IPM - 2

UNIVERSITY OF KENTUCKY
College of Agriculture, Food and Environment

Kentucky Integrated Crop Management Manual for Field Crops

"CORN"

Section 1
Pages 1 – 30

Kentucky Integrated Crop Management Manual for Corn

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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/Ag/IPM/

For the most current information on pests view the **Kentucky Pest News** at:
http://www2.ca.uky.edu/agcollege/plantpathology/extension/kpnindex.htm

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

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Ric Bessin. University of Kentucky. Wireworm, pg. 3; Black cutworm larva and Black cutworm moth, pg. 4; Brown stink bug and Stink bug damage, pg. 5; Southwestern corn borer, pg. 9; Fall armyworm and Fall armyworm moth, pg. 11; Corn rootworm larvae and Southern corn rootworm, pg. 13; Western corn rootworm, pg. 14; Common stalk borer, pg. 14; Corn root aphid and Japanese beetles, pg. 15.

Bradley Higbee. Paramount Farming. Nabid (damsel bug) and Pirate bug, pg. 19. Bugwood.org.

University of Kentucky. Department of Entomology. Corn flea beetle, pg. 6; Armyworm and Armyworm moth, pg. 7; European corn borer and European corn borer moth, pg.8; Southwestern corn borer moth, pg. 9; Fall armyworm damage, pg. 11; Corn leaf aphid, pg. 12; Beneficial Insects: Lady beetles and Lacewings, pg. 18.

Preface

Agriculture is the world's most important industry because of rapidly expanding populations which 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.

As a participant in Kentucky's IPM program, you are an important member of a team responsible for providing these types of information. Your enthusiasm, professionalism and ability will allow all of us to obtain the information the farmer needs to make important management decisions. Your sound judgment and dedicated effort will directly affect the success of this program.

Section 1

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Corn Scouting

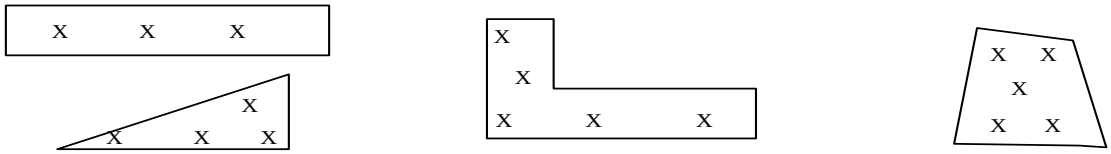
There are several important procedures to follow when scouting corn for insects, weeds and diseases. The following table indicates the type of monitoring locations required for each pest group as well as the procedure to follow each week once those locations are established.

Pests	Monitoring Stations	Procedure/Location
Insects	Random	20 Plants or Rating
Weeds	Permanent	30 feet of row
Diseases	Random	l0 foot radius, 20 plants or ears or 3-4 rows of plants 20' in length

The actual number of locations sampled depends on field size. Use the following table to determine the number of locations. Select your monitoring sites to insure that you are sampling each representative area of the field (see fields below).

Field Size (acres)	No. of Locations	Field Size (acres)	No. of Locations
1-14	2	151-164	14
15-24	3	165-174	15
25-34	4	175-184	16
35-50	5	185-200	17
50-64	6	201-214	18
65-74	7	215-224	19
75-84	8	225-234	20
85-100	9	235-250	21
101-114	10	251-264	22
115-124	11	265-274	23
125-134	12	275-284	24
135-150	13	285-300	25

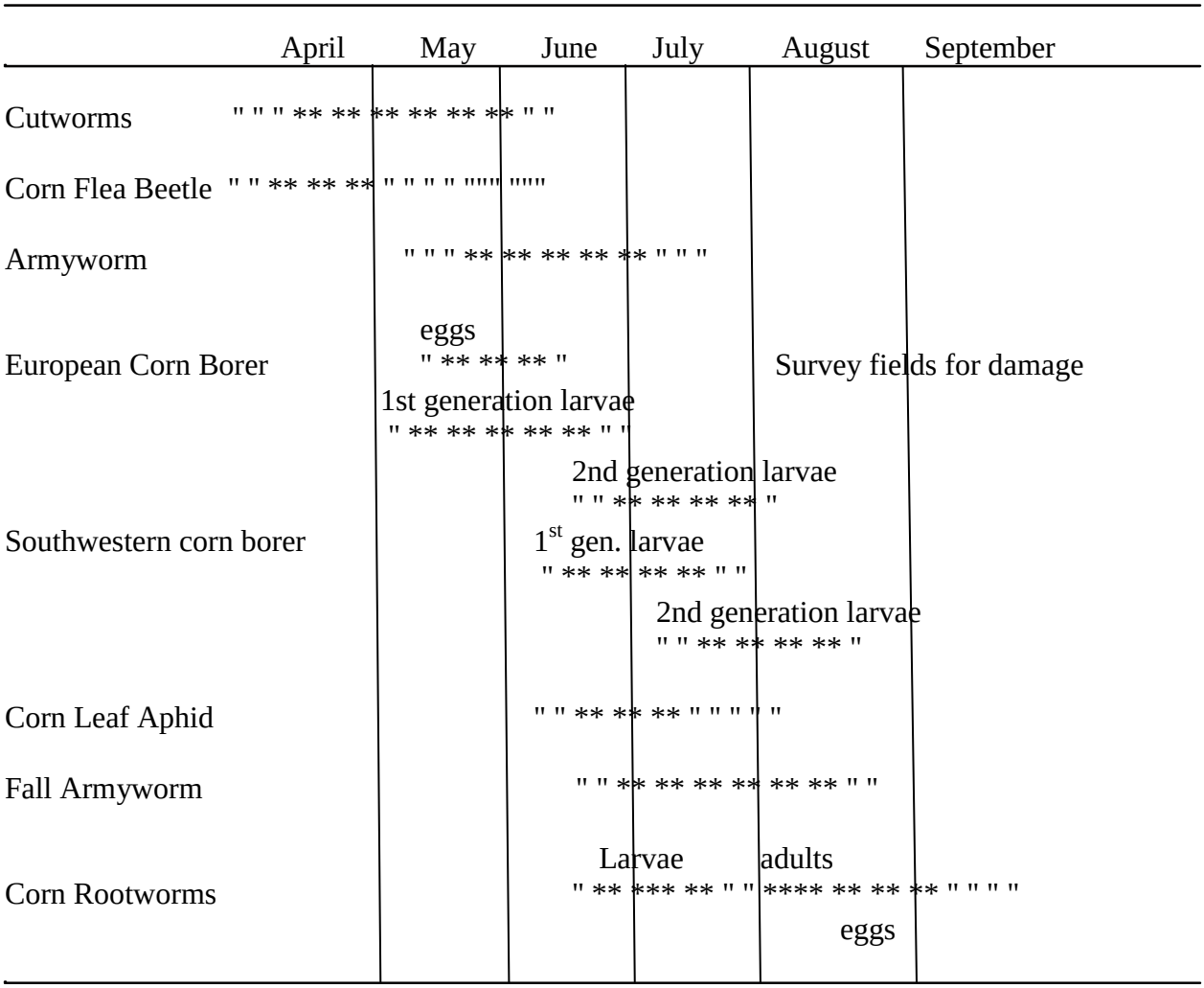
POSSIBLE SAMPLE AREAS



Scouting Corn for Insects

Douglas W. Johnson and Ric T. Bessin

Corn Insect Calendar for Kentucky



*period when economic populations are most likely to occur.

Scouting Procedures for Insects in Corn

How to scout a field

Specific survey procedures are described for each insect. In general, EXAMINE 20 PLANTS PER LOCATION and record insects found per plant or percentage of damaged plants. Select locations randomly so that they will be representative of the entire field. Don't survey along field margins unless specifically directed to do so. Don't limit surveys to one side or end of a field. IF YOUR SURVEY IS NOT RANDOM, IT IS NOT REPRESENTATIVE OF THE WHOLE FIELD. You may find a lot of problems on your return visit if the field is not scouted correctly.

Sampling Corn Wireworm

Wireworms cause damage by boring into seeds or into the base of seedlings. Preventive treatments are necessary because there are no rescue treatments. Bait stations can be used to check for wireworms before planting. Two stations are recommended per acre.

A bait station is made by digging a hole 4 inches deep and about 9 inches wide. Place 1/2 cup of untreated corn-wheat mixture in the bottom of the hole and fill with loose dirt. (Figure 1) Do not pack the dirt. Cover the trap with a piece of plastic. This will warm the soil and speed germination of the corn and wheat. Gases produced by the breakdown of the corn-wheat mixture will attract wireworms to the station.

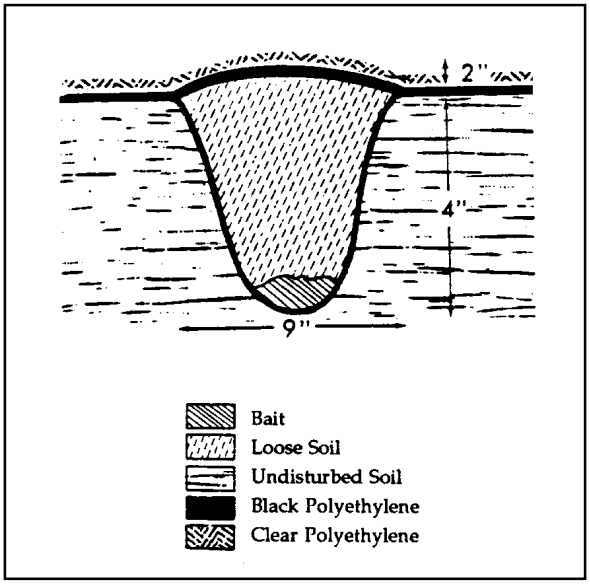


Figure 1. Wireworm bait station.

Stations should be set at least 3 weeks before your planned planting date. Check them in two weeks by digging up the bait and searching through the seeds for wireworms. Note any white grubs you find while establishing and checking wireworm bait stations. You need to record the number of wireworms found in each station.

You may wish to check only certain areas of a field rather than the entire field. For example, you may want to check an area where wireworm damage occurred last season. This can be done by randomly selecting 5 locations to bait. Samples should be 1-foot square and 6 inches deep. This type of sampling should also be done before corn is planted and **the number of wireworms in each sample should be recorded**.

Threshold Guide: If you find an average of one or more wireworms per bait station, use a soil insecticide or insecticide seed treatment at planting. Rescue treatments after damage is visible are not effective. If damage is sufficient to justify replanting, a soil insecticide should be applied during replanting.

Time periods, recommendations and sizes of bait stations were developed by the Illinois Cooperative Extension Service.

Wireworm

Soil Insect Sample

Samples for other soil insects, such as white grubs, will be collected only once, about 4 to 6 weeks after plant emergence. Take the samples from outside each end of your 30-foot weed location sets. Remove a six-inch cube of soil (6" wide x 6" long x 6" deep) that includes the root zone of a plant. Sift the soil through a piece of 1/4" X 1/4" mesh screen to separate the grubs and other insects from the soil. **Record the number of white grubs, wireworms, etc., from each sample.** Place them in a vial of alcohol with a **pencil-written** label giving county, cooperator name, field number and date. Bring the vials in to your county extension agent. If no soil insects are found, indicate that in the comments section of the report form.

Cutworms

Occurrence: From planting through mid-June. Fields having one or more of the following characteristics should be watched very carefully: 1) history of cutworm damage; 2) surface litter - especially soybean residue; 3) fair to poor drainage or overflow land; 4) late planted or 5) winter annual weeds prior to tillage.

Black cutworm larva

Preventive Management: Prepare field and control weeds 10 to 14 days prior to planting. Black cutworm is usually more serious in late-planted fields that have high amounts of crop residue of winter weed growth.

When to scout: Corn plants should be monitored twice weekly during the first 2 weeks after emergence. Watch for leaf feeding, wilted plants or cut stalks. Infestations are often spotty so check carefully for damage. Make counts only if cutworm damage is noticed in the field. Continue to scout damaged fields once an infestation is found. It is vital to know planting dates so fields will not be overlooked during this critical period.

Black cutworm moth

Description: Larvae are light gray to nearly black and may have a faint, narrow mid-dorsal stripe. (See Field Corn Insect picture sheet.) Larvae vary from 1/4 inch long after hatch to 1-3/4 inches long when full grown.

Damage: Small worms chew small holes in the leaves. Larger worms (about 1/2 inch long) cut small plants and may pull parts into their burrow. Symptoms are cut or wilted plants.

How to scout: Begin making counts when cut or wilted plants are first seen.
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 infestation on the report form. 2) Look for live cutworms around freshly damaged plants. They will generally be covered or underground during the day. First, check under clods near the base of the plant. Then, dig up an area three inches in diameter and three inches deep around the plant. Record the average number and length (inches) of "live" cutworms per 100 plants

and whether they were found near the soil surface or deep. Place some specimens in vials containing alcohol for identification by your county extension agent. 3) Make stand counts in the field. These counts can be used in making a treatment decision.

Record: Record the number of cut plants found per 20 plants examined at each site. Record the average length of "live" cutworms found. Note if they were found near the soil surface or deep.

Economic Threshold: 3% or more cut plants and 2 or more cutworms (1 inch or smaller) per 100 plants. If conditions are borderline, check the field again in 24 to 48 hours or until a final decision is made. Take stand counts during this time to help determine if treatment may be necessary.

For more information see ENTFACT-59 Cutworm Management in Corn.

Stink Bugs

Brown stink bug

Occurrence: Early May through early June, usually in reduced tillage fields following soybeans or with a wheat cover crop. The brown marmorated stink bug is new to Kentucky and is a late season pest feeding on developing ears and kernels.

When to scout: Check corn from emergence until plants are 12 inches tall for stink bugs attacking seedlings, and after the blister stage of kernel development for stinks bugs attacking the ear.

Description: Stink bugs that can injure corn are brown, shield-shaped insects with piercing-sucking mouthparts. Adults have two pair of wings held flat over the back. The insects may be found feeding near the base of the plant or crawling along the surface of the soil.

Stink bug damage

Damage: The bugs insert their needle-like mouthparts into the plant to remove liquid. Symptoms on the leaves appear as small, round, yellow holes in a line across the unrolled leaf. These insects can kill young seedlings or cause plants to tiller from the base. Most stunted plants will recover and produce a normal yield. Yield from plants that tiller will be reduced by about 70%. Damage may be localized or may occur over a wide area.
Damage to developing ears late in the season can result in individual kernels that are shriveled.

How to scout: Examine 20 plants per location for symptoms of stink bug feeding or the insects themselves. Stink bugs feed at the base of corn plants. Late in the season examine 20 ears for presence and number of stink bugs.

Record: Record the number of stink bugs present per 20 plants examined at each site. Note the average height of the plant. Height should include the extended leaf.
Late in the season record the number of stink bugs (adults and nymphs) per ear.

Economic Threshold: A rescue treatment should be considered if stinkbug numbers average one or more per 3 foot of row and plants are less than 12 inches tall (extended leaf height). Thresholds have not been established for brown marmorated stink bugs feeding on the ear.

For more information see ENTFACT-305 Stink Bug Damage To Corn.

Corn Flea Beetle

Occurrence: Planting until mid-June. Insecticide seed treatments usually keep corn flea beetle numbers low on young seedlings.

Preventive Management: Fields with a history of serious flea beetle damage and Stewart's Wilt should be planted with a Stewart's Wilt resistant variety, particularly following a mild winter.

When to scout: Check corn from emergence until 12 inches tall. Flea beetle stress may be great on late-planted corn. However, early-planted fields may also show noticeable damage.

Description: Corn flea beetles are very small, dark insects that jump readily when disturbed.

Corn flea beetle

Damage: These beetles are leaf feeders. They make small feeding scars on the surface giving leaves a gray, frosted appearance. Damage is generally serious on plants less than six inches tall. Flea beetles transmit Stewart's wilt or bacterial leaf blight on field corn.

How to scout: Examine 20 plants at each location and rate for feeding damage according to the following scale:

0 - no damage or scratch marks
1 -scattered scratch marks on less than 50% of plants; plants appear healthy
2 - feeding on new leaves of 50% or more of plants; some leaves whitish
3 - leaves browning, plant dying

Also, estimate the number of beetles on each of the 20 plants. This must be done carefully because the beetles will jump at the slightest disturbance.

Record: Record a rating of 0 to 3 for each group of 20 plants examined. Note an estimate of the average number of beetles on the 20 plants in your comments.

Economic Threshold: Some plants killed or leaves taking on whitish cast; especially if field has a history of Stewart's wilt. Cool temperatures will slow corn growth and increases susceptibility to flea beetle damage.

Armyworm

Occurrence: Mid-May through June. Armyworm infestations usually develop in small grain or grass fields. Larvae can crawl into conventionally tilled corn fields, with damage occurring first in border rows. Infestations

may develop throughout no-till corn following small grains or grass. Cool, wet springs favor armyworm development.

When to scout: Corn should be surveyed from emergence to knee-high.

Description: Larvae are greenish brown with a narrow, mid-dorsal stripe and two orange stripes along each side. The yellowish head is honeycombed with dark lines.

Damage: Armyworms feed at night and damage corn by stripping the leaves. They feed from the margin in toward the midrib. They also feed in the whorl and may destroy the bud.

How to scout: 1) SURVEY FIELD EDGES where margins border small grains or large grassy areas and watch for damaged plants while walking through the field. If armyworms are found, check 20 plants per location and rate feeding damage as described before using 0 through 3.

2) Examine 20 plants per location, within the field. Record number of damaged plants at each location. Calculate the percentage of damaged plants in the same manner as done for cutworms. During the day armyworms are usually under surface litter or in soil cracks; they may not be up feeding on the plants. Under scout Comments note the average larval size (1/2"). Include a field map if spot treatments are warranted.

Armyworm

Record: Of the 20 plants observed at each sample site, record the number of damaged plants observed. Calculate and note the percent infestation. Use the 0 to 3 scale given on the previous page for the Corn Flea Beetle to rate the feeding damage in your Comments. Also, note the average length of the larvae and mark heavily infested areas on your field map.

Economic Threshold: The following guidelines may be used:

1) 35% or more of plants in field are infested and 50% or more defoliation is seen on damaged plants and

2) Larvae average 1/2 to 3/4 inch long. (Worms greater than 1-1/4 inch in length have completed most of their feeding).

Armyworm moth

Comments: Warm spring weather favors parasite and disease development. Small, oval, yellowish eggs behind the head of the larvae indicate a parasitized armyworm. Note the percentage of worms that appear to be parasitized or diseased. Remember that armyworms hide under debris or on the ground during the day.

For more information see ENTFACT-109 Armyworms in Corn.

European Corn Borer

Occurrence: First generation: late May to late June. Early planted corn has greatest potential for damage. Second generation: late June to August. Late planted corn is most attractive to this generation. Third generation: late July on.

Preventive Management: Early planting dates increase the chance of economic infestations with first generation European corn borer. Late planting increases the likelihood of second generation infestations. B-t corn hybrids reduce the need to scout for this insect.

When to scout: A computer model will accurately predict the dates to begin scouting. Check with your county agent for local predictions.

European corn borer

Description: Fifteen to 35 white eggs are laid in masses on the underside of corn leaves, often near the midrib. Individual eggs overlap each other much like fish scales. The mass darkens prior to hatching. The black head capsule of the larva is distinct about 24 hours prior to hatch. Larvae are flesh-colored and marked with small, round, brown spots. They vary from 1/8 inch long after hatch to about 1 inch long when full grown. The head may be red-brown to black.

European corn borer moth

Damage: Results of feeding by small first generation borers appears as "window pane" or "shot holes" in the whorl leaves. Some borers enter leaf mid-ribs and cause them to break. Second generation damage includes feeding on stalks, tassels, ear shanks, leaf collars and developing kernels. Larvae may be found feeding on pollen and leaf tissue behind the leaf sheath and axil.

How to scout: 1st generation: 1) Randomly select and examine 20 consecutive plants at each location in the field. 2) Look carefully into whorls and count and record the number of plants showing fresh "shot hole" (window pane) damage in the whorl. Small areas of fresh surface feeding may be seen before "shot holes" appear. 3) Pull out the whorls of two damaged plants from each location and carefully unroll the whorl looking for small whitish borers with distinct (black) heads. Note percentage of plants infested with live larvae and average size (1/8, 1/4, 1/2, 3/4 or 1+ inches in length). Percent damage is figured by dividing the total number of plants with "shot hole" and "window pane" feeding by the total number of plants examined. Multiply this number by 100 and record in the percentage infestation column on the report form.

Second-generation: Give special attention to late planted fields. 1) Survey 20 plants per location. 2) Check plants for egg masses and signs of borer feeding. Examine closely the lower surface of leaves and at the ear. When an egg mass is found, record the hatching stage according to the following: white, cream, black head, or hatched. 3) Check the middle one-third of each plant for damage and live larvae. Second generation larvae are usually found feeding at the base of leaf sheaths. Pull leaves from the ear zone of one plant per location and record number of larvae found in leaf axil and their size (1/8, 1/4, 1/2, 3/4 or 1+ inches in length). Percent damage is calculated in the same manner as for first generation.

Record: Of the 20 plants examined at each site, record the number showing fresh "shot hole" damage in the whorl. Record the percentage of plants infested with live larvae and the average length of the larvae. If an egg mass is found, note the hatching stage as white, cream, black head or hatched. Note in your Comments if borers have entered the stalk or are still in the whorl.

Economic Threshold: 1st generation: Field corn controls should be considered if 50% of the plants show "shot hole" or "window pane feeding" damage and live larvae are present; NOTE: Also, refer to European corn borer computer decision management software available in your local county agricultural agent's office and/or ask them for a copy of ENT-49 for further information. Treatment may be justified for popcorn and seed corn fields if 25% or more of the plants are infested. Once larvae have bored into the stalks, treatment will **not** be effective.

Second generation: Treatment is suggested if egg masses average one per plant and egg hatch has begun or if 50% of plants inspected have live larvae feeding on the leaves or tassels in leaf axil or behind sheaths. If your examination indicates that half or more of the larvae have entered the stalk, insecticide treatment is not recommended.

For more information see ENTFACT-106 Predicting European Corn Borer Development, ENTFACT-118 Bt-Corn for Corn Borer Control, and ENTFACT-140 Corn Borer Resistance Management with Bt Corn.

Southwestern Corn Borer

Occurrence: First generation, early June; second generation, mid-July. Serious losses are usually associated with later planting dates. There can be a third generation occurring in August and September. Currently, southwestern corn borer appears to be restricted to some areas west of I-65 in the south western portion of Kentucky.

Southwestern corn borer

Preventive Management: Early planting is a major management tool. Typically most serious in late planted (after May 5) corn.

When to Scout: Early June through August, particularly in late planted fields (after May 1).

Southwestern corn borer moth

Description: Flattened, fish scale-like, eggs are laid singly or in groups of 2 to 5. Initially eggs are greenish-white, but develop three distinct red transverse lines within 24 to 36 hours. Summer-form larvae are milky-white with a brown head and have eight rounded, brown or black spots in a row around the forward part of each segment with two additional spots behind the row of eight (the overwintering form does not have distinctive spots on the body). Full-grown larvae are about one inch.

European corn borer larvae can be mistaken for southwestern corn borer. European corn borer larvae grow to about 1 inch, are creamy white with numerous brown spots and faint gray stripes running the length of the body. Southwestern corn borers do not have these stripes running the length of the body.

Damage: First-generation larvae feed for the first two weeks within the whorl of the plant resulting in "window pane" or "shot holes" in the emerging leaves. Older larvae move down the stalk and tunnel into the stalk. Numerous holes in the emerging leaves and leaf breakage due to mid-rib tunneling are characteristic. Destruction of the bud in the whorl by first generation larvae can result in a "dead heart".

The second-generation of this insect causes the greatest damage. These larvae feed in the mid and lower zones of tassel-stage corn. Typically, they feed between the layers of husk on the primary ears. After about two weeks, the larvae begin tunneling in the stalk. Unlike ECB, SWCB does not "wander" through the stalk. Characteristically they make a straight line through the middle of the stalk. In the fall, borers that will remain larvae throughout the winter migrate to the base of the plant and tunnel downward. These larvae often girdle the plant at the base before chewing the tunnel. This is the most serious damage caused by SWCB because stalks snap off at the soil surface.

How to Scout: **First Generation**: Monitor fields in early June for initial shot hole feeding to whorl leaves. If damage is noted while walking through the field, examine 20 consecutive plants for each of several locations within the field and record the number of plants with damage. Select the starting point for each location randomly. Pull out the whorls from 2 damaged plants from each sample to note if the larvae are still present in the whorl and determine if the damage was caused by SWCB or ECB.

Second Generation: Give special attention to late-planted fields. Survey 20 plants per location. Check plants for eggs and signs of larval feeding. Check the bottom two-thirds of the plant for damage and live larvae. Determine if the damage was caused by SWCB or ECB.

Record: Of the 20 plants examined at each site, record the number showing fresh "shot hole" damage in the whorl. Record the percentage of plants infested with live larvae and the average length of the larvae. Note in your comments if the larvae have entered the stalk.

Economic Threshold: Similar to management of ECB, timing is critical for control. Larvae can be effectively controlled only while they are feeding within the whorl. Once they enter the stalk, they are protected from treatment. Management of the SWCB relies on maintaining the first generation infestations below an economic threshold. Control of the first generation should be considered if 35% of the plants show damage and live larvae are present in the whorls. Controls aimed at the second generation are less effective and not economical.

How to Scout: **First Generation**: Monitor fields in early June for initial shot hole feeding to whorl leaves. If damage is noted while walking through the field, examine 20 consecutive plants for each of several locations within the field and record the number of plants with damage. Select the starting point for each location randomly. Pull out the whorls from 2 damaged plants from each sample to note if the larvae are still present in the whorl and determine if the damage was caused by SWCB or ECB.

Second Generation: Give special attention to late-planted fields. Survey 20 plants per location. Check plants for eggs and signs of larval feeding. Check the bottom two-thirds of the plant for damage and live larvae. Determine if the damage was caused by SWCB or ECB.

Record: Of the 20 plants examined at each site, record the number showing fresh "shot hole" damage in the whorl. Record the percentage of plants infested with live larvae and the average length of the larvae. Note in your comments if the larvae have entered the stalk.

Economic Threshold: Similar to management of ECB, timing is critical for control. Larvae can be effectively controlled only while they are feeding within the whorl. Once they enter the stalk, they are protected from treatment. Management of the SWCB relies on maintaining the first generation infestations below an economic threshold. Control of the first generation should be considered if 35% of the plants show damage and live larvae are present in the whorls. Controls aimed at the second generation are less effective and not economical.

For more information see ENTFACT-108 Southwestern Corn Borer.

Fall armyworm

Fall Armyworm

Occurrence: Late June to frost. Late maturing fields are most likely to become infested.

When to scout: Begin checking in mid-June and continue throughout the season. Your county agent will know if FAW infestations are serious.

Description: Larvae vary from light tan to nearly black with three thin light yellow lines down the back. There is a wider dark stripe and a wavy yellow red-splotched stripe on each side. They resemble both armyworms and corn earworms but fall armyworms have a prominent white inverted Y mark on the front of the head. The spherical gray eggs are laid in clusters of about l50, usually on the leaves of host plants. Masses are covered with a coating of moth scales or fine bristles.

"Y" mark on head of Fall armyworm

Damage: Larvae feed on the leaves leaving "window pane" type damage and later burrow deep into the whorl. The tassel, leaves on the upper portion of the plant, and the ear may be partly or totally destroyed. The damage to the ear of corn may be far more important than the leaf damage.

How to scout: l) Begin checking corn in mid-June for fall armyworm activity. Survey 20 plants from each location, initiating your count randomly. Small larvae will cause "window pane" damage. Record damage, plus the number and size of worms. Collect specimens for verification. Feeding by small armyworms resembles corn borer damage. 2) A few days before tasseling and silking, check closely for infestations.

Fall armyworm moth

Large larvae in the whorls will be pushed out by the emerging tassels. They may attack the developing ears. Egg and small larvae masses may be found on the leaves and behind leaf sheaths. Determine if an infestation of large larvae or small larvae will be present to attack the very small, developing ears. Continue to check closely for this insect until silks begin to dry. Figure percent damage in the same manner as done for European corn borer.

Record: Of the 20 plants examined at each site, record the number of plants showing damage at each site. Note the average length of the larvae in your comments.

Economic Threshold: Egg masses present on 5% of the plants or when 25% of plants are infested with larvae. Treatment must be applied before larvae burrow deep into the whorls or enter ears of more mature plants.
For more information see ENTFACT-110 Fall Armyworms in Corn.

Fall armyworm damage

Corn Leaf Aphid

Occurrence: From about four weeks prior to tasseling until tasseling.

When to scout: Begin about three weeks prior to tasseling.

Description: Aphids are small, pear-shaped insects with soft bodies. They vary from blue-green to gray and have piercing sucking mouthparts. They occur in clusters in the whorl. Some may have small, clear wings.

Damage: Corn may be stunted or wilted, especially when plants are under drought stress. Aphids secrete a sugary substance known as "honeydew". Tassels of moderately to heavily infested plants may be quite sticky from accumulations of this secretion. Aphids cause the greatest damage while feeding in the whorl.

Corn leaf aphids

How to scout: Examine 20 plants per location. Rate infestations on each plant using the scale below:

0 - no aphids
l - l to l0 aphids/whorl
2 - 11 to 50 aphids/whorl
3 - more than 50 aphids/whorl

Aphids occur in clusters in the curl of leaves, in the whorl or on un-emerged tassels. Check also for discolored brown or golden aphids. These are diseased or parasitized. Record these observations.

Record: Record the aphid ratings for aphids observed on 20 plants at each site. In your comments rate the infestations at each site using the 0 to 3 scale. Note if the aphids are below the ear zone or if they are a discolored brown or golden color which indicates that they are parasitized by a small wasp.

Economic Threshold: Consider treatment if the average rating is 2 or above about three weeks before tasseling. (10 per whorl if plants are under moisture stress.)

Note: If plants are not under drought stress and l0 or more predators on each plant, controls probably are **not** justified. It is doubtful if treatment pays after 50% of tassels have emerged.

For more information see ENTFACT-126 Corn Leaf Aphid.

Corn Rootworm Larvae

Occurrence: Mid- through late June. Larvae feed on corn roots for about four weeks. Infestations may be limited to specific areas within fields. Corn may have a yellow cast and may show symptoms of nutrient deficiency or drought stress due to root damage when knee high. Damage occurs in fields that were in corn the previous season.

Preventive Management: Rotation is the most effective management strategy to prevent problems with Western and Northern corn rootworms in Kentucky.

When to scout: Watch for irregular growth patterns and stress symptoms as you scout corn fields.

Corn rootworm larvae

Description: Corn rootworm larvae have cylindrical white to cream bodies with a brown to black head and a pair of small legs on each of the first three segments behind the head. There is a small brown or black area on the top of the last segment. Full grown larvae are about l/2 inch long.

How to Scout: Dig up a 6" cube of soil containing the root zone of stressed plants. Carefully break away the soil and look for rootworm larvae and evidence of chewing on the plant roots.
Indicate infested areas of the field on a field map. If you encounter lodging, record the percentage of lodged plants in random areas of the field. This is done by examining groups of 20 consecutive plants and recording the number bent or lodged.

Compute the percentage as explained in the cutworm section.

Soil compaction, drought stress and other factors can produce symptoms similar to rootworm damage. Confirm your diagnosis by examining root systems for larvae and chewing damage.

For more information see ENTFACT-141 Insect Management with Continuous Corn and ENTFACT-152 Corn Rootworms in Kentucky.

Corn Rootworm Adults

Occurrence: Mid-July through silking. Silk feeding is a problem only if it occurs before and during the maximum period of pollen shed.
When to scout: From onset of silking until silks are brown. Also late planted corn should be inspected in the whorl stage for adult beetles.

Southern corn rootworm

Description: Three species of corn rootworm beetles are found in Kentucky. The Northern Corn Rootworm adult is pale green to yellow and about l/4 inch long. The Southern Corn Rootworm

adult (also called the spotted cucumber beetle) is about 3/8 inch long. It is yellow-green with ll conspicuous black spots on the wing covers. The Western Corn Rootworm Beetle is yellow with three black stripes on the wing covers. It is relatively new in Kentucky. If you suspect them in a field, collect some for identification.

Western corn rootworm

How to scout: If you do not see any beetles as you walk through the field, do not spend your time surveying. However, if beetles are active, follow these guidelines. l) Make counts on 20 plants from each location beginning with random selection of initial plant. Make counts on every third or fourth plant until 20 plants per location are examined. 2) Rootworm beetles fly readily when disturbed so approach each plant carefully. Count the beetles on the ear tip, tassel, leaf surfaces and behind the leaf axil. Record the number of Northern and Western corn rootworm adults present. 3) Note percent of silks clipped back to l/2 inch or less. Make sure you record beetles found as Northern or Western rootworm adults. Southern corn rootworms are important only as silk feeders.

Record: Record the number of Northern and Western corn rootworm adults per twenty plants examined at each site. Note the percentage of silks clipped back to ½ inch or less. Note the presence of Southern corn rootworm adults.

Economic Threshold: Treatment may be necessary if silks are clipped back to l/2 inch or less before 50% of plants are pollinated and five or more beetles are present per plant.

****Note: Your counts of Northern and Western corn rootworm beetles are used to make soil insecticide/ BT Rootworm recommendations for the following year. If your counts of Western and/or Northern approach or reach an average of 20 beetles per 20 plants (l per plant) it is advisable to use a rootworm insecticide or BT hybrid for rootworm if the field is to be planted in corn next year.**

For more information see ENTFACT-152 Corn Rootworms in Kentucky and ENTFACT-147 Corn Rootworm Resistance Management with Bt Corn.

Common Stalk Borer

Occurrence: The stalk borer has appeared as early as May 31, but normally it is not observed till mid-June. Cultivated crops near weedy areas, especially giant ragweed, are most often attacked. Damage is usually minimal in conventional or minimum-till fields, but can be a problem in no-till fields.

Common stalk borer

Preventive Management: Fall weed management in and around fields that will be planted with corn.

When to Scout: Corn plants from 2 to 24 inches tall will be attacked.

Description: Small larvae are cream colored with a dark brown or purple band around their body. Several brown or purple lengthwise stripes may be present. Adult moths are grayish brown with small white spots along the front edge and tips of their forewings. The hind wings are a pale gray-brown. Wingspan is about one inch.

Damage: Damage is greatest in weedy border rows of conventional fields or throughout reduced tillage fields. The stalk borer will tunnel deep into the whorl leaves of the corn. This results in the unfolding leaves having irregular holes and ragged edges and the upper leaves may wilt or die. Sawdust-like feces can be seen in the whorl or coming out of the entry hole in the stalk. Unrolling the whorl will usually reveal the borer.

How to Scout: Check 20 plants at each location. Record the average number found per location on the report form. You may also want to check around border rows of conventional tilled fields in May-June. In no-till fields a random check throughout the field is necessary.

Record: Check 20 plants per location and record the average number found at each location.

Economic Threshold: An economic threshold has not been established. A "rescue" insecticide treatment will rarely be effective, and only if it is applied when the larvae are moving from the weeds to the corn seedlings will any control occur. Treatments applied after the larvae have entered the plants are not effective.
In conventional corn, killing grasses and weeds along field edges by mowing, burning or using herbicides will aid in controlling the borer. This however should not be done between planting and early July while the borers are active. Stalk borer can also be reduced in no-till corn by reducing the number of weeds.

For more information see ENTFACT-100 The Common Stalk Borer in Corn.

Corn Root Aphids

Corn root aphids are pests of continuous corn. Examine the roots of wilted or stunted plants for these blue or green insects. Ants occur with corn root aphid infestations. Ant hills may be seen along the rows.

Corn root aphid

Japanese Beetles

Are metallic green beetles about l/2 inch long. There is a row of white tufts on the side of the body below the bronze wing covers. These beetles feed on silks. Record the number of beetles found per location. (Number/20 ears). Treatment may be necessary if silks have been clipped to l/2 inch and there are three or more beetles per ear.

For information on life cycle of Japanese Beetle see ENTFACT-409 Japanese Beetles.

Japanese beetles

For insecticide information see ENT16-Insecticide Recommendations for Corn – 2015.

Agronomic Practices Affecting Insect Pests of Corn

	Early planting	Late planting	Rotation	Weed Management	Comments
European corn borer	■	■			
Southwestern corn borer		■			Fields west of I-65 planted after May 1 are at greatest risk.
Armyworm			■		Armyworms may infest wheat and small grain cover crops and subsequently become economically damaging to corn.
Western and Northern corn rootworms			■		Only a problem in continuous corn in Kentucky.
Southern corn rootworms					
Fall armyworm		■			Fields planted after June 1 are more at risk.
Corn earworm		■			
Wireworms and white grubs			■		Wireworms and white grubs are more of a problem in corn following established sod.
Common Stalk Borer				■	May be more of a problem with reduced tillage.
Cutworms		■	■	■	Cutworms may be slightly more common in corn after soybeans or in reduced tillage situations.

Some Beneficial Insects

General Survey Procedure for all beneficial forms: Thoroughly check 20 plants per each location and note types and numbers of beneficial species observed. Record the number found of each beneficial insects per 20 plants.

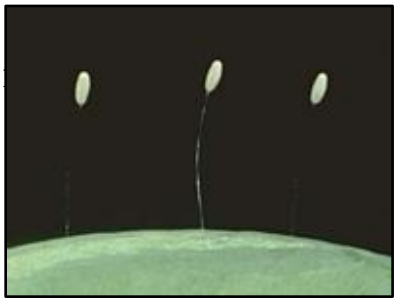
Lady Beetles
Adult lady beetles are orange or red with black or brown spots. The female lays orange eggs. The larvae are usually brown or black with orange, red or tan markings. The larvae and adults of these beetles will eat aphids, eggs and small larvae of corn borers and other soft-bodied insects.

Lady beetle larvae

Lady beetle adult

Lady beetle adult

Lacewings
The adult golden-eye lacewing is about 3/4 inch long. It is green and has lacy wings. The egg is perched on the tip of a hair like stalk that is about 3/4 to one inch long. The larvae are brown and white and may grow up to about l/2 inch in length. These larvae are called aphid lions, but they feed on other soft-bodied insects as well as aphids.



Green lacewing eggs

Green lacewing larva

Green lacewing adult

Nabids

Nabids (damsel bugs) feed on various insects. They are about l/2 inch long and grayish to brownish white.

Nabid (damsel bug)

Pirate Bug

Pirate Bugs

Pirate bugs (insidious plant bugs) are l/l6 to l/8 inch long.

The body is black and each wing has a triangular black spot. They feed on eggs and small larvae of corn earworms and corn borers.

FIELD CORN BENEFICIAL INSECTS

Lady Beetle Larvae

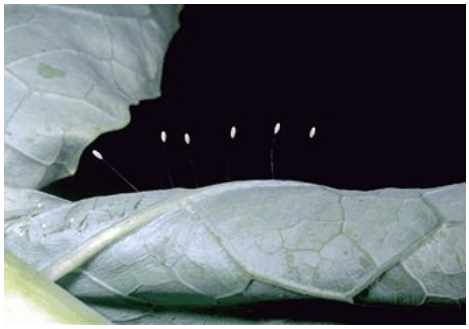
Lady Beetle

Lady Beetle

Ground Beetle Larva

Ground Beetle

Ground Beetle



Lacewing Eggs

Lacewing Larva

Green Lacewing

Robber Fly

Damsel Bug

Minute Pirate Bug

Assassin Bug

Spined Soldier Bug

Braconid Wasp

Scouting Procedures for Weeds In Corn

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

Scouting procedures used for weeds in corn will be different from those used for insects and diseases. You will check fields each week for the presence of the weeds listed in this section. The reason for this season-long survey is to determine when these weeds begin growth in cornfields. 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 corn producers.

When to survey the field:

Beginning within l0 to l4 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 (acres)	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 l00 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, (l) row middle (the area between two (2) rows). Put a marker (wire flag or cane pole) 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. This method may require that you repaint the markers 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, 30 inch wide rows by 40 feet long) within this survey site where weeds are present and mark with flags or paint. Survey in this same 100 $Ft.^2$ area 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.

Your survey sites will be easy to locate early in the growing season but as the corn grows taller, the wire flags will become more difficult to locate. Therefore, pull up the corn on each side of the wire flags (about three or four feet in each direction) and mark on your field map the survey site location (for example, the number of rows in from a fence, roadway, etc.). All flags should be pulled when the last survey is made. Some IPM counties use six-foot bamboo stakes with flagging in order to locate the weed sites for a longer period.

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 $Ft.^2$ area, it is not necessary to count all of them (in heavily grass infested fields,

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} area
giant foxtail	80
fall panicum	80
wild cane	80
johnsongrass	80
giant ragweed	40
honeyvine milkweed	40
wild cucumber	40
others	40

How long to survey:

The field should be surveyed until the corn is approximately four feet tall. If no weeds have appeared up to this point, then survey at two to three week intervals for the remainder of the growing season.

Record: Record the predominate species of weeds found and the number of each counted at each survey site. Mark your survey sites on the map and note the average height of the weeds and problem areas.

Other observations in the field:

As you walk over the field conducting your survey, not only for weeds, but for insects and diseases, be observant. If you see a heavy infestation of weeds, either on the survey form or another form, 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.

Note: See pages 24-30 for information on weed mapping, grass identification and broadleaf identification.

Estimated impact on corn yield with different weed species at various populations in corn with 150 bu/ac yield potential.

Weed Pressure category (yield loss potential)	***Foxtail spp.***	***Johnsongrass***	***Pigweed spp.***	***Morningglory spp.***	***Common Cocklebur***	***Giant Ragweed (Horseweed)***	***Estimated yield loss by a single species***	***Estimated yield loss by all species***
	-- Weed density per 100 sq ft --						**(bu/ac)**	**(bu/ac)**
Slight (0-5%)	10	8	5	5	4	2	<2	<10
Low (5-10%)	20	15	10	10	8	4	5	25
Moderate (10-20%)	50	30	25	30	10	8	10	40
Severe (20-40%)	100	75	50	60	30	20	20	50
Very Severe (>40%)	200	125	75	100	50	40	35	75

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".

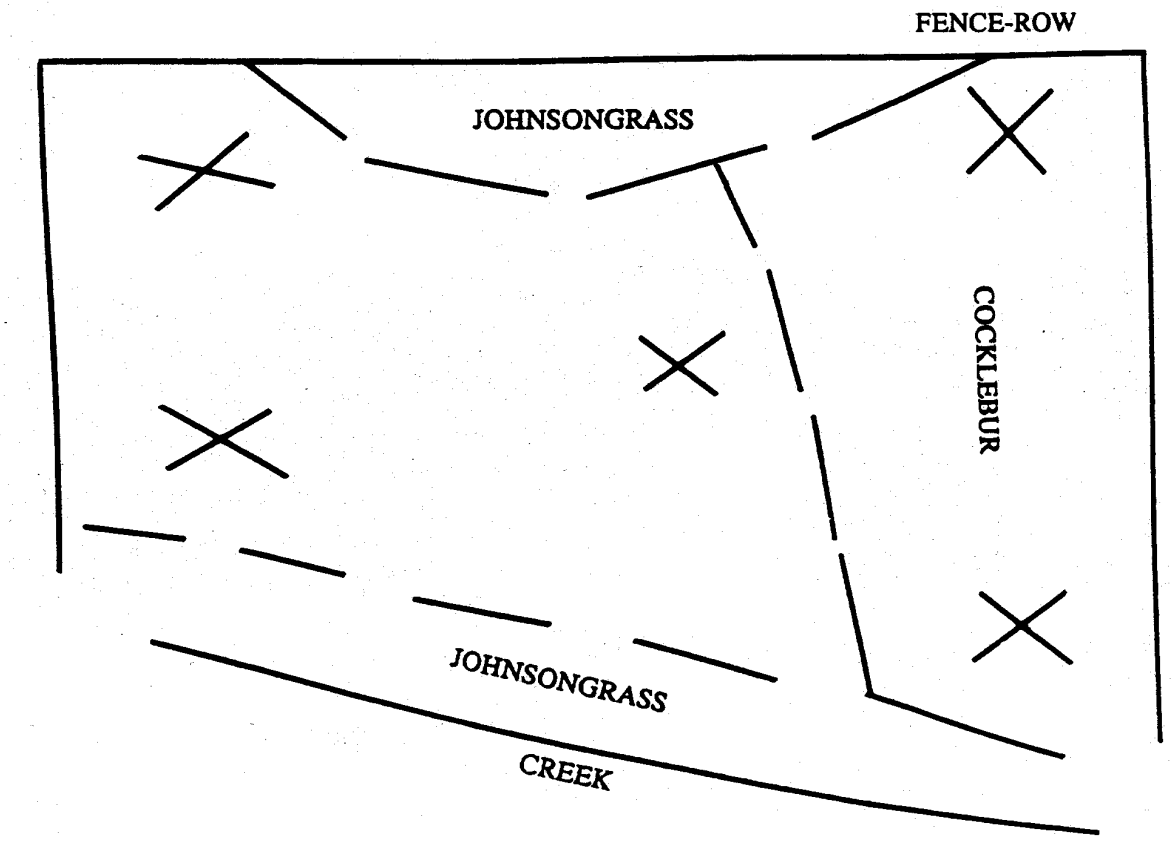
1) Outline the shape of the field on the report form. Make notations as to locations of fences, roads, woods, etc.

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.

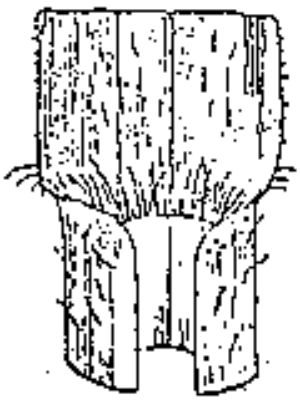


Identification Of Common Weedy Grasses By Vegetative Characteristics

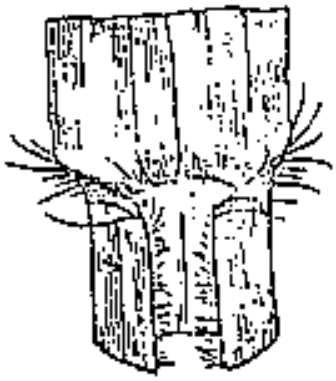
Grass	Vegetative Characteristics						
	Ligule			Sheath		Blade	
None	Hairy	Membrane	Smooth	Hairy	Smooth	Hairy	Rough
Large crabgrass		X		X		X	
Smooth crabgrass		X	X		X	at base	
Giant foxtail	X		X				X
Green foxtail	X		X				X
Yellow foxtail	X	X	X			at base	
Goosegrass		X		at top	X	at base	
Johnsongrass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

*Characteristics may vary with age.

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



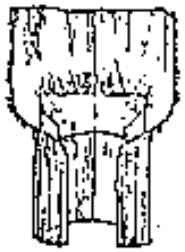
Giant Foxtail



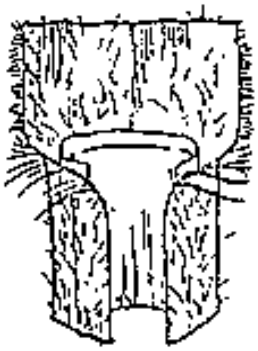
Green Foxtail

Yellow Foxtail

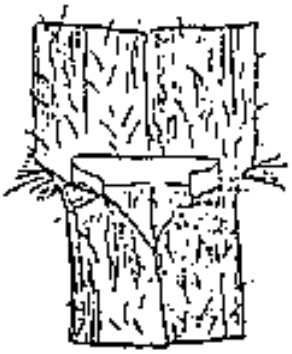
Wild Cane



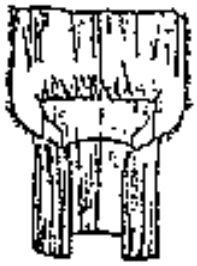
Large Crabgrass



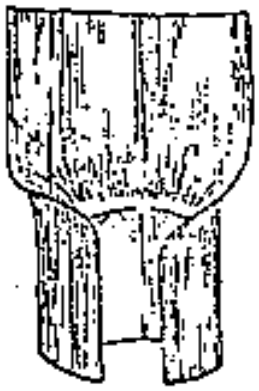
Smooth Crabgrass



Goosegrass



Johnsongrass



Fall Panicum

Identifying Characteristics For Certain Seedling Broadleaf Weeds			
	Cotyledon	**Leaf**	**Other**
1. Common Chickweed	Small and thick Oval shaped Pointed tip	Oval shaped Pointed tip Opposite	
2. Cocklebur	Thick Long and Narrow	Oblong Toothed edges Alternate	
3. Burcucumber	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. Morningglory Bigroot	Butterfly shaped with long narrow blades	Heart-shaped Hairless Alternate	Viney stem Established plants develop large perennial root

	Cotyledon	Leaf	Other
11. Morningglory, Entireleaf	Butterfly shaped	Heart-shaped Hairy - Alternate	Viney stem
12. Morningglory, Ivyleaf	Butterfly shaped with prominent veins	3-lobed Hairy Alternate	Viney stem
13. Morningglory, Pitted	Butterfly shaped with long narrow blades	Shape is variable Hairless Alternate	Stem and leaf margin often purple Viney stem
14. Morningglory, 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 spiny 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