burcucumber can reduce yield by up to 48 percent[3] and the weighty vines of this weed can lodge corn[4].

When burcucumber emerges, the seedling's cotyledons are thick and oblong (Figure 2), similar to the cultivated cucumber. The hypocotyl, or stem below the cotyledons, is covered with many short hairs that point downward. The plant has a fibrous root system and uses branched tendrils (thin coiled appendages along the stem that are similar to what is found on peas) to move up surfaces in search of sunlight (Figure 3).

The leaves are in an alternate pattern along the stem, and are 2 to 8 inches long and wide. The leaves are hairy, broadly heart-shaped, and generally have 3 to 5 pointed lobes and a toothed margin (Figure 4). Burcucumber stems are also hairy, especially at the leaf nodes. These hairs are one of the main differences between burcucumber and wild cucumber (*Echinocystis lobata*), which has a stem that usually lacks hairs.

Figure 2: Burcucumber seedling emerges from soil. The cotyledons are thick and oblong.

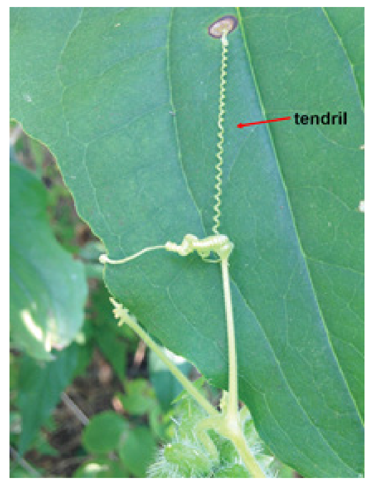

Figure 3: Burcucumber uses tendrils to climb up objects, or in this case another plant, to reach sunlight.

Figure 4: The leaves of burcucumber are broad, hairy, and have 3 to 5 lobes.

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The burcucumber flowers are usually whitish with a green tint and have 5 petals. The fruit are produced in clusters of 3 to 20 and resemble small cucumbers (about ½ to ¾ inches long and ¼ inch thick) that are covered with bristles/spines (Figure 5).

Figure 5: The burcucumber fruits are small, similar to miniature cucumbers, grow in clusters, and have spines covering the surface.[5]

Due to the ability of this weed to germinate throughout the corn and soybean growing season, burcucumber can be a challenging pest to eliminate. While foliar-applied herbicides can control current flushes, herbicides with residual activity can help minimize flushes of burcucumber that may occur later in the season.

In corn, pre-emergence (PRE) applications of atrazine or atrazine-containing pre-mixes will provide early-season control, but a post-emergence (POST) herbicide application will usually be necessary. Weed scientists at Penn State University have found that two and three-way mixes of products like Lexar or Corvus + atrazine in corn are some of the more effective PRE treatments that can reduce the density and size of burcucumber plants by the time of the POST application. Beacon (primisulfuron) and products that contain this active ingredient, dicamba-containing products (Banvel, Clarity, Distinct, Marksman, Status, etc.), Callisto and products that contain this active ingredient, Liberty, and glyphosate products (Roundup, Touchdown, etc.) are all effective POST treatments in corn.

In soybean, there are a variety of PRE treatments that will provide initial suppression and reduction in the burcucumber population, but similar to corn, a POST treatment will almost always be required. Effective PRE herbicides for burcucumber include products that contain chlorimuron (Authority XL, Authority Maxx, Envive, Valor XLT, etc.) or imazethapyr (Pursuit, Authority Assist, etc.), and these treatments must be followed by an effective POST treatment such as Classic, Liberty (Liberty Link soybean only), glyphosate, or Synchrony STS (STS soybean only).

For more information on burcucumber and other challenging weeds, please visit our web site at: weedid.missouri.edu

[1]Childs DJ, Jordan TN, and RL Blackwell. (1996) Survey of problem weeds in Indiana. Purdue University Cooperative Extension Service. WS-10.

[2]Johnson Q, and M VanGessel. (2012) Burcucumber control in cropland. University of Delaware College of Agriculture and Natural Resources Weed Facts WF-4.

[3]Esbenshade WR, Curran WS, Roth GW, Hartwig NL, and MD Orzolek. (2001) Effect of tillage, row spacing, and herbicides on the emergence and control of Burcucumber (Sicyos angulatus) in soybean (Glyince max). Weed Technology 15:229-235.

[4]Nice G, Johnson W, and T Bauman. (2005) Identifying and controlling Burcucumber. Purdue Extension Weed Science: www.btny.purdue.edu/weedscience/

[5]Mohlenbrock RH. (1989) Midwest wetland flora: Field office illustrated guide to plant species (hosted by the USDA-NRCS PLANTS database). Midwest National Technical Center, Lincoln, NE.

Challenges to Safely Store Record Soybean and Corn Production

Current predictions from USDA/NASS for corn and soybean production in Missouri in 2014 is 562.8 and 259.9 million bushels. If realized, those would be record production levels for both crops. To put that in perspective, if the total number of bushels (822.7 million) predicted to be produced in Missouri was piled on to a football field (pile has straight sides equal to football field dimensions), the pile would be slightly more than 4 miles high. That's higher than some commercial airplanes fly. A railroad hopper car carries about 4200 bushels. It would take over 195,000 cars to carry Missouri's predicted corn and soybean production. Those cars would equal a train about 2200 miles long. A train that long would reach from St. Louis to Kansas City nearly 9 times.

Even if late season stress or disease decreases yields slightly, Missouri farmers will have some hard decisions to make on where and how to store or transport their crops. University of Extension has a team of experts working on collecting information that will benefit farmers making temporary grain storage decisions

(see http://extension.missouri.edu/main/spotlight/grain.aspx).

Many Missouri farmers do not have enough on-farm storage to handle a record crop. And, most elevators and other commercial grain storage sites will quickly fill with grain. Because of current transportation challenges (lack of hopper cars and engines to pull them) grain will not move quickly from farm to end-user.

The cooler temperatures we enjoyed this summer are partly responsible for the record yields, but they also slowed corn grain maturity. Corn plants will reach black layer later than usual this year. This means that corn grain will likely be harvested at higher grain moistures than in the recent past. So, farmers will incur greater drying costs. Because of the large corn production throughout the Midwest, propane and other energy sources used for drying grain might become more difficult to obtain. Planning in advance of harvest will be important to ensure corn grain can be dried to safe storage percentages.

Because grain prices are low, farmers might be tempted to leave corn in the field longer than normal to allow for greater in-field drying. This action can increase preharvest and harvest corn yield losses. Delayed maturity means that air temperatures during in-field drying will probably be

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cooler than normal. This means a greater number of days to reach a target grain moisture. More days means increased exposure to unpleasant weather events such as wind and rain. It also means additional days for stalk rot fungi to cause their damage to stalk and ear shank strength. There are also fungi that do not cause diseases, but digest dead tissues. Mature plants die and these saprophytic fungi begin to break down tissues even before harvest occurs. Cooler temperatures will decrease activity of all these fungi, but they are still active and may increase stalk lodging and shank breakage.

Soybean maturity will also be later because of the cool summer temperatures. But, because soybean maturity is closely tied to photoperiod length, the delay for soybean will be much less than delay for corn. Soybean seeds dry (and rewet) in the field more quickly than corn kernels. Except in extreme situations with late planting, soybean grain moisture is not likely to be a concern.

The two biggest enemies of grain storage are moisture and temperature. Greater moisture percentages and warmer temperatures increase the growth and activity of grain storage pests, especially fungi. At physiological maturity (black layer for corn and R7 for soybean) seed moisture percentage is about 32 and 60% for corn and soybean. Although the plant dies at maturity, the seeds (grain) remain alive. Respiration occurs in living seeds even when removed from the plant and stored. One product of respiration is water. The purpose of respiration is to produce energy, and the by-product of that energy the production of heat.

Stored grain will increase in moisture percentage and temperature unless seed respiration is reduced or eliminated. One of the purposes of grain drying is to reduce respiration to a minimum that is nearly equal to zero. The seed embryo remains alive, but it is not producing water or generating heat. This drying occurs naturally in the field for soybean, but artificial drying is often necessary for corn. Safe year round storage moisture is 13% for corn and 12% for soybean. This low moisture is necessary to store grain through the hot and humid months of summer. If grain temperature is cool (e.g. less than 50F), then grain can be stored at higher moistures. One of the purposes of aeration (air movement without heat) is to cool the grain and remove some of the moisture generated by respiration.

Storing grain outside presents several challenges. It would be quite expensive to dry grain to 13% moisture. So, most farmers will attempt to store grain at moisture percentages that allow seed respiration to occur. Some temporary storage solutions, such as grain bags, will not allow aeration and this presents a challenge to dissipate heat and moisture unless respiration is limited by cool air temperatures.

Another method of preserving stored grain is through reduction of oxygen. Seed respiration and fungi growth require oxygen. If oxygen levels are reduced, then seed production of heat and moisture is also reduced. Growth of fungi responsible for grain spoilage is also slowed or prevented. This is what happens in high moisture corn storage. Corn at moistures around 28% is placed in nearly airtight bins. Rapid seed respiration quickly reduces oxygen to near zero and grain is preserved. It not easy to predict the consequences of placing grain at more moderate moistures, e.g. 18%, in airtight bags. Respiration might be fast enough to reduce oxygen to safe levels before grain spoilage. However, localized wet areas from respiration generated moisture are possible.

Record yields mean that Missouri farmers have many decisions to make about grain handling and storage. Low grain prices complicates some of these decisions and increases the need for safe, but long term, storage. Attention to details is important to maximize grain production, but that attention doesn't end at the combine. Save storage, especially of grain placed outside in temporary storage, will be a challenge. Seeds are living organisms and understanding how they react with potential enemies and weather conditions will help maintain grain quality and value.

Influence of Corn and Soybean Herbicide Treatments on Cover Crop Stands

by Mandy Bish and Kevin Bradley

One thing to consider this fall with regards to planting cover crops is how these crop species will respond to herbicide carryover. Relatively little research has been published on this topic, and the factors that affect carryover, such as moisture and soil temperature, will likely vary from year-to-year. With that in mind, we have summarized our one year of data on the effects of herbicide carryover on cover crops. This is preliminary data collected in 2013 from Columbia, MO, and the experiments are currently being repeated.

Tables 1 and 2 show stand reduction of cover crops planted in the fall following either corn or soybean, which had one of 14 different herbicide treatments. Green boxes indicate stand loss of <15% relative to the same cover crop grown on non-treated soils. Yellow boxes specify stand loss of 15 to 30% and red boxes denote stand loss of >30%. In the two experiments conducted last year, annual or Italian ryegrass (*Lolium multiflorum*) that was planted following either corn or soybean that was treated post-emergence (POST) with pyroxasulfone (Zidua) had >50% stand reduction relative to annual ryegrass grown on non-treated soils (Tables 1 and 2). Tillage radish stand reduction was greater than 30% when following corn that had a POST application of flumetsulam (Python) or following soybean that had a POST application of either imazethapyr (Pursuit), S-metolachlor + fomesafen (Prefix) or fomesafen (Flexstar) (Figure 1). Similar effects of fomesafen on tillage radish have also been observed by Dr. Mark Bernard's group at Western Illinois University in which they applied different concentrations of fomesafen (from 12.5% of the labeled rate up to the labeled rate to mimic possible carryover rates) 5 days prior to planting the tillage radish. The group observed greater than 40% damage to the tillage radish at the 1X rate of fomesafen. Bernard's group also studied wheat and cereal rye across many of the same herbicides that we tested, including: mesotrione (Callisto), pyroxasulfone (Zidua), flumioxazin (Valor), cloransulam methyl (Firstrate), fomesafen (Flexstar), sulfentrazone (Spartan), isoxaflutole (Balance Flexx), and atrazine (Aatrex). They found less than 20% visual damage at the 1X rate across all herbicides for both crops.

While this data provides some insight into cover crop selection based on previous herbicide usage, it is only preliminary.

For more information regarding cover crops and weed science, including herbicide carryover, see our Weed Science data in the following slideshow: http://bit.ly/1s3DHuf.

Figure 1.

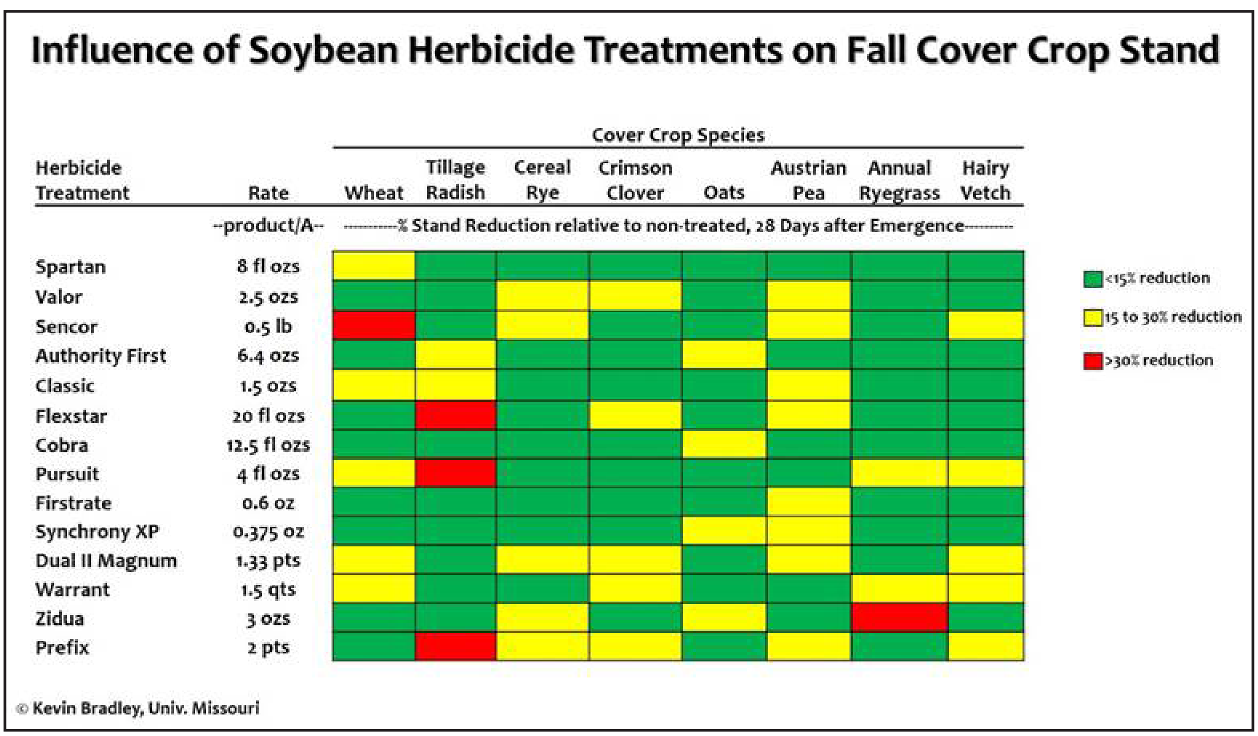


Figure 2.

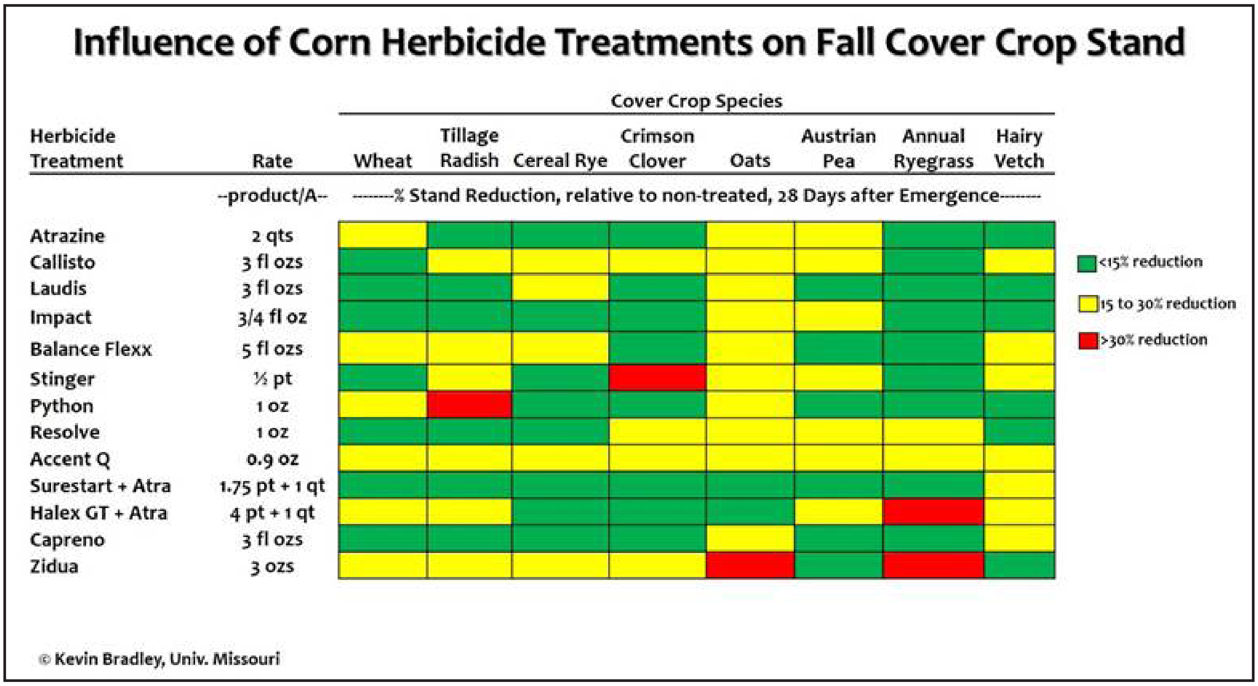


Figure 3.

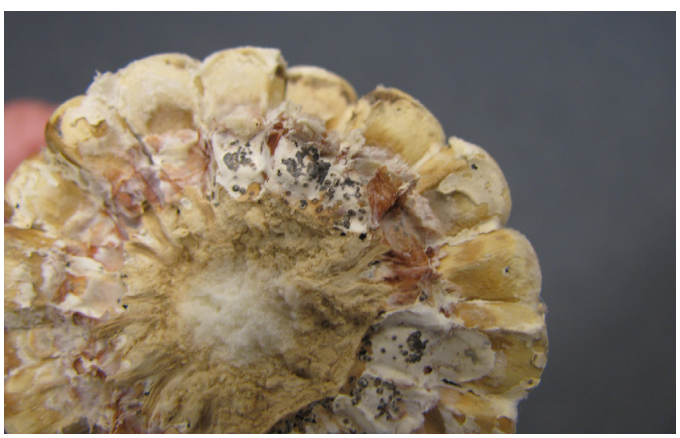
Ear and Kernel Rots of Corn

by Laura Sweets

Diplodia ear rot

Ear with beginning stages of Diplodia ear rot

Diplodia ear rot with thick mat of mold growth



Fungal fruiting bodies evident as black flecks on kernels and cob tissues

After a slow start because of unusually low soil temperatures and wet conditions, corn took off and has looked beautiful across most of the state for much of the season. With the spell of hot, dry weather late in August, it is turning and corn harvest is beginning or rapidly approaching in many parts of the state.

Diplodia ear rot, Penicillium ear rot, Gibb ear rot and *Aspergillus* species other than *Aspergillus flavus* are common problems year in and year out but the severity varies with weather conditions at pollination or close to harvest. Penicillium ear rot, Gibb ear rot and *Aspergillus niger* are particularly evident on the exposed tips of ears, around insect tunnels and on ears that have remained upright. If there are periods of wet weather before corn is harvested, some of the corn plants that died prematurely may show the black discoloration caused by secondary fungi coming in on the senescing plant tissues. Temperatures have been unusually cool through much of the season so the likelihood of problems with *Aspergillus flavus* and aflatoxin is low. Descriptions of the common ear and kernel rots of corn are given below. So far the levels of ear and kernel rots appear to be low. This could change if regions of the state move into a pattern with more frequent rains or heavy dews or if harvest is delayed due to wet conditions.

Both *Diplodia maydis* and *Diplodia macrospora* can cause **Diplodia ear rot** of corn. The ear leaf and husks on the ear may appear prematurely bleached or straw-colored. When the husk is peeled back, dense white to grayish-white mold growth will be matted between the kernels and between the ear and the husks. Small, black fungal fruiting bodies may be scattered on husks or embedded in cob tissues and kernels. The entire ear may be grayish-brown, shrunken, very lightweight and completely rotted. Diplodia ear rot is favored by wet weather just after silking and is more severe when corn is planted following corn.

Penicillium ear rot is usually evident as discrete tufts or clumps of a blue-green or gray-green mold erupting through the pericarp of individual kernels or on broken kernels. Penicillium appears as small, discrete colonies of mold growth with a dusty or powdery appearance. The fungus may actually invade the kernel giving the embryo a blue discoloration. Blue-eye is the term used for this blue discoloration of the embryo.

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Penicillium ear rot

Penicillium erupting through pericarp of single kernel

Penicillium ear rot

Penicillium and Aspergillus niger on tip of same ear

Gibb ear rot

Gibb ear rot (caused by *Gibberella zeae*) usually begins as a pinkish white mold at the tip of the ear. Early infected ears may rot completely with husks adhering tightly to the ear and a pinkish to reddish mold growing between husks and ears. Although mold growth usually has a pinkish to reddish color, it can appear yellow to yellow-orange to yellow-red or even primarily off-white. Gibb ear rot typically begins at the tip of the ear but under favorable conditions it can move down the ear causing extensive damage. It may also develop around injuries from hail, birds or insects.

Aspergillus niger is also common on exposed ear tips. This fungus will be evident as black, powdery masses of spores on the tip of the ear or around insect tunnels.

Aspergillus niger on tip of ear

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Black corn occurs when any of a number of saprophytic or weakly parasitic fungi grow on corn plants in the field. *Alternaria, Cladosporium, Aureobasidium* and other species are frequently found on these discolored or black plants. Since the affected plants may have a sooty appearance these fungi are sometimes called sooty molds. These sooty molds or secondary fungi tend to develop on plants when wet or humid weather occurs as the crop is maturing or if harvest is delayed because of wet weather. Typically these fungi come in on plants that are shaded, undersized, weakened or prematurely ripened and on senescing foliage. Plants that are lodged or that have been stressed by nutrient deficiencies, plant diseases or environmental conditions may be more severely affected. Although many of these fungi produce dark or black mold growth, the color of the mold growth can range for dark or black to olive green or even pink to white.

Black corn

These secondary fungi tend to develop on senescing plant tissues, primarily leaf, stalk and husk tissue, but under favorable conditions can cause infection of the kernels. Infected kernels might show a black discoloration.

It is possible that these sooty molds or secondary fungi could contribute to stalk deterioration or stalk rot. Lodging could become a problem in these fields, especially if there are high winds or strong storms before harvest.

Aspergillus flavus is evident as greenish-yellow to mustard yellow, felt-like growth on or between kernels, especially adjacent to or in insect damaged kernels. *Aspergillus flavus* is favored by high temperatures and dry conditions, so Aspergillus ear rot is typically associated with drought stress. The fungus survives in plant residues and in the soil and spores are spread by wind or insects to corn silks where the spores initiate infection.

Aspergillus flavus colony on ear

Management of Ear and Kernel Rots: Little can be done to prevent or reduce the invasion of corn by fungi in the field. These ear and kernel rots tend to be more severe on ears with insect, bird, hail or other physical damage. Ears well covered by husks and maturing in a downward position usually have less rot than ears with open husks or ears maturing in an upright position. However, if ear and kernel rots developed in the field, it is important to harvest the field in a timely manner and to store the grain under the best possible conditions. Both Penicillium and Aspergillus can continue to develop on corn in storage if the grain is not stored at proper moisture content and temperatures. These two fungi can cause serious storage mold problems.

Adjust harvest equipment for minimum kernel damage and maximum cleaning. Before storing grain, clean bins thoroughly to remove dirt, dust and any grain left in or around bins. Thoroughly clean grain going into storage to remove chaff, other foreign material and cracked or broken kernels. Dry grain to 15% moisture as quickly as possible and monitor grain on a regular basis throughout storage life to insure moisture and temperature are maintained at correct levels. Protect grain from insects.

Stored grain should be monitored on a regular basis during the storage period to be certain storage molds are not developing in the grain mass. This will be especially important of grain stored in temporary storage structures.

Weather Data for the Weekly Period September 24, 2014

Station	County	Weekly Temperature (ºF)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	September 1-24	Departure from long term avg.	Accumulated Since Apr 1	Departure from long term avg.
Corning	Atchison	78	57	86	46	66	+3	5.61	+2.84	3360	+127
St. Joseph	Buchanan	74	57	82	50	65	+2	1.80	-1.87	3216	-1
Brunswick	Carroll	78	53	86	45	65	+1	2.12	-0.61	3384	+121
Albany	Gentry	75	54	85	43	63	0	5.01	+2.07	3093	-68
Auxvasse	Audrain	78	52	86	46	65	+1	4.30	+0.80	3208	-99
Vandalia	Audrain	77	51	85	45	64	0	4.75	+1.29	3128	-133
Columbia-Bradford Research and Extension Center	Boone	76	52	84	46	64	-1	7.33	+4.06	3197	-198
Columbia-Capen Park	Boone	80	51	87	45	64	-1	6.54	+3.32	3228	-279
Columbia-Jefferson Farm and Gardens	Boone	77	53	84	47	65	0	7.17	+3.98	3302	-102
Columbia-Sanborn Field	Boone	77	56	85	49	66	+1	6.47	+3.19	3491	-23
Columbia-South Farms	Boone	76	54	83	48	65	0	7.29	+4.01	3268	-131
Williamsburg	Callaway	80	50	85	43	64	0	5.53	+1.88	3241	-12
Novelty	Knox	75	50	79	45	62	-1	6.90	+3.82	2952	-239
Linneus	Linn	75	53	82	46	64	+1	9.19	+6.33	3078	-69
Monroe City	Monroe	77	50	84	44	63	-1	5.63	+2.34	3087	-166
Versailles	Morgan	78	54	84	47	66	+1	3.33	-0.24	3465	-12
Green Ridge	Pettis	77	54	82	46	65	0	3.46	-0.46	3281	0
Lamar	Barton	79	55	84	48	67	+1	2.30	-1.80	3548	-79
Cook Station	Crawford	79	48	87	39	63	-2	1.04	-2.60	3321	-146
Round Spring	Shannon	77	49	86	42	62	-3	2.09	-1.15	3196	-139
Mountain Grove	Wright	76	52	84	44	64	-1	2.10	-1.67	3205	-105
Delta	Cape Girardeau	79	50	87	43	64	-4	2.51	-0.28	3431	-394
Cardwell	Dunklin	81	55	89	47	67	-3	2.77	+0.24	3815	-325
Clarkton	Dunklin	83	52	89	43	66	-4	1.98	-0.76	3732	-350
Glennonville	Dunklin	80	54	88	47	67	-2	1.48	-1.24	3787	-269
Charleston	Mississippi	80	54	87	46	67	-1	2.20	-0.45	3757	-107
Portageville-Delta Center	Pemiscot	81	57	88	48	68	-2	1.88	-0.99	3908	-201
Portageville-Lee Farm	Pemiscot	81	56	88	46	67	-3	1.88	-1.02	3924	-155
Steele	Pemiscot	81	54	87	45	67	-3	4.77	+2.15	3817	-299

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

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