Field Corn IPM Scouting Procedures

Overview:

A variety of pests can potentially attack field corn during the growing season. The sequence in which these pests occur is generally predictable; as is the relative priority with which first year corn and continuous corn should be monitored for specific pests. A scouting calendar is included to help time general scouting activities. For development of a complete field corn management program, this reference should be used in conjunction with the Cornell Recommends for Integrated Field Crop Management and the Cornell Soils and Field Crops Handbook.

To be cost-effective, individual management inputs for field corn must consider years in production, expected crop use (high moisture or grain), and future rotational plans. Pest control considerations must include information on crop stage, population, and expected time until harvest.

The field corn IPM scouting procedures are divided into five main sections:

Field Inspection Procedures:

General Monitoring:

The effectiveness of an IPM approach to field corn production will largely depend on the amount and timeliness of information available to make management decisions. It is critical that information on pest presence and abundance be collected that is representative of the whole field or area to be managed. For this reason, pest information is collected from sampling sites selected at random throughout the field. It is recommended that a "zig-zag", "M", or "W" shaped sampling pattern be walked through the field. If possible, avoid sampling 100-150 feet or 50 rows from the edge of the field since pest populations in these areas may not be typical of the majority of the field. A different entrance and exit should be taken each field visit to increase the potential of finding isolated problems.

A record of significant findings should be kept for each field visit. This information should include field name or identification, date, crop stage, crop condition, and significant pest problems including: pest(s) observed, abundance (average count, rating, %, or as appropriate). It is recommended that spring and fall weed surveys be made. It is also recommended that an early season corn population assessment be made.

The field corn scouting calendar may be consulted as a guide to expected seasonal occurrence of field corn pests and cultural activities. Additional information not found in these IPM scouting procedures may be obtained from the Cornell Recommends for Integrated Field Crop Management and the Cornell Field Crops and Soils Handbook.

Corn Population Assessment:

Population assessments, number of plants per acre, should be made early in the season to provide an indication of the productivity potential of the field. Corn populations depend greatly on soil type, planting date, crop use, hybrid selection, tillage practices, and pest pressure. Field corn grown for silage is generally planted to obtain a final population of about 28,000-30,000 plants per acre, while corn grown for grain is planted to obtain a final population of about 26,000-28,000 plants per acre depending on such factors as geographic location and soil productivity group. Planting rates are frequently 15% higher than the actual population expected. Actual stand counts should be compared against expected plant populations (seeds dropped, target population) to assess potential impact of early season pests or other stand establishment problems.

Determining Plant Population Method:

Select 5-10 sites at random throughout the field. Determine the width between rows. Use the following table to estimate corn populations. Count and record the number of corn seedlings observed within a given length of row per field. Multiply the average number of plants in the row for the specific length of row by 1,000 to obtain expected plants per acre. **Note:** Efficiency of individual planter boxes may be checked by comparing seedling counts from adjacent rows. If they are still visible, use tire tracks and the marker disk furrow as references, note tire tread direction.

Plant Stands - Corn

Planting Rate/A	Final Stand/A (10% Loss)	Row Spacing 15"	20"	28"	30"	32"	36"	38"	40"
		Inches Between Kernels							
20,000	18,000	20.9	15.7	11.2	10.5	9.8	8.7	8.3	7.8
22,000	19,800	19.0	14.3	10.2	9.5	8.9	7.9	7.5	7.1
24,000	21,600	17.4	13.1	9.3	8.7	8.2	7.3	6.9	6.5
26,000	23,400	16.1	12.1	8.6	8.0	7.5	6.7	6.3	6.0
28,000	25,200	14.9	11.2	8.0	7.5	7.0	6.2	5.9	5.6
30,000	27,000	13.9	10.5	7.5	7.0	6.5	5.8	5.5	5.2
32,000	28,800	13.1	9.8	7.0	6.5	6.1	5.4	5.2	4.9
34,000	30,600	12.3	9.2	6.6	6.1	5.8	5.1	4.9	4.6
36,000	32,400	11.6	8.7	6.2	5.8	5.4	4.8	4.6	4.4
Row feet/1000th A		34'10"	26' 2"	18' 8"	17' 5"	16' 4"	14' 6"	13' 9"	13' 1"
Row feet/A		26,136	26,136	18,668	17,424	16,335	14,520	13,755	13,068

Length of row required for 1/1000 acre at various row widths:

Row Width (in.)	Length of row for 1/1000 acre
15	34' 10"
20	26' 2"
30	17' 5"
32	16' 4"
36	14' 6"
38	13' 9"
40	13' 1"

Considerations:

Plant populations significantly above or below that expected may indicate planter calibration problems. Lower plant populations may indicate seedling establishment problems such as poor seed germination due to unfavorable soil moisture or seed quality, less than optimal planting depth, soil borne insect or disease problems, soil crusting, or bird, deer or other vertebrate damage. While walking the field look for seeds on the soil surface, closure of the seed furrow, seed : fertilizer placement, animal tracks, very wet or dry areas, soil crusting, and other factors which crop establishment.

SEE ALSO:

- Plant Populations and Row Spacing for New York Corn, Cornell Extension Bulletin 276.00, 5/1978.
- When to Replant Corn, Cornell Extension Bulletin 277.00, 5/1978.
- Cornell Field Crops and Soils Handbook, Guide to Corn Populations in NY State.
- Cornell Recommends for Integrated Field Crop Management

Weed Scouting Procedures:

General Overview:

Weeds compete with the crop for limited resources and may also serve as alternate hosts for various insect and disease pests. Weed monitoring is conducted to detect significant weed problems, rank them for relative severity and sort them by management type (annuals, biennials, perennials, grasses and broadleaves). Weed monitoring provides information to tailor weed management efforts that reduce the impact of the weeds with greatest potential impact. Early season weed monitoring should be conducted preplant, and corn emergence through 4-5th leaf stage (VE-V5, See Appendix). at a stage when annual broadleaf and grass weeds are less than 1.5 inches. End of season weed surveys should be taken to help assess future needs and options for weed control. Weed infestations can be visually estimated and rated for potential impact using the following system. Predominant weed species should be noted and ranked in order of importance. It is not necessary to make detailed counts of individual weeds. Economic thresholds have not currently been established for weeds in field corn under New York conditions.

Evaluating Weed Presence- Weed Rating Scale*:

The intensity of each weed species should be determined using the following rating scale:

None	No weeds present
Few	Weeds present but very few plants within the field. Enough plants to produce seed but not enough to cause significant economic loss in the current year.
Common	Plants dispersed throughout the field, an average of no more than 1 plant per 3 feet (.91m) of row, or scattered spots of moderate infestation.
Abundant	Fairly uniform concentrations across field. Average concentrations of no more than 1 plant per foot (.30m) of row or scattered spots of severe infestations.
Extreme	More than 1 plant per foot (.30m) of row for broadleaf weeds and 3 plants per foot of row for grasses, or large areas of severe infestations.

* From: Michigan State Univ. Field Crops Scout Manual.

Common weeds found in row crops in New York are listed below.

COMMON WEEDS IN FIELD CROPS IN NEW YORK

Annual Broadleaves	Annual Grasses	Biennial Weeds
Bedstraw, Common	Barnyard Grass	Burdock
Buckwheat, Wild	Broome, Downy	Carrot, Wild
Campion, White	Crabgrass, Large	Ground ivy
Chickweed, Common	Fall Panicum	Groundcherry, Smooth
Cocklebur, Common	Fall Panicum	Horsenettle
Corn Speedwell	Foxtail, Giant	Mullein, Common
Dodder	Foxtail, Green	Rocket, Yellow
Galinsoga, Hairy	Foxtail, Yellow	Teasel. Common
Groundsel*, Common	Goosegrass	Thistle, Bull
Henbit	Orchardgrass	
Jimson Weed	Wild Oat	**Perennial Weeds**
Lambsquarters*, Common	Wild Proso Millet	Bindweed, Field
Lettuce, Prickly	Witchgrass	Bindweed, Hedge
Morning Glory, Ivy Leafed		Canada Thistle
Mustard, Wild		Chickweed, Mousear
Nightshade, Black		Dandelion, Common
Pigweed, Prostrate		Dock, Curly
Pigweed, Redroot		Hemp Dogbane
Pigweed*, Smooth		Horsenettle
Pineapple weed	**Winter Annuals**	Horsetail, Field
Purslane, Common	Bluegrass, Annual	Johnson Grass
Ragweed*, Common	Chamomile, Corn	Milkweed, Common
Smartweed, Pennsylvania	Deadnettle, Purple	Nutsedge, Yellow
Sowthistle, Annual	Mustard, Wild	Plantain, Buckhorn
Sunflower, Wild	Radish, Wild	Sowthistle, Perennial
Velvetleaf	Shepherd's-purse	Quackgrass
* Triazine Resistant Strains		Wire Stem Muhly

Early Season Weed Scouting:

Preseason weed surveys, made the previous fall, are very helpful in determining weed control strategies prior to planting. Early season pre-plant and post emergence weed surveys should be conducted VE - V5, particularly if prior information is not available. It is especially important to monitor fields for weed growth during the first two to three week period following corn emergence to evaluate weed control actions and identify need for supplemental control measures. If a problem is detected, individual weed species must be identified, the severity of their infestation assessed, the approximate height and growth stage of both the weeds and the corn recorded, and the location of the infestation recorded. Information should be collected on the predominant weed species and particular types of weeds observed, i.e. grasses or broadleaves, annuals, biennials and perennials. Consult the weed rating guide outlined above for ranking weed importance. Weed infestations may not be uniform across the entire field, so record observations that are representative of the field condition. Usually an accurate assessment of the weed problems can be obtained by walking each quarter of the field and recording observations along the total route. Keep a record of significant weed infestations by drawing their location and logging their species composition on a map of the field (See Appendix). Weed surveys should be made early season and updated as necessary

throughout the growing season, including any comments regarding the efficacy of weed control efforts. This record can be consulted with other field history information for adjusting future weed management decisions.

The first survey for weed infestations in a field are needed within one week after corn emergence through the fourth or fifth leaf stage of field corn (VE-V5). This information aides in decisions regarding the implementation and timing of supplemental control measures such as rotary-hoeing, row cultivation, and/or post emergence herbicides. Cultivation is an effective way of controlling weeds in corn up to 2 1/2 feet tall. If, however, chemical control measures are to be used, weed seedlings, especially grasses, must be detected and identified when they are less than two inches (5cm) tall. Postemergence herbicides are usually most effective when weeds are young and actively growing. Degree of control will vary dependent on type of weed and stage of growth.

Adequate moisture is necessary for effective weed control with many soil applied herbicides. Too little rainfall can mean that there is not enough to allow adequate incorporation of the herbicide into the soil. However, too much rain can cause the movement of more soluble herbicides downward below the zone where they are most effective. Within seven days of application, one-half inch of rainfall is ideal for good performance of a number of herbicides. When rainfall is not adequate within 7 to 10 days after applying a preemergence herbicide, rotary-hoeing can help to control emerging weeds before their roots become anchored in the soil. This extends the time for adequate rain to occur.

Fall Weed Survey:

A fall weed survey should be taken during August or early September. Follow the procedures outlined in the early season weed monitoring section. Develop a weed map, collecting and recording information on predominant weed species and their location. Rank weeds by relative severity of infestation and by type (annual, perennial, biennial grass or broadleaf).

The purpose of the final weed survey is to provide information representative of the overall status of weed problems in the field. This information will play an important role in the development of weed management strategies for the following year. Heavy weed infestations along field borders, approximately the first 100 feet from the field margin, or unique areas such as along waterways or in low, poorly drained areas should also be noted on a weed map. Isolated heavy weed infestations should be noted on a weed map for possible spot treatments.

Herbicide-Resistant Weeds:

Triazine-resistant biotypes or strains of common lambsquarters, smooth pigweed, common groundsel and common ragweed have been confirmed in New York. These triazine-resistant biotypes were originally controlled with one or more of the triazine herbicides at normal use rates. Weed populations dominated by the triazine-resistant strains, however, are not controlled with even the highest recommended triazine use rates. In addition, there is cross-resistance among the different triazine herbicides used in corn.

Triazine-resistant strains may be suspected where a single species of annual broadleaf, such as those listed above, is the dominant or only broadleaf species present in a field treated with a triazine herbicide (atrazine, Aatrex, Bladex and Princep).

Diagnosing a Herbicide Resistance Problem:

1. All other causes of herbicide failure have been eliminated. (Herbicide properly applied: rate?, timing?, placement?, incorporation?, appropriate weed growth stage? Favorable weather during / following application?, Adequate reaction time?)
2. Other weed species on herbicide label (than the suspect weed) were controlled effectively?
3. Field has history of continuous use of same herbicide or herbicides with same mode of action?

4. The weed species that now demonstrates potential resistance was controlled effectively in the past by the herbicide?

NOTE: In the midwest, weed biotypes have been detected with resistance to ALS inhibitor herbicides. Careful management of herbicides, including integrated use of crop rotation, cultural practices and rotated use of herbicides with different modes of action is critical to minimize development of herbicide resistance. For further discussion consult the Cornell Field Crops and Soils Handbook and the Cornell Recommends for Integrated Field Crop Management.

SEE ALSO:

• Cultivation Basics for Weed Control in Corn, J. Mt Pleasant & J. Frisch, Cornell, SCAS Ext Series No. E93-4

Field Corn Insect Scouting Procedures:

General Overview:

Field corn is scouted for insect pests at two general corn growth stages during the growing season: Early- at emergence (VE-V5, seedling stages), and Late- at time of tassel/silking (VT-R3). Monitoring corn at the mid-whorl stage of development (V6-V10) may also be advised if European Corn Borer, or Armyworm infestations are suspected or if severe weed and disease problems, especially Anthracnose leaf blight, have been previously identified. Common insect pests expected in field corn grown in New York appear in the following table.

INSECT PESTS OF FIELD CORN IN NEW YORK EXPECTED AT VARIOUS GROWTH STAGES:

	Time During Season		
Insect	**April/May**	**June**	**July/August**
Seed Corn Maggot[a/]	X		
Slugs ◊[d/]	X		
Wireworm[b/]	X		
White Grubs[b/]	X		
Armyworm[c/]	X	X	
Cutworm[c/]	X	X	
European Corn Borer*[c/]	x	X**	X**
Common Stalk Borer[c/]		X	X
Fall Armyworm[c/]		X	X
Potato Stem Borer/Hop Vine Borer[c/]		X	X
Corn Rootworm larvae*			X
Corn Rootworm adult*[e/]			X

[a/] problem in fields with high organic matter under cool moist conditions; [b/] often a problem of first year corn after sod; [c/] generally associated with weedy fields, particularly those with high grass weed pressure; [d/] generally associated with moist conditions and heavy crop residue; [e/] problem in continuous corn, not considered a problem in first year corn; ◊ Snail-like mollusk, not an insect. * Principle corn pest under New York Conditions; **ECB: Late May through early July 1st generation, Late July through early September 2nd generation.

Early Season Insects (April/May) - Corn Growth Stages VE - V5:

Early season insect pests can be monitored while conducting plant population assessments and spring weed surveys while corn is emerging through approximately the fifth leaf stage (VE - V5). Gaps in the expected number of corn seedlings per foot of row, and/or presence of wilting, stunted or cut plants may indicate a pest problem. A record should be kept of the cause of the missing or damaged seedlings and of the percent of total plants affected by the particular pest. Seed should be found buried about 2 inches deep about every 6-9 inches depending on population rate. Where gaps are present, carefully excavate the area to determine the presence and condition of seeds. Assess seeds for feeding damage by seed corn maggot, wireworm or presence of a disease. Seedlings showing injury should be carefully excavated and assessed for presence of cutworm, wireworm, stem borers, white grubs or root diseases. Pay particular attention to insects that may be found in the soil surrounding the plant. Damage to 5% or more of seedlings by seed corn maggot,

wireworm and white grubs is considered significant, however, rescue treatments such as replanting are rarely economical and should be carefully considered. Slugs may cause damage to young seedlings under cool moist conditions. Slugs can be traced by the presence of shiny slime trails they leave from the plant to hiding places. Digging through cracks in the soil to cooler, more moist, regions should reveal their presence. No chemical control measures are currently recommended for slugs in field corn. Early season pests, such as cutworm and armyworm, may be expected in areas of poor grass weed control and along field borders, or wet areas. Early detection of cutworm and armyworm, while the larvae are 1/2 inch or less in length, is necessary for effective control. Cutworm damage is indicated where young plants are clipped close to ground level. Cutworms are nocturnal and hide in the soil or debris near the base of the plant during the day time. An economic threshold for cutworm has been reached when 5% of the plants have been affected. Armyworm damage is indicated when leaves have a tattered appearance from the edge of the leaf margin. Armyworm larvae may frequently be found in the leaf axils or whorls. Armyworms should be treated when most plants show damage and three larvae per plant are found. Only the infested area and a 50-75 foot surrounding border need be treated. If armyworm infestations are detected, monitoring of adjacent small grain fields may be advised. It should be noted that the growing point of corn is below the soil surface prior to the V6 stage. Seedlings damaged before this stage will likely recover IF the growing point and root system has not been damaged.

SEE ALSO:
• Plant Populations and Row Spacing for New York Corn, Cornell Extension Bulletin 276.00, 5/1978; When to Replant Corn, Cornell Extension Bulletin 277.00, 5/1978.

Mid-Season Insects (June) - Corn Growth Stages V6 - V10:

Common insect pests during the mid-season, in the mid-whorl stages (V6-V10), include fall armyworm, corn rootworm larvae and adults, and European corn borer (1st and 2nd generation). As in cutworm and armyworm, early detection of fall armyworm, while 1/2 inch or less in length, is necessary if they are to be effectively controlled. Only the infested area and a 50-75 foot surrounding border need be treated. European Corn Borer (ECB) is another common pest of field corn during the mid-season. Timing the control actions for this pest during the growing season is very difficult. ECB moths enter and lay eggs in the field over an extended period of time. ECB larvae must be controlled before the penetrate the plant to feed. The best current management for ECB is the use of a hybrid with a good standability rating. Chemical treatment of ECB is rarely used in New York field corn. For these reasons, ECB is not generally a high priority for scouting programs. ECB can, however, be a serious problem if combined with the Anthracnose stalk rot disease. Where significant numbers of corn plants are observed with damage from both ECB and Anthracnose fields should be monitored closely for signs of excessive lodging.

ECB have two generations per year under New York conditions. The first generation of these moths begin to lay eggs in the field late May to early July. The second generation may be expected from late July to early September. Early detection of ECB involves searching for egg masses and signs of larval feeding. Egg masses appear as a grouping of flat, overlapping, scale-like individual eggs. Egg masses are extremely small (about 1/16 in.), and can be found on the under surface of the lower six corn leaves. Larvae feed on the leaves and in the whorls (white scratch-like marks and pinholes on the leaf surface). ECB larvae typically bore into corn leaf midribs (causing the leaves to break at the point of penetration) and corn stems. The threshold for first generation ECB is reached when 75% of the plants show signs of larval feeding. The threshold for second generation ECB is reached when 100 egg masses are detected on 100 plants. Early detection of ECB is critical if chemical control measures are to be considered since treatment application must be made before the ECB larvae have penetrated the corn plant.

Late Season Insects (July/August) - Corn Growth Stages VT - R3:

Late season insect monitoring is principally for adult corn rootworm (CRW) beetles and to a lesser extent for European Corn Borer (ECB). Monitoring for these pests is done during the time from tassel emergence through grain fill. Treatment for ECB is generally not necessary or practical. Fields should, however, be assessed for ECB damage to determine the potential need for early harvest particularly, if significant amounts of Anthracnose Leaf Blight is also present. Anthracnose Leaf Blight can under appropriate conditions lead to the development of Anthracnose Stalk Rot. As mentioned earlier, the combination of ECB & Anthracnose Stalk Rot has been found to significantly affect yield through excessive lodging which interferes with harvest. If significant amounts of lodging are observed, earlier harvest of grain corn for silage may be advisable to minimize losses due to crop lodging.

The principal insect pest monitored late season is the corn rootworm (CRW) beetle. Two types of CRW occur in New York, Northern CRW (NCRW) , a light green colored beetle, and Western CRW (WCRW), a yellowish beetle with two dark longitudinal stripes. The northern CRW has historically been the most common species. The western CRW, a recently introduced species, has rapidly extending its range from western New York eastward. CRW beetles cause two types of damage: larvae feed on corn roots affecting crop growth, yield, and increase the potential for lodging, and adult beetles feed on pollen and silks interfering with grain fill.

Corn Rootworm Monitoring:

General Overview:

Corn rootworm beetles have a two growing season life cycle under NY conditions. Eggs laid in the field in late summer, will overwinter and hatch the following spring and attack corn if corn is re-planted in the same field. Since CRW larvae can only attack corn, rotation is an effective means of avoiding CRW damage.

Presence of CRW beetles in corn is closely associated with particular corn growth stages. CRW larvae which have been feeding on corn roots will emerge as adults during the time from tasselling (VT) through the silking and pollination period (R1 - R3), which lasts approximately three (3) weeks. Differential emergence patterns cause early CRW beetle populations to be dominated by males. Later in the season, populations are predominantly female. During the 10-21 pre-egg laying period, CRW beetle females feed on corn silks and pollen. CRW beetles should be monitored at this time for two reasons. First, clipping of corn silks by high populations of CRW adults can result in poor grain fill. Secondly, the relative abundance of adult beetles in corn fields in August provides an indication of the potential CRW risk to corn planted in the same fields the following year. CRW eggs laid in the field the previous year will overwinter, hatch, and the CRW larvae will feed on young corn roots reducing yield potential and cause lodging.

Fields at Risk from Corn Rootworm:

A number of factors influence the potential for damage from corn rootworm including: years in corn, planting date, crop stress, weed control, soil texture, manure applications, hybrid selection, and pollination conditions. The impact of an individual factor may vary with a specific field situation. The influence of some factors, such as soil texture and manure, are poorly understood at this time. Several generalizations, however, are possible.

- A soil insecticide is seldom economically justified in first year corn for rootworm control.
- Annually rotated corn will seldom need to use a corn rootworm insecticide.
- Early planted corn following late planted corn in the same field the previous year may be at risk from CRW larval feeding.
- Given an equal number of CRW beetles, silage corn is at higher economic risk than corn grown for grain.
- Corn fields should be monitored if they are to be planted to corn the following year.

Fields planted to continuous corn are at greater risk to economic CRW infestation than first year corn, since CRW eggs are laid the previous fall in existing corn fields. The longer corn is planted to the field on a continuing basis, the greater the likelihood of it developing economic CRW infestations. Continuous corn planted after late planted corn the previous year is at high risk, due to the attractiveness of the late pollinating corn to CRW beetles, resulting in heavier than normal egg laying in the field.

Corn in its last year of a rotation may not require scouting for CRW if: i) there is no possibility of changing the field's rotation schedule for the following year, or ii) if the field would not be treated if scouting indicated sufficient CRW populations to cause a significant silk clipping problem and subsequent interference with grain fill.

Factors Which Enhance Corn Rootworm Problems	**Factors Which Reduce Corn Rootworm Problems**
• Continuous Corn	• Crop Rotation
• Late Planted Corn Previous Year, Early planted Corn This Year	• Soil Insecticide (If Warranted by Monitoring Information)
• Abundance of Late Season Pollinating Weeds	• Sandy Soil Texture*
• Crop Stress (e.g. Drought, Nutrient Deficiency, Herbicide Damage, Excessive Temperature, Moisture, etc.)	• Healthy Crop
	• Manure Applications*
• Uneven Stand Emergence	• Uniform Stand Emergence
• Extended Pollination Time	• Uniform Pollination Date
* Not well understood	

Corn Rootworm Scouting Procedures:

Scouting procedures for CRW are based on the premise that the corn crop is generally uniform in development and pollination date. Since CRW beetles are pollen feeders they will be relatively evenly distributed in fields with uniform pollination and crop development. Uneven crop development as the result of germination problems, weed competition, water stress, etc. will result in fields having pockets of plants with varying maturity and pollination dates. Accurate assessment of CRW populations is difficult in these fields, since beetles will be attracted and concentrated on pollinating plants. In these situations, it is important to estimate the average crop growth stage across the field and to obtain an estimate of the CRW population which is representative of the majority of the field. This situation may require adjusting the monitoring strategy, such as collecting and evaluating more detailed information within high CRW population areas of the field.

If at all possible, scouting for CRW should be made at least 150 feet or 50 rows into the field. Counts made along the field borders may provide misleading information since CRW adults are attracted to pollen sources, such as golden rod, foxtail, or other weeds, growing between fields or along field margins.

Adult corn rootworm sampling in continuous corn should be initiated after **mature females** have been detected in the field. Start checking females for the presence of eggs one week after pollination in the earliest flowering fields. Females are the larger-sized beetles with expanded abdomens and can be checked for eggs in the following way. Capture the beetle between your thumb and forefinger and squeeze the contents of the beetle out the abdomen. Mature eggs are white, about the size of a pin head, and shaped like footballs. Check at least a dozen beetles for the presence of eggs. Once mature females have been detected in a field, sample the field at seven day intervals until either an economic population has been recorded in a single sampling or a sub-economic population has been recorded for three consecutive weeks.

To monitor CRW beetles, carefully and quietly approach a corn plant, grasp the ear silks in one hand to confine any beetles in the silks and search the remainder of the plant from bottom to top. CRW beetles are easily startled and quickly tumble off plants when disturbed. DO NOT count CRW beetles on adjacent plants, since the same insect could be counted more than once! Quickly search the plant looking for beetles on and under leaves, in leaf axils, and on tassels. After searching the entire plant bottom to top, search the ear silks for remaining beetles. After completing the search, record the number of beetles found on the plant. Where mixed populations of beetles are present, **record beetle numbers by species** (i.e. number of WCRW and number of NCRW).

Two CRW sampling procedures will be described: a sequential plan and a fixed site number plan. The techniques are identical except for the number of plants needed to sample per field visit before reaching a rotate/treat decision. Decisions are based on the average number of CRW beetles observed per plant. Two action thresholds will be discussed.

Selecting an Action Level

Current Year CRW Recommendation: **Adult Control**
(to prevent significant silk clipping and interference with grain fill)
Average of 10 WCRW and/or NCRW beetles per plant.

Considerations: Pollination is still taking place, beetles are still present, 50% or less of the plants have pollinated (pollination has occurred if silks are limp and curled on the ends, may appear green to brown), **or** 50% of plants show signs of silk clipping to < 0.5 inches, or new silks are < 0.5 inches long.

Checking Pollination: Another method to assess pollination is to carefully strip the husk from an ear, making sure not to disturb the silks in the process. Hold the exposed ear by the butt end and shake it to see what percentage of the silks easily fall from the ear. Do Not pull or forcibly tear the silks from the individual kernels. Silks will easily separate from pollinated kernels.

Following Year CRW Recommendation: Assessing Need for CRW Larval Control
(to prevent yield losses and crop lodging in field replanted to continuous corn)

The action threshold for northern CRW is an average of two beetles per plant, while the action threshold for the more damaging western CRW is an average of one per plant.

or

An average of 1 WCRW or "WCRW-equivalent" beetle per plant
(2 northern CRW's = 1 western CRW-equivalent)

CRW Sampling Window:

Corn rootworms begin to emerge about the time of pollen shed. Male beetles are generally the first to emerge. Females begin to emerge about ten days later. When taking beetle counts it is important that female beetles be present in the field to accurately assess egg laying and the potential for CRW damage next season. WCRW beetles typically exhibit different color patters for each sex. Most WCRW females have distinct dark stripes along their wing covers, while wing covers of males have a broad dark streak with no color distinction between wings. Both sexes of NCRW beetles are pale to light green . To determine if female beetles have emerged and are mature, use the method described above.

Sampling in continuous corn fields should be initiated **one week after initiation of pollen shed and silking** (R1 - R3 growth stages) and should continue on a seven day interval

until the ear silks are brown, approximately 3 weeks after tassels are first visible). Guidelines for using CRW scouting to determine rotation or treatment decisions follow.

Sampling first year corn fields for CRW should be initiated **two weeks after initiation of pollen shed and silking** and should continue on a seven day interval for three weeks until the population numbers of corn rootworm adults peak, then decline for 2 weeks **or** until an economic population is detected resulting in a "rotate/treat decision".

Different courses of action are required for each of the following sampling situations.

CRW Over Threshold?

Week 1	Week 2	Week 3	Comments*
Yes			**Field at Risk,** Sampling the third week is not necessary.
No			**Resample in 7 Days**
No	**Yes**		**Field at Risk,** Sampling the third week is not necessary.
No	**No**		**Resample in 7 Days**
No	**No**	**Yes**	**Field at Risk,** No further sampling necessary this year.
No	**No**	**No**	**Field Not at Risk**

*Assumes female CRW in field, even pollination throughout field

"Fields at Risk" for CRW damage - should be rotated out of corn or a soil insecticide should be used next year at planting for CRW control.

Fields "Not at Risk" for CRW damage - Soil insecticide for CRW control is not needed at planting; an insecticide seed treatment is recommended for control of seed corn maggot.

Sequential Sampling Procedure:

Sequential sampling methods combine streamlined sampling procedures with treatment thresholds to maximize sampling accuracy and minimize sampling efforts. A sequential sampling technique has been developed for monitoring CRW in uniformly pollinating corn fields. This technique effectively assesses the potential for CRW injury to fields replanted into corn the following year. Sequential sampling methods are particularly time efficient when CRW populations are very high or very low.

Sequential scouting procedures are based on the premise that the pest is uniformly distributed throughout the field. As previously discussed, CRW beetles are pollen feeders which tend to be relatively evenly distributed in fields with uniform pollination and crop development. Uneven crop development, as the result of germination problems, weed competition, water stress, etc., will result in pockets of plants with varying maturity and pollination dates. Accurate assessments of the average number of CRW beetles per plant will be difficult in these field situations, since beetles will be attracted and concentrated on pollinating plants. For this reason fields with uneven crop development **should not** be sampled using the sequential sampling procedure.

Example (action threshold = average 1 CRW beetle per plant)

1) Use the CRW monitoring technique described in the CRW overview section.

2) Inspect three randomly selected plants for the presence of corn rootworm adults from three different sites within the field. Sum the total number of adults observed on the three plants and refer to the sequential sampling table for the action level you selected. **Remember** the total number of northern CRW need to be divided by **two (2)** to convert the northern CRW counts to western CRW equivalents**.**

Example Corn Rootworm Sampling Worksheet:

Sample Site (Plants Sampled)	BEETLE COUNTS	
	WCRW	NCRW
3		
4		
5		
6		
7		
x		
55		

TOTAL		
Total NCRW /2 =		

WCRW + NCRW	

3) Locate the row of numbers corresponding to three plants sampled in table 1. Compare the number of corn rootworm adults counted (WCRW counts plus western CRW equivalents, i.e. number of NCRW /2) on the three plants with the numbers listed under each of the three columns. If the number of observed CRW adults fall within the range of numbers listed in a specific column, follow the instruction at the head of the column. For example, if the total number of CRW adults observed on three plants is 11 or more individuals, the field has exceeded the action level for that week and the field needs to be resampled in seven days. **If** the field has exceeded the selected action level for two consecutive weeks, then no further sampling is necessary for the remainder of the season. **If** the field is planted to corn the following growing season, a soil insecticide is recommended to prevent economic losses by corn rootworm. **If** the number of corn rootworm adults observed on three plants fall between 0-10, then another plant needs to be sampled. If after 8 plants have been sampled, no corn rootworm adults have been detected, then the field should be resampled in 7 days. **If** "no decision" has been reached after 55 plants have been sampled (no. of beetles counted fall within the continue sampling column), divide the total number of corn rootworm adults (western CRW counts plus western CRW equivalents) by the total number of plants sampled. **If** this number is greater than or equals the selected action level (usually 1 beetle per plant) and the field has exceeded the threshold for two sequential weeks, then the field needs to be treated with a soil insecticide next year if corn is going to be planted in this field the following season.

SEE ALSO:
• Sampling and Management of Corn Rootworm in New York Field Corn, Cornell Extension Field Crop Insect Fact Sheet 501.00, 7/1991.

Fixed Site Number CRW Sampling Procedure:

For use in fields with **uneven physiological development** or where sequential sampling is not being used.

1) Use the CRW monitoring technique described in the CRW overview section.

2) Examine 10 plants in each of at least five locations in the field. Select plants at random, do not sample adjacent plants. Move slowly and quietly as you approach the plant to avoid disturbing the beetles. Count and record the number of beetles on the entire plant beginning with those on the lower leaves and working your way to the top. Pay particular attention to those areas where pollen may have collected such as ear tips, the tassel, the leaf surface, and behind the leaf axils, etc.

3) Calculate the total number of northern and western CRW beetles separately. Determine the average number of CRW beetles per plant as described earlier. Divide the total number of beetles in the field (counts of WCRW + western CRW equivalents) by the number of plants sampled (50 plants) to calculate the average number of beetles per plant for the field. Fields need to be sampled for a minimum of 3 consecutive weeks during the optimum sampling window before a management decision about CRW can be made. If the average number of beetles per plant exceeds the selected action level (1 CRW beetle per plant), a rotate/treat action threshold has been reached.

SEE ALSO:
• Sampling and Management of Corn Rootworm in New York Field Corn, Cornell Extension Field Crop Insect Fact Sheet 501.00, 7/1991.

NOTE: For a further discussion of insect control practices in New York consult the Cornell Field Crops and Soils Handbook and the Cornell Recommends for Integrated Field Crop Management.

Table 1. Corn Rootworm Sequential Sampling: Rotate/Treat Decisions, Next Year

Number of plants sampled	Resample in 7 days	Continue sampling	Discontinue sampling
3	-	0-10	11
4	-	0-11	12
5	-	0-12	13
6	-	0-13	14
7	-	0-14	15
8	0	1-15	16
9	1	2-16	17
10	2	3-17	18
11	3	4-18	19
12	4	5-19	20
13	5	6-20	21
14	6	7-21	22
15	7	8-22	23
16	8	9-23	24
17	8	9-24	25
18	9	10-25	26
19	10	11-26	27
20	11	12-27	28
21	12	13-27	28
22	13	14-28	29
23	14	15-29	30
24	15	16-30	31
25	16	17-31	32
26	17	18-32	33
27	18	19-33	34
28	19	20-34	35
29	20	21-35	36
30	21	22-36	37
31	22	23-37	38
32	23	24-38	39
33	24	25-39	40
34	25	26-40	41
35	26	27-41	42
36	27	28-42	43
37	28	29-43	44
38	29	30-44	45
39	30	31-45	46
40	31	32-46	47
41	32	33-47	48
42	33	34-48	49
43	34	35-49	50
44	35	36-50	51
45	36	37-51	52
46	37	38-52	53
47	38	39-53	54
48	39	40-54	55
49	40	41-54	55
50	41	42-54	55
51	42	43-54	55
52	43	44-54	55
53	44	45-54	55
54	44	45-54	55
55	54	-	55

* Action level = 1.0 CRW beetle per plant

Disease Scouting Procedures:

General Overview:

At first glance, diseases may not be dramatically obvious; yet they can be a significant production constraint. Heavy disease pressure can reduce yield and quality of grain and silage. Fungal leaf blights and stalk rots are the most significant diseases affecting corn in New York. Seedling diseases are more likely problems under cool moist conditions. Mid and Late season disease problems are often enhanced by extended periods of wet weather. Continuous corn may be particularly at risk if diseased corn debris is present from the previous year.

Monitoring for diseases in field corn is easily be done while scouting for insect and weed pests. Generally, diseases must occur in epidemic proportions to be economically important. Note concentrations of diseased plants since they may provide inoculum to infect healthy plants. Disease monitoring is necessary to detect and identify these problems in a timely manner. Primary attention should be paid to plants showing signs of premature yellowing and senescence. Plants may die suddenly or may begin to die from the bottom up. Disease symptoms on the lower portions of the plant often reflect a moister environment which is more favorable for disease development. If a significant disease problem is detected, the status of the disease in the field should be noted during each scouting visit. Record the approximate location(s) of diseased plants on a field map and estimate the percent of plants affected in the field. Correct identification of the disease will often require a laboratory diagnosis. **Note**: disease diagnosis will be enhanced by including samples of the diseased tissue that have green as well as damaged areas. Where possible, include information on hyrbid, field conditions, previous cropping history, amount of crop debris, soil moisture, and presence of apparently diseased weeds in these areas. Information on submitting specimens to the diagnostic clinic is available through the local Cornell Cooperative Extension office.

Common corn diseases and their expected times for occurrence are listed below.

DISEASES OF FIELD CORN IN NEW YORK EXPECTED AT VARIOUS GROWTH STAGES:

	Time During Season		
Disease	**April/May**	**June**	**July/August**
Pythium Damping Off	X		
Rhizoctonia Damping Off	X		
Anthracnose Leaf Blight	X		X
Eye Spot	X	X	X
Gray Leaf Spot		X	X
Yellow Leaf Blight		X	X
Northern Leaf Blight		X	X
Southern Leaf Blight		X	X
Northern Leaf Spot		X	X
Anthracnose Stalk Rot		X	X
Common Rust		X	X
Common Smut		X	X
Gibberella Stalk Rot			X
Fusarium Stalk Rot			X

SEE ALSO:

- Cornell Field Crops and Soils Handbook, 10/1987
- Cornell Recommends for Integrated Field Crop Management.

Anthracnose Leaf Blight (ALB) is a foliar disease which may be common in fields where corn debris from the previous year has been left on the soil surface. Occurs on the lower leaves in early spring during periods of wet, cloudy weather. Symptoms appear as small, oval to elongate water soaked lesions on leaves. These semitransparent spots gradually enlarge up to 3/4 inch long and become tan at the center with red, reddish-brown, or yellow-orange borders. The enlarging lesions may coalesce, blighting the entire leaf. Severely blighted leaves yellow, shrivel, and die. Fruiting bodies of the fungus may appear as tiny black specks in concentric circles in the centers of the lesions in wet weather. In the late season symptoms may appear on the upper leaves. This same fungus may also cause severe top dieback and stalk rot.

Gray Leaf Spot (GLS) is a disease recently introduced to New York. This disease is favored by "no-till" or minimum tillage continuous corn, and moist. Leaf lesions are very distinctive with a rectangular, gray colored necrotic area, 1/16 - 1/4 inch wide and 1/2 to several inches long. These distinctive symptoms will remain apparent on infected crop residue. This fungus may also attack barnyard grass, johnsongrass and other sorghum spp.

Northern Corn Leaf Blight (NCLB) is a relatively common corn disease in NY. Lesions are typically cigar shaped, 1 to 6 inches long. Symptom expression will, however, vary with hybrid. In damp weather these lesions may develop spore producing concentric ring or target shaped zones. This fungus may also attack johnsongrass, sorghum grass, sudan grass.

Southern Corn Leaf Blight (SCLB) is another relatively common corn disease in NY. Two strains are known Race O and Race T. Race O attacks leaves only. Lesions are typically between leaf veins and are tan in color. Race T attacks leaves, stalks, leaf sheaths, ear husks, shanks, ears and cobs. Lesions are typically tan with yellow green or chlorotic halos, later lesions have dark, reddish brown borders. Symptom expression for both races varies with hybrid.

Gibberella Stalk Rot (GSR) is a stalk rot that attacks the lower internodes, turning them tan to dark brown. Superficial fungal fruiting bodies are evident on the stalks often in concentric rings. Stalks often have an internal pink to reddish discoloration. The Gibberella fungus may also attack wheat, oats and barley. Growers may wish to consider early harvest of corn grown for grain if GSR is present, and early season root stress has occurred causing poor seedling root development (very wet soil moisture) followed by stresses causing poor pollination: e.g. drought, foliar diseases, ECB, CRW, etc.

Fusarium Stalk Rot (FSR) is similar to GSR but tends to attack plant roots, the base and lower internodes. Rot from this disease begins soon after pollination and becomes more severe as the plant matures. The whitish-pink to salmon discoloration of the pith, stalk breakage, and premature ripening are the same as GSR. The causal organism may also attack sorghum, wild carrot, soybeans, alfalfa, fall panicum, ground cherry, wheat, clover. Growers may wish to consider early harvest of corn grown for grain if FSR is present, and early season root stress (very wet soil moisture) has occurred causing poor seedling root followed by stresses causing poor pollination: e.g. drought, foliar diseases, ECB, CRW. etc.

Anthracnose Stalk Rot (ASR) is perhaps the most prevalent disease attacking corn in NY. This disease is expressed late in the season sometime after the dough stage. Symptom development is generally systemic. Leaves turn yellow or reddish, lodge and fall off, at the time when the lower leaves begin to senesce. Stalk symptoms may appear after tasselling as narrow, vertical or oval, water-soaked lesions in the rind. These lesions become tan to reddish brown and finally dark brown to black late in the season, and may cover the lower internodes or the entire stalk. In advanced infections stalk lesions may coalesce forming relatively large, dark brown to shiny black, blotchy areas or streaks that may be somewhat sunken.

Anthracnose/European Corn Borer is an insect/disease interaction that bears particular mention. Recent studies have shown a significant interaction between European Corn Borer and the fungal disease Anthracnose, caused by a species of *Colletotrichum*. Each of the pests can cause independent damage to corn, however, when both attack the plant at the same time severe stalk damage and lodging can occur. If a significant number of plants have been affected by this disease/insect complex it may be advisable to consider earlier harvest for silage rather than allow the corn to be harvested for grain and risk yield losses due to lodged stalks.

Common Smut may attack any above ground plant part, particularly young, actively growing, or meristematic tissues. White, soft galls are indicative of the smut disease. Older smut galls are filled with dark brown to black spore masses. Galls are often found on ears, tassels or on plant parts damaged by hail or mechanical damage. Smut will very rarely kill a plant. In Central America and in gourmet stores in the US, young corn smut galls are considered a delicacy and sold for a premium price in farmers markets.

General Field Crop Problems (Vertebrate, Noninfectious, Abiotic):

In addition to the weed, insect and disease problems already mentioned, unhealthy plants will occasionally be found showing discoloration or other physical abnormalities. Other situations may be encountered where plants are physically missing and an apparent cause is not obvious. If a *significant* areas or number of plants are affected the cause of the problem should be determined.

If symptoms are suggestive of a pest problem, check for on, in and around plants for signs of a biotic pest. Look for: insect frass, sporulating fungi, diseased areas, stunted roots, bird droppings, animal tracks from blackbirds, deer, raccoons, escaped heifers, etc. If appropriate, submit a representative sample of the damaged plants for a laboratory diagnosis.

SEE ALSO:
- Cornell Pest Management Recommendations for Vertebrates
- Crop/Soil Trouble Shooting Form in Appendix

If symptoms are not suggestive of a pest problem consider the following.

Identifying Unknown Field Crop Problems:

- Is a field pattern is evident (isolated to the field margin, headlands, low areas, areas of different soil types; is the pattern: linear, circular or irregular in shape; isolated to: individual row(s), plants of a particular growth stage or age?)
- Note symptoms, are they general (whole plant) or specific (only on specific plant parts)?
- Is there a physical difference in appearance: gall, epinasty, buggy whipping, elongation, stunting, root proliferation, color, texture, etc.?
- Is problem new or "historical" (observed annually in same location or time of year)?
- Does field history provide clues or possibilities?
- Possible causes: Improper pH or Soil Fertility, Herbicide Damage, Flooding, Drought, Broken Tile, Frost, Lightning, Wind, Mechanical (Cultivation) Injury, Soil Compaction, Planter Problems, Anhydrous Ammonia or Herbicide Burn, Hail Damage, Genetic Aberrations, Air Pollution, Delayed Effects of an Earlier Imposed Stress.
- Refer to the Diagnostic Guide: Problems in Corn Planting, Cornell Recommends for Integrated Field Crop Management, and the Cornell Field Crops and Soils Handbook.

Field Corn Integrated Pest Management Tactical Plan

Date(s) Completed	Crop Growth Stage	Task / Activity
	Pre-Plant	Review field history, crop records, rotational sequence, fertility and pH, weed inventory to assess pest management needs
	Pre-Plant	Adjust rotation sequence if possible to minimize risk of corn rootworm injury or need for soil insecticide.
	Pre-Plant	conduct spring weed inventory to assess weed management needs
	Pre-Plant	Select and Purchase adapted hybrid(s) of appropriate maturity group, disease resistance, and good standability rating.
	Pre-Plant	Calibrate planter, fertilizer, and pesticide application equipment.
	Pre-Plant	No-till or reduced tillage field corn: Appropriate preplant burn down of weeds.
	Pre-Plant	Pre-plant herbicide application as warranted by weed inventory.
	Pre-Plant	Appropriate ground (field, seed bed) preparation.
	Plant	Test banding of herbicides to minimize herbicide costs.
	Plant	Use seed treatment to reduce risk of seed corn maggot and seedling diseases.
	Plant	Sound agronomic practices regarding planting depth, seed, fertilizer, and soil insecticide placement.
	Pre-emergence	Pre- emergence herbicide application as warranted by weed inventory.
	Emergence	Early season assessment(s) for emergence, plant population, and early stand establishment .
	Post-emergence	Early season assessment(s) for seedling diseases, seed corn maggot, cutworm, and other early stand establishment problems.
	Post-emergence	Early season assessment(s) for weed escapes.
	Post-emergence	Consider cultivation for early season weed control (2 - 6 corn leaf stage).
	V5-V6 leaf stage	Check field for pre-sidedress nitrogen levels (PSNT).
	V5-V6 leaf stage	Apply nitrogen sidedress as determined by PSNT.
	Mid-whorl	Early season assessment(s) for diseases, cutworm, European corn borer, weed escapes, and other early season problems.
	Late-whorl	Assessment(s) for diseases, armyworm, European corn borer, and other problems.
	Tasselling and Silk Stages	Assessment(s) for diseases, corn rootworm beetles, European corn borer, and other problems.
	Grain Fill Stages	Assessment(s) for diseases, corn rootworm beetles, European corn borer, lodging and other problems.
	Grain Fill Stages	Assess maturity / grain stage to aide in timing harvest.
	Harvest	Yield and quality checks.
	Post Harvest	Update Crop Records.
	Post Harvest	Fall weed inventory.