KENTUCKY INTEGRATED CROP MANAGEMENT MANUAL FOR SOYBEANS

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For additional and current information please consult the following web sites:

For more IPM information and links to many pest and crop management sites view the IPM web page at: http://www.uky.edu/Agriculture/IPM/ipm/htm.

For the most current information on pests view the **Kentucky Pest News** at: http://www.uky.edu/Agriculture/kpn/kpnhome.htm.

For up-to-date weather, and crop and pest models view Ag-weather at: http://www.agwx.ca.uky.edu/Kyagwx.html.

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Preface

Agriculture is the world's most important industry. This level of importance will continue due to rapidly expanding populations that demand increased amounts of food and fiber. Crop protection problems associated with this increased production have become more complex. A simplistic approach to pest control leads to serious environmental complications. A truly successful pest management program must take a multi- disciplinary, multi-crop approach in order to supply the farmer with reliable pest control information. An approach to crop production based on sound economic, ecological, technical and social considerations is required to assist the farmer to achieve needed production levels, while maintaining food safety and environmental quality.

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SOYBEANS

SOYBEAN SCOUTING

Soybean scouting techniques are similar to those utilized in corn except that the insects are sampled by using a shake cloth or sweep net and the disease sampling radius varies from 10 to 30 feet.

Pests	Monitoring Stations	Procedure/Location
Insects	Random	one - 4 foot shake sample or 48 plant beat-sweep
Weeds	Permanent	100 $ft.^2$ area
Diseases	Random	10 to 30 ft. radius or 10 ft of two rows

How to scout a Field:

Use the table below to determine the number of locations you need to survey. For example, 80 acre field 8 locations; 5 locations for 50 acres and 4 locations for 30 acres).

Select locations randomly so that they will represent the entire field. Don't survey along field margins or limit surveys to one side or end of a field.

IF THE SURVEY IS NOT RANDOM IT WILL NOT REPRESENT THE WHOLE FIELD and you may find a lot of problems on your return visit.

Specific survey information for each insect will follow. In general, you will either make one shake-cloth sample per location or a sweep net sample. In additional pests, note any beneficial species present.

Field Size	No. of locations	Field Size	No. of locations
1-14	2	115-124	11
15-24	3	125-134	12
25-34	4	135-150	13
35-50	5	151-164	14
51-64	6	165-174	15
65-74	7	175-184	16
75-84	8	185-200	17
85-100	9	201-214	18
101-114	10	215-224	19
115-124	11	225-234	20

See: Entfact – 118, Procedure for selecting random locations for sampling.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa113.pdf

Scouting Procedures for Insects on Soybeans

Doug Johnson, Ric T. Bessin and L.H. Townsend

SOYBEAN INSECT CALENDAR FOR KENTUCKY

	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
Bean Leaf Beetle Adults	" " " " **	seedling ** ** " "	damage " " "	Adults " " ********	pod feeding " " "	
Dectes Stem Borer	Larva/pupal	Larval/pupal		Adult activity	Larval tunneling/ overwintering	Larval tunneling/ overwintering
Grasshoppers (Conventional)			" "** **	** ** ** ** " "	"	
Grasshoppers (no-till)	" **	**	" " " " ** * **	* **	** " " "	
Green Cloverworm			" " " "	" * **	** " "	
Green Stinkbug				" " "** **	** * ** "	
Mexican Bean Beetle	" " "	**	** * ** " "	" " * **	** ** "	" "
Soybean Aphid		"	""""""""""	**********	**********	**********
Soybean Podworm				* *	* ** **	** " " "

*Period when economic populations are most likely to occur.

Scouting Equipment:

The presence of soybean insects can be determined by shaking the soybean plants over the row middle onto a shake-cloth sampler. It should be placed on the ground between the rows to make counting easier. While kneeling at the edge of the cloth, reach on the outside of one of the rows and bend an "armful" of plants over the cloth (this should normally be about 24" of row). Shake the foliage vigorously for several seconds. Repeat on the other row. Quickly count the insects and record the numbers present. You now have sampled four row feet. Pull up one plant; estimate the percent defoliation (leaf

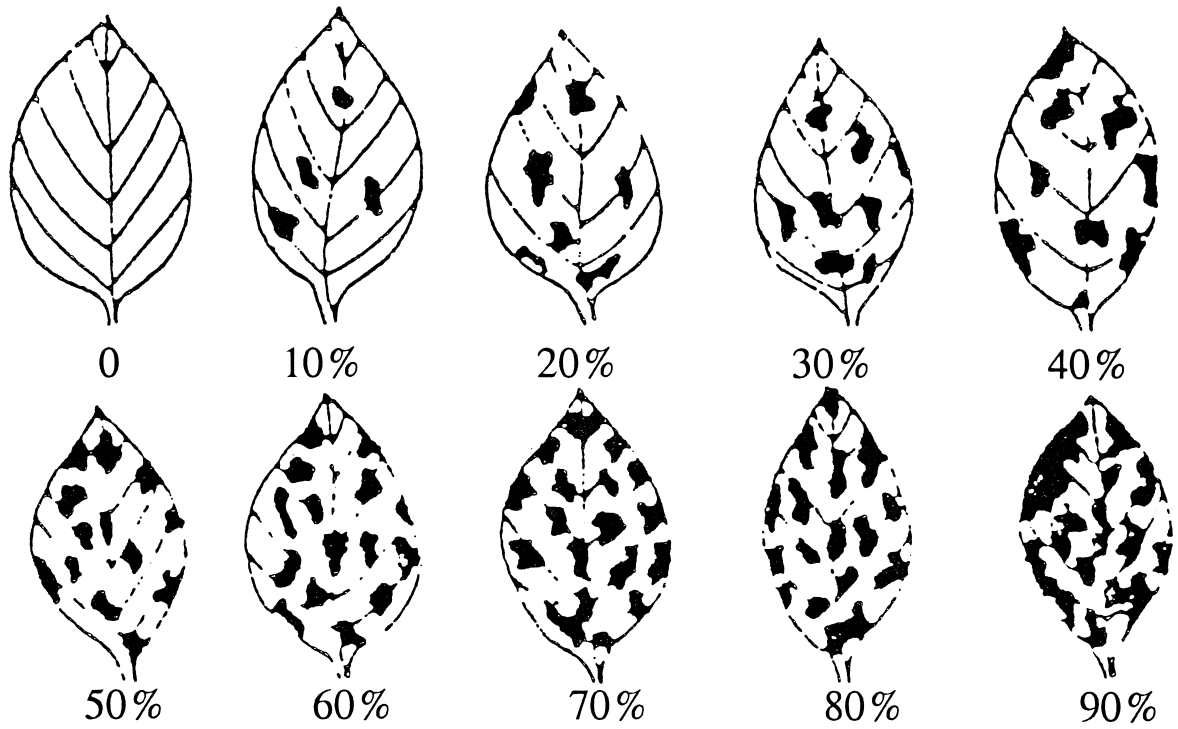
surface missing. See Percent Defoliation Estimates, below) and record this also. Keep in mind that plants should be placed on a light background to determine percent defoliation. Go to additional sites until you have taken the number of samples necessary for that field size.

Solid seeded soybeans cannot be sampled accurately with the shake cloth method. Instead, shake the insects from a total of 48 plants per location into a 15 inch sweep net. Hold the rim of the net up against the plants and shake them so that the insects are knocked into the net.

When plants are small several may be included each time you shake them in the sweep net. As plants grow, fewer and fewer plants may be shaken at any one time. Be sure you shake undisturbed plants because insects will move from disturbed plants.

Sweep net based sampling procedures and economic thresholds have been established for a few insect pests. Where available these specific procedures are listed in the text.

Percent Defoliation Estimates for Soybeans



View all the leaves on the plant when estimating the average defoliation. Often leaves at the top will have the most defoliation while leaves at the bottom will have the least. You need to establish the average for the entire plant.

Seedling Pests

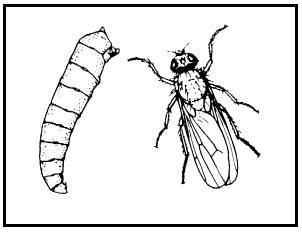
Seed Corn Maggot

Occurrence: These pests most often feed on seeds planted early into cool, wet soil with a lot of surface residue. Damage is not usually noticed until "skips" appear in the newly emerging stand.

Preventive Management: Delay planting soybeans until soil conditions favor rapid seed germination. Use an insecticide seed treatment when planting into cool wet soil.

When to scout: If skips or uneven stands are seen after plant emergence.

Description: The adult stage of the seed corn maggot looks very much like a small house fly. The larval stage is a slender, off-white maggot with a pointed head and blunt tail.



Damage: Ungerminated seed will be riddled with small holes or have the inside eaten leaving only the outer shell. If detected early, the maggots should be present.

How to scout: Look for areas of poor stand. Carefully dig up some seed and examine for the presence of insects and/or damage.

Record: Estimate the area and amount of stand reduction in the Comment section.

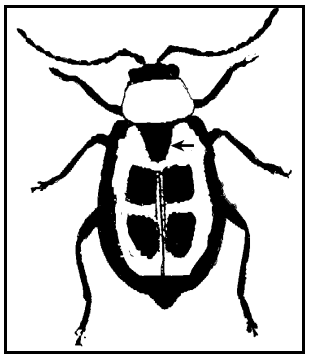
Economic Threshold: There is no rescue treatment for this pest. Estimate area and amount of stand reduction for reporting in Comments. This information will be useful when making a decision on replanting.

Bean Leaf Beetle

Occurrence: From plant emergence throughout the season. (See soybean insect calendar for probable damage dates). Bean leaf beetles are present in most soybean fields every year. In some years, seedlings may be damaged heavily. Damage to larger plants is relatively rare.

When to scout: Plant emergence to 1st completely unrolled trifoliate; then, from pod set through pod fill.

Description: Adults are about 1/8 to 1/4 inch long. The body is slightly convex and the beetle is longer than wide. Color is variable, ranging from light brown to dark red, spots and/or stripes may be present or absent. (See plate 1 Soybean Insect picture sheet). All bean leaf beetles will have a backwards-pointing black triangle behind the head as indicated by the arrow in the above picture. Larvae, small worms living below



ground, are seen only when digging up plants.

Damage: Bean leaf beetles feed on cotyledons and leaves and pods. Leaf feeding consists of very distinctive almost circular holes. Feeding on cotyledons and pods usually appears as scooped-out holes in the surface.

How to scout seedlings: Look for stand reduction (cotyledon stage) and heavy leaf feeding while crossing the field. If damage is noticed, try to establish that bean leaf beetle is the problem by looking for them on the plant. In cotyledon stage, defoliation will be obvious and characteristic.

Record: Record the percent defoliation.

Economic Threshold for seedlings: Control should be considered if 30% stand loss due to cotyledon feeding or 30% defoliation has occurred (see Table 3, page 18).

How to scout mid-season: The insect densities can be determined by using either the sweep net, ground cloth procedure or pod sampling. Each of the three methods is equally reliable. Sampling for beetles should not be done before mid morning or while dew is present. Economic Threshold tables are given for each of the three methods on page 18.

Sweep net procedure. Take 20-sweep samples at each sample location. Sweep as you walk down the row; calculate an average number of beetles per sweep; consider an insecticide application if the beetles count reaches the economic threshold.

Ground cloth procedure. Place a two foot wide strip of cloth on the ground between the rows; bend plants over the cloth and shake them vigorously (this provides a four foot sample); count the number of beetles on the cloth; repeat at each sampling location; determine the average number of beetles per foot row; consider an insecticide application if the count reaches the economic threshold.

Pod sampling procedure. At each sample location collect five plant samples (see table on page 1 for number of locations to sample); calculate an average number of pods with holes in the pod wall per five plants; consider an insecticide application if the number of injured pods reaches the economic threshold and bean leaf beetles are still present in the field.

Record: Pod Sampling Procedure- Record the number of injured pods per five plants sampled at each sample site. Note if the insect is still present in the field.
Sweep Net Procedure- Record the average number of beetles per sweep at each sample site.
Ground Cloth Procedure: record the average number of beetles per foot row.

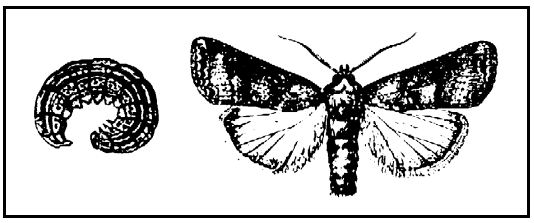
Economic Threshold: See Table 3, page 18.

Cutworms

Occurrence: Plant emergence to 2 weeks following plant emergence. Fields having one or more of the following characteristics should be watched more closely: 1) history of cutworm damage, 2) surface litter of crop residue, 3) fair to poor drainage of overflow land, 4) winter annual weeds prior to planting.

When to scout: If cut plants are noticed during the two week period following emergence.

Description: Larvae are light gray to nearly black with a faint, narrow, mid-dorsal stripe. The skin appears to contain tiny granules. Larvae vary from 1/4 inch long after hatch to 1-1/4 to 1-3/4 inches long when full grown. They will be coiled in a compact "C" when uncovered.



Damage: Cutworms are active at night. Initial damage is usually leaf feeding. Larger cutworms cut small plants and may pull parts into their burrow. Symptoms are cut or wilted plants.

How to scout: Look for stand reduction or cut plants when walking through the field. Begin making counts when cut or wilted plants are first seen. Remember the number of locations you need to make counts is based on the field size. 1.) Randomly determine each starting point. Examine 20 consecutive plants per location and write down the number of cut plants. Determine the percent plants cut by dividing the total plants cut by the total number of plants inspected. Multiply this figure by 100 and record the percent damaged plants on the report form. 2.) Look for live cutworms around damaged plants. First, check under clods around the base of the plant. Then, dig up an area three inches in diameter and three inches deep around the plant. Use a knife blade to sift through the soil. REMEMBER, DON'T CHECK PLANTS UNLESS THEY ARE DAMAGED! Place some specimens in vials containing alcohol for identification.

Record: Record the number of cut plants found per 20 plants examined at each site. Note the average length and number of live larvae found.

Economic Threshold: Control may be justified if 30% or more of the plants are lost or damaged. Infestations may be spotty within a field.

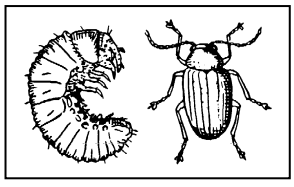
Grape Colaspis Grubs (Soil)

Occurrence: Larvae are active in the early spring and may be full grown by the first part of the summer (May - June). After feeding on plant roots, they pupate in the soil and emerge as beetles during June. The insect is most likely to be found in a field that has followed a legume such as clover. Grape Colaspis grubs may also cause similar damage in corn.

Preventive Management: Avoid planting on a spring-plowed field of timothy or clover. Fall plowing can aid in control.

When to Scout: From plant emergence until the first trifoliate leaf appears.

Description: The larvae are small white grubs. They are 1/8 to 1/6 of an inch long and can be found in the



soil near the plant's roots. The adult is a tan beetle about 1/6 of an inch long. The body of the beetle will be covered with rows of very fine evenly spaced holes.

Damage: Leaves of damaged plants turn purple, as with a nutrient deficiency or moisture stress because the larvae have eaten the root hairs from the plant. The small grubs can be found in soil surrounding the plant roots.

Feeding damage by the adult beetle appears later in the season. The rounded holes in the leaves are similar to those caused by the southern corn rootworm. One surface of the leaf will be eaten away giving a windowpane effect. Adult beetles will usually cause little economic damage, however, a large number of adults may indicate that there was a high grub population earlier.

How to Scout: Record the size of the damaged area and take a stand count. Sift through the soil and check roots, to see if grubs are still present. This information can be used when deciding whether to replant.

Record: Record if insects are still present, and note the size of the damaged area and estimated stand.

Economic Threshold: There is no economic threshold for root damage. Assess the stand to determine whether or not to replant damaged areas. Establish whether or not live grubs are still present to evaluate usefulness of insecticidal control at replant.

Foliage Feeders

Green Cloverworm

Occurrence: Mid-June through August.

Description:

Larvae are slender and light green caterpillars with three pairs of white stripes running the length of the body. There are three pairs of legs near the head, three pairs of fleshy legs near the middle of the body and a pair of fleshy legs at the tail end. Green cloverworms wiggle violently when disturbed. These caterpillars are often parasitized or diseased. Parasitized larvae will have small eggs on their body often near the head. Diseased larvae may appear Awatery@ and behave sluggishly or be covered in a fungal growth.

Damage: Green cloverworms feed extensively on soybean leaves. Young larvae skeletonize the underside of the leaf. Older larvae eat all of the leaf except the largest veins.

How to scout: Shake cloth sample. Make one four-foot shake-cloth sample per location. Record the number of parasitized or diseased larvae.

Record: Record number of worms at each site and note the percent defoliation.

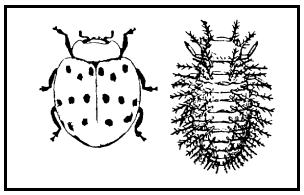
Economic Threshold: Treatment decisions are based on a variable threshold scheme (see Table 1, page 16). This table will correspond to the number of worms you find with each shake-cloth sample.

Mexican Bean Beetle

Occurrence: Occasionally seen in soybean fields along the Ohio River.

When to scout: Plant emergence to pod set.

Description: Adults are rounded copper beetles with 16 black spots on their back. They are about 5/16 inch long and 1/5 inch wide. Larvae are oval and yellow with branched spines. Full-grown larvae are about 1/3 inch long.



Damage: All stages feed on beans. Young larvae feed on the underside of the leaf. Older larvae eat through the leaf, leaving only the veins. This type of feeding gives the leaves a lacy appearance.

How to scout: Look for adults feeding on seedlings. When plants are taller use the shake cloth method. Record % defoliation.

Record: Record the total number of beetles per 4 ft. of row observed at each site. Calculate the average number for 4 ft. of row. See Table 2 on page 17 for the economic threshold.

Economic Threshold for Mexican Bean Beetle:

STAGE OF GROWTH	DATE	INSECTS/4 ROW FOOT TO JUSTIFY CONTROL
Seedling	June	3 or more adults
prebloom	July	20 or more larvae plus adults
bloom	July - August	16 or more larvae or adults
pod set	August	16 or more larvae or adults

Japanese Beetle

Occurrence: Early to mid-June through August.

Description: They are metallic green and bronze beetles about 2 inch long. There is a row of white tufts on the side of the body below the bronze wing covers.

Damage: Adults are leaf feeders. They begin feeding at the top of the plant and work downward. They will chew the leaf tissue between the veins. This type of damage gives the leaves a brown lacy appearance. Infestations may start with beetles feeding on weeds, especially smartweed, then moving to soybeans.

How to scout: When Japanese Beetles are seen, estimate the amount of defoliation.

Record: Record percent defoliation.

Economic Threshold: Control should be considered if 30% or more defoliation before bloom, 20% or more defoliation from bloom to pod fill, or 30% or more defoliation from pod fill until harvest **OR** if defoliation exceeds the economic injury levels listed in Table 2 (page 17).

Grasshoppers

Occurrence: Grasshoppers are likely to occur in at least two situations depending upon the tillage used. **No-tillage** - grasshoppers may occur very early in the season, and be evenly distributed across the field. This is true especially if the field was pasture or fallow before planting.

Conventional-tillage - Grasshoppers usually are not a problem until mid-summer when they move into fields from pastures or grassy areas.

When to scout: **No-till** cotyledon to first trifoliate very important. **Conventional till**- usually during dry spells. But - insects will be present all season.

Description: There are several species of grasshoppers present in Kentucky soybean fields. All have enlarged "jumping" legs. Mature hoppers will have wings. Some species never get larger than 1/2 to 3/4 inch. It is the small species that usually cause the most damage.

Damage: Grasshoppers are mainly foliage feeders which usually appears as very ragged holes beginning first on leaf margins. Under severe cases, petioles and stems will be eaten.

How to scout: Grasshoppers are active and very difficult to count. Watch for large numbers of hoppers as you move through the field. If defoliation is occurring consult defoliation Tables on page 3.

Record: Record percentage of defoliation. Estimate the number of grasshoppers per square yard.

Economic Threshold: Consult Table 2 - Percent Defoliation Charts for Determining Defoliation Required for Economic Injury to Soybeans (page 17).

Soybean Aphid* (AKA Chinese Aphid)

Occurrence: Not completely known at this time but probably mid- to late season. Certainly late planted / late maturing beans are most at risk.

Description: Small pale to bright yellow, soft bodied, pear shaped insects. Aphids have a pair of black cornicles (Atail pipe@ looking structures) sticking out the rear end. You may also see some small, white, aphids. However, this is the only aphid that colonizes soybeans in the US. If you find a single aphid it might be another species but if you find several aphids in a colony it is soybean aphid.

Damage: Soybean aphids have piercing sucking mouth parts. Damage is done by removing nutrients from leaf cells. Leaves will appear to yellow like a Alack of nitrogen." No foliage will be removed. Additionally, this pest is able to move viral pathogens that can cause diseases in soybean.

How to Scout: (**NOTE**: there is a faster method of sampling under development by the University of Minnesota. It is less accurate but much easier to perform. Because it is still in development you must get the updated worksheet each year at: http://www.soybeans.umn.edu/crop/insects/aphid/aphid_sampling.htm)

Examine thirty, whole plants, scattered throughout the field. For plants in growth stages V (vegetative), through R5 (beginning seed), count the total number of aphids on each plant, up to two-hundred and fifty (250). **NOTE:** This is a change from the 2005 procedure.

Record: The number of aphids per plant, for each of the thirty plants. Then average the individual plant numbers to produce the average number of aphids per plant for the field.

Economic Threshold: If the field has an average of two hundred fifty (250) aphids per plant during vegetative stages through reproductive stage R5 (beginning seed), 80% of the plants are infested, and the population is on the increase, a control is likely needed. Control after R5 is very unlikely to result in an economic return. See page 61 for soybean growth stages. Additionally, the absence of predators and parasitoids, the presence of honeydew and sooty mold and, evidence of plant stress, (especially drought) but also, soybean cyst nematode, & leaf and stem disease will increase the need to control the aphids.

IMPORTANT NOTE – Soybean aphid is a new and exotic pest. There is much we do not know about how they will affect KY grown soybeans. Therefore, these procedures are likely to change. Watch the IPM web pages at **http://www.uky.edu/Agriculture/IPM/ipm.htm** for updates.

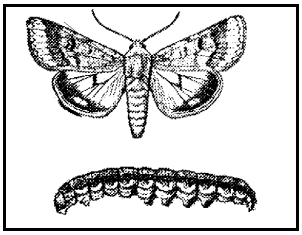
Pod Feeders

Soybean Podworm
(AKA: corn earworm)

Preventive Management: Soybean fields using narrow row spacing form a complete canopy sooner, so they are less attractive to egg laying moths.

When to Scout: Late bloom through maturity. Late planted fields, especially those in which a closed canopy did not develop, are at greatest risk.

Description:



Adults are buff to light green moths with a wingspan at rest of about 1/2". Eggs are white to pink, about 1/30" wide and laid singly. Larvae (worms) are very small to 1 1/2" in length when full grown. They are usually tan to pale green with several dark stripes down the back. However, color may be quite variable, with some individuals almost black.

Damage: These insects feed almost exclusively on pods. They eat away the pod wall and completely consume the seed.

How to scout: Shake cloth sample.

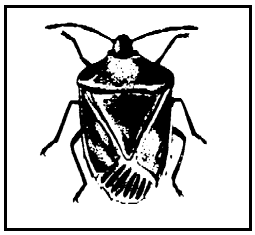
Record: Record the number of worms per a four foot sample area. Calculate the number of worms per foot of row.

Economic Threshold: Two worms per row foot.

Stink Bugs

When to scout: Beginning bloom (R1) through maturity.

Description:



Adults are 1/2-inch long, green or brown insects with sucking mouthparts. The body is shield-shaped. Nymphs are wingless and quite variable in color.

Damage: Stink bugs feed on beans in the pod. This causes discolored, shriveled beans.

How to scout: Stink bugs are often first found in border rows along wooded areas. You may wish to sample here first before sampling the complete field.

Shake cloth – Make one four-foot sample per location.

Sweep Net – Using a 15" sweep net, take a series of twenty five sweeps at each location.

Record: **Shake Cloth** – Record the number per four-foot sample.

Sweep Net – Record the number of stink bugs per set of 25 sweeps.

Economic Threshold: Chemical treatment may be needed if:

Shake cloth counts average two stink bugs per four row-foot sample.

Sweep Net counts: 3 stinkbugs / 25 sweeps from beginning bloom to beginning pod (R1 – R3) or 9 stinkbugs / 25 sweeps from full pod to full seed (R4 to R6).

Stem Damage

Dectes Stem Borer
(AKA Soybean Stem Borer)

Occurrence: The exact distribution in Kentucky is not known. However, the complete soybean production area in the western third of the state is at risk. At present no damage has been seen in Fayette County Trials.

Description: Adults are small gray beetles with long antennae. They emerge in July and lay their eggs in July and August. Larvae are small (approximately 1/2 inch) white worms. The head end is obviously wider than the remainder of the body which tapers to the rear end. A dark brown set of jaws can often be seen on the head.

Damage: Larva (worm) of this pest tunnels inside plant stems. This may result in some loss but is not the main problem. As larva mature, they move to the base of the plant and form an "over wintering" chamber. In doing this the larva girdle the inside of the stem. This weakens the stem often resulting in lodged plants, the main source of yield loss.

Scouting: At each location collect ten stems. Split the stems and check them for "hollowed out" centers and the presence of the insect and excrement.

Record: Percentage of infested stems. Use this to gauge which fields are at greatest risk to lodge.

Economic Threshold: There is no established economic threshold because there is no know method of control. Heavily infested fields should be harvested as early as possible to prevent lodging and resulting harvest loss.

Control: There is no know method of control.

Additional Information

Entfact-133, Seed corn Maggot in KY grown soybean.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa133.pdf

Entfact-131, Bean leaf beetle in KY grown soybeans.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa131.pdf

Entfact-132, Cutworm in KY soybeans.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa132.pdf

Entfact-142, Green cloverworm in KY soybeans.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa142.pdf

Entfact-143, Japanese beetles in KY soybeans.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa143.pdf

Entfact-116, Three common KY grasshoppers and their natural enemies.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa116.pdf

Entfact-144, Soybean podworm in KY soybean.
http://www.uky.edu/Agriculture/Entomology/entfacts/pdfs/entfa144.pdf

Agronomic Practices Affecting Insect Pests of Soybeans

	Tillage	Row Spacing	Early planting	Late planting	Rotation	Weed Management	Comments
Seedcorn Maggot	Y		Y				Use an insecticide seed treatment when planting into cool wet soil.
Cutworms				Y	Y	Y	Cutworms are more common in fields with excessive surface litter of crop residue, winter annual weeds, and fair to poor drainage.
Grape Colapsis	Y				Y		More common when soybeans follow clover. Avoid planting on a spring plowed field of timothy or clover.
Grasshoppers					Y		Reduced tillage can favor grasshoppers following pasture or a fallow year.
Southern podworm		Y		Y			The sooner the canopy closes, the less attractive the plants are for oviposition. Late planting and wide rows can delay canopy closure.

Table 1. The number of GREEN CLOVERWORMS per foot of row that will cause economic injury to soybeans.

Pre-bloom (5 to 6 trifoliates)- treatment recommended when defoliation exceeds 35%.

PRIOR TO BLOOM | BLOOM STAGE | POD FILL | APPROACHING MATURITY

Anticipated Yield of 25 bu/A

Cost of Treatment

Market Value	$6	$8	$10	$12
$5	14	15	16	17
$6	14	15	16	17
$7	13	14	15	16
$8	13	14	15	16

Market Value	$6	$8	$10	$12
$5	25	28	32	35
$6	24	27	31	34
$7	22	26	29	32
$8	21	24	27	29

Market Value	$6	$8	$10	$12
$5	24	27	30	33
$6	22	25	28	31
$7	20	23	26	29
$8	18	22	24	27

Market Value	$6	$8	$10	$12
$5	37	43	50	53
$6	34	40	47	52
$7	31	37	43	48
$8	28	34	39	44

Anticipated Yield of 35 bu/A

Cost of Treatment

Market Value	$6	$8	$10	$12
$5	13	14	15	16
$6	13	14	15	15
$7	12	13	14	15
$8	12	13	13	14

Market Value	$6	$8	$10	$12
$5	21	24	27	30
$6	20	23	26	29
$7	19	22	25	27
$8	17	20	22	25

Market Value	$6	$8	$10	$12
$5	20	23	26	28
$6	18	21	24	26
$7	16	19	22	24
$8	15	18	20	22

Market Value	$6	$8	$10	$12
$5	29	35	40	45
$6	27	33	38	43
$7	25	30	34	38
$8	22	27	32	36

Anticipated Yield of 45 bu/A

Cost of Treatment

Market Value	$6	$8	$10	$12
$5	12	13	14	14
$6	12	13	13	14
$7	11	12	13	13
$8	11	12	13	13

Market Value	$6	$8	$10	$12
$5	18	21	24	26
$6	18	20	23	25
$7	17	19	22	23
$8	15	18	20	22

Market Value	$6	$8	$10	$12
$5	15	19	21	23
$6	15	18	20	22
$7	14	17	19	21
$8	13	15	18	20

Market Value	$6	$8	$10	$12
$5	24	30	34	38
$6	23	28	32	36
$7	21	25	29	33
$8	19	23	27	30

How to Use These Tables:

Because of the difficulty in determining percentage defoliation, you may prefer to use the tables above for determining approximate economic injury levels of the GREEN CLOVERWORM. First select the table most nearly representing the growth stage of your beans and anticipated yield from the field. Then locate the estimated cost per acre of control (top line) and the estimated value per bushel of your beans (left-hand column). The number found at the point where these lines and columns intersect is the approximate number of GREEN CLOVERWORMS per foot of row that will cause economic injury to soybeans. Do not allow infestations of this insect to exceed this level.

For example, suppose your soybeans are at the stage of early pod-fill, anticipated yield is 35 bushels per acre. Your cost of control is $6 per acre, and the estimated market value of your beans is $8 per bushel. The correct answer is 15 green cloverworms per foot of row.

Table 2. Percent Defoliation Charts for Determining Defoliation Required for Economic Injury to Soybeans

Pre-bloom (5 to 6 trifoliates)-treatment recommended
when defoliation exceeds 35 percent.

	FULL BLOOM				POD FILL STAGE				APPROACHING MATURITY			
Anticipated Yields 25 bu/A												
Market Value / Cost of Treatment	$6	$8	$10	$12	$6	$8	$10	$12	$6	$8	$10	$12
$5	34	39	43	47	21	26	29	32	37	43	50	56
$6	32	37	41	45	20	24	27	30	34	40	46	52
$7	30	34	34	42	19	22	25	27	31	37	42	47
$8	28	32	32	39	18	20	23	26	28	34	39	44
Anticipated Yield 35 bu/A												
Market Value / Cost of Treatment	$6	$8	$10	$12	$6	$8	$10	$12	$6	$8	$10	$12
$5	29	33	37	40	18	22	25	27	29	36	40	45
$6	27	31	35	38	17	20	23	25	27	33	38	42
$7	23	27	30	33	16	18	21	23	25	30	34	38
$8	23	27	30	33	15	17	19	21	22	27	31	35
Anticipated Yield 45 bu/A												
Market Value / Cost of Treatment	$6	$8	$10	$12	$6	$8	$10	$12	$6	$8	$10	$12
$5	25	30	33	37	16	18	22	24	25	31	35	34
$6	24	28	31	34	15	17	20	22	21	28	32	36
$7	22	25	28	31	14	16	18	20	21	25	29	33
$8	21	24	27	29	13	15	17	19	19	23	27	30

The ability of soybean plants to sustain defoliation without yield reduction varies with the growth of the plant. Under favorable growing conditions the average percent defoliation figures given in this appendix can be used to determine economic injury levels. When the percentage of foliage removed approximates that given in the table for your particular set of variables (cost of treatment, projected yield and projected selling price of beans) treatment should be considered.

For example, if your beans are in bloom stage, you anticipate the yield will be 35 bushels per acre with a selling price of $8.00 per bushel and the cost of treating will be $6.00 per acre, defoliation must be 23 percent or greater to justify treatment.

TABLE 3
Bean Leaf Beetle Economic Thresholds for Soybeans

A. Bean leaf beetle injured pods/ 5 plant sample[a,b]

Market value	Management Costs $ / acre			
$ / bu	$ 7.00	$ 8.00	$9.00	$10.00
5.00	30.8-36.7	35.2-42.0	39.5-47.1	43.9-52.4
6.00	25.4-30.3	29.1-34.7	32.6-38.9	36.2-43.3
7.00	21.6-25.8	24.8-29.6	27.7-33.1	30.9-36.9
8.00	19.5-23.3	22.3-26.6	25.0-29.8	27.8-33.2
9.00	17.2-20.5	19.7-23.5	22.0-26.3	24.5-29.3
10.00	15.0-17.9	17.6-21.0	19.7-23.5	22.0-26.2

[a]ET range is set at 67 and 80 percent of the economic-injury level.
[b]Based on a row spacing of 30 inches and approximately 8 plants per foot of row.

B. Bean leaf beetles per sweep

Market value	Management Costs $ / acre			
$ / bu	$ 7.00	$ 8.00	$ 9.00	$10.00
5.00	2.9-3.5	3-4.0	3.7-4.5	4.2-5.0
6.00	2.4-2.9	2.7-3.3	3.1-3.7	3.4-4.1
7.00	2.0-2.4	2.4-2.8	2.6-3.1	2.9-3.5
8.00	1.8-2.2	2.1-2.5	2.4-2.8	2.6-3.2
9.00	1.6-1.9	1.9-2.2	2.1-2.5	2.3-2.8
10.00	1.5-1.7	1.7-2.0	1.9-2.2	2.1-2.5

ET range is set at 67 and 80 percent of the economic-injury level.

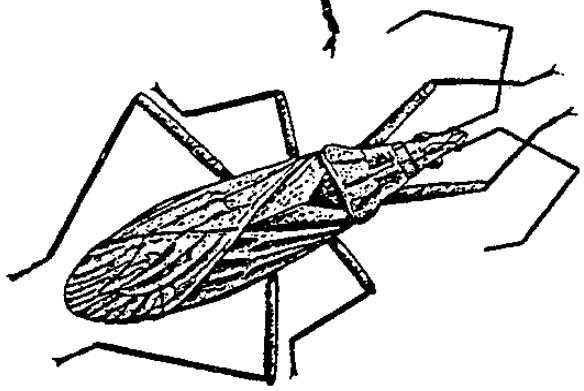
C. Bean leaf beetles per foot of row [a,b]

Market value	Management Costs $ / acre			
$ / bu	$ 7.00	$ 8.00	$ 9.00	$10.00
5.00	4.6-5.5	5.3-6.3	6.0-7.1	6.6-7.9
6.00	3.8-4.6	4.4-5.2	4.9-5.9	5.5-6.5
7.00	3.3-3.9	3.7-4.4	4.2-5.0	4.7-5.6
8.00	2.9-3.5	3.4-4.0	3.8-4.5	4.1-5.0
9.00	2.6-3.1	3.0-3.5	3.3-4.0	3.7-4.4
10.00	2.3-2.8	2.6-3.2	3.0-3.6	3.3-4.0

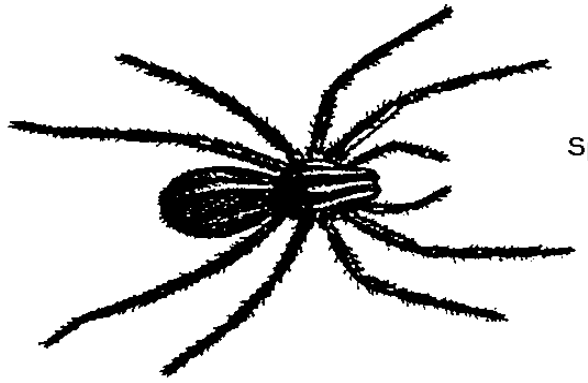
[a]ET range is set at 67 and 80 percent of the economic-injury level.
[b]Based on a row spacing of 30 inches.

Beneficial Insects of Soybeans

Big-Eyed Bug



Damsel Bug



Spiders

Scouting Procedures for Weeds in Soybeans

James R. Martin, J. D. Green and William Witt

Weeds listed in this manual will be checked each week for their presence in the field. The reason for this season-long survey is to determine when these weeds begin growth in soybeans. Many of the weeds to be surveyed will not appear in any of the fields that you will survey. However, these weeds are common in Western Kentucky, and are of great economic importance to the soybean producers.

When to survey the field:

Start 7 to 10 days after planting, and at weekly intervals, thereafter. You will be notified when the field is planted and can plan your surveys to best fit your schedule.

Number of locations per field:

The number of survey sites will be determined by the size of the field. The following guide is to be used:

Field Size	No of Locations
1-14	2
15-24	3
25-34	4
35-50	5

Select the survey sites so they will cover the entire field. Never survey within 100 feet of a fence or roadway. More weeds are found in field margins than in other portions of the field and surveying in these areas could result in an incorrect recommendation being made to a producer.

Sampling procedure:

At each survey site selected, select one (1) row middle (the area between two (2) rows). Put a wire flag in one of the rows, then measure 75 feet and place another flag in the row. Paint may also be used to mark these areas. You may need to repaint the markers. Your survey sites will be easy to locate each time you visit the field. This will be your survey site (one row middle x 75').

When weeds begin to grow during the season, select a 100 $Ft.^2$ area (for example 40 ft. long by 30 inches wide rows) within this survey site where weeds are present, and mark with flags or paint. Survey in this same 30' strip each week. It is very important to survey the same area so that we will know when the weeds begin to grow. The number and kinds of weeds vary throughout a field, and if you do not sample the same area, you might not encounter the weeds you are counting early in the growing

season, but as the soybeans grow taller, the wire flags will become more difficult to locate. Therefore, pull up the soybean plants on each side of the wire flags (about three or four feet in each direction) and mark on your field map the location of the survey sites (for example, the number of rows in from a fence, roadway, etc.).

Hopefully, there will not be a large number of weeds present in your survey site. However, if you encounter a large number of weeds in a 100 $Ft.^2$ section, it is not necessary to count all of them (in heavily grass infested field, it would not be uncommon to have several hundred plants). The following table can be used to know when to stop counting.

Weed	Maximum number of weeds to count/100$Ft.^2$
cocklebur	20
common lambsquaters	20
giant ragweed	20
jimsonweed	20
morning glory	20
smooth pigweed	20
smartweed	20
velvetleaf	20
wild cucumber	20
giant foxtail	40
johnsongrass	40
wild cane	40
fall panicum	40

How long to survey:

The field should be surveyed **until the middles are overlapped with soybean plants**. If no weeds have appeared up to this point, then you can survey at two to three week intervals for the remainder of the growing season. Be sure and pull your flags when the last count is made. The farmer does not want any wire flags going through his combine.

Record: Record each weed, the number counted and the average height of each type of weed.

Other observations in the field:

As you walk over the field conducting your survey, not only for weeds, but also for insects and diseases, be observant. If you see a heavy infestation of weeds, either note on the survey form or another form and bring it to the attention of your supervisor. It could be that special control procedures will be needed. Certain areas of a field are more likely to have large weed numbers than others. Some of these are near fences, roadways, drainage ditches and in low areas where water tends to stand.

Impact of weeds on soybean yield.

The competitive ability of weeds with soybean varies depending on the weed species. The following table demonstrates that some weeds are much more competitive than others. This also demonstrates the need for correct identification of weeds during the scouting process.

Approximate yield loss from various populations of weed species, if not controlled in first trifolialate soybean with a 40-bu/ac yield potential and uniform distribution of weeds across the field and growing with soybean for the entire season.

Weed Pressure category (% ground cover)	Foxtail spp.	Johnsongrass	Smooth Pigweed	Morningglory spp.	Common Cocklebur	Giant Ragweed (Horseweed)	Estimated yield loss by a single species	Estimated yield loss by all species
	number of weeds per 100 sq ft -						(bu/ac)	(bu/ac)
Slight (0-5%)	10	5	5	5	1	1	< 5	< 10
Low (5-10%)	20	10	10	10	4	4	10	15
Moderate (10-20%)	40	20	25	20	15	15	20	25
Severe (20-35%)	75	50	50	50	30	30	25	30
Very Severe (> 35%)	150	75	75	100	40	40	30	35

Mapping Fields for Weeds

One of your most important duties as a scout is to prepare a "weed map" of each field that you survey. This map will be of benefit to the grower in planning his weed control program for the coming years.

Steps in preparing a "weed map".

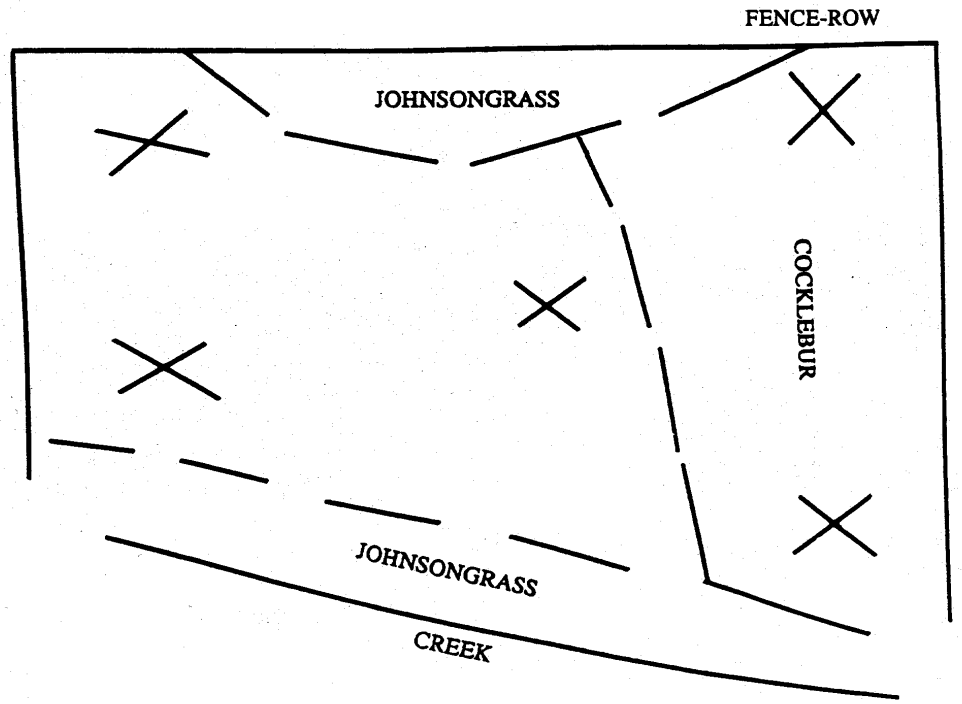
1) Outline the shape of the field on the report form. Make notations as to locations of fences, roads, woods, etc.

2) Mark the approximate locations of severe weed infestations or weeds not listed on the survey form and mark the locations where you make your counts.

3) This map should be drawn each time you scout the field.

4) Be sure and indicate any weed problems on the map that would assist the grower in making management decisions.

The following example can be used as a guide in preparing a "weed map" of your fields.

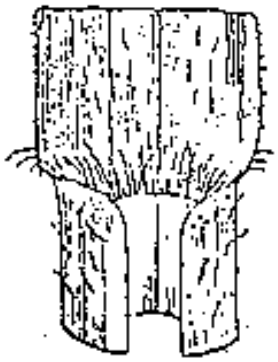


IDENTIFICATION OF COMMON WEEDY GRASSES BY VEGETATIVE CHARACTERISTICS

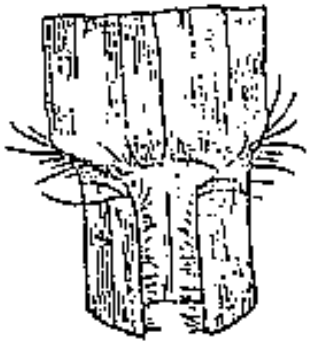
GRASS VEGETATIVE CHARACTERISTICS

	Ligule			Sheath		Blade		
	None	Hairy	Membrane	Smooth	Hairy	Smooth	Hairy	Rough
Large crabgrass			X		X		X	
Smooth Crabgrass			X	X		X	at base	
Giant foxtail		X		X				X
Green foxtail		X		X				X
Yellow foxtail		X	X	X		X	at base	
Goosegrass			X		at top	X	at base	
Johnsongrass		x fused	X	X		X		
Fall panicum		at base		X		X		

Note:
These are the usual characteristics; however, there may be variations.



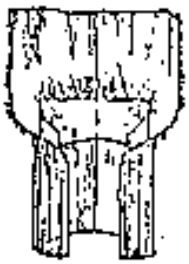
Giant Foxtail



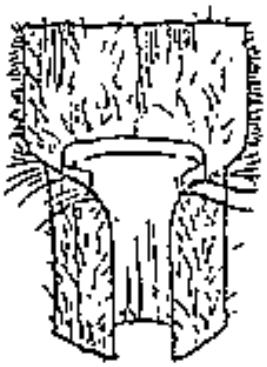
Green Foxtail

Yellow Foxtail

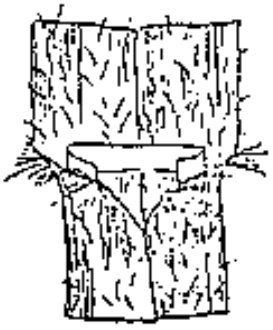
Wild Cane



Large Crabgrass

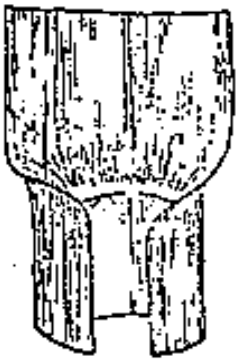


Smooth Crabgrass



Goosegrass

Johnsongrass



Fall Panicum

IDENTIFYING CHARACTERISTICS FOR CERTAIN SEEDLING BROADLEAF WEEDS

	Cotyledon	Leaf	Other
1. Chickweed	Small and thick Oval shaped Pointed tip	Oval shaped Pointed tip Opposite	
2. Cocklebur	Thick Long and Narrow	Oblong Toothed edges Alternate	
3. Cucumber, Wild	Thick Oblong	Somewhat lobed Alternate	Viney Stem
4. Eastern Black Nightshade	Small and Spoon shaped	Oval shaped Alternate	Lower surfaces of leaves often purple
5. Henbit	Round	Round shaped Toothed margins Deep crevices in surface Opposite	Square stem
6. Honeyvine Milkweed	Heart-shaped Opposite	Viney stem Long stem	
7. Hophornbeam Copperleaf	Oval shaped Toothed margins Opposite		
8. Jimsonweed	Thick Long and narrow	Heart-shaped with smooth edges near base and irregular edges at tip Alternate	Pungent odor
9. Lambsquarters	Small and Narrow	First 2 leaves are opposite and subsequent leaves are alternate	Leaves appear white, especially on underside
10. Morning glory Bigroot	Butterfly shaped with long narrow blades	Heart-shaped Hairless Alternate	Viney stem Established plants develop large perennial root
11. Morning glory, Entire leaf	Butterfly shaped	Heart-shaped Hairy Alternate	Viney stem
12. Morning glory, Ivy leaf	Butterfly shaped with prominent veins	3-lobed Hairy Alternate	Viney stem
	Cotyledon	Leaf	Other
13. Morning glory, Pitted	Butterfly shaped with long narrow	Shape is variable Hairless	Stem and leaf margin often purple

	blades	Alternate	Viney stem
14. Morning glory, Tall	Butterfly shaped with prominent veins	Heart shaped Alternate	Viney stem
15. Pigweed, Redroot	Narrow and about 1/4 inch in length	Oval Shaped Alternate	Taproot is red Stems are hairy
16. Prickly sida	Oval shaped 3 veins on upper surface	Oval shaped Toothed margins Alternate	2 to 3 spiney projections below each node
17. Ragweed, Common	Thick, spoon-shaped and small	Deeply divided Hairy Opposite	Emits a strong odor when crushed
18. Ragweed, Giant	Thick Spoon-shaped	Develop lobes with growth Opposite	
19. Shepherdspurse	Fleshy Small (2-3 mm) Round shaped	First leaves are round, other leaves are somewhat lobed	
20. Smartweed, Ladysthumb	Fleshy Narrow 3/4 inch long	Oblong and pointed Alternate	Membrane sheath at node is hairy
21. Smartweed, Pennsylvania	Fleshy Narrow 3/4 inch long	Oblong and pointed Alternate	Membrane sheath at node is not hairy
22. Velvetleaf	Fleshy and oval shaped Small hairs	Pubescent on leaf and stem Alternate	Pungent odor

Scouting Procedures for Diseases in Soybeans

Donald E. Hershman

The main reasons for scouting soybean fields for diseases include: 1) assessing potential stand losses (caused by diseases) that may require replanting; 2) determine the identity, incidence, and severity of active diseases, at key growth stages (to facilitate making fungicide use decisions); 3) develop historical disease data base for your farm; 4) help identify fields that may require early harvest and/or are not worth harvesting due to extreme disease; and 4) crop yield potential assessment.

When scouting for diseases in any crop, proper disease identification is essential. Once you are familiar with common diseases that occur in Kentucky, you will find they are not very difficult to identify. This guide will help, but the best teacher is experience. You are encouraged to attempt to identify diseases yourself, and then send a sample to one of the University of Kentucky's two Plant Disease Diagnostic Laboratories for confirmation. This service is available, at no cost, through your local county Extension office.

Initially, the thought of scouting for crop diseases can seem daunting. However, you will soon learn that the number of diseases you are likely to encounter is not that large. In addition, they tend to occur at specific times (and plant stages) during the season. They will **not** occur at the same time! The below chart will give you some idea of when specific diseases are most likely to be observed in your crop. When scouting, make notes about disease incidence in each spot you scout. In these notes, include the percent of plants with visible symptoms, and where in the canopy symptoms are most prevalent (lower, mid, upper canopy). Notes on disease severity, are also in order. You might find it helpful to use a 1-3 disease severity rating scale, where 1 is light severity and 3 is severe. Make management decisions based on the average disease situation in the field.

Observation Times for Soybean Diseases

	Pre-emergence	Seedling	Vegetative	Bloom	Beginning Pod	Pod Fill	Maturity
Seedling Blight		**********					
Brown Spot					**********	**********	**********
Soybean Cyst Nematode			**********	**********	**********	**********	**********
Downey mildew				**********	**********	**********	**********
Virus Diseases				**********	**********	**********	**********
Phytophthora root & stem rot			**********	**********	**********	**********	**********
Anthracnose					**********	**********	**********
Soybean Rust				**********	**********	**********	**********
Northern & Southern Stem Cancker					**********	**********	**********
Sudden Death Syndrome					**********	**********	**********
Cercospora Leaf Blight				**********	**********	**********	**********
Charcoal Rot					**********	**********	**********
Frogeye Leaf Spot			**********	**********	**********	**********	**********
Pod & Stem Blight						**********	**********

Description of Soybean Diseases

Anthracnose

Examination Period: Every two weeks from beginning pod fill to harvest maturity. Examine two rows of plants 10 feet in length.

Symptoms: Symptoms appear most frequently on stems and pods as irregularly-shaped brown areas. In advanced stages, affected tissues are covered with black fruiting bodies that resemble tiny pin cushions, thickly covered with black spines. These structures can be seen with the use of a 10x hand lens. There is no definite arrangement of these fruiting structures on the stems or petioles as in the case of pod and stem blight. Seeds from infected pods may be shriveled or moldy and may have dark spots on the seed coat.

Occurrence: Prolonged periods of wet, humid, warm weather favor the disease, which occurs late in the season. Early maturing varieties are frequently more likely to become infected. Fields that have been in soybeans the previous year are more likely to have anthracnose problems.

Brown Spot

Examination Period: Every four weeks from flowering until physiological maturity. Observe two rows of plants 10 feet in length at various spots throughout the field.

Symptoms: Irregular, dark brown spots from small specks to 1/6" develop on upper and lower leaf surface. Some spots may coalesce. Affected leaves often turn yellow and drop. Generally, lower leaves are first affected, and the disease then moves throughout the canopy, conditions permitting. All soybean varieties are susceptible to brown spot, but some varieties appear to be more susceptible than others.

Occurrence: Brown spot is present in nearly all young soybean fields each year to one extent or another. Symptoms usually disappear with the advent of hot, dry weather stops disease development. Warm, moist weather is favorable to the fungus. The disease can be worse where soybeans are following no-till soybeans and/or if early-maturing varieties are planted, since they tend to mature when conditions favor disease. River bottom fields or fields subject to fog or morning shade are usually the most impacted.

Cercospora Leaf Blight

Examination Period: Every four weeks from flowering until physiological maturity. Observe two rows of plants 10 feet in length at various spots throughout the field.

Symptoms: Affected leaves, mostly in

the upper canopy, will develop a bronze-purple stippling, usually concentrated between the veins on the upper leaf surface of upper canopy leaves. Close inspection will reveal that the stippling is the result of numerous pinpoint spots. Veins as seen on the leaf undersides may be darkened. Eventually, affected tissue becomes necrotic (brown) and starts to roll and deteriorate. Under severe disease conditions considerable upper canopy defoliation can occur. Seed harvested from affected pods often have a purplish color known as purple seed stain.

Occurrence: Cercospora leaf blight is typically a late season disease and tends to be most severe when warm, wet conditions coincide with grain fill. The disease can be worse where soybeans are following no-till soybeans and/or if early-maturing varieties are planted, since they tend to mature when conditions favor disease. River bottom fields and fields subject to morning fog and/or shade tend to be the most commonly affected. Varieties show minimal differences in susceptibility.

Charcoal Rot

Examination Period: Every four weeks from beginning pod fill until harvest. Examine two rows of plants 20 feet in length and keep your eye open for any suspected areas of the field.

Symptoms: Root systems are extensively rotted and have superficial and imbedded, pinpoint, black structures in roots and lower stems that resemble small flecks of charcoal (hence the name). The imbedded black bodies will appear as black streaks when the wood is scraped longitudinally with a knife. The sub epidermal black bodies are easily seen by peeling the "skin" off the roots and lower stems. Premature wilting and death of the plant may result and often occur as groups of plants in varying size areas.

Occurrence: Charcoal rot is most severe when conditions are wet during the vegetative growth stages followed by plants come under severe moisture stress during the reproductive stages. Dry, high temperature soils favor the expression of charcoal rot late in the season. Problems may be worse where soybeans were grown the previous year. One-hundred percent of the plants in a field can be infected because of the widespread occurrence of the causal fungus in all agricultural soils.

Downy Mildew

Examination Period: Every four weeks from V2 stage to physiological maturity. Observe two rows of plants 10 feet in length at various spots throughout the field.

Symptoms: Small, cream to yellow, irregular lesions can occur on any leaf, but they are most frequently observed in the upper 1/3 of the canopy. The underside of lesions will have a downy appearance, hence the name, downy mildew.

Occurrence: Seems to occur under any conditions that favor soybean growth, but the most severe infections are associated with hot, humid weather. The disease rarely impacts yield.

Frogeye Leaf Spot

Examination Period: Every four weeks from vegetative stage until maturity. Observe two rows of plants 10 feet in length.

Symptoms: Spots can occur on leaves in the lower, middle, or upper canopy. Spots are roughly circular, often if a faint yellow-green halo when young. Older spots have an ashen center and a purplish border (i.e., a "frog's eye). Severely diseased leaves frequently have a tattered appearance as affected tissue falls away from weathering. Soybean varieties can differ significantly in their susceptibility to frogeye leaf spot.

Occurrence: Generally develops in the late vegetative through pod fill stages. Leaves are only susceptible to infection while they are still expanding and at physiological maturity. Most severe symptoms are found in fields planted to susceptible varieties and in fields prone to fog or subject to morning shade. River bottom fields are frequently the most severely impacted, although frogeye can usually be found at very low levels in almost every field, every year.

Phytophthora Root and Stem Rot

Examination Period: Every four weeks from V2 stage to physiological maturity. Observe two rows of plants 10 feet in length at various spots throughout the field.

Symptoms: Plants of any age may wilt and die. On plants with at least a few visible nodes, the base of affected plants will have a distinct dark brown canker that encircles the stem, beginning at the plant base, extending up the stem 6 -8 in. or more. Leaves dry up on the plant and remain attached.

Occurrence: This is not a common disease in Kentucky even though the pathogen is commonly present in soils. Typically, soil conditions are not favorable for infection and disease development. The disease is favored by cool, wet soils, especially those with high organic matter content. However, there are certain fields in the Commonwealth that do have a history of recurring Phytophthora root and stem rot. Early-planted fields are at greatest risk. The disease is rarely seen in doublecrop soybean do to the warmer, dryer soil conditions in late-June – early July when doublecrop soybean is planted.

Pod and Stem Blight

Examination Period: Every two weeks from beginning pod fill to harvest maturity. Examine two rows of plants 10 feet in length.

Symptoms: Pod and stem blight is generally first observed occurring on fallen petioles near the base of attachment and on stems just above petiole attachment. Small, black, pimple-size structures (pycnidia) can be observed to align themselves in linear rows. Pycnidia, are also commonly distributed on the pod surface.

Occurrence: Warm, humid weather favors the disease which occurs late in the season. Planted early maturing varieties are generally more likely to become infected. Fields that have been in soybeans the previous year are more likely to be affected. Similarly, fields subject to delayed harvest are frequently affected. Pod and stem blight

is the primary biological cause of reduced soybean seed quality in Kentucky.

Seedling Blight

Examination Period: Every two weeks from planting until V2 stage. Look for dead or dying seedlings two rows of plants 10 feet in length at various spots through the field

Symptoms: Generally only scattered individual plants or small groups of plants are killed. Several fungi can cause seedling blight and the symptoms observed may vary according to the fungi involved. Infected seedlings may contain small, black, dry, sunken lesions on the cotyledons. Infected stem tissue may be translucent to brown or orange-brown in color. A soft, water rot is often produced. Dry weather may cause infected plants to become dry and shredded. Outermost tissues of larger roots may slough off. Smaller roots may be decayed and break away from plants when pulled from the soil.

Occurrence: Low soil temperatures from 50F to 60F and high soil moisture are favorable to disease development. Low, wet and compacted areas of the field are likely to show the first symptoms of the disease. No-till fields may be more prone to seedling blights due to the tendency for fields to be somewhat cooler and wetter compared with their tilled counterpart. Disease is also favored if seed planted is of marginal quality, especially if no seed fungicide was used.

Soybean Cyst Nematode

Examination Period: Every four weeks from V2 until harvest. Observe all areas of the field with and without suspected symptoms.

Symptoms: **It is very common for SCN to damage crops without there being any obvious disease symptoms.** However, in some fields, under certain conditions, disease symptoms will be evident. Look for stunted yellow plants in roughly circular to oval areas of the field. Randomly dig (*do not pull*) up 20 plants (healthy and suspect) and examine the roots with hand lens for small, white, yellow, or dark brown lemon shaped cysts. Do not confuse cysts with nitrogen fixing nodules which will be 100 - 1000x larger than cysts. Cysts are small, but once you know what you are looking for, they can often be seen by the unaided eye. If you see cysts, this means there will likely be significant yield loss in the field. But whether or not you see cysts, if your recent crop yields are not up to par, collect soil samples from suspect fields immediately after harvest and have a SCN analysis done. Sampling instructions can be obtained at you county extension office and on-line:

http://www.ca.uky.edu/agcollege/plantpathology/ext_files/SCNsamplingInstructions.pdf

Occurrence: When symptoms do occur, they will be especially pronounced where soil fertility is inadequate, soil is sandy, and/or under moisture stress conditions. However, do not count on symptoms as a means of verifying the presence or absence of SCN. Damage is most likely to occur in fields which have SCN-susceptible or moderately susceptible varieties as part of a fields crop sequence. **Note:** recent surveys have found that most SCN populations in Kentucky can now reproduce to at least some extent on most SCN-resistant varieties marketed in Kentucky. Some varieties marketed as being resistant, in fact, are nearly fully susceptible.

In other words, it is imprudent to assume you are doing a good job of managing SCN even where no symptoms are seen, where proper crop rotation is practiced and where SCN-resistant varieties have been routinely planted. If yields are not up to par, have an SCN soil analysis done for each problem field.

Soybean Rust

Examination Period: Weekly from flowering stage until maturity.

Symptoms: It is almost impossible to find extremely low levels of soybean rust in the field. Instead, samples must be incubated for 24-48 hrs and then observed at high magnification by a trained diagnostician. However, soybean rust is fairly easy to detect in the field once incidence has reached 5-10% (i.e., 5-10 leaves/100 observed) or more. Small brown lesions, with pustules, form on both leaf surfaces, but primarily on the undersides of leaves. Lesions are commonly first seen in small groupings along leaf veins or on leaf margins. This has to do with how water has flowed across and dried on the leaf surface. Observe lesions with a 20-30x hand lens. Look for very small brown raised structures that have the appearance of an "egg over easy" when young and a miniature volcano when old. When conditions are favorable (e.g., moist), look for clusters of clear spores coming from pustules. If initial field observations are unsuccessful, collect 100 suspect leaves, incubate them in a plastic bag for 24 hrs, and then observe them. Incubation frequently induces pustules to produce spores which are necessary to visually confirm the presence of soybean rust. Early stages of soybean rust are easily confused with other fungal and bacterial diseases, even thrip injury. When in doubt, collect leaves and submit them to one of UK's two plant disease diagnostic laboratories for observation.

Occurrence: The soybean rust fungus does not overwinter in Kentucky. Rather, the causal fungus overwinters in the deep South and then blows north as the season progresses. Portions of fields that are subject to morning shade or fog are often the first to show symptoms. Lesions with pustules first develop in the lower canopy, usually after the crop begins to flower and especially during pod fill. The disease then moves into the upper canopy, provided conditions remain favorable for disease development. Hot and dry weather can stifle disease progress. Soybean rust is favored by moisture and moderate temperatures. Once disease severity reaches 20% or more, defoliation will usually occur within the next 6-8 weeks. During extremely hot and dry weather, disease progress frequently comes to a standstill until more favorable conditions return. All commercially available soybean varieties are highly susceptible to soybean rust.

Stem Canker

Examination Period: Every two weeks from beginning pod fill to harvest maturity. Examine two rows of plants 10 feet in length for initial signs and symptoms, but be observant over a much wider area for advanced symptoms of plant decline and death.

Symptoms: Look for dark, red-brown to tan, girdling cankers in the vicinity of stem nodes, often at the 4th or 5th node. Faint concentric rings may be visible within the canker. Diagnostic symptoms include healthy green stem tissue above and below the canker, diseased stems mixed in with healthy stems, leaves that die on the plant, but remain attached, and wilting terminals of affected plants during the heat of the day.

Occurrence: The disease is more prominent in fields under continuous soybean production and is favored by moderate temperatures and moisture as well as early planting dates. Plants are infected in the early vegetative stages, but symptoms do not appear until the pod fill stages. Diseased plants may be widely scattered throughout a field or confined to groups. In severe cases, entire fields may be affected. Varieties differ in susceptibility to stem canker.

Sudden Death Syndrome (SDS)

Examination Period: Every two weeks from beginning pod fill until maturity. Examine two rows of plants 20 feet in length and keep an eye out for any suspicious areas within the field. SDS can be detected from a considerable distance, but confirmation requires close inspection of affected plants.

Symptoms: Initially, leaves show numerous, irregularly-shaped bright yellow blotches between the veins, which later become brown, while the main veins remain green. Occasionally, early disease symptoms mimic virus infections; the toxin that causes leaf symptoms can induce the appearance of leaf mottling and crinkling symptoms characteristic of virus infections. Leaflets may fall off the plants, leaving the petioles attached, thus, resembling feeding damage by grasshoppers. Pods of affected plants may shrivel and fall off the plant if foliar symptoms are evident by early pod development. If infections occur late, foliar symptoms may look severe, but yield may be little impacted. The fungus that causes SDS causes a root rot and also produces one or more plant toxins that result in aboveground symptoms. In the later stages of disease development, roots will be completely deteriorated and stems will have a milky brown interior when cut length-wise with a knife. At advanced disease stages, it is common to see signs of the causal fungus sporulating on severely diseased roots. Look for cobalt blue masses, especially on diseased primary and secondary roots.

Occurrence: SDS usually develops in "hot spots" or streaks in fields. Affected plants most commonly first show foliar symptoms about the mid pod fill stage of development. However, root rotting is often evident weeks before, during the vegetative stages. Symptoms often get progressively worse until the plants die, but plants and fields have also been known to recover from light, early disease. SDS is most common in fields with high soil fertility, poor field drainage characteristics, soil compaction and/or soybean cyst nematode infestations, especially when planted early. Foliar symptoms can be confused with stem canker, but no visible canker forms in SDS-affected plants. SDS rarely develops in late-planted or doublecrop soybean because of higher soil temperatures. Varieties differ significantly in susceptibility to SDS.

Virus Diseases

Examination Period: Every two weeks from V2 stage until R6 (full pod stage). Observe two rows of plants 10 feet in length.

Symptoms: Plants infected early in the season are stunted. Leaves are stunted, misshapen, puckered and occasionally with dark green areas along the veins. A yellow mottling in the form of spots may develop on young leaves of infected plants. Later season symptoms may include a browning of yellow spots and a brown discoloration of the veins. When more than one virus is present, plants may become severely stunted and deformed with puckered leaves. Positive identification of soybean virus diseases cannot be done in the field. Samples must be submitted to a qualified plant disease diagnostic laboratory for proper identification.

Occurrence: Temperatures between 65° F and 78° F are most favorable for virus symptom expression. Higher temperatures may mask symptoms. Aphids and bean leaf beetles transmit soybean viruses. The former commonly transmits soybean mosaic virus, bean yellow mosaic virus, and alfalfa mosaic virus in Kentucky. Bean leaf beetles transmit bean pod mottle virus. Soybean mosaic virus is also seed transmitted and, thus, is often seen when farmer saved seed has been planted. The earlier symptoms are observed, the greater the potential yield damage caused by the virus.

SOIL SAMPLING AND SOIL TESTING

Lloyd Murdock

The most important factor of soil testing and fertility recommendations is obtaining a good soil sample. There is more room for error in this step than any other in getting reliable soil test results and recommendations.

Method:

The proper procedures for obtaining a good soil sample are well-established. Publication AGR-16 (Appendix I) contains a complete explanation of these procedures.

Time of Sampling:

Soil samples for alfalfa, small grains and soybeans can be taken anytime in the fall, winter or spring as long as it is at least six weeks after the last fertilizer application.

Recent fertilizer applications can distort the soil test results and fertilizer recommendations.

The best time to sample is in the late winter or spring for that year's fertilization. This gives all the nutrients in the soil and those released by the plant a chance to equilibrate. Fall sampling is also good but needs attention paid to sampling location to ensure a more representative sample in row crops. An equal number of samples should be taken from the row middle and from next to the row.

Early season scouting notes should be recorded and areas needing special attention should be outlined on the field map and soil sampled, if needed, to help determine the cause of the problem. The best overall suggestion when special notes are lacking is to wait at least six weeks after the fertilizer application but sample while the general crop condition and field are still visible.

Soil Sampling Depth:

Crop	Depth of Sample
No-till soybeans	4"
Conventional soybeans	6-8"

Identifying Compacted Soil

Lloyd Murdock

Most compaction results from the use of machinery on soil which is too wet to work well, or from overworking soil and destroying its natural structure. Pressure from tires and tillage tools compress more soil into a given volume. In the process, the natural soil aggregates are broken down and large pores become smaller. This increases the density of the soil and makes it more difficult for roots to penetrate the soil and decreases plant available water.

There are several ways to help determine if the soil is compacted sufficiently to cause problems. A soil penetrometer, tiling rod or a three foot length of 3/8-inch diameter steel rod sharpened on one end and having a handle welded to the other end are easy tools to use in identifying compacted layers. Such tools should be marked in six inch increments and should uniformly be pushed into the **soil when the moisture content is too wet for** tillage. Under these conditions, compacted layers can be "felt" due to resistance in pushing the rod through the soil, and depth to and thickness of the compacted zone can be identified.

The best method for identifying soil compaction is with a soil penetrometer. This is similar to a tiling rod but has a gauge that measures the amount of pressure required to push the rod into the soil. An Annual Field Compaction Record Sheet is on page 55 and gives instructions on how to use the penetrometer and how to make a field recording.

Regardless of the method used, a number of sites in each field should be checked (similar to a soil test) and if severe compaction is found it needs to be confirmed. The penetrometer will also give high readings for a dry soil and heavy clay layer. Therefore, if severe compaction is suspected in a field by the use of a penetrometer then a soil probe or shovel needs to be used to look at the layer and confirm that high readings were not due to a clay or dry layer.

End rows and areas of high traffic may need to be sampled and treated separately.

ANNUAL FIELD COMPACTION RECORD

University of Kentucky
Department of Agronomy

FARM_____ FIELD _____ ACRES_____

MAJOR SOIL TYPE _____ YEAR_____

Site	Reading	Depth of Highest Reading
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Site	Reading	Depth of Highest Reading
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

SUMMARY

% of reading 200 or less _____

% of reading 300 or more _____

Most common depth
of readings 300 or more _____

METHOD

Push penetrometer into the soil slowly (do not surge). Note the highest psi reading and the depth at which it occurs. Continue to push until the resistance drops and note the depth where this happens.

Always use the penetrometer when the soil is too wet for proper tillage and when it is not saturated with water.

Avoid or test separately field entrances and turn row areas that have excessive traffic and do not represent the field. Readings should be taken in a random manner over the rest of the field.

INTERPRETATION

With readings of 300 psi or above, the compaction is considered severe. If 1/3 of the readings are 300 or more, a corrective action and change in tillage practices should be considered. When 1/2 of the field readings are 300 or more, then changes definitely need to be made. If severe compaction is identified in only a portion of the field, then corrective action should only be considered in that portion.

EXAMPLE RECORD

Site	Reading	Depth of Highest Reading
1	175	6-12
2	200	9-15
3	300	9-15
4	175	6-12
5	300+	9-15
6	225	9-15
7	200	6-12
8	300+	6-15
9	150	3-18
10	250	9-15

SUMMARY

% of readings 200 or less 50

% of readings 300 or more 30

Most common depth of readings 300 or more 9-15

Recognizing Deficiency Symptoms In Soybeans

Lloyd Murdock

Symptoms of a nutrient deficiency can be confused with those of a plant disease or other problems. Nutrient deficiency symptoms under unfavorable growing conditions such as drought or wet weather do not necessarily indicate a shortage of fertilizer. Information on previous soil treatments and a soil test are needed to identify a deficiency. Your local County Extension Office can provide you with the equipment and instructions needed to have your soil tested. The following are descriptions of nutrient deficiency symptoms in soybeans:

Nitrogen (N)

Nitrogen deficiency in soybeans are rare. Young plants will appear pale green and the number of root nodules will be decreased or nonexistent. Sometimes the root nodules can be present but inactive due to excessive water or extreme drought. Active nodules will be "beef steak" red in the center of the nodule. Occasionally, nitrogen deficiency symptoms are caused by soybean cyst nematode or a microorganism causing root rot.

Potassium (K)

Symptoms will sometimes but not always appear first and be the most severe on older leaves. The first indication of a deficiency will be yellow mottling on the edges of leaflets. This will form an irregular but continuous border on the leaf. This area will eventually turn brown and die. Potassium deficiency will delay branching, reduce the number of pods set and reduce the number of beans per pod. Low Potassium soil test levels, Soybean Cyst Nematodes and soil compaction are some of the causes of Potassium deficiency symptoms.

Manganese (Mn)

Plants with a manganese deficiency will be stunted and have short, thin stems. Their foliage will be pale green to yellow. However, the veins of the leaves will stay green. The faded area of the leaves will next develop small brown lesions. The new leaves will change colors first. Old leaves will remain green and appear healthy. High soil pH and poorly drained soils are the main causes of this symptom.

SOYBEAN GROWTH STAGES

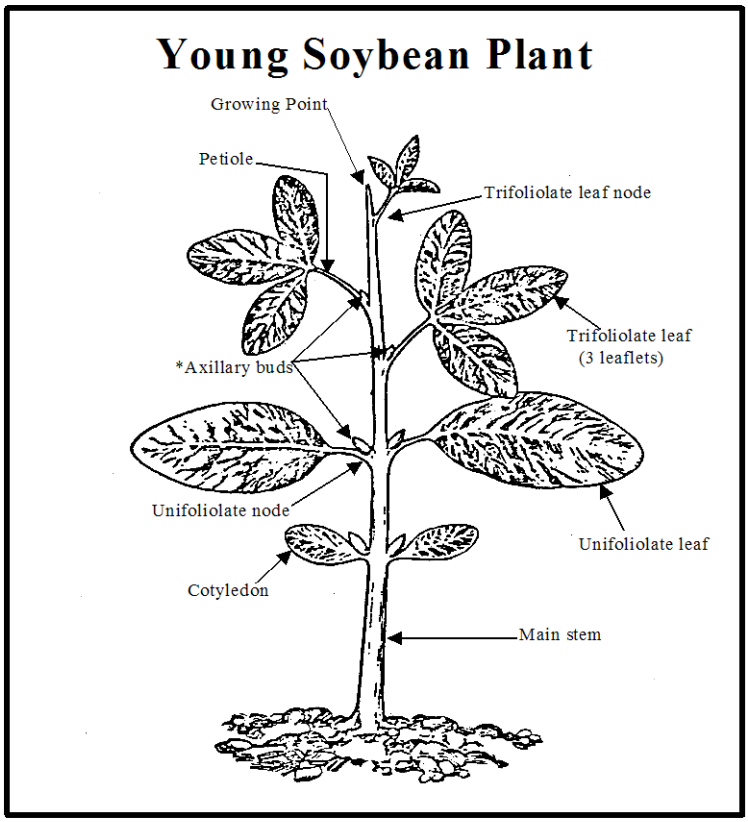
Jim Herbek

GROWTH STAGE		DESCRIPTION
Vegetative (V) Stages:		Begins with emergence (VE) and ends with Vn (last V stage prior to bloom).
Emergence	(VE)	Cotyledons above the soil surface.
Cotyledon	(VC)	Unifoliolate (single leaflet) leaves unrolled sufficiently so the leaf edges are not touching. The unifoliolate leaf node is the first node.
First-trifoliolate	(V1)	One fully developed trifoliolate (three leaflets) leaf. Is the first trifoliolate leaf node above the unifoliolate node.
Second-trifoliolate	(V2)	Two fully developed trifoliolate leaves. The first two trifoliolate leaf nodes above the unifoliolate node have fully developed leaves.
Third-trifoliolate	(V3)	Three trifoliolate leaf nodes on the main stem have fully developed trifoliolate leaves beginning with the first trifoliolate leaf node above the unifoliolate node.
nth-trifoliolate	(Vn)	The last V stage is designated V(n), where (n) represents the number for the last fully developed trifoliolate leaf on the main stem prior to beginning bloom (R1). (n) can be any number beginning with 1 for V1. The (n) for the the last V stage prior to beginning bloom (R1) will fluctuate with variety and environmental conditions. Varieties with an indeterminate growth habit (most varieties in maturity groups 00 to IV) will have a lower V(n) because they bloom earlier than varieties with a determinate growth habit (varieties in maturity groups V to IX). The V stages (node stages) following VC are defined and numbered according to the uppermost fully developed trifoliolate leaf node on the main stem. ***Determination of a fully developed leaf:*** A leaf is considered fully developed (leaf node is counted) when it has unrolled or unfolded leaflets (i.e. the two edges of each leaflet have separated (unrolled) and the two edges are no longer touching each other). For example, the V4 stage is defined when the leaflets on each of the first four trifoliolate leaf nodes are

		unrolled (i.e. four trifoliolate leaves are fully developed). The unifoliolate leaf node is unique because the unifoliolate (single leaflet) leaves are produced from it on directly opposite sides of the stem. The unifoliolate node is technically two separate nodes, but they are counted as one because they occur at the same position on the main stem. All other true leaves are trifoliolate (three leaflets) leaves, and are produced singularly (from different nodes) and alternate (from side to side) on the stem. The cotyledons (modified leaf storage organs) also arise opposite on the stem just below the unifoliolate leaf node. When the unifoliolate leaves (or the first few trifoliolate leaves) are lost (through injury or natural aging), the position of the unifoliolate node can still be determined by locating the two leaf scars (slight indentations) on the lower stem where the leaf petioles were attached that permanently mark where the unifoliolate leaves had grown. These unifoliolate leaf scars are located just above the two opposite scars, which mark the cotyledonary node position. Any leaf scars above the opposite unifoliolate leaf scars appear singularly and alternately on the stem, and mark node positions where trifoliolate leaves had grown.
Reproductive (R) Stages:		(Begins with bloom (flowering) and ends with maturity).
Bloom:		
Beginning bloom	(R1)	One open flower at any node on the main stem.
Full bloom	(R2)	Open flower at one of the two uppermost nodes on the main stem with a fully developed trifoliolate leaf.
Pod-Fill:		
Beginning Pod	(R3)	Pod 5 mm (3/16 inch) long at one of the four uppermost nodes on the main stem with a fully developed trifoliolate leaf.
Full pod	(R4)	Pod 2 cm (3/4 inch) long at one of the four uppermost nodes on the main stem with a fully developed trifoliolate leaf.
Seed-Fill:		
Beginning seed	(R5)	Seed 3 mm (1/8 inch) long in a pod at one of the four uppermost nodes on the main stem with a fully developed trifoliolate leaf.
Full seed	(R6)	Pod containing a green seed that fills the pod cavity at one of the four uppermost nodes on the main stem with a fully developed trifoliolate leaf.

Maturity:

Beginning Maturity	(R7)	One normal pod on the main stem that has reached its mature pod color (normally brown or tan). Seed is yellow (has lost all green color).
Full maturity	(R8)	Ninety-five percent of the pods that have reached their mature pod color. Five to ten days of drying weather are required after R8 before the soybean has less than 15 percent moisture.



*The upper junction between the main stem and a leaf petiole is called an axil. In each axil there is an axillary bud. This bud usually developes a flower cluster, but may remain dormant, or may develop into a branch.

Plant Populations In Soybeans

Jim Herbek

Some producers prefer soybean stands reported as plants per foot of row (based on row spacing). Others prefer soybean stands reported as plants per acre. Stand/population determinations for each of these are explained below.

Stand Counts should be determined around the second week after emergence. A 10 foot piece of rope or measuring tape can be used for measuring the length of row. Place this rope between two rows and count the number of plants in both rows within a ten foot distance (for a total of 20 linear feet of row for each count). Repeat this process in five locations in the field for each 50 acres or portion thereof, thus giving a **total of 100 linear feet of row** for each 50 acres or less.

The exact 20 feet of distance for each count (total of 100 linear feet for 5 counts) **is important** due to the nature of the population formula, which is based on 100 feet of row (see table in next column)

Try to pick out representative rows for stand counts. If areas of the field are quite different in respect to stands, these areas should be counted and noted separately.

Stand (plants per foot of row)

Divide the total number of plants counted in 100 linear feet of row by 100 to determine the average number of plants per foot.

Example:
Number of plants in 100 feet = 620
620 ÷ 100 = 6.2 plants per foot of row.

Population (plants per acre)

Row width: Measure the distance between rows in several locations to determine the row spacing. Or, check with the producer to find out what row width was used in planting.

Population determination: Multiply the total number of plants counted in 100 feet of row by the "C" (conversion) factor for the appropriate row spacing (see table below).

Example:
Stand Count for 100 feet = 461
Row width = 15 inches
461 x 348.48 = 160,649 plants per acre.

Row Width	C Factor*
7"	746.78
8"	653.37
10"	522.74
15"	348.48
20"	261.35
30"	174.24

*To find the "C" (conversion) factor for other row spacings, divided 43,560 by the row spacing (in feet) and then divide that result by 100 (for 100 linear feet of row counted).

Examples of the number of stand/population determination needed for various field sizes.

39 acre field	=	One population determination (100 feet of row)
76 acre field	=	Two population determinations (100 feet of row each)
141 acre field	=	Three population determinations (100 feet of row each)
232 acre field	=	Five population determinations (100 feet of row each)

When more than 50 acres are involved in a field, determine the plant population for the whole field by averaging the plant populations that were obtained for each 50 acre portion. Also, draw a map of the field indicating the location of each 50 acres or portion thereof counted and the plant population obtained in each location.

Soybean plant stands may range from one plant per foot of row (narrow rows) to 12 plants per foot of row (wide rows) depending on row width. Soybean plant populations (plants per acre) may range from less than 100,000 to over 200,000 plants per acre, but will generally be in the range of 120,000 to 170,000 plants per acre.

Broadcast Soybeans

Plant populations for soybeans not planted in rows can be determined by making stand counts using two methods: a) counts on a square foot basis; or b) hula-hoop method:

a). Plants per square foot method: Use a four foot square area to make counts. Obtain a four foot square by marking a rope into two foot lengths and forming a square or use a fold-up wooden rule to form a 2 foot x 2 foot square. Count the number of plants contained in the four foot square area. Repeat this process in 10 locations in the field for each 50 acres or portion thereof, thus giving a total of 40 square feet for each 50 acres or less. Determine plant populations by dividing the total number of plants obtained in 40 square feet by 40 to determine the average number of plants per square foot. Multiply the average plants per square foot by 43,560 square feet per acre to obtain the population (plants per acre).

Example:
Total plants in 40 sq. ft. = 140
140 ÷ 40 sq. ft. = 3.5 plants per sq. ft.
3.5 x 43,560 = 152,400 plants per acre.

b). Hula-hoop method: Stand counts can be taken using a hula-hoop. Randomly toss the hoop and count the number of plants within the circle. Repeat this process in 10 locations in the field for each 50 acres or portion thereof, thus giving a total of 10 counts for each 50 acres or less. Determine plant populations by dividing the total number of plants obtained in 10 hoop counts by 10 to obtain the average number of plants counted per hoop. Plants per hoop can then be converted to plants per acre by multiplying the average number of plants counted per hoop by the factor (for the inside diameter of the hoop used) shown in the table below.

Example:
Total plants in 10 hoop counts = 156
156 ÷ 10 hoop counts = 15.6 plants per hoop
Inside diameter of hoop = 28 inches
15.6 x 10,000 = 156,000 plants per acre.

Inside Diameter of Hoop	26”	28”	30”	32”	34”	36”	38”
Multiplication Factor	11,800	10,000	8,900	7,800	6,900	6,200	5,500

Estimating Soybean Yield Prior to Harvest

Jim Herbek

The following are guidelines to get an estimated soybean seed yield while the crop is still standing in the field. Proceed with caution since variability in soybean stand, pods per plant, seeds per pod, and seed size can all drastically affect the final yield. These estimates become highly variable when conducted before seed fill is completed. Even with these attempts to get as representative a sampling as possible, there is still variability with the yield estimates because of assumptions about final pod number, seed number and seed size.

Estimates should be made in five to ten locations across the field to get a better estimate for yield. Obviously, the more locations you sample, the better the estimate. Each of the locations selected should represent those areas of the field.

Step 1. Determine size of area to be investigated.

Select 1/1,000th of an acre because the numbers are easy to calculate. The feet of row needed to equal 1/1,000th acre for various row widths are shown in the table below. The following steps are based on using 1/1,000th acre. If another size is selected, then adjust the calculations accordingly.

Row width and feet of row needed to equal 1/1,000th acre.

Row Width (inches)*	Feet of row needed to equal 1/1,000th acre
6	87 feet 1 inch
7	74 feet 8 inches
7.5	69 feet 8 inches
15	34 feet 10 inches
20	26 feet 2 inches
30	17 feet 5 inches

*To determine the length of row needed for other row widths, divide 43,560 by the row width (in feet) and then divide the result by 1000.

Step 2. Estimate plants per 1/1,000th acre.

Count the number of plants within the required length of row determined in Step 1. Make several counts and determine an average.

Step 3. Estimate plant population.

Multiply the average number of plants from Step 2 by 1,000 to estimate plants/acre.

Step 4. Estimate pods per plant.

Pick 10 plants in a row and count the pods on each plant. Determine the average number of pods per plant.

Step 5. Estimate pods per acre.

Multiply the pods per plant from Step 4 by the number of plants per acre determined in Step 3.

Step 6. Estimate seed number.

Healthy soybean plants will average about 2.5 seeds per pod. For healthy soybeans, multiply pods per acre from Step 5 by 2.5 seeds per pod to estimate seeds per acre. For soybeans under stress, the seeds per pod could drop to 2 or 1.5 or even less under highly stressful situations. You can actually evaluate the seeds per pod from the same soybean plants used in Step 4.

Step 7. Estimate seed weight.

The seed size (weight) estimate used in this calculation can make a large difference in yield estimations. Seed size is highly variable and can range from 2200 seeds per pound (large seed) to over 3500 seeds per pound (small seed) and is dependent on variety and also growing season conditions. Thus, it is difficult to know what seed size (seeds per pound) to use to obtain pounds per acre.

In Kentucky, about 2,800 seeds per pound is an average number. Divide the number from Step 6 by 2,800 to determine pounds of seed per acre. Under stressful conditions, the seed size may be smaller, meaning that more seeds per pound are needed. The original seed size from the seed bag may provide the best indication of soybean seed size.

Step 8. Estimate bushels/acre.

One bushel of soybeans typically weighs 60 pounds. Divide the number from Step 7 by 60 to estimate bushels per acre.

EXAMPLE

Step 1. Area size for 1/1000th acre

- Soybean row width = 15 inches.
- Make counts in 34' 10" of row.

Step 2. Estimate plants per 1/1000th acre

- Average plant count from 10 locations = 140 plants.

Step 3. Estimate plant population

- 140 plants x 1000= 140,000 plants/acre.

Step 4. Estimate pods per plant

- Average pod count from 10 or more plants = 30 pods/plant.

Step 5. Estimate pods per acre

- 30 pods/plant x 140,000 plants/acre = 4,200,000 pods/acre.

Step 6. Estimate seed number

- Healthy soybean plants. No stress.
- Assume 2.5 seeds/pod.
- Or, make actual counts (several plants).
- 2.5 seeds/pod x 4,200,000 pods/acre = 10,500,000 seeds/acre.

Step 7. Estimate seed weight (seed size)

- Estimate based on growth conditions or use 2800 seeds/lb average.
- Or, from seed bag = 3000 seeds/lb.
- 10,500,000 seeds/acre ÷ 3000 seeds/lb = 3500 lbs/acre.

Step 8. Estimate bushels per acre

- 3500 lbs/acre ÷ 60 lbs/bushel = 58 bushels/acre (estimate).

APPENDIX