Corn

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Seedcorn Maggot

Seedcorn Maggot Sampling/Decision Making

Preventive treatment is advised on early and no-till plantings before soil is warm enough to promote quick germination. Old sod fields, pasture, heavily manured fields and fields with previous histories of seedcorn maggot damage should be treated regardless of planting time or type of tillage.

Table 4.11 - Recommended Pesticides for Controlling Seedcorn Maggot

Insecticide (Formulation)	Amount active ingredient	Amount product	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	2.0-2.8 oz/A (based on 30-inch row spacing)	0.12-0.16 oz/1,000 row ft	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Row width adjustment: for row spacing < 30 inches, adjust rate of product not to exceed 2.8 oz/A. Note: Diminished control may occur when rates are decreased below recommended minimum rates per 1,000 row ft.
bifenthrin (Capture LFR [1.5EC])	0.04-0.08 lb AI/A	3.4-6.8 oz/A	—	Apply 5- to 7-inch band (T-band) over open furrow or in-furrow with the seed. Maximum 0.1 lb/A/season as an at-plant application. Maximum 0.3 lb/A/season of at-plant plus foliar applications of other bifenthrin products. Use of Capture LFR is prohibited in all coastal counties.
clothianidin (Poncho 250)	0.25 mg AI/kernel	1.13 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.
imidacloprid (25%) (Concur planter box seed treatment) (Latitude planter box seed treatment)	—	1.5 oz/42 lb seed	grazing or feeding: 45	Mix thoroughly in planter box prior to planting. Avoid breathing dust and contact with skin and eyes.
thiamethoxam (Cruiser 5FS)	0.25 mg AI/kernel	1.13 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.

Note: Check labels of the various granular and liquid soil insecticides for information and product efficacy on seedcorn maggot control.

Wireworms

Wireworm Sampling/Decision Making

First-year corn following established sod frequently is attacked by wireworms. Early sampling before planting should include bait stations. Two paired bait stations per acre are made by placing 0.5 cup of an equal mixture of untreated corn/wheat in the soil 4 inches deep and 9 inches wide (see Fig. 1). Set bait stations in fields to be planted at least 3 weeks before the planting date. Check by digging in about 2 weeks and record the number of wireworms for each station. Economic thresholds for wireworms have not been established on corn; however, if an average of 1 or more wireworms per bait station are found, a soil insecticide should be applied in the seed furrow to protect the germinated seed and newly-emerged seedlings.

Table 4.12 - Recommended Pesticides for Controlling Wireworms

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	2.0-2.8 oz/A (based on 30-inch row spacing)	0.12-0.16 oz/1,000 row ft	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Row width adjustment: for row spacing < 30 inches, adjust rate of product not to exceed 2.8 oz/A. Note: Diminished control may occur when rates are decreased below recommended minimum rates per 1,000 row ft.
bifenthrin (Capture 1.15G)	0.032-0.096 oz	3.2-8.0 oz (3.5-8.7 lbs/A)	30	**RESTRICTED USE.** Apply in-furrow at planting. **Use highest rate for heavy pest pressure.**
bifenthrin (Capture LFR [1.5EC])	0.04-0.08 lb/AI/A	3.4-6.8 oz/A	—	Apply 5- to 7-inch band (T-band) over open furrow or in-furrow with the seed. Maximum 0.1 lb/A/season as an at-plant application. Maximum 0.3 lb/A/season of at-plant plus foliar applications of other bifenthrin products. Use of Capture LFR is prohibited in all coastal counties.
chlorethoxyfos (Fortress 5G)	0.15 oz	3.0 oz	—	**RESTRICTED USE.** Available only in SMARTBOX closed handling system. Apply as needed by scouting. Apply in furrow at planting for best control. Rotational crops may be planted 30 days after application.
chlorpyrifos (Lorsban 15G)	2.4 oz	16.0 oz	35 grain, 14 silage, 14 grazing	Apply at planting in a 6-to 7-inch band over the row, in front of the presswheel and incorporate the granules into the top 1 inch of soil. Can also be applied in-furrow.
clothianidin (Poncho 250)	0.25 mg AI/kernel	1.13 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.
ethoprop (Mocap 10G)	1.2 oz	12.0 oz	—	Apply at planting in a 6- to 7-inch band on the row **over a closed seed furrow.** Mix the granules with the top 0.5 inch of soil.
fipronil (Regent 4SC)	0.12 oz (min. 30-in rows)	0.24 oz	—	**RESTRICTED USE.** Make 1 in-furrow application at planting only. Apply in 1 gal water/A directly into the seed furrow. **Do not apply more than 0.13 lb AI/A or 4.2 fluid oz of Regent 4SC/A.**

Table 4.12 - Recommended Pesticides for Controlling Wireworms (cont.)

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
imidacloprid (25%) (Concur planter box seed treatment) (Latitude planter box seed treatment)	—	1.5 oz/42 lb seed	grazing or feeding: 45	Mix thoroughly in planter box prior to planting. Avoid breathing dust and contact with skin and eyes.
phorate (Thimet 20G)	1.2 oz	6.0 oz	30	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. **Do not apply Thimet in-furrow.**
tefluthrin (Force 3G)	0.12-0.15 oz	4.0-5.0 oz	30	**RESTRICTED USE.** Apply in-furrow at planting for best control. Rotational crops may be planted 30 days after application.
terbufos (Counter 15G)	1.2 oz	8.0 oz (Do not exceed 8.7 lb produce/A)	30	**RESTRICTED USE.** Apply at planting in 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. Can also be applied in-furrow. **If application is made at planting, do not make postemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Cutter 15G applications may result in severe crop injury.
thiamethoxam (Cruiser 5FS)	0.25 mg AI/kernel	1.13 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.

White Grubs

White Grub Sampling/Decision Making

Planting into pastures, old sod fields, or following soybeans may be at high risk for grub damage. Sampling should be done 2 to 3 weeks before planting by randomly selecting 10 samples, each sample 1 square foot in area, per 10-acre field. At each sample, dig the soil out to a depth of 6 inches and count the number of grubs. Treatment may be required if the count equals 2 grubs per square foot. Most grub species complete their feeding stage by **early May in Virginia** to mid-May in Maryland and Delaware. Late-planted corn and conventional-tilled corn are at lower risk for damage.

Table 4.13 - Recommended Pesticides for Controlling White Grubs

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	2.5-2.8 oz/A (based on 30-inch row spacing)	0.14-0.16 oz/1,000 row ft	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** SUPPRESSION ONLY. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Row width adjustment: for row spacing < 30 inches, adjust rate of product not to exceed 2.8 oz/A. Note: Diminished control may occur when rates are decreased below recommended minimum rates per 1,000 row ft.
bifenthrin (Capture 1.15G)	0.032-0.096 oz	3.2-8.0 oz (3.5-8.7 lbs/A)	30	**RESTRICTED USE.** Apply in-furrow at planting. **Use highest rate for heavy pest pressure.**
bifenthrin (Capture LFR [1.5EC])	0.04-0.08 lb AI/A	3.4-6.8 oz/A	—	Apply 5- to 7-inch band (T-band) over open furrow or in-furrow with the seed. Maximum 0.1 lb/A/season as an at-plant application. Maximum 0.3 lb/A/season of at-plant plus foliar applications of other bifenthrin products. Use of Capture LFR is prohibited in all coastal counties.
chlorethoxyfos (Fortress 5G)	0.15 oz	3.0 oz	—	**RESTRICTED USE.** Apply as needed by scouting. Apply in-furrow at planting for best control. Rotational crops may be planted 30 days after application.
chlorpyrifos (Lorsban 15G)	2.4 oz	16.0 oz	35 grain, 14 silage, 14 grazing	Apply at planting in a 6- to 7-inch band over the row, in front of the presswheel and incorporate the granules into the top1 inch of soil. Can also be applied in-furrow.
clothianidin (Poncho 250)	0.25 mg AI/kernel	1.13 oz/80,000 seeds	—	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin and eyes.
fipronil (Regent 4SC)	0.12 oz (min 30-in rows)	0.24 oz	—	**RESTRICTED USE.** Make 1 in-furrow application at planting only. Apply 1 gal of water/A directly into the seed furrow. **Do not apply more than 0.13 lb. AI/A or 4.2 fluid oz of Regent 4SC/A.**
imidacloprid (25%) (Concur planter box seed treatment)	—	1.5 oz/42 lbs seed	grazing or feeding: 45	Mix thoroughly in planter box prior to planting. Avoid breathing dust and contact with skin and eyes.
phorate (Thimet 20G)	1.2 oz	6.0 oz	30	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. **Do not apply Thimet in-furrow.**

Table 4.13 - Recommended Pesticides for Controlling White Grubs (cont.)

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
tefluthrin (Force 3G)	0.12-0.15 oz	4.0-5.0 oz	—	**RESTRICTED USE.** Available only in SMARTBOX closed handling system.Apply as needed by scouting. Apply in furrow at planting for best control. Rotational crops may be planted 30 days after application.
terbufos (Counter 15G)	1.2 oz	8.0 oz (Do not exceed 8.7 lb product/A)	30	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. Can also be applied in-furrow. **If application is made at planting, do not make postemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter15G applications may result in severe crop injury.
thiamethoxam (Cruiser 5FS)	0.25 mg AI/kernel	1.13 oz/80,000 seeds	—	See previous remarks.

Baited Wire Trap Procedure for Scouting

Seedcorn maggot, wireworms, and white grubs can be scouted before planting

The wire trap itself consists of a 2-ft long by 3-inch wide strip of 0.25-inch hardware cloth (see Fig. 2). To strengthen the hardware cloth strip and to facilitate the placement of the corn seed bait, the strip should be bent lengthwise at a 90° angle. Use only corn seeds that have **not been treated** with an insecticidal seed treatment for bait. About 2 weeks before planting, place 20 seeds about 1 inch apart in each wire trap and then bury the baited wire trap 2 inches deep in the soil. Install at least 1 baited wire trap for every acre of corn to be planted. Remove the traps from the soil after 2 weeks and determine the average number of seeds with feeding damage in the wire traps. The following suggested guidelines may help you determine whether your field is at risk to wireworms, seedcorn maggots, or white grubs.

Suggested Treatment Guidelines Using the Baited Wire Trap Method

Conditions for using the baited wire trap method for field corn

1. Unless continuous corn fields have already been scouted for corn rootworms, baited wire traps should only be used in fields in which corn typically is grown in rotation with soybeans, alfalfa, sorghum, or peanuts (see exceptions below for explanation).
2. Refer to the following suggested treatment guidelines for seedcorn maggots, wireworms, and annual white grubs to determine if a granular insecticide may be needed at planting to prevent serious stand loss.

Seedcorn maggot

A granular insecticide may be needed at planting if the average number of seeds damaged by seedcorn maggots in the baited wire traps is **25 percent** or more; otherwise, an insecticidal seed treatment should be sufficient.

Wireworms

A granular insecticide may be needed at planting if the average number of seeds damaged by wireworms in the baited wire traps is **10 percent** or more; otherwise, an insecticidal seed treatment should be sufficient.

Annual white grubs (i.e., grubs with a 1-year life cycle: Japanese beetle, green June beetle, etc.):

A granular insecticide may be needed at planting if the average number of seeds damaged by annual white grubs in the baited wire traps is **5 percent** or more. **Note: unlike seedcorn maggot and wireworms, insecticidal seed treatments are not labelled for control of white grubs.**

Default

If you are unable to discern which pest is responsible for damaging the corn seeds in the baited wire traps, and if the average number of seeds damaged in the baited wire traps is **5 percent** or more, then a granular insecticide may be needed at planting to prevent serious stand loss.

Exceptions

Cropping situations in which the producer is strongly encouraged to make an in-furrow, T-band, or banded over-the-row application of a granular insecticide when planting field corn (**and not just rely on an insecticidal seed treatment**) are the following:

a. when planting corn in old sod or pasture fields, because severe damage from true white grubs (i.e., *Phyllophaga* spp. with 2- to 3-year life cycles) and/or wireworms may occur.

b. when a field is in continuous corn production, because the potential for corn rootworm damage can be severe, and because seed treatments do not control corn rootworms.

Some notes on insecticidal seed treatments

"Agrox® D-L Plus," "Kernel Guard,"and "Triple Seed Protectant" all contain the insecticide active ingredients diazinon and lindane and have similar recommended labeled rates. Results of field tests conducted in Virginia have shown that "Agrox® D-L Plus" was effective in minimizing damage caused by wireworms and seedcorn maggots to germinating corn seeds. At less than $1/acre, the relatively low cost of the seed treatment and minimal impact to the farm environment (about 0.25 oz insecticide active ingredient/acre), makes the seed treatment an excellent choice when planting corn that typically is grown in rotation with crops such as soybeans or peanuts.

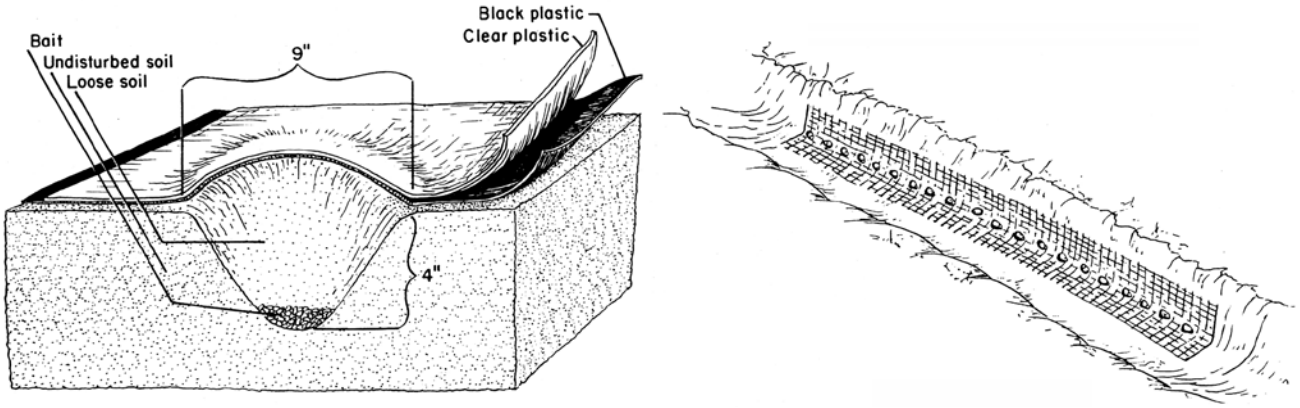

Fig. 4.4 Left - Bait Station (Cross Section); Right - Baited Wire Trap

Corn Root Aphid

Although corn root aphids are only a sporadic pest of field corn in Virginia, planting field corn no-till, without application of a granular insecticide, can lead to serious problems if corn root aphids are present. Corn root aphids damage corn by piercing the roots with their stylet-like mouthparts and extracting the sap. The growth of infested corn plants often is stunted and, under severe infestations, may be arrested at a height of only 10 inches.

The ability of this aphid to infest corn roots is highly dependent upon certain species of ants commonly known as corn field ants. Shortly after germination, the ants begin carrying the aphids to the developing corn roots. Aphid numbers increase rapidly once in contact with the roots; females are capable of producing 40 to 50 live nymphs each, and generations can be as short

as eight days during warm growing conditions. The ants benefit from this relationship by harvesting the droplets of honeydew produced by the aphids while feeding on the roots.

To determine if a field is at risk to corn root aphids, no-till fields should be scouted for the presence of anthills before planting because, unlike conventionally-tilled fields, no-till fields are more likely to have established ant colonies. It should be kept in mind, however, that it is possible for a field to have anthills present without the presence of corn root aphids. Although no specific label reference to corn root aphids has been found among the list of insecticides currently available for use on field corn, application of a granular insecticide at planting to control wireworms or corn rootworms may alleviate a corn root aphid problem. In addition, two cultural practices which can play a role in minimizing corn root aphid infestations are deep tillage every other year to weaken ant colonies, and crop rotation to prevent the buildup of large ant and aphid populations.

Billbug

The southern corn billbug and maize billbug are known to occur throughout the coastal plain of North Carolina and in the Tidewater Region of southeastern Virginia. Unlike other areas of Virginia, the relatively higher organic matter content and poorer drainage characteristics of the soils in southeastern Virginia are two factors considered favorable to billbug infestations.

Both adult and immature stages of billbugs damage corn seedlings. Adult billbugs chew into the side of corn seedlings and feed on the inner plant tissue. Eggs are deposited by females within the feeding cavity and hatch in 4 to 15 days. The legless larvae feed in and around the taproot for several weeks. There is only one generation per year. Damaged seedlings which survive infestation typically are stunted, or otherwise deformed, and may exhibit excessive suckering and rows of transverse holes on the leaves.

Rotation is considered the least expensive and most effective method of controlling billbug infestations provided that corn is rotated about 0.25 mile from its previous location. When rotation is not possible, it is suggested that border rows and volunteer clumps of corn be inspected for billbug infestations. If an insecticide is to be used to control billbugs, it should be applied when billbugs are first observed or at the first indication of feeding damage.

Table 4.14 - Preemergence Use of Insecticides to Control Billbugs

Note: at-plant granular insecticide applications are not considered to be as effective as postemergence applications for controlling billbugs.

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
chlorpyrifos (Lorsban 15G)	1.2-2.4 oz	8.0-16.0 oz	35 grain, 14 silage, 14 grazing	Apply at planting in a band or T- band. Do not apply in-furrow.
clothianidin (Poncho 1250)	1.25 mg AI/kernel	5.64 oz/80,000 seeds	–	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin. Follow up foliar sprays may be needed under heavy pest pressure.
terbufos (Counter 15G)	1.2 oz	8.0 oz (Do not exceed 8.7 lb product/A)	30	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. Can also be applied in-furrow. **If application is made at planting, do not make postemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter15G applications may result in severe crop damage.
thiamethoxam (Cruiser 5FS)	1.25 mg AI/kernel	5.64 oz/80,000 seeds	–	See previous remarks.

Table 4.15 - Postemergence Use of Insecticides to Control Billbugs

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
chlorpyrifos (Lorsban 4E)	1.0-1.5 lb/A	2.0-3.0 pt/A	35 grain, 14 silage, 14 grazing	Apply with sufficient water to ensure a minimum spray volume of 20-40 gal/A and 40 psi by ground. On corn less than 6 inches tall, apply spray in a 9-12 inch wide band over the row. On corn over 6 inches tall, apply the insecticide spray using drop nozzles directed at the base of the plant.

Cutworm

Cutworm Sampling/Decision Making

Late-planted, minimum-till fields with heavy spring weed growth on poorly drained soils are the most likely to encounter cutworms. Corn fields should be checked twice a week from the spike through the 5th-leaf stage. Leaf feeding is the first sign that cutworms are present. Look for small, irregular holes in leaves and cut plants. Note any leaf feeding that may have resulted from cutworms too small to cut plants and check these areas again in 24 to 48 hours. If cutworms are present, examine at least 10 sets of 20 plants throughout the field and record the percentage of cut or damaged plants. At the same time, look under clods and dig 1 to 2 inches deep around the bases of damaged plants to find cutworms. Record the average size and number of cutworms.

As a general guideline, before the 3rd- to 5th-leaf stage, a rescue treatment should be applied if 10% or more of the young plants show fresh leaf feeding and cutworms are present. At the 3rd- to 5th-leaf stage, treatment should be applied if 5% of the plants are cut and there are 4 or more cutworms per 100 plants.

Table 4.16 - Preemergence Use of Insecticides to Control Cutworms

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
bifenthrin (Capture LFR [1.5EC])	0.047-0.062 lb	4.0-5.3 oz	—	**RESTRICTED USE.** Insecticide must be preplant incorporated (PPI) and can be tank mixed with PPI herbicides. Product should be applied no deeper than intended planting depth. Use of product is prohibited in all coastal counties.
chlorethoxyfos (Fortress 5G)	0.15 oz	3.0 oz/1,000 row ft	—	**RESTRICTED USE.** Available only in SMARTBOX closed handling system. For optimal cutworm control, apply at planting as a T-band and incor- porate granules into the top 1 inch of soil. Rotational crops may be planted 30 days after application.
chlorpyrifos (Lorsban 4E)	0.5 - 1 lb	1.0-2.0 pt	35 grain, 14 silage, 14 grazing	Broadcast – use minimum of 20 gal water/A.

Table 4.16 - Preemergence Use of Insecticides to Control Cutworms (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
chlorpyrifos (Lorsban 15G)	1.2 oz/1,000 row ft	8.0 oz/1,000 row ft	35 grain, 14 silage, 14 grazing	At plant band or T-band application.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Broadcast apply as necessary to maintain control.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.015-0.025 lb	0.96-1.60 oz	21	**RESTRICTED USE.** Apply by ground or air using sufficient water for full coverage. **Aerial application**: Use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** Apply from 5 days before planting up to emergence. Band or Broadcast—use minimum 10 gal finished spray/A by ground or 2 gal/A by air.
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** See previous remarks.
tefluthrin (Force 3G)	0.12-0.15 lb	4.0-5.0 oz/1,000 row ft	—	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel. Do not apply as either a band or T-band unless the granules can be incorporated into the top 1 inch of soil using tines, chains, or other suitable equipment. Rotational crops may be planted 30 days after application.
zeta-cypermethrin (Mustang Max)	0.001 lb	0.16 oz/1,000 row ft	30 grain and stover, 60 forage	**RESTRICTED USE.** Apply as in-furrow, band or T- band, using a minimum 4-inch band.

Table 4.17 - Postemergence Use of Insecticides to Control Cutworms

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
bifenthrin (Capture LFR [1.5EC])	0.047-0.062 lb	4.0-5.3 oz	—	**RESTRICTED USE.** Insecticide must be preplant incorporated (PPI) and can be tank mixed with PPI herbicides. Product should be applied no deeper than intended planting depth. Use of product is prohibited in all coastal counties.

Table 4.17 - Postemergence Use of Insecticides to Control Cutworms (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
chlorpyrifos (Lorsban 4E)	1-1.5 lb	2.0-3.0 pt	35 grain, 14 silage, 14 grazing	Use sufficient water to ensure thorough coverage of treated plants.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** See previous remarks.
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** Use minimum 2 gal finished spray/A by air or 10 gal/A by ground. Apply prior to brown silk stage.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Use sufficient water to ensure thorough coverage of treated plants.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.015-0.025 lb	0.96-1.60 oz	21	**RESTRICTED USE.** Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
carbaryl (Sevin XLR Plus)	2.0-3.0 lb	2.0-3.0 qt	0	For optimum control, apply 12-inch band over the row using sufficient water to ensure thorough coverage of treated plants. Broadcast—use minimum 20 gal water/A.
carbaryl (Sevin 4F)	2.0-3.0 lb	2.0-3.0 qt	0	See previous remarks.
methyl parathion (Penncap-M 2F)	0.5-1.0 lb	2.0-4.0 pt	12	**RESTRICTED USE.** Check label for spraying instructions before use. Best control obtained when young larvae are treated. Fields with high populations of weeds (e.g., dock, yellow rocket, and coarse grasses) are highly attractive to egg- laying cutworm moths.
methomyl (Lannate LV 2.4) (Lannate 90 SP)	0.45 lb 0.45 lb	1.5 pt 0.5 lb	3 forage 21 ears 21 fodder	**RESTRICTED USE.** Apply when insects first appear. Use sufficient water to ensure thorough coverage of treated plants.
zeta-cypermethrin (Mustang Max)	0.008-0.0175 lb	1.28-2.8 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A.
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.025-0.06 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Armyworm

True Armyworm Sampling/Decision Making

No-till fields planted into a small grain cover crop, pastures, or weedy fields all have a high risk for armyworm infestation. Survey field edges where margins border small grains or large grassy areas and watch for damaged plants. If armyworm damage is seen, examine 20 plants at each of 5 locations within the field and record the percentage of damaged plants, the average size, and the severity of injury.

Armyworms usually migrate from small grains starting in late May. Spot treatments may be warranted if infestations are confined to small areas. Control for armyworms is recommended if 35 percent or more of the plants are infested and 50 percent or more defoliation is seen on the damaged plants, provided that larvae average less than 0.75 inch long. Worms greater than 1.25 inches in length usually have completed their feeding.

Table 4.18 - Preemergence Use of Insecticides to Control Armyworms

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Effective against 1st and 2nd instars only. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
bifenthrin (Capture LFR [1.5EC])	0.047-0.062 lb	4.0-5.3 oz	—	**RESTRICTED USE.** Insecticide must be preplant incorporated (PPI) and can be tank mixed with PPI herbicides. Product should be applied no deeper than intended planting depth. Use of product is prohibited in all coastal counties.
chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	35 grain, 14 silage, 14 grazing	Broadcast-use minimum of 20 gal water/A.
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** Apply from 5 days before planting up to emergence. Band or Broadcast use minimum of 10 gal finished spray/A by ground or 2 gal/A by air.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** See previous remarks.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Broadcast apply as necessary to maintain control.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** For control of small larvae only. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12/A pt after milk stage.

Table 4.19 - Postemergence Use of Insecticides to Control Armyworms

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Effective against 1st and 2nd instars only. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
bifenthrin (Capture LFR [1.5EC])	0.047-0.062 lb	4.0-5.3 oz	—	**RESTRICTED USE.** Insecticide must be preplant incorporated (PPI) and can be tank mixed with PPI herbicides. Product should be applied no deeper than intended planting depth. Use of product is prohibited in all coastal counties.
chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	35 grain, 14 silage, 14 grazing	Use sufficient water to ensure thorough coverage of treated plants.
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** Use minimum 2 gal finished spray/A by air or 10 gal/A by ground. Apply prior to brown silk stage.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** Use minimum 2 gal finished spray/A by air or 10 gal/A by ground. Apply prior to brown silk stage.
esfenvalerate (Asana XL)	0.03 - 0.05 lb	5.8 - 9.6 oz	21	**RESTRICTED USE.** Use sufficient water to ensure thorough coverage of treated plants.
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A.
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** For control of small larvae only. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/ A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12/A pt after milk stage.
carbaryl (Sevin XLR Plus)	1.0-2.0 lb	1.0-2.0 qt	0	See previous remarks.
carbaryl (Sevin 4F)	1.0-2.0 lb	1.0-2.0 qt	0	See previous remarks.

Table 4.19 - Postemergence Use of Insecticides to Control Armyworms (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	12	**RESTRICTED USE.** Check label for spraying instructions before use. Best results are obtained when young larvae are treated.
methomyl (Lannate LV 2.4) (Lannate 90 SP)	0.225-0.45 lb 0.225-0.45 lb	0.75-1.5 pt 0.25-0.5 lb	3 forage 21 ears 21 fodder	**RESTRICTED USE.** Apply when insects first appear. Use sufficient water to ensure thorough coverage of treated plants.
Bacillus thuringiensis (Biobit WP)	—	1.0-4.0 lb	0	Make initial application when economically-damaging populations exist. Applications must be made to early instars— repeat as necessary.
Bacillus thuringiensis (Javelin WG)	—	0.5-1.5 lb	0	See previous remarks.

Slugs and Snails

Slug, Snail Sampling/Decision Making

Slugs can become serious pests in no-till fields during spring periods of cool, wet weather. Fields with heavy layers of manure, crop refuse, or thick weed cover are at higher risk from slugs. Because slugs feed at night and hide during the day in the mulch and surface trash near the seedlings, they often are not suspected of being the cause of the shredded leaves on the young corn seedlings. Yet slugs can be found during the day by turning over clods of dirt and surface trash near the seedlings. It is suggested that samples be taken from the area around 5 plants in 10 locations of the field to determine the average number of slugs associated with each plant. Populations of 5 or more slugs around each plant at the spike through the 3rd-leaf stage may be economic, especially if injury is heavy, plant growth is slow, and cool, wet conditions prevail. During dry, warm weather, 10 or more slugs per plant may be tolerated. Also, corn seedlings that have reached the 3rd-leaf stage of growth generally are able to outgrow feeding damage by slugs.

Cultural practices which may help reduce slug populations include reduction in the use of manure, shift to conventional tillage practices for at least one season, and minimum tillage to reduce the amount of surface trash.

Table 4.20 - Postmergence Use of Insecticides to Control Slugs and Snails

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
metaldehyde (Deadline M-Ps)	0.4-1.6 lb	10.0-40.0 lb	0	For best results, apply product in evening. Especially beneficial if applied following rain or watering. It should be noted that most corn-producing states are suggesting an application rate of 12 to 15 lb/A, if banded over or along side the row after the plants have emerged. Recent Delaware field trials indicate good results against slugs using 10 lb Deadline M-Ps/A broadcast with a cyclone spreader. Spreader must be calibrated to deliver at least 5 pellets/sq ft. Slugs generally stop feeding in 2-3 hours and die within 2-3 days.

Stalk Borer

Stalk Borer Sampling/Decision Making

Good weed control can help eliminate some stalk borer egg-laying sites, but overwintering eggs may be laid on fall-planted small grains such as rye. A postemergence insecticide application is suggested **only** if the larvae **have not bored** into the stalks. Given this restriction, a treatment may be warranted if more than 4, 6, or 10 percent of the plants at the 2nd-, 3rd-, or 4th-leaf stages exhibit signs of stalk borer feeding damage. Refer to sampling procedures for true armyworm.

An alternative strategy for managing stalk borer infestations is to apply a burndown herbicide **at least 10 days before** corn is planted. The slightly earlier burndown herbicide application means that a suitable alternative host (i.e., corn) will not be available to the stalk borer larva as it emerges from its herbicide-treated host. As a consequence of this action, the exposed larvae are subject to a much higher mortality rate from such factors as predation, starvation, and adverse environmental conditions.

Table 4.21 - Preemergence Use of Insecticides to Control Stalk Borers

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
DO NOT rely on a preemergence burndown herbicide and combination insecticide application to control stalk borer.				
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
bifenthrin (Capture LFR [1.5EC])	0.047-0.062 lb	4.0-5.3 oz	—	**RESTRICTED USE.** Insecticide must be preplant incorporated (PPI) and can be tank mixed with PPI herbicides. Product should be applied no deeper than intended planting depth. Use of product is prohibited in all coastal counties.
chlorpyrifos (Lorsban 4E)	1-1.5 lb	2.0-3.0 pt	35 grain, 14 silage, 14 grazing	Apply approximately 11 days **after** application of Roundup herbicide or 3 to 5 days **after** complete burndown with Gramoxone (paraquat). **DO NOT** use Lorsban 4E in combination with a burndown herbicide for control of stalk borer.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** Must be applied before larva bores into stalk. Apply as required scouting. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** Apply when or shortly before stalk borer larvae move into corn from surrounding weeds, grasses, or rye cover crop. Mowing or application of a burndown herbicide is suggested to initiate movement. Use minimum 2 gal finished spray/ac by air or 10 gal/A by ground. Apply prior to brown silk stage.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** See previous remarks.

Table 4.21 - Preemergence Use of Insecticides to Control Stalk Borers (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Application must be made early in migration from grassy areas to corn, before stalk borers enter plants.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.72-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A.
bifenthrin (Capture LFR [1.5EC])	0.04-0.08 lb AI/A	3.4-6.8 oz/A	—	Apply 5- to 7-inch band (T-band) over open furrow or in-furrow with the seed. Maximum 0.1 lb/A/season as an at-plant application. Maximum 0.3 lb/A/season of at-plant plus foliar applications of other bifenthrin products. Use of Capture LFR is prohibited in all coastal counties.
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.025-0.06 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/ season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Garden Symphylan

Garden Symphylan Sampling/Decision Making

Because of its sensitivity to low soil moisture, garden symphylans frequently will move up and down as much as 2 to 3 ft in the soil profile. Thus, it is possible to observe typical feeding symptoms of root hair pruning and purple leaves without garden symphylans being present. No sampling method is available. Treat only if field history indicates that heavy infestations are likely.

Table 4.22 - Postmegence Use of Insecticides to Control Garden Symphylan

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
terbufos (Counter 15G)	1.2 oz/1,000 row ft	8.0 oz/1,000 row ft (Do not exceed 8.7 lb product/A)	30	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and lightly incorporate. Can also be applied in-furrow. **If application is made at planting, do not make postemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter 15G applications may result in severe crop injury.
chlorethoxyfos (Fortress 5G)	0.15 oz	3.0 oz	—	**RESTRICTED USE.** Available only in SMARTBOX closed handling system. Apply at planting as a T-band over the row behind the planter shoe and in front of the presswheel. **Do not apply as a surface band behind the presswheel**. May also be applied in-furrow. Granules must be incorporated into the top 1 inch of soil. Rotational crops may be planted after 30 days after application.
chlorpyrifos (Lorsban 15G)	1.2-1.8 oz/1,000 row ft	8.0-12.0 oz/1,000 row ft	35 grain, 14 Silage, 14 grazing	Apply at planting in a 6- to 7- inch band over the row, in front of the presswheel and incorpo rate the granules into the top 1 inch of soil.

Western Corn Rootworm

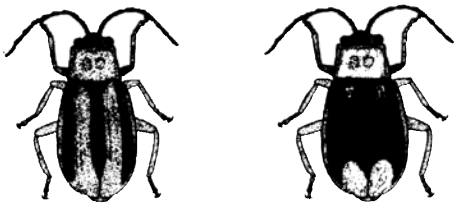

Fig. 4.5 Western Corn Rootworm Adults
Markings range from distinct black and yellow regions (left) to a 'blotchy' black (right).

There is one generation of western corn rootworm (WCR) per year. In late summer, adults lay eggs in soil **in cornfields**. Eggs overwinter in the soil and hatch the following spring. Larvae (grubs) immediately search for corn roots on which to feed, and then pupate in the soil. Adults (beetles) emerge from late June through August and fly to corn plants to feed and mate.

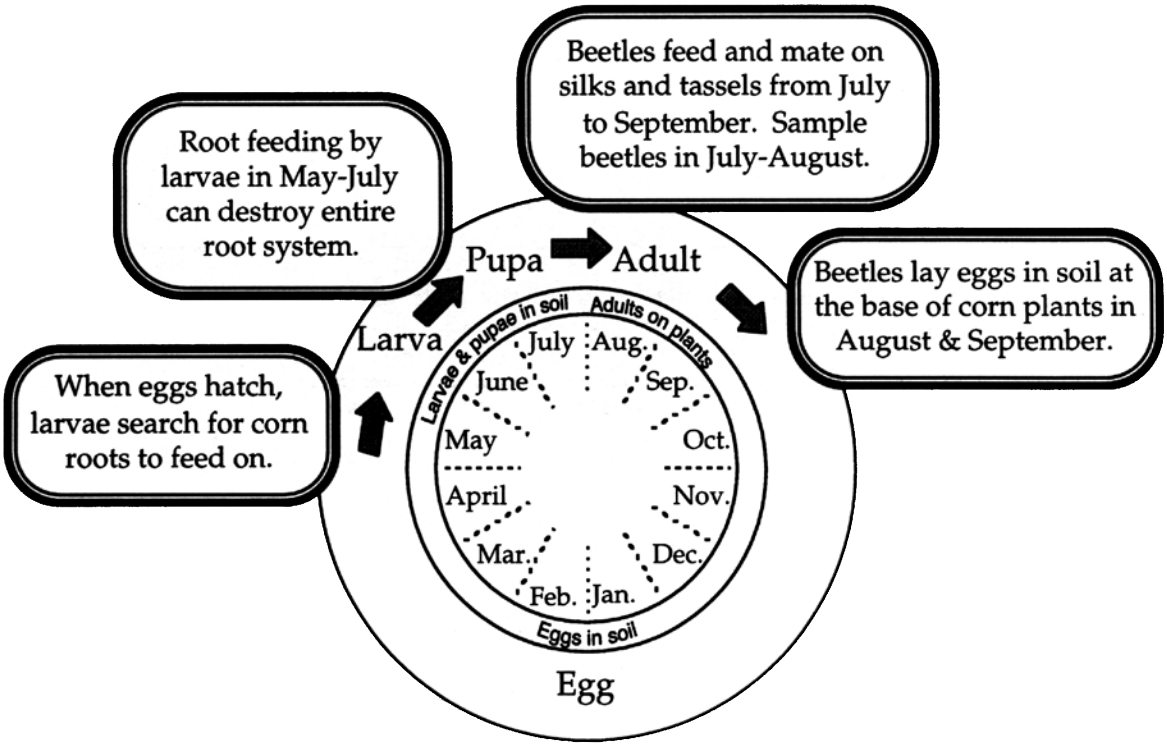

Fig. 4.6 Western corn rootworm life cycle in Virginia

Larvae feed almost exclusively on corn roots, so control is easily accomplished through crop rotation. However, many farmers do not have the option of rotating out of corn, thus the next best control measure is to apply a granular insecticide at planting. As the life cycle indicates, treatment of first year corn to control WCR is not necessary. Also, rootworm populations in subsequent years of continuous corn may not be large enough to warrant treatment. Economic damage thresholds for rootworm beetles have been developed by correlating beetle populations in a particular field with subsequent larval feeding damage occurring the following year.

Sampling

Western corn rootworm beetles should be sampled in July and August to determine whether a control measure is needed the following year. Two methods for scouting corn rootworm beetles are described on the next page.

1. Yellow sticky card method

Place 4 x 6 inch Olson® (available from Olson Products, P. O. Box 1043, Medina, OH 44258) two-sided yellow sticky cards (traps) in cornfields starting in early July. Use the table below to determine how many traps to install. Place traps about 300 feet apart and at least 100 feet in from all field edges. Place a series of traps along the same corn row. When approaching the field edge, cross over about 30 rows and place another series of traps along a row until the entire field is covered. Use flags to mark the location of each trap. Use continuous flagging (forestry tape) when crossing rows and to mark the start of the trap line. Attach traps to corn plants at a height of about 4 feet. Break off any leaves on the plant and adjacent plants that could possibly stick to a trap. Monitor the traps every 9 to 10 days, recording the number of western corn rootworm beetles on each trap. At each site remove the release paper from the unused side of the trap and re-install the trap on the corn stalk with the fresh side exposed. Install new traps every other visit.

Table 4.23 - Determining the number of traps to place in a field

Field Size (Acres)	Number of Traps per Field
1 to 5	3
6 to 10	6
11 to 15	9
16 to 20	13
21 to 25	16
26 to 30	19
31 to 35	23
36 to 40	26
41 to 45	30
46 to 50	34
51 to 55	37
56 to 60	40

Decision Making

After counting the rootworm beetles on all traps, determine the average number of beetles per trap per week using the following formula:

Average beetles per trap per week = *Total Beetles ÷ No. of usable traps ÷ No. of days since last sampled x 7*

If a field has 20 or more rootworm beetles per trap per week, that field is above threshold and should be rotated out of corn or treated with a granular insecticide at corn planting next year for rootworm control. Once a field exceeds the threshold there is no need to scout it again this year.

If trap catch never reaches 20 beetles per trap per week, the field is below threshold and no treatment is recommended for rootworm control the following year. Scouting can be discontinued if trap counts decline for three consecutive sampling periods.

2. Ear zone count method

Survey fields 4 or 5 times from the second week in July through the third week in August to estimate the number of western corn rootworm beetles in the field. Count the corn rootworm beetles in the ear zone of 50 corn plants throughout each field. The ear zone is the area from the upper surface of the leaf just below the ear to the lower surface of the leaf just above the

ear, and includes the ear and ear leaf. Calculate the average number of beetles per ear zone. When scouting fields that have been in corn more than one year, an average count of 1.0 beetle or more per ear zone indicates that a granular insecticide should be applied if the field is to be planted in corn the following year. When scouting first year corn, control for rootworms the following year if the average count is 0.75 beetles or more per ear zone, because primarily egg-laying females migrate to new cornfields.

Table 4.24 - Western Corn Rootworm

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
bifenthrin (Capture 1.15 G) (Capture LFR [1.5EC] see label for details)	0.096 oz	8.0 oz (8.7 lbs/A)	30	**RESTRICTED USE.** Apply at planting in a 5- to 7-inch band over the row, in front of the press wheel. Granules must be incorporated into the top one inch of soil. Apply in-furrow only for light to moderate pest pressure. Do not apply to soil where there is greater than 30% cover of crop residue remaining.
terbufos (Counter 15G)	1.2 oz	8.0 oz (Do not exceed 8.7 lb product/A)	30	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the press wheel and lightly incorporate. Can also be applied in-furrow. **If application is made at planting, do not makepost emergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter 15G applications may result in severe crop injury.
tefluthrin (Force 3G)	0.12-0.15 oz	4.0-5.0 oz	–	**RESTRICTED USE.** Apply at planting in a 7-inch band over the row, in front of or behind the presswheel and incorporate the granules into the top 1 inch of soil. Can also be applied in-furrow. Rotational crops may be planted 30 days after application.
chlorethoxyfos (Fortress 5G)	0.15 oz	3.0 oz	–	**RESTRICTED USE.** Available only in SMARTBOX closed handling system. Apply at planting as a T-band over the row behind the planter shoe and in front of the presswheel. **Do not apply as a surface band behind the presswheel**. May also be applied in- furrow. Granules must be incorporated into the top 1 inch of soil. Rotational crops may be planted 30 days after application.
chlorpyrifos (Lorsban15G)	1.2 oz	8.0 oz	35 grain, 14 silage, 14 grazing	Apply at planting in a 6- to 7-inch band over the row, in front of or behind the presswheel and incorporate the granules into the top 1 inch of soil. Can also be applied in-furrow.
fipronil (Regent 4SC)	0.12 oz (min. 30-in rows)	0.24 oz	–	**RESTRICTED USE.** Make 1 in-furrow application at planting only. Apply in 1 gal water/A directly into the seed furrow. **Do not apply more than 0.13 lb AI/A or 4.2 fluid oz of Regent 4SC/A.**
clothianidin (Poncho 1250)	1.25 mg AI/kernel	5.64 oz/80,000 seeds	–	Product is usually applied by manufacturer to seed upon request of grower at the time seed is ordered. Avoid breathing dust and contact with skin.
thiamethoxam (Cruiser 5FS)	1.25 mg AI/kernel	5.64 oz/80,000 seeds	–	See previous remarks.

Table 4.24 - Western Corn Rootworm (cont.)

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
YieldGard CB (corn borers, corn earworm, suppression of fall armyworm) YieldGard RW (western and northern corn rootworm larvae) YieldGard Plus (all of the above for YieldGard CB and RW) Herculex I (cutworms, corn borers, corn earworm, fall armyworm) Herculex RW (western, northern, Mexican corn rootworm larvae) Herculex XTRA (all of the above for Herculex I and Herculex RW) Agrisure CB/LL (corn borers, corn earworm, suppression of fall armyworm) Agrisure RW (western, northern, Mexican corn rootworm larvae) (Genetically engineered corn plants that express one or more Bt proteins which kill root, stalk, and ear feeding insects.)				Read the product use guides for information on implementing a corn rootworm resistance management plan for your farm.

Corn Rootworm Resistance Management

(Adapted from Martin Rice, Iowa State University.)

EPA requires companies to ensure that 20 percent of the planted acreage of Bt rootworm hybrids be set aside where non-Bt corn will be grown to serve as a refuge. These refuge acres will support populations of corn rootworm not exposed to the Bt protein and reduce the possibility of corn rootworm developing resistance to Bt corn. The corn rootworm population in the refuge will help prevent resistance development by cross-breeding with any insects that may emerge from the Bt cornfield. This resistance management strategy was developed as a condition of registration, and EPA requires monitoring and documentation to show these measures are followed.

The following information on refuge requirements was modified from a Monsanto publication, "YieldGard Rootworm Insect Resistance Management-2003 IRM Guide."

Refuge Requirements

On each farm, up to 80 percent of corn acres may be planted with Bt rootworm corn. Plant at least 20 percent of the corn acres to a corn refuge that does not contain a Bt technology for control of corn rootworms. The corn refuge can be treated for corn rootworm larvae and other soil pests with soil-applied, seed-applied, or foliar-applied insecticides. The corn refuge can be treated with a non-Bt insecticide to control late-season pests such as European corn borer; however, the Bt rootworm corn also must be treated. Corn refuge options include Bt corn borer hybrids, Roundup Ready corn, and conventional corn, but no other Bt product for corn rootworm management.

Plant the refuge within or adjacent to the Bt rootworm cornfield. The corn refuge can be separated by a ditch or farm road but not by another field. Adjacent refuge fields must be owned by or managed by the grower.

Refuge Planting Requirements

Any corn hybrid that does not contain a Bt technology for control of western or northern corn rootworm and is planted within or adjacent to the Bt rootworm field corn can serve as a refuge.

Plant a refuge on every farm where Bt rootworm corn hybrids are planted.

Plant the refuge at the same time as Bt rootworm corn.

Effectiveness of the refuge can be reduced if the plant stand and plant vigor are decreased. The result of fewer, less thrifty plants translates into fewer susceptible insects in the refuge.

Mixing non-Bt seed with Bt rootworm seed for use in the refuge is not permitted.

Plant the refuge and the Bt rootworm corn in fields with similar crop history. For example, if the field planted to Bt rootworm was corn the previous year, then the refuge also must be planted in a field that was planted to corn the previous year.

Refuge Configuration Options

The refuge on each farm may be arranged in a number of configurations. These options offer the flexibility to easily incorporate an effective corn refuge into farm operations.

Options include the following:

- Plant a corn refuge adjacent to each Bt rootworm cornfield.
- Plant a corn refuge as large strips or blocks within a Bt rootworm field.
- Split the planter to alternate at least 4 (preferably 6) consecutive rows of corn refuge with Bt rootworm corn.
- Plant field perimeters or end rows to a corn refuge.

Table 4.25 - Western Corn Rootworm

Insecticide (Formulation)	Amount active ingredient per 1,000 row ft	Amount product per 1,000 row ft	Time limits: days before harvest	Remarks
Herculex XTRA YieldGard Plus (Genetically engineered proteins that kill both European corn borer and corn rootworms)				Read the product use guides for information on implementing a European corn borer and corn rootworm resistance management plan for your farm.

There are two possible refuge deployment options for stacked Bt products.

1. **Common refuge for both corn borers and corn rootworms in non-cotton-growing counties**. The common refuge must be planted with corn hybrids that do not contain Bt technologies for the control of corn rootworms or corn borers. The refuge area must represent at least 20% of the stacked Bt acres. It can be planted as a block adjacent to the stacked Bt field, perimeter strips, or in-field strips. If perimeter strips are implemented, the strips must be at least 4 (preferably 6) rows wide. If strips within the stacked Bt field are implemented, then at least 4 (preferably 6) consecutive rows could be planted. The common refuge can be treated with a soil-applied or seed-applied insecticide to control rootworm larvae and other soil pests. The refuge can also be treated with a non-Bt foliar insecticide for control of late season pests if pest pressure reaches an economic threshold for damage; however, if rootworm adults are present at the time of a foliar application, then the stacked Bt field must be treated in a similar manner.

2. **Separate refuge areas for corn borers and corn rootworm in non-cotton-growing counties**. Acceptable corn borer refuge options are either a non-Bt conventional corn hybrid or a Bt corn rootworm single stack hybrid. Unacceptable corn borer refuge options are Bt lepidopteran single stack hybrids that target corn borers, cutworms, corn earworm, or armyworms. The refuge must represent at least 20% of the grower's stacked Bt corn acres, and must be planted within a 1/2 mile of the stacked Bt field. The corn borer refuge can be treated with a soil-applied or seed-applied insecticide for corn rootworm larval control, or a non-Bt foliar-applied insecticide for corn borer control if pest pressure reaches an economic threshold for damage. The corn rootworm refuge must be planted with a non-Bt corn rootworm-protected hybrid, but can be planted with Bt hybrids that control corn borers. The corn rootworm refuge must represent at least 20% of the grower's stacked Bt corn acres and be planted as an adjacent block, perimeter strips, or in-field strips. The corn rootworm refuge can be treated with a soil-applied or seed-applied insecticide to control rootworm larvae and other soil pests. The refuge can also be treated with a non-Bt foliar insecticide for control of late season pests; however, if rootworm adults are present at the time of foliar applications then the stacked Bt field must be treated in a similar manner. Growers who fail to comply with the IRM requirements risk losing access to the product.

3. Common and separate refuges for Bt corn grown in cotton-growing counties must be 50% of the Bt acres.

Adapted from:
Sharlene R. Matten, Ph.D., IRM Team Leader
USEPA/OPP/BPPD (7511c), 1200 Pennsylvania Ave., NW, Washington D.C. 20460

European Corn Borer (ECB)

First Generation

The potential for first-generation damage in field corn during the whorl stage is impossible to predict prior to planting. The best strategy is to scout each field and apply a whorl application of a granular or liquid insecticide if the ECB infestation exceeds the treatment threshold (see Decision Making below). Historically, not all fields need to be treated with insecticides every year because statewide economic infestations have occurred in only 3 out of the last 22 years. Furthermore, many corn hybrids are able to tolerate moderate levels of leaf and stalk injury without economic yield loss. **Also, corn grown for silage rarely needs to be treated for ECB**.

The decision to treat a first generation ECB infestation should be based on the follow two criteria: (1) the number of plants exhibiting fresh whorl feeding damage, and (2) the presence of live larvae. ECB mortality typically is very high during the first 3 to 5 days after egg hatch. Plant resistance, natural enemies, and adverse environmental conditions are major causes of ECB larval mortality.

Sampling On a weekly, or more frequent basis begin checking for whorl feeding damage when the plants with extended leaves are 17 inches. Randomly select 5 sets of 20 consecutive plants from throughout the field. Determine the percentage of plants that exhibit fresh whorl feeding. Note: newly hatched larvae feed on the leaves, causing a characteristic "window pane" or "shothole" type of damge that is readily visible as the whorl unrolls. In addition, dissect 2 infested plants from each sample of 20 plants and look for live larvae in the whorl of the stalk.

Decision Making. Treatment is suggested if 80 percent or more of the plants exhibit whorl feeding damage and if 80 percent or more of the damaged plants (i.e., 8 out of the 10 dissected plants) have at least 1 live larva per plant.

Second Generation

Although second generation ECB are more likely to attack corn that has been planted late, all corn grown for grain should be scouted when plants with extended leaves are 17 to 24 inches.

Sampling. To assess the potential for economic damage, begin scouting for egg masses when second generation moths emerge and begin egg-laying. The presence of ECB moths in areas bordering a field can be used to indicate a likely infestation. To survey for these moths, walk along the grassy sides of the field and look for large numbers of moths flying when disturbed. However, if no other information is available, it is suggested that scouting for egg masses be initiated the last week of June and continued at 2 to 3 day intervals through the third week of July. Randomly select 5 sets of 20 consecutive plants from throughout the field. Count the number of egg masses found on each plant. ECB moths usually lay their eggs in masses on the undersides of leaves, 2 or 3 leaves below the ear; however, because they can be laid anywhere, it is suggested that every leaf be inspected for egg masses.

Decision Making. To reduce a potential economic loss from second generation ECB in field corn grown for grain, an insecticide treatment is warranted if 35 percent or more of the plants in the pre- to post-tasseling stage of development have at least 1 egg mass per plant.

General Guidelines for Use of Bt Corn in Virginia

The USEPA has identified specific cotton-growing counties in Virginia where corn growers who plant Bt corn hybrids for corn borers or other lepidopterous insects (such as cutworms, armyworms, etc.) and/or corn rootworms also must plant a 50 percent non-Bt corn refuge.

The Virginia counties subject to the 50 percent corn refuge requirement are: Dinwiddie, Franklin City, Greensville, Isle of Wight, Northampton, Southampton, Suffolk City, Surrey, and Sussex.

Most Bt corn borer hybrids on the market today are targeted at controlling the corn borers and corn rootworms. These pests are capable of causing serious damage to corn and are considered two of the most important insect pests of corn in the U.S. Annual costs associated with corn borer and corn rootworm management and crop loss across the U.S. are estimated at more than $2 billion.

What Is Bt Corn?

A Bt corn hybrid refers to a corn plant that has been genetically engineered to express a crystalline protein derived from a common soil bacterium, *Bacillus thuringiensis*. Although researchers have identified numerous strains of Bt proteins, only a handful have been incorporated into the current lines of commercial corn hybrids. Bt proteins are highly toxic to European corn borer and corn rootworm larvae. In general, Bt corn plants with the genetic events BT11 and MON810 (YieldGard) express the Bt protein throughout the plant tissue including the green tissue, silk, pollen, and kernels.

European Corn Borer Life Cycle

European corn borer is a moth that has two main generations per year in Virginia. It overwinters as a fifth instar larva inside pieces of corn stalks, and it has a host range of over 200 plant species. The main damage caused by corn borer larvae results from tunnels bored into the stalk about two weeks before silking. A cornfield that averages one or more tunnels per stalk can expect a yield reduction of about 5%. Despite the fact that it is relatively simple to scout for this pest during the growing season, few growers in Virginia actually do. Their main reasons for not scouting are based on years of observing low levels of stalk breakage and ear drop at harvest.

What Other Corn Pests Are Controlled by Bt Hybrids?

The events BT11 (Syngenta Seeds) and MON810 (Monsanto, YieldGard Corn Borer) provide good control of late-season corn earworm and fall armyworm. These events only provide partial control of armyworm. The event TC1507 (Pioneer/Dupont and Dow AgroSciences Herculex I Insect Protection) protects against black cutworm and fall armyworm, as well as European corn borer. The events MON863 (Monsanto, YieldGard Rootworm) and MIR604 (Sygenta, Agrisure) offers excellent protection from corn rootworms.

Pest Risk Philosophy

The inability to identify at planting which cornfields will be at risk of European corn borer infestation means that the decision to plant a Bt corn hybrid must depend on factors other than pest presence. From a grower's perspective, such factors might include:

1) A philosophy of general pest risk aversion

2) A field's previous pest history (marginal value at best for European corn borer)

3) An attempt to minimize buildup of corn earworm populations that might otherwise pose a threat to soybeans late in the season

4) A perceived indirect benefit of reducing mycotoxin infections associated with stalk tunneling and ear feeding insects

Unfortunately, clear-cut answers to the above scenarios, as well as others you may think of, are not available. Nevertheless, it is possible to develop reasonable guidelines for use of Bt corn hybrids in Virginia if the question is approached from the standpoint of pest potential and the economics of control.

Results of 1997-1999 Field Studies Conducted in Eastern Virginia

From 1997-1999, European corn borer damage was surveyed in 172 non-Bt cornfields in eastern Virginia, and the performance of selected Bt corn hybrids grown in eastern Virginia was evaluated. Details of these studies can be found in Virginia Cooperative Extension publication 424-031, *Virginia Corn Hybrid and Management Trials*, for each of the study years. For complete details, please consult the following URLs for 1997, 1998, and 1999, respectively: *http://www.ext.vt.edu/pubs/grains/424-031/424-031.html*; *http://www.ext.vt.edu/pubs/grains/424-031-98/424-031-98.html*; *http://www.ext.vt.edu/pubs/grains/424-031-99/424-031-99.html*; The following points summarize the results:

1. Of 172 surveyed fields, only 2% (3 fields) had exceeded the economic threshold for damage (i.e., one or more, > 0.5-inch tunnels per stalk).

2. Three years of field tests in eastern Virginia under both irrigated and non-irrigated conditions, and in the absence of economic infestations of European corn borer, revealed that Pioneer 3394 (a non-Bt corn hybrid) consistently produced grain yields as good as or better than those of the Bt corn hybrids.

3. A multi-year doublecrop corn hybrid study showed that late-planted corn (i.e., corn planted after the first week in June) is at severe risk of European corn borer damage. Also, recent survey results of European corn borer damage in non-Bt cornfields of western Virginia were similar to those of surveys conducted in eastern Virginia. Of 78 surveyed fields, less than 8% (6 fields) had exceeded the economic threshold for damage.

General Guidelines for Planting Bt Corn Borer Hybrids in Virginia

1. Most corn (≥ 90%) planted timely in Virginia (i.e., from April to early May) will likely not realize an economic benefit from Bt corn because of the lack of European corn borer pressure early in the season.
2. It is strongly recommended that Bt corn be planted anywhere late-planted corn (i.e., corn planted mid to late May or later) is grown in Virginia because of the increasing risk of corn borer damage.

EPA Refuge Requirements for Planting Bt Corn Hybrids

In corn growing areas where cotton is not grown, a maximum of **80% Bt corn acres** can be planted **if 20% of the remaining corn acres are planted to a non-Bt corn hybrid.** The non-Bt corn refuge can be located up to **1/2 mile** from the Bt corn field if it is not treated with any foliar insecticides for European corn borer. If there is a possibility that the refuge will be treated with insecticides for European corn borer, then the refuge needs to be within **1/4 mile** of the Bt corn field. Under no circumstances should sprayable Bt insecticides be applied to the non-Bt corn refuge.

In corn growing areas where cotton is also grown, a maximum of **50% Bt corn acres** can be planted **if 50% of the remaining corn acres are planted to a non-Bt corn hybrid.** The refuge must be located within **1/2 mile** of the Bt corn field, and if at all possible it should be placed within **1/4 mile** of the Bt corn field.

Acceptable Refuge Planting Schemes

1. Separate non-Bt corn fields within 1/4 to 1/2 mile (see above comments)
2. Large non-Bt corn strips or blocks within the Bt field
3. Split the planter to alternate at least 4 (preferably 6) consecutive rows of corn refuge with the Bt corn borer corn.
4. Planting pivot corners to non-Bt corn
5. Planting field perimeters or end rows to non-Bt corn

For details on YieldGard Plus resistance management plan for European corn borer and western corn rootworm go to the following: *http://www.pioneer.com/canada/crop_management/05YGPL.pdf* and review the "2005 YieldGard Plus Use Guide."

Table 4.26 - European Corn Borer (ECB)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Application must be made prior to the larva boring into the plant. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
Bacillus thuringiensis (Dipel 10G)	1.0 lb	10.0 lb	0	**First generation:** Make whorl application shortly after egg hatch and before larvae bore into the stalks. **Second generation:** Apply when egg-mass counts reach or exceed the economic threshold.
Bacillus thuringiensis (Agree WG)	0.038-0.076 lb	1.0-2.0 lb	0	Apply when small, newly-hatched larvae are present and actively feeding. Use sufficient water for thorough spray coverage. Use high rate for heavy infestations.
chlorpyrifos (Lorsban 15G)	0.9-1.2 oz/1,000 row ft	6.0-8.0 oz/1,000 row ft (band application) 5.0-6.5 lb (broadcast by air)	35 grain, 14 silage, 14 grazing	Uniformly broadcast granules over the plants by air or directly into whorls by ground. Do not exceed 2 applications/season. Do not graze or harvest for silage within14 days of last treatment.
permethrin (Pounce 1.5G)	0.1-0.2 lb	6.7-13.3 lb	—	**RESTRICTED USE.** Foliar use—direct granules into the whorl. Do not apply more than 0.4 lb AI/A after brown silk stage.
chlorpyrifos (Lorsban 4E)	0.75-1.0 lb	1.5-2.0 pt	35 grain, 14 silage, 14 grazing	**First generation:** Apply when 25 to 50% of plants show pinholefeeding or leaf-feeding scars. Ground applications should be directed into the whorl. **Second generation:** Apply when egg- mass counts reach or exceed the economic threshold. Do not graze or harvest for silage within 14 days of last treatment.
fipronil (Regent 4SC)	0.12 oz (min. 30-in rows)	0.24 oz	—	**RESTRICTED USE.** For control of first generation only. Make 1 in-furrow application at planting only. Apply in 1 gal water/A directly into the seed furrow. **Do not apply more than 0.13 lb AI/ A or 4.2 fluid oz of Regent 4SC/A.**
esfenvalerate (Asana XL)	0.04-0.05 lb	7.8-9.6 oz	21	**RESTRICTED USE.** **First generation:** Apply when eggs are in blackhead stage or starting to hatch. Ground application suggested— use 20-30 gal carrier/A and direct spray to both sides of leaves. **Second generation:** Apply when eggs are in blackhead stage or starting to hatch. Good coverage above, below, and in the ear zone is essential.

Table 4.26 - European Corn Borer (ECB) (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	—	**RESTRICTED USE.** Foliar spray—use minimum 1 gal finished spray/A by air or 10 gal/A by ground. Apply prior to brown silk stage.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	—	**RESTRICTED USE.** See previous remarks.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** Must be applied before larva bores into stalk. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.72-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A. 60 forage
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.
carbaryl (Sevin XLR Plus)	1.5-2.0 lb	1.5-2.0 qt	0	For optimum control, use minimum 3 gal water/A by air or 15 gal/A by ground.
carbaryl (Sevin 4F)	1.5-2.0 lb	1.5-2.0 qt	0	See previous remarks.
carbofuran (Furadan 4F)	0.75-1.0 lb	1.5-2.0 pt	30	**RESTRICTED USE.** Foliar spray—apply when eggs begin to hatch. Use minimum 1 gal finished spray/A by air or 10 gal/A by ground. When using ground equipment, direct spray into the whorls for first generation and into the ear zone for second generation.
methyl parathion (Penncap-M 2F)	0.5-1.0 lb	2.0-4.0 pt	12	**RESTRICTED USE.** Check label for spraying instructions before use. First generation: Whorl application— 2 pt/A by ground; broadcast application—3-4 pt/A. Second generation: Broadcast application—2-4 pt/A.

Flea beetle

Flea Beetle Sampling/Decision Making

Flea beetles rarely require control; however, treatment may be necessary if 10 or more flea beetles are present on young corn seedlings at the 1- to 2-leaf stage of growth. No preemergence treatments are recommended for control of flea beetles.

Table 4.27 - Flea Beetle

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
carbaryl (Sevin XLR Plus)	1.0-2.0 lb	1.0-2.0 qt	0	Optimum timing and good coverage are essential to control.
carbaryl (Sevin 80S)	1.0-2.0 lb	1.25-2.5 lb	0	See previous remarks.
chlorpyrifos (Lorsban 4E)	2.0 lb	2.0-3.0 pt	35 grain, 14 silage, 14 grazing	Use sufficient water to ensure thorough coverage of treated plants.
imidacloprid (25%) (Concur planter box seed treatment)	—	1.5 oz/42 lbs seed	45 grazing or feeding	Controls flea beetle up to the first true leaf. Mix thoroughly in planter box prior to planting. Avoid breathing dust and contact with skin and eyes.
permethrin (Pounce 3.2EC)	0.1-0.2 lb	4.0-8.0 oz	30 grain and stover, 0 forage	**RESTRICTED USE.** Use minimum 2 gal finished spray/A by air or 10 gal/A by ground.
permethrin (Ambush 2E)	0.1-0.2 lb	6.4-12.8 oz	30 grain and stover, 0 forage	**RESTRICTED USE.** See previous remarks.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Use sufficient water to ensure thorough coverage of treated plants.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** Apply as required by scouting. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A.
methomyl (Lannate LV 2.4) (Lannate 90 SP)	 0.225-0.45 lb 0.225-0.45 lb	 0.75-1.5 pt 0.25-0.5 lb	3 forage, 21 ears, 21 fodder	**RESTRICTED USE.** Use sufficient water to ensure thorough coverage of treated plants.
methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	12	**RESTRICTED USE.** **Check label for spraying instructions before use.** Use sufficient water to ensure thorough coverage of treated plants.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.72-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A. 60 forage
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.025-0.026 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Grasshoppers

Grasshopper Sampling/Decision Making

Damage may occur during mid- to late-summer, especially during periods of drought. Examine fields next to pastures and other grassy areas where grasshoppers overwinter and develop. Treatment of these adjacent breeding sites before the young grasshoppers move into the corn field may reduce the area that must be sprayed later. Treatment of non-cropped areas is suggested when young grasshoppers reach 20 per square yard. Treat field margins when young grasshoppers enter the field from roadsides. Treatment of entire field is seldom necessary; however, field sprays may be justified when 5 to 8 grasshoppers per square yard are present during the silking period.

Table 4.28 - Grasshoppers

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0165-0.022 lb	2.1-2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	35 grain, 14 silage, 14 grazing	Use sufficient water to ensure thorough coverage of treated plants.
esfenvalerate (Asana XL)	0.03-0.05	5.8-9.6 oz	21	**RESTRICTED USE.** Apply as necessary to maintain control.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** Apply as required by scouting. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A.
carbaryl (Sevin XLR Plus)	0.5-1.5 lb	0.5-1.5 qt	0	Use lower rate for nymphs on small plants. Use higher rate for mature grasshoppers.
carbaryl (Sevin 4F)	0.5-1.5 lb	0.5-1.5 qt	0	See previous remarks.
malathion (Malathion 8EC)	1.0 lb	1.0 pt	0	For young grasshoppers only. Spray may be applied by air or ground equipment. **Dilute application**: use 20 to 60 gal water/A. **Concentrate application**: use ≥5 gal water/A.
carbofuran (Furadan 4F)	0.13-0.25 lb	0.25-0.5 pt	30	**RESTRICTED USE.** Use sufficient water to ensure thorough coverage of treated plants. Use minimum 2 gal finished spray/A by air or 10 gal/A by ground.
dimethoate (Dimethoate 4EC)	0.5 lb	1.0 pt	14	Do not make more than 3 applications/year. Do not feed or graze within 14 days of last application.
methyl parathion (Penncap-M 2F)	0.25-0.75 lb	1.0-3.0 pt	12	**RESTRICTED USE.** **Check label for spraying instructions before use.** Use higher rates if majority of grasshoppers are large and weather conditions are cool. Do not harvest, cut for forage, or graze within 12 days of application.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.72-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A. 60 forage

Table 4.28 - Grasshoppers (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.025-0.026 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/ season for foliar applications. Do not graze live-stock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Spider Mite

Spider Mite Sampling/Decision Making

Spider mite populations often seem to explode as plants reach the grain-fill period, especially during extended hot, dry weather when the plants are stressed. Sprays applied for other insect pests during mid-summer can devastate the mite predator complex and thus may increase mite populations. If corn has not dented, treatment may be warranted if mite colonies are present along the midribs on the lower surfaces of one-third to one-half of the leaves on 50 percent of the plants. This can also be expressed as 15 to 20 percent of the total leaf area covered with mite colonies, and mites are beginning to colonize significant areas of the field.

Table 4.29 - Spider Mite

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
dimethoate (Dimethoate 4EC)	0.33-0.5 lb	0.67-1.0 pt	14	Do not make more than 3applications/year. Do not feed or graze within 14 days of last application.
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.1 lb	10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/ season for foliar applications. Do not graze live-stock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Corn Leaf Aphid

Corn Leaf Aphid Sampling/Decision Making

Aphids are rarely a problem because infestations either build up too late, or they are controlled by beneficial insects such as lady beetles, lacewings, and parasitic wasps. Economic infestations may occur in mid-summer inside the leaf whorl surrounding the developing tassel. If treatment is considered it should be applied before 50 percent of the tassels emerge to be most effective. Unfold the whorl leaves of 20 plants at each of 5 locations in the field and note the severity of aphid colonies and any natural enemy activity. Treatment may be needed when 25 percent of the plants are heavily infested and natural enemy activity is low.

Table 4.30 - Corn Leaf Aphid

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
malathion (Malathion 8EC)	1.0 lb	1.0 pt	0	Spray may be applied by air or ground equipment. **Dilute application**: use 20 to 60 gal water/A. **Concentrate application**: use ≥5 gal water/A.
methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	12	**RESTRICTED USE.** **Check label for spraying instructions before use.** Do not harvest, cut for forage, or graze within 12 days of application.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** Suppression only. Apply as required by scouting, usually at intervals of 7 or more days. Apply by ground or air using sufficient water for full coverage. **Aerial application:** use ≥2 gal water/A. Do not apply >0.48 pt/A/season. Do not apply >0.24 pt/A after silk initiation. Do not apply >0.12 pt/A after milk stage.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.72-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A.
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Japanese Beetle

Japanese Beetle (Adult Feeding) Sampling/Decision Making

Damage is caused when the adult beetles prevent pollination by clipping silks during the early stage of silking. Begin scouting in mid-July before pollination to determine the number of beetles present and the potential for silk clipping damage. Pollination takes place during a period of about 36 hours. If the silks are wilted and/or have turned brown, pollination is complete and further silk feeding will not affect yields. Examine 20 plants in each of 5 locations in the field to determine the stage of pollination, the number of beetles per plant, and the percentage of plants with silks cut back to 0.5 inch or less. An insecticide application may be necessary if 50 percent of the plants have silks cut back to 0.5 inch or less, there is an average of more than 3 Japanese beetles per silk, and the plants are still pollinating.

Table 4.31 - Japanese Beetle

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
carbaryl (Sevin 80S)	1.0-2.0 lb	1.25-2.5 lb	0	Direct spray to fresh silks. If corn has been pollinated, there usually is no need for control. Most earworm and borer insecticides also will control Japanese beetles.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	21	**RESTRICTED USE.** Apply as required by scouting. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.72-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A. 60 forage
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.

Fall Armyworm

Fall Armyworm Sampling/Decision Making

Damage occurs during mid-summer through harvest. Scout at least weekly all late plantings of both silage or grain corn before tassel emergence. Examine 20 consecutive plants at each of 5 locations in the field for the presence of whorl feeding. Larvae feed in the whorls of the plants causing a shredded or ragged appearance. They may burrow deep into the whorls and feed on the growing tips. Plants infested with fall armyworms often recover and grow normally without any significant effect on yield. Control at the whorl stage is usually not practical, particularly by air, and should not be attempted unless 75 percent of the plants exhibit whorl feeding and one or more larvae per plant are found. This threshold drops to 50 percent if 2 or more larvae per plant are found. Spray young plants when fall armyworms infest 15 to 20 percent of the plants.

Table 4.32 - Fall Armyworm

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.022 lb	2.8 oz	grain or fodder: 21 Green forages after last application: 0	**RESTRICTED USE.** Effective against 1st and 2nd instars only. Maximum product per 7-day interval: 2.8 oz/A. Maximum product per crop season: 11.2 oz/A. Maximum number of applications per season: 4. Minimum application volume (water): 10 gal/A by ground, 2 gal/A by air.
methomyl (Lannate LV 2.4) (Lannate 90 SP)	0.225-0.45 lb 0.225-0.45 lb	0.75-1.5 pt 0.25-0.5 lb	3 forage 21 ears 21 fodder	**RESTRICTED USE.** Lannate is considered the insecticide of choice for fall armyworm control. Apply at high rate in a minimum of 50 gal water/A. Spray must be directed into the whorls. Zero days to harvest for ears or 3 days to livestock grazing and feeding.
carbaryl (Sevin XLR Plus)	1.0-2.0 lb	2.0-4.0 pt	0	Optimum timing and good coverage are essential for effective control.
carbaryl (Sevin 80S)	1.0-2.0 lb	1.25-2.5 lb	0	See previous remarks.
carbaryl (Sevin 4F)	1.0-2.0 lb	2.0-4.0 pt	0	See previous remarks.
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use minimum 10 gal water/A. 60 forage
zeta-cypermethrin bifenthrin (Hero [1.24EC])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** Use of Hero on corn is prohibited in all coastal counties. Do not apply more than 0.4 lb AI/A/season for foliar applications. Do not graze livestock in treated areas or cut treated crops for feed within 30 days of last application. Do not apply if heavy rainfall is imminent.