IPM-2

Kentucky Integrated Crop Management Manual for Field Crops

"Corn"

Integrated Crop Management Manual

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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.

Revised January 2008
This manual is provided by the Kentucky Integrated Pest Management Program.

Acknowledgements

The procedure for sampling for corn wireworms and several line drawings of insects were adapted from the Illinois Integrated Pest Management Manual.

The following individuals have provided information, expertise and/or revised portions of this manual:

Monroe Rasnake, University of Ky., Department of Agronomy
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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.

Table of Contents

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.

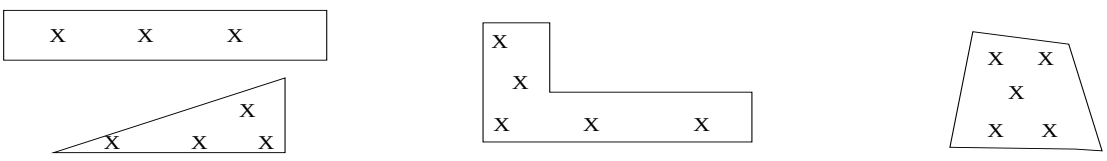
Pests	Monitoring Stations	Procedure/Location
Insects	Random	20 Plants or Rating
Weeds	Permanent	30 feet of row
Diseases	Random	l0 foot radius, 20 plants or ears or 3-4 rows of plants 20' in length

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

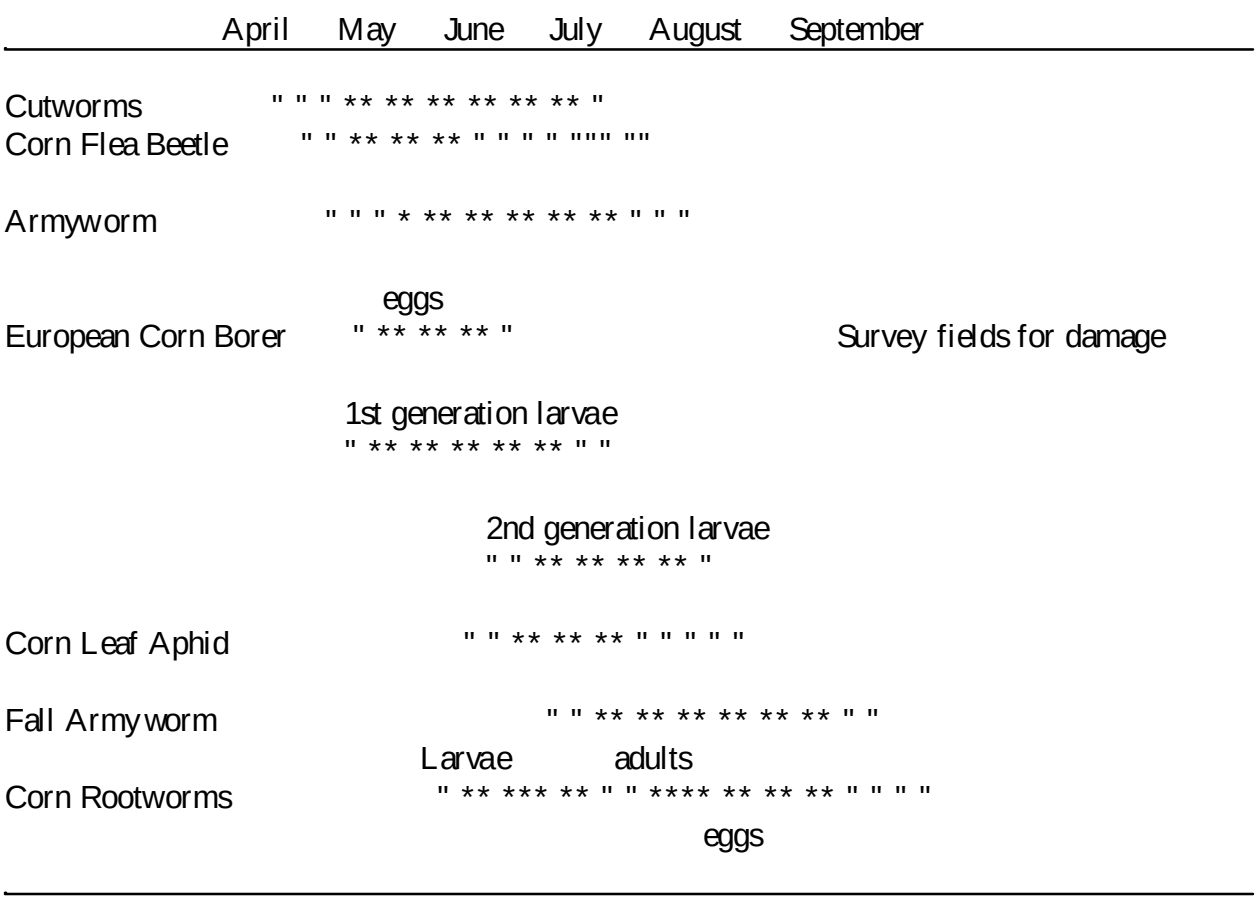
POSSIBLE SAMPLE AREAS



Scouting Corn for Insects

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.

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.

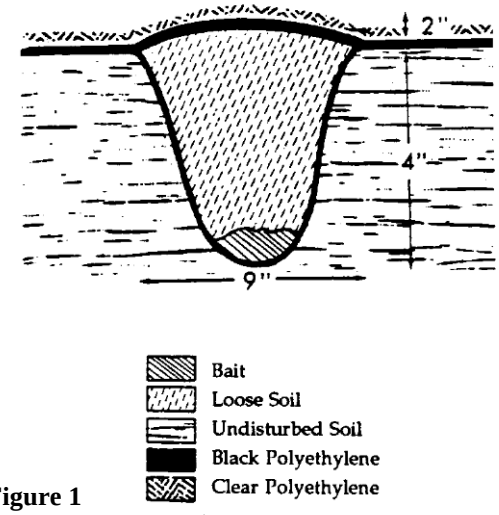


Figure 1

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 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.

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.

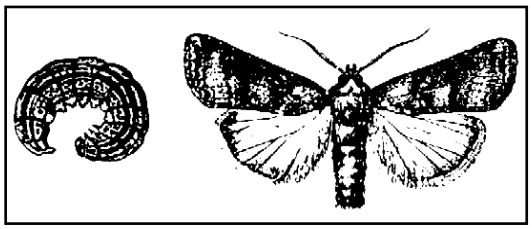
Cutworms

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.

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.

Description: Larvae are light gray to nearly black and may have a faint, narrow mid-dorsal stripe. (See Corn Insect picture sheet #5). 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.

Stink Bugs

Occurrence: Early May through early June, usually in reduced tillage fields following soybeans or with a wheat cover crop.

When to scout: Check corn from emergence until plants are 12 inches tall.

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.

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.

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.

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.

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).

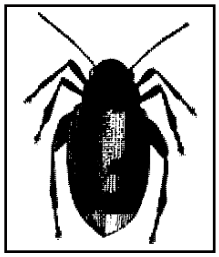
Corn Flea Beetle

Occurrence: Planting until mid-June.

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.



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.

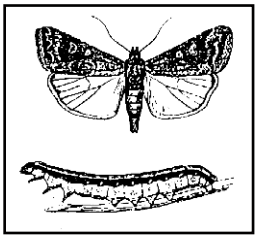
Record: Record a rating of 0 to 3 for each group of 20 plants examined. Note an estimate of the average number of beetles on the 20 plants in your comments.

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. (See Corn Insects Picture Sheet).

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.

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).

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.

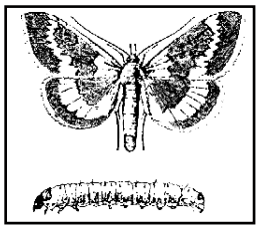
European Corn Borer

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.

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. (See Corn Insects Picture Sheet).

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 agents 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.

2nd 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.

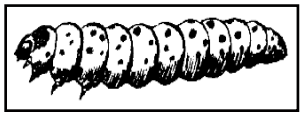
Southwestern Corn Borer

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.

Preventive Management: Early planting is a major management tool. Typically most serious in late planted (May 1) corn.

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

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.

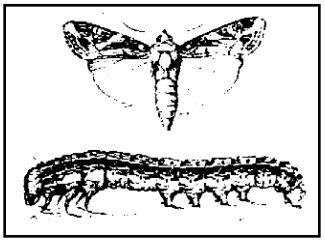
Economic Threshold: Similar to management of ECB, timing is critical for control. Larvae can be effectively controlled only while they are feeding within the whorl. Once they enter the stalk, they are protected from treatment. Management of the SWCB relies on maintaining the first generation infestations 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.

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.



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, 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.

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.

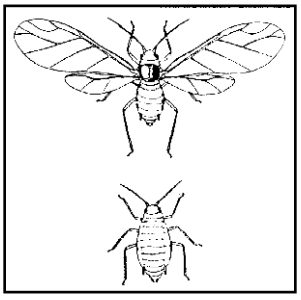
Economic Threshold: Egg masses present on 5% of the plants or when 25% of plants are infested with larvae. Treatment must be applied before larvae burrow deep into the whorls or enter ears of more mature plants.

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.

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 unemerged 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.

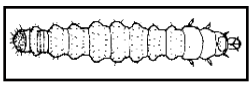
Corn Rootworm Larvae

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.

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. (See Corn Insects Picture Sheet).



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.

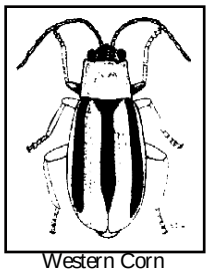
Indicate infested areas of the field on a field map. If you encounter lodging, record the percentage of lodged plants in random areas of the field. This is done by examining groups of 20 consecutive plants and recording the number bent or lodged. Compute the percentage as explained in the cutworm section.

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.

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.



Western Corn Rootworm Beetle

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. (See Corn Insect Picture Sheet).

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 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 if the field is to be planted in corn next year.

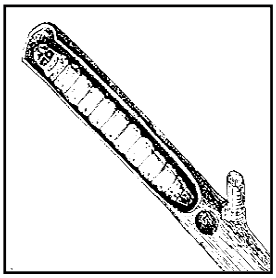
Common Stalk Borer

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.

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.

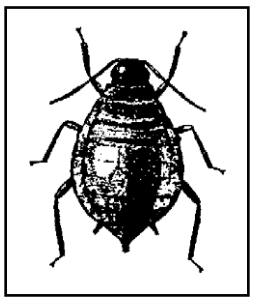
Record: Check 20 plants per location and record the average number found at each location.

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.

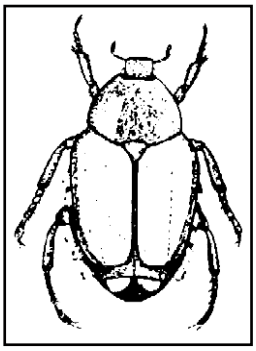
Corn Root Aphids

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.



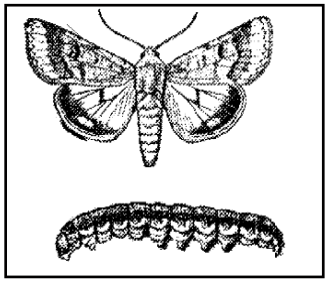
Japanese Beetles

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 per 20 ears). Treatment may be necessary if silks have been clipped to l/2 inch and there are three or more beetles per ear.



Corn Earworms

Corn earworms vary from green to brownish black. (See Corn Insects Picture Sheet). They may be found feeding in the ear tips following silking. Larvae established in the ear cannot be controlled by an insecticide application. Preventive treatments necessary for control are not economically justified on field corn.



Agronomic Practices Affecting Insect Pests of Corn

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

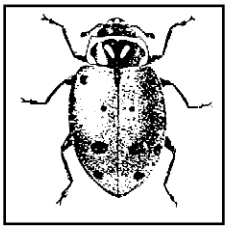
Some Beneficial Insects

Note: Refer to Beneficial Insects Picture Sheet for pictures of these 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.

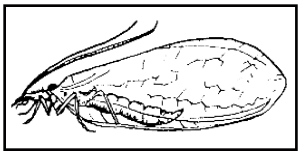
Lady Beetles

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.



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.



Nabids

Nabids (damsel bugs) feed on various insects. They are about ½ inch long and grayish to brownish white.

Pirate Bugs

Pirate bugs (insidious plant bugs) are 1/16 to 1/8 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.

Scouting Procedures for Weeds In Corn

James R. Martin and J. D. Green

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 25-36 for information on weed mapping, grass identification and broadleaf identification.

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".

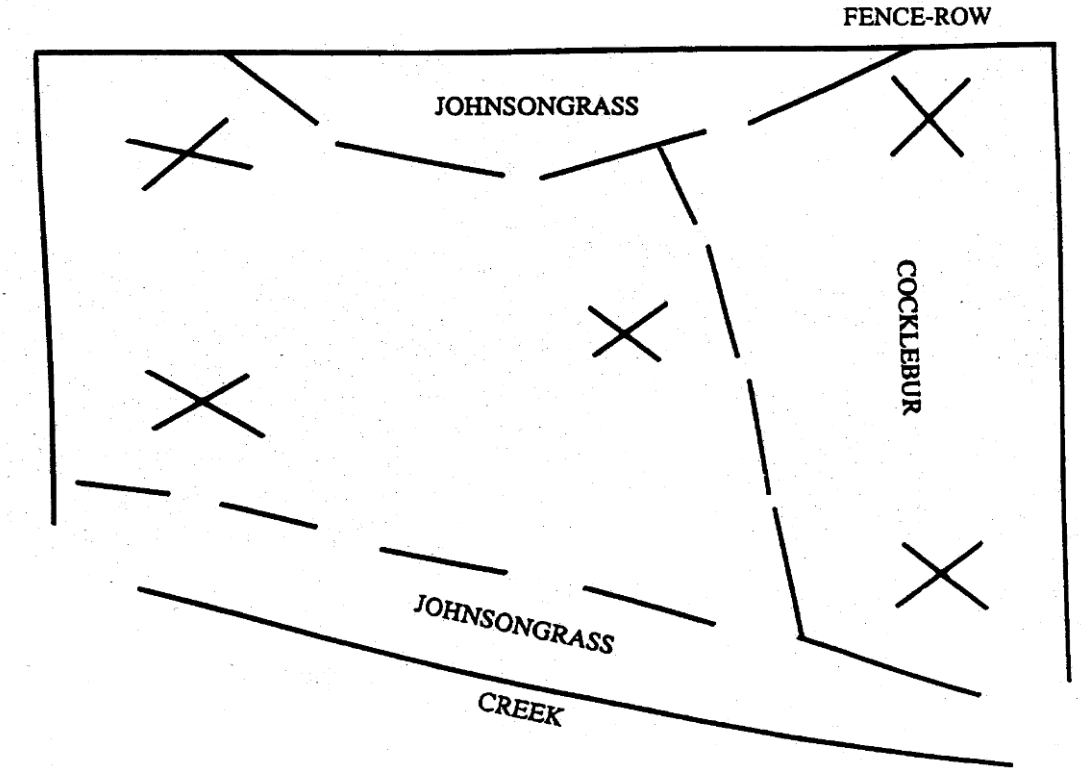
1) Outline the shape of the field on the report form. Make notations as to locations of fences, roads, woods, etc.

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.

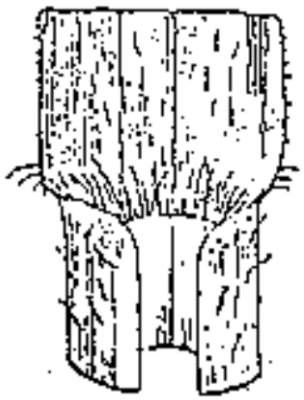


Identification Of Common Weedy Grasses By Vegetative Characteristics

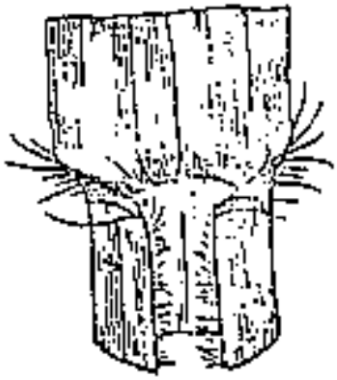
Grass	Vegetative Characteristics						
	Ligule			Sheath		Blade		
	None	Hairy	Membrane	Smooth	Hairy	Smooth	Hairy	Rough
Large crabgrass		X		X			X	
Smooth crabgrass		X		X		X	at base	
Giant foxtail		X		X				X
Green foxtail		X		X				X
Yellow foxtail		X	X	X			at base	
Goosegrass			X		at top	X	at base	
Johnsongrass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



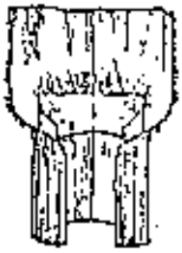
Giant Foxtail



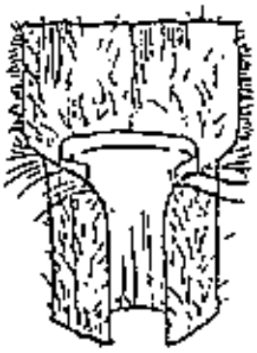
Green Foxtail

Yellow Foxtail

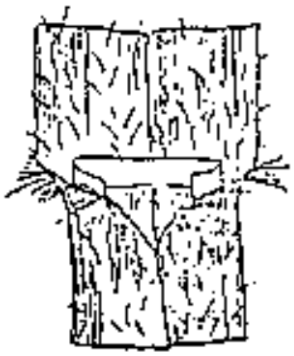
Wild Cane



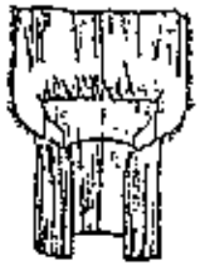
Large Crabgrass



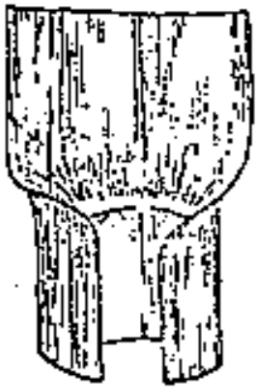
Smooth Crabgrass



Goosegrass



Johnsongrass



Fall Panicum

Identifying Characteristics For Certain Seedling Broadleaf Weeds			
	Cotyledon	Leaf	Other
1. 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

	Cotyledon	Leaf	Other
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
13. Morning glory, Pitted	Butterfly shaped with long narrow blades	Shape is variable Hairless Alternate	Stem and leaf margin often purple 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 Corn for Diseases

Paul Vincelli

Observation Times for Corn Diseases

	SEEDLING April	KNEEHIGH May	WHORL June	TASSEL July	SILK DENT DOUGH August	MATURITY September
Seedling Blights	**********					
Virus Complex			**********			
Leaf Spots						
Anthracnose		**********				
Bacterial Leaf Blight		**********	**********	**********	**********	
Northern Corn Leaf Blight			**********	**********		
Gray Leaf Spot			**********	**********		
Other (Rust, Brown spot, etc.)			**********	**********		
Stalk Rots						
Anthracnose Top Die Back					**********	
Diplodia Stalk Rot					**********	
Gibberella Stalk Rot					**********	
Charcoal Stalk Rot					**********	
Anthracnose Stalk Rot					**********	
Ear Rots						
Diplodia Ear Rot					**********	
Fusarium Ear Rot					**********	
Gibberella Ear Rot					**********	
Other Ear Rot					**********	

Description of Corn Diseases

Seedling Blights

Examination Period: Soon after emergence of corn seedlings and two more times at two week intervals. Observe two rows of plants l0 feet in length.

Symptoms: Pythium, Diplodia and Fusarium are the three fungi most often associated with seedling blight in Kentucky. The damping-off symptoms may occur before or after emergence. Pre-emergence symptoms often include a soft rot of stem tissues and discoloration of affected areas ranging from whitish-gray to pink, to dark brown or black. Post-emergence symptoms are yellowing, wilting and death of leaves. Examine underground parts thoroughly to

rule out insect injury. Know what chemicals have been applied in case chemical injury may have occurred.

Occurrence: Look for seedling blight in poorly drained, cool, wet soils. Chemical injury usually follows closely the patterns of application. This is especially evident at the turn rows. Seedling blights are usually scattered with no regular pattern, although they may be associated with low, wet areas.

Rating Scale:
0 = no seedling blight observed;
l = 1-4% of plants affected;
2 = 5-20% of plants affected;
3 = 2l-l00% of plants affected.

Record: Record a rating of 0 to 3 for each site scouted.

Virus Complex

Examination Period: Once per month in June, July and August. Observe two rows of plants 10 feet in length at several representative locations.

Symptoms: Corn plants affected with the virus complex generally lack vigor, have an off-green to yellowish color, may be stunted and may develop reddening of leaves in mid to late season. Closer examination of leaves may reveal mottling, yellow to dark-green mosaic patterns or light green to yellow streaks and stripes in leaves. Nutrient problems can sometimes be confused with the virus complex. Nutrient problems generally affect a group of plants whereas virus-infected plants are

often, but not always, individual plants that may be next to the healthy plants.

Occurrence: Often found in fields with a rhizome johnsongrass problem and where susceptible corn hybrids are grown. Check the University of Kentucky corn hybrid test results bulletin for hybrid reaction to virus complex.

Rating Scale:
0 = no virus symptoms observed;
l = 1-4% of plants showing symptoms, plants have an off-green color, little or no stunting;
2 = 5-20% of plants showing symptoms, definite off-green color, some plants stunted;
3 = greater than 20% of plants showing symptoms, definite stunting in many of the plants, some plants having reddish leaves, ear absent or small and poorly developed.

Record: Record a rating of 0 to 3 for each site observed.

Leaf Spots

Anthracnose

Examination Period: Make observations every three weeks when plants are between the knee-high and whorl stages. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: Anthracnose, caused by the fungus Colletotrichum graminicola, is often the first disease that shows up on corn. Small, round to irregular, water-soaked spots first appear on lower leaves. Spots later turn yellow and then brown with reddish-brown borders. Numerous spots can cause leaf tips or entire leaves to turn yellow. With the aid of a hand lens, black spines can be seen arising from the center of the spots. Infection begins on lower leaves and can work its way up the plant.

Occurrence: Anthracnose causes a leaf spot disease when corn is in the seedling stage. Plants become somewhat resistant as the crop develops. If weather permits, plants of some hybrids become susceptible to the "top-dieback" and stalk rot phase of the disease later in the season (see stalk rot section). High moisture and moderate temperatures favor the disease. The early season disease is generally more severe in fields where continuous no-till corn has been grown. Detection of anthracnose at the seedling stage should alert scouts to watch for the disease later in the season.

Rating Scale:
0 = no anthracnose;
1 = lower most leaf contains some yellow anthracnose lesions;
2 = lower most leaf yellowed and dried up, anthracnose lesions found on second and third leaves;
3 = second and third leaves dried up and anthracnose found on highest leaves.

Record: Record a rating of 0 to 3 for each site observed.

Bacterial Wilt (Stewart's Wilt)

Examination Period: Every four weeks from kneehigh through whorl stages and again every four weeks after tasseling until dent stage. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: The disease is characterized by leaves showing pale green to yellow streaks with irregular or wavy margins which run parallel to veins and may extend the length of the leaf. The streaked areas may die and become straw colored. Sometimes entire leaves die and dry up. Infections are most noted early in the pre-tassel (whorl) stage or later after tasseling. Infections after tasseling are generally more severe on upper leaves. Early season symptoms include plant death. Look for dark brown cavities in the lower stalk pith with no evidence of insect injury on lower stalk. See Corn Diseases I Picture Sheet.

Occurrence: More prevalent following mild winters. The bacterium is carried through the winter and transmitted to corn by the corn flea beetle.

Rating Scale:
0 = no bacterial wilt symptoms;
l = an occasional streak lesion on several plants or one dead plant;
2 = all plants contain bacterial wilt lesions on one or more leaves or 2 to l0% of plants dead;

3= leaves severely wilted and dropping, nearly all leaves of all plants affected or over l0% of plants killed.

Record: Record a rating of 0 to 3 for each site observed.

Northern Corn Leaf Blight (NCLB)

Examination Period: Every four weeks from whorl through dent stage. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: Symptoms of NCLB, caused by the fungus Setosphaeria turcica can often be confused with symptoms of bacterial wilt, especially late in the season. Lesions are long (l" to 6"), elliptical in shape with pointed ends, grayish-green or tan in color and develop first on lower leaves (see Corn Diseases I Picture Sheet). NCLB lesions differ from bacterial wilt lesions in that they are generally definite in shape, have greater width and do not follow leaf veins for extended lengths.

Occurrence: Look for this disease developing first on lower leaves when corn plants are from waist to shoulder high. The disease is favored by temperatures from 65-80E F and heavy dew during the growing season.

Rating Scale:
0 = no symptoms;
l = a few lesions on lower leaves of some plants;
2 = nearly all plants have some lesions and lesions are not confined to only lower leaves;
3 = all plants have lesions on nearly all leaves, some or all leaves dried up and killed.

Record: Record a rating of 0 to 3 for each site observed.

Southern Corn Leaf Blight (SCLB)

Examination Period: Every four weeks from whorl through dent stage. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: Small, rectangular-shaped lesions are one-fourth by one-half to three-fourths inch in size. Lesions are parallel-sided and have buff to brown borders. Coalescing of lesions can cause leaf death. (See Corn Diseases I picture sheet.)

Occurrence: Infection begins on lower leaves and may continue to uppermost leaves. Symptoms are observed throughout the entire field. Warm (68-90E F) weather is conducive to infection and disease development. Long dry periods are unfavorable.

Rating Scale:
0 = no symptoms;
l = a few lesions on lower leaves some plants;
2 = nearly all plants have some lesions and lesions are not confined to only lower leaves;

3 = all plants have lesions on nearly all leaves, some or all leaves dried up and killed.

Record: Record a rating of 0 to 3 for each site observed.

Gray Leaf Spot

Examination Period: Every two weeks from tasseling to maturity. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: Long, narrow, parallel-sided, tan or gray-to-tan lesions, up to l/4 by l to 2 inches, may merge to form large gray blotches that kill leaves. (See Corn Diseases l Picture Sheet). Appears similar to southern corn leaf blight (especially in the early stages of lesion development), except gray leaf spot has lesions that are longer and more grayish in color.

Occurrence: Infection begins on lower leaves and may continue to uppermost leaves. Symptoms are observed throughout the field. Warm, damp weather and overcast foggy days are conducive to infection and disease development. Successive corn plantings in the same field and minimum tillage practices increase this disease. Long dry periods are unfavorable for disease development.

Rating Scale:
0 = no symptoms;
l = a few lesions on lower leaves of some plants;
2 = nearly all plants have some lesions and lesions are not confined to only lower leaves;
3 = all plants have lesions on nearly all leaves, some or all leaves dried up and killed.

Record: Record a rating of 0 to 3 for each site of observed.

Common Rust

Examination Period: Every four weeks from whorl through dent stage. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: The rust fungus attacks corn leaves by producing circular to oblong golden-brown to cinnamon-brown pustules on both leaf surfaces (see Corn Diseases l picture sheet). Rust pustules contain a thin membrane that ruptures exposing the brightly colored spores of the fungus. About mid-season, these pustules turn to a brownish- black color, which can be found on mid to upper leaves.

Occurrence: Cool temperatures of 60-72E F and high relative humidity favor rust development and spread.

Rating Scale:
0 = no symptoms;
l = a few pustules on a few leaves of some plants;
2 = most leaves on all plants contain scattered populated pustules;
3 = nearly all leaves of all plants contain numerous pustules, some

leaves have turned brown and withered.

Record: Record a rating of 0 to 3 for each site observed.

Southern Rust

Examination Period: Every four weeks from whorl through dent stage. Observe

two rows of plants l0 feet in length at several representative locations.

Symptoms: Symptoms are somewhat similar to common rust, however, with southern rust the pustules (uredia) are light cinnamon brown, circular to oval and densely scattered on the upper leaf surface. The chocolate brown to black stage (telia) is circular to elongate, frequently appearing in circles around the uredial pustules and remaining covered by the epidermis longer than in common rust.

Occurrence: Disease is favored by high temperature (80E F) and high relative humidity. Southern rust is not as common year to year as is common rust.

Rating Scale:
0 = no symptoms;
l = a few pustules on a few leaves of some plants;
2 = most leaves on all plants contain scattered populated pustules;
3 = nearly all leaves of all plants contain numerous pustules, some leaves are chlorotic and dry.

Record: Record a rating of 0 to 3 for each site observed.

Physoderma Brown Spot

Examination Period: Every four weeks from whorl through dent stage. Observe two rows of plants l0 feet in length at several representative locations.

Symptoms: Lesions at first appear as very small oblong to round yellowish spots

on the leaf blade, leaf sheath and stalk. See Corn Diseases I picture sheet. Lesions may occur in bands across the leaf blade and primarily occur on the part of the leaf closest to the stalk. With age, the yellowish spots turn to chocolate brown to reddish brown and join together to form large irregular angular blotches. Infected stalks may break at the nodes.

Occurrence: Quite common on many hybrids, although it rarely causes economic damage. Temperatures from 75-86E F and free water on leaf surface favor this disease.

Rating Scale:
0 = no symptoms;
l = a few yellow lesions on a few of the plants;
2 = many plants contain lesions which are chocolate to dark brown in color;
3 = nearly all plants infected, some plants showing stalk breakage.

Record: Record a rating of 0 to 3 for each site observed.

Stalk Rots

Anthracnose Top-Die-Back

Examination Period: One time when lower leaves begin normal yellowing anywhere between two to three and one-half feet above ground level.

Symptoms: When corn plants begin their normal yellowing, or "firing" from the bottom of the plant upward, anthracnose top-dieback (Colletotrichum graminicola) affected plants also begin to yellow or redden from the top down (see Corn Diseases I Picture Sheet). The three to four leaves about ear level that remain green are very striking to the eye. Yellowing, reddening and dying of corn plant tops can be caused by severe lower stalk rot by anthracnose, rot of the upper stalk by anthracnose or by borer holes made by insects. Make sure you rule out insect injury before making your diagnosis of anthracnose top-dieback.

Occurrence: The anthracnose fungus is favored by moderate temperatures and high moisture. Time of infection may vary dependent on hybrid and weather. Generally, when plants begin to fire from the base of the plant top symptoms can be observed, if present.

Rating Scale: Count the number of plants per 20 plants at each location that have the top two or more leaves discolored (yellowish or reddish). Distinguish these symptoms from symptoms caused by the virus complex. Record the number of infected plants on the form.

Record: Of the twenty plants observed at each location, record the number having the top two or more leaves showing a yellowish or reddish discoloration.

Lower Stalk Rots of Corn

Examination Period: One time at harvest maturity before crop is harvested or the last scouting period, whichever comes first.

Symptoms: In Kentucky, late season lower stalk rot is commonly caused by one of four fungi, Diplodia, Gibberella, Macrophomina or Colletotrichum. Distinguishing characteristics of the four stalk rots are as follows:

1. Diplodia stalk rot - (Diplodia maydis). Appears several weeks
2. after silking with affected plants dying suddenly

and resembles frost injury. The lower stalk is spongy and discolored (see Corn Diseases II picture sheet.) Small, dark-brown to black spots (pycnidia) may develop just below the stalk epidermis near nodes, although these are difficult to find without some experience. Upon splitting the stalk a disintegrated brownish pith is encountered.

2. Gibberella stalk rot - (Gibberella zeae). Leaves suddenly turn dull, grayish green and lower internodes soften and turn

tan or brown. Small superficial black spots (perithecia) of the fungus may at times be seen on the stalk. The stalk interior frequently shows a pink to reddish discoloration and shredded pith (see Corn Diseases II Picture Sheet). The pink discoloration, and superficial perithecia which may be easily dislodged by rubbing a fingernail, over them distinguish Gibberella from Diplodia stalk rot.

3. Charcoal Rot - (Macrophomina phaseolina). Charcoal rot begins as a root infection, spreads into the lower stalk internodes and causes early ripening, shredding and breaking at the crown. The

black spots (sclerotia) on the vascular strands of the shredded pith give the interior of the stalks a charred appearance (hence its name) and are a characteristic sign of this disease (see Corn Diseases II Picture Sheet.).

4. Anthracnose stalk rot - (Colletotrichum graminicola). Dark discoloration on exterior nodes and internodes of corn stalks (see Corn Diseases II Picture Sheet.). Occasionally dark spines can be seen in darkened areas with the aid of a hand lens. Interior shredding of stalk pith is also common.

5. Fusarium stalk rot - (Fusarium verticillioides). Pith whitish-pink to salmon-colored. Can be difficult to distinguish from Gibberella; lab analysis often usually necessary for diagnosis of this stalk rot.

Occurrence: Symptoms of stalk rots are frequently first noted on early maturing varieties and on corn stalks producing two ears. Production of two ears further reduces stalk sugar content and results in wobbly stalks. Some surface discoloration, especially around the nodes, may be noted. Unbalanced fertility, low Potassium (K), poor soil drainage, mechanical and insect damage, foliar diseases, variety, excessive plant density and inadequate row spacing influence the development of stalk rots.

Rating Scale: Examine 20 stalks in each of five sites per field. Check for stalk rot by either of the following methods: 1.) Squeeze the base of the stalk with your hand or 2.) Push the stalk 8 to 10 inches from its vertical position to check for

lodging. Record number of plants containing disintegrated brownish pith (Diplodia), pink or reddish discoloration (Gibberella), black, charred appearance (Charcoal rot) and/or dark black exterior and shredded pith (Anthracnose). Some plants may have more than one fungus present. If so, record both. Observe any injury that may have occurred due to corn borers or other insects and enter observations on survey report following SCOUT COMMENTS.

Record: List the four types of stalk rots described previously and record the number of stalks showing symptoms of each. Some plants may have more than one type of fungus present and should be recorded for both. Note any observation of insect damage.

Action: Schedule the field for early harvest if 10 to 15% of the plants are showing stalk rot. If harvesting early, be sure to dry grain quickly to prevent ear and kernel rots.

Ear Rots

Examination Period: One time at harvest maturity before crop is harvested.

Symptoms: The more common ear rots occurring in Kentucky include: Diplodia, Gibberella and Fusarium. Color photos of each of these ear rots can be found in the Corn Diseases II Picture Sheet. Distinguishing characteristics of the three ear rots are given below.

1. Diplodia ear rot - is often characterized by a white mold found growing between kernels. The mold, which can cover the entire ear and become quite extensive, usually begins at the ear base and moves up from the shank. Black pycnidia may be scattered on husks, floral bracts and sides of kernels. Husks on ears may become bleached with inner husks adhering tightly to one another or the ear. Infected ears are often lightweight and stand upright in the field.

2. Gibberella ear rot - is associated with a reddish mold often beginning at the ear tips. Early infection may cause the entire ear to rot and husks to be pressed tightly to the ear and pink to red mold growth between husks and ears.

3. Fusarium kernel or ear rot - usually infects only individual or groups of kernels scattered over the ear. Salmon-pink to reddish-brown discoloration occurs on kernels, especially in areas that have been damaged by ear worms or corn borers.

Occurrence: Ear rots are most often observed on corn hybrids that have poor husk development, on ears that have been damaged as a result of insect or bird feeding, or on hybrids that tend toward ear maturation in the upright position. Injured kernels, wetting and rewetting of the ear, and plant stresses earlier in the year enhance ear rot development. Ear rots are generally not observed until late in the season, near harvest maturity.

Rating Scale: Examine 20 ears in a row in each of five locations in the field by observing husks and then husking ears to look at ears and kernels. Where two ears occur on the same plant, observe only one ear; thus, you will be examining 20 plants, preferably from the same 20 plants used for stalk rot data.

Record: Record the type of ear rot and the number of ears showing symptoms per 20 ears observed at each site. If possible use the same stalks observed for stalk rot and observe only one ear per stalk.

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 contains a complete explanation of these procedures.

Time of Sampling:

An excellent time for sampling is anytime after harvest and before fertilizer is applied for the next crop. Recent fertilizer applications can distort the soil test results and fertilizer recommendations. If sampling after planting, soil samples should be taken at least six weeks after the last fertilizer application. 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.

Corn presents a special problem if the soil is sampled when the crop is growing. As the height of the plants reach three feet it becomes increasingly difficult to walk through the field and view the terrain for any areas that need separate sampling. In the process of early season scouting notes should be recorded and areas needing special attention should be out lined on the field map. The best overall suggestion for early sampling when special notes are lacking is to wait at least six weeks but sample while the general crop condition and field are still visible.

Late application of nitrogen to corn and the use of anhydrous ammonia require some special attention. When nitrogen is applied four to six weeks after planting, the best time for early sampling would be just before the delayed application. When anhydrous ammonia is applied between the row anytime after planting, do not sample within six inches of the application slit.

Soil cores should not be taken from where fertilizers were banded in or beside the row. If it is not known where the fertilizer band is located, then no soil cores should be obtained within 4 to 6 inches of corn rows if row fertilizer was used.

Soil samples for alfalfa, small grains and soybeans can be taken anytime in summer or fall as long as it is at least six weeks after the last fertilizer application. It is always best to sample after the final harvest for the year or before spring planting or regrowth begins. In a double-cropping system (small grains and soybeans), sampling before the small grain planting is sufficient for fertilizer recommendations to be made for both crops.

Soil Sampling Depth:

Crop	Depth of Sample
Alfalfa and pastures	4"
No-till corn or soybeans	4"
Conventional corn or 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 generally causes the soil to be more difficult for plant roots to penetrate.

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 53 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. In addition to a compacted soil, the penetrometer will give high readings for a dry soil and heavy clay layer. Therefore, if severe compaction is found in a field then a soil probe or shovel needs to be used to look at the layer that was found compacted and confirm that high readings were not due to a clay or dry layer.

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 Nutrient Deficiencies in Corn

A nutrient deficiency symptom in a plant does not always indicate a shortage of fertilizer. Under unfavorable growing conditions, such as drought or cold or wet weather, plants may not be able to take up the nutrients.

A field history and a soil test provide the best information needed to determine if a deficiency exists and the fertilizer needs for your crop. Your local County Extension Office can provide you with the equipment and instructions needed to have your soil tested. The following are symptoms of nutrient deficiencies in corn:

Nitrogen (N)

Young plants deficient in Nitrogen are stunted, spindly and pale green to yellowish green. In more mature crops, the older leaves will become a pale yellow while the new leaves remain green. This is because nitrogen is transferred from old to new leaves. Because of this, the nitrogen deficiency symptoms will appear first and be the most severe in the older leaves. There will be a V - shaped yellowing of the leaves starting at the tips and moving down the center vein. The edges of the leaves may remain green. Deficiency symptoms will appear on the bottom leaves and appear to work its way up the plant.

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Phosphorus (P)

Mild deficiencies of phosphorus cause reduced growth and few leaf symptoms. Young plants will appear stunted and dark green in color. The root systems of small plants are often not efficient in taking up phosphorus from the soil. Symptoms due to this will often disappear when the plants are 24 to 40 inches tall.

Phosphorus deficiencies often appear first and are most severe in the older leaves, working its way up the plant. In some varieties, purple or a purple-red color develop on the dark green older leaves. The color may be only on the outside margins of the leaf or the entire leaf may turn. Young leaves are usually not affected. The tips of old leaves may also turn yellow. The color will advance toward the base of the leaf either in a broad front or along the edges of the leaf. The yellow area then turns brown as the plant tissue dies.

Phosphorus deficient plants may produce only one ear with fewer and smaller kernels than normal.

Potassium (K)

A mild potassium deficiency will cause stunted growth and pale green foliage. With a severe deficiency, plants will become very stunted and have spindly stems. Potassium deficiencies, like most others, appear first and are more severe in older leaves. Symptoms begin with the tip of the older leaves turning a pale yellow. This quickly turns to pale brown and spreads along the edge of the leaf towards the base. The center vein of the leaf and the area around it will turn a pale green.

Potassium deficient plants may produce only one ear which will be pointed and underdeveloped at the tip. The kernel size will also be smaller than normal.

Zinc (Zn)

Symptoms of Zinc deficiency usually appear within two weeks after plants emerge. Young leaves will have light streaks that will turn to a broad white band starting from the edge of the leaf and extending to the center vein. The leaf edges, center vein area and tip will remain green. Zinc deficiency symptoms will develop first and be the most severe on new leaves. Cold, wet soil conditions can cause temporary Zinc deficiencies in young plants due to a small, slow growing root system that reduces the uptake of zinc. These symptoms usually disappear when the plant passes the sixth leaf stage.

Ear and tassel development are both effected by a zinc deficiency. Ears will be small with only a few grains and the tassel may be distorted and free of pollen if the deficiency is severe.

Genetic Stripe

White stripes in leaves and a scattering of some white leaves can be what is known as Genetic Stripe. This condition may occur on only a few scattered plants and may even appear on only one side of the plant. The cause is due purely to genetics and should not be confused with a disease or deficiency symptom.

Growth Stages Of Corn

Jim Herbek

Growth Stage	Description
Vegetative (V):	(Begins with seedling emergence and ends with tasseling).
Emergence (VE)	Tip of the plant (coleoptile) is emerged from the soil surface.
	After emergence, vegetative corn growth stages are determined by leaf stages until tasseling occurs. Each leaf stage is defined according to the uppermost leaf that has a **visible leaf collar**. Starting at the bottom of the plant, count all leaves with a visible collar. The uppermost leaf counted with a visible collar is the leaf stage. The collar (discolored line) is between the leaf blade and leaf sheath. The back of the collar is the first part of the collar that will be visible.
1st leaf (V1)	Collar of 1st leaf visible. First leaf is usually oval-shaped. Subsequent leaves are longer and come to a sharper point.
2nd leaf (V2)	Collar of 2nd leaf visible.
nth-leaf	(n) number of leaves on plant with a visible collar. The (n) will fluctuate with hybrid and environment. Leaf development usually occurs at the rate of two fully emerged leaves per 7-10 days, but the time interval between leaf stages as well as total leaf numbers developed may vary between different hybrids/maturities, growing seasons, planting dates and locations.
	As plants develop, some of the lowest leaves are torn from the plant. If this occurs, leaf stage can be determined by examining internode length at the base of the stalk. To do this, corn plants must be dug and the lower stalk split lengthwise completely through the base. The first three internodes between the first four leaf nodes never elongate. The first elongated stalk internode (4th internode) is usually ½ inch in length. The first node above this internode is the fifth leaf node (5th leaf attached). Once this node has been determined, the remaining visible collars can be counted. The 5th internode (below the sixth leaf node elongates to about 1 inch and the 6th internode (below the 7th leaf node) elongates to about 2 inches.
Tasseling (VT)	The last branch of the tassel is completely visible. Silks not yet visible.

Growth Stage	Description
Reproductive (R):	(Begins with silking and ends with physiological maturity).
Silking (R1)	Silks are visible outside the ear husks on 50% of the plants. Occurs approximately 2-3 days after tasseling. Pollen is shedding.
Blister (R2)	Cob is full size. Kernels appear as white translucent grains. Endosperm and inner fluid of kernel is clear in color. Approximately 10-14 days after silking.
Milk (R3)	Inner fluid of kernel resembles a milk-like substance. Kernel displays yellow color on the outside (for yellow hybrids). Approximately 18-22 days after silking.
Dough (R4)	Endosperm has developed a heavy dough-like consistency. Approximately 24-28 days after silking. Just prior to R5, kernels begin to form dents or dry in tops of kernel.
Full Dent (R5)	All kernels are dented. Approximately 35-42 days after silking. The kernels are drying down, beginning at the top where a hard layer of starch is forming. This starch layer appears as a line across the kernel when viewed from the back side (opposite side of embryo). With maturity, the hard starch layer/line will advance toward the bottom of the kernel. The accumulated starch will be hard above the line and soft below the line as it advances.
Physiological Maturity (R6)	Kernel has reached maximum dry weight, but the grain will still have high moisture. The hard starch layer has advanced completely to the base of the kernel and a black or brown abscission layer has formed at the kernel base. This black layer formation occurs progressively from the tip ear kernels to the basal kernels of the ear. Determine by breaking an ear of corn in half, pulling off a kernel, and examining the tip for a black layer. Grain is approximately 30-35% moisture content, but this can vary between hybrids and environments.
Maturity	Grain is mature and drying. Seed moisture content of < 30%. "Maturity" at this stage is entirely a matter of moisture loss until harvest. Average moisture loss is 1/2% per day, but can range up to 1-2 % per day depending on weather and hybrid.

DETERMINING PLANT POPULATIONS IN CORN

Jim Herbek

Stand counts should be made from two to four weeks after emergence. Count the number of plants in 20 feet of row. The distance is measured by laying a 10 foot rope between the rows or using a measuring tape. Count the number of plants on both sides of the rope or tape (for a total of 20 linear feet of row for each count). Do this in five places 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.

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. 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 below).

Examples of the number of population determinations needed for various field sizes are given below.

41 acre field = one population determination (100 feet of row)
69 acre field = two population determinations (100 feet of row each)
136 acre field = three population determinations (100 feet of row each)
218 acre field = five population determinations (100 feet of row each)

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 they used in planting.

Determination of populations per acre: Multiply the total number of plants counted in 100 feet of row by the "C" (conversion) factor for the appropriate row width (see table below).

Row Width	C Factor*
15”	348.48
19"	275.11
20"	261.36
24"	217.80
30"	174.24
36"	145.20
38"	137.56
40"	130.68

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

Example: Stand Count for 100 feet = 150
Row Width = 30 inches
174.24 x 150 = 26,136 plants per acre

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.

If possible, also draw a map of the field indicating the location of each 50 acres or portion thereof counted and the average plant population obtained in each location.

Plant populations in corn can range from 16,000 to over 30,000 plants per acre, but will generally be in the range of 22,000 to 28,000 plants per acre.

ESTIMATING CORN YIELDS PRIOR TO HARVEST

Jim Herbek

Step 1. Determine ear population of good ears in 1/1000 acre. Do not include "nubbins" in the count. The length of a single row needed to equal 1/1000 acre for various row widths are shown below.

Row Length to Sample
(1/1000 acre)

Row width in inches*	Length of row
40	13'
38	13' 9"
36	14' 6"
30	17' 5"
20	26'
15	34' 10"

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

One check of yield for each 20 acres in size is suggested. Crop uniformity greatly influences the accuracy. The less uniform the field, the greater the number of samples that should be taken to estimate yield for the field. Repeat the procedure throughout the field as many times as you deem to be representative. Obviously, the more samples you measure, the more accurate the estimate. This "estimate" method provides only "ballpark" grain yields and is probably only accurate within plus or minus 30 bushels of the actual yield.

Step 2. Determine ear size:
Randomly select and determine the ear size of three ears in each 1/1000 acre.

Ear size is determined by counting the number of kernel rows and the average number of kernels per row. Do not include the extreme butt or tip kernels in these counts.

Step 3. Calculate estimated yield for **each** of the three ears per check site using the formula: number of ears in the check site x number of kernel rows x average number of kernels per row x .01116. The result is the grain yield per acre at 15.5% grain moisture.

Step 4. Average the three determinations (3 ears) of estimated yield at each check site. The field estimate will be the average of all check sites. Draw a map of the field indicating the yield estimate for each check site

(Adapted from the Corn Yield Calculator, Developed by the Agriculture Engineering Dept., University of Illinois)