Insects

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Insect Control in Field Crops

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Note: before applying any insecticide to a crop, make sure that a definite insect problem exists. If you are unable to make this determination, contact your local county Extension agent for advice or assistance. Use pesticides only when necessary.

Grain Crops, Soybeans, Forages

Cultural Control Methods

Although the recommendations in this publication deal primarily with chemical control, the use of insecticides on field crops should be considered supplementary to insect control by cultural methods. In many instances, growers who follow accepted cultural practices can expect little trouble from insect pests. This is especially true in the case of insects attacking conventionally tilled field corn.

Some of the most beneficial cultural methods for problem insects affecting field crops are plowing, fertilization, and crop rotation. Deep and clean plowing in the spring destroys insects in the soil (corn earworms and root aphids) and in dead stalks (European corn borer), as well as those feeding on winter weeds and clover (root webworms and cutworms). Proper fertilization gives corn and other field crops the ability to outgrow insect attacks. Rotating corn prevents trouble with corn root aphids and corn rootworms.

In addition to cultural methods, there are field crop varieties on the market that are resistant to certain insects. For example, some of the field corn varieties show resistance to corn leaf aphids and at least two of the varieties of wheat recommended in Maryland are resistant to Hessian fly.

Alfalfa Weevil

There are two cultural control tactics that can be utilized to reduce alfalfa weevil damage. In the late fall, remove the alfalfa for hay or by grazing. This removes the overwintering egg-laying sites for the adult weevils, and will help reduce the number of alfalfa weevil larvae attacking the crop the following spring. Early harvest can sometimes be used in the spring instead of insecticide sprays, if the crop has obtained sufficient growth before larval feeding damage becomes severe.

Potato Leafhopper

Spring-planting alfalfa with a companion crop of oats will help prevent soil erosion, and also reduce potato leafhopper infestations in the first summer cutting of alfalfa.

True Armyworm

In no-till corn planted into winter rye cover crop, research at Virginia Tech has shown that rotary mowing of the rye cover crop after it has initiated seed heads will not only kill the cover crop, but also will dramatically reduce the number of armyworm larvae early in the growing season when the corn is susceptible to damage from armyworm feeding. If mowing is to be used to kill the winter cover crop, corn planting should follow as soon as possible after mowing to facilitate coulter penetration of the rye mulch.

Northern and Western Corn Rootworms

Rotating corn with any other crop [except for squash, pumpkin, etc. (Cucurbitaceae)] for one year will control corn rootworms, since the eggs of these pests are laid in corn fields during the summer.

Note: Any insecticide applied to a crop in bloom will kill honey bees and other pollinating insects. The magnitude of bee loss can be lessened considerably by spraying in late afternoon or evening.

Table 4.1 - Chemical Class, Oral LD_{50}, Worker Re-entry Time, and Toxicity of Some of the Insecticides Recommended in this Publication

		Toxicity to Mammals				Worker re-entry time in days	Toxicity[3] to		
Insecticides	**Trade name**	**Chemical class[1]**	**Oral LD_{50}[2]**	**Acute oral**	**Acute dermal**		**Birds**	**Fish**	**Bees**
Acephate	Orthene	OP	361	Moderate	Moderate	*	Moderate	Low	NA
Bacillus thuringiensis	Dipel, Thuricide	LO	—	Very low	Very low	*	Very low	Very low	Very low
Carbaryl	Sevin	C	500	Low	Low	*	Low	Very low	High
Chlorpyrifos	Dursban, Lorsban	OP	163	Moderate	Moderate	*	Moderate	NA	NA
Diazinon	Diazinon	OP	76	Moderate	Moderate	*	Moderate	High	High
Dimethoate	Dimethoate	OP	215	Moderate	Moderate	*	Moderate	Low	High
Disulfoton	Di-Syston	OP	2	High	High	*	Moderate	NA	Moderate
Ethion		OP	70	Moderate	Moderate	1	High	High	Low
Ethoprop	Mocap	OP	62	High	High	*	Moderate	NA	NA
Fenvalerate	Pydrin	P	450	Moderate	Low	*	NA	High	High
Malathion		OP	1,000	Low	Low	*	Low	High	High
Methidathion	Supracide	OP	25-65	High	Moderate	*	NA	NA	NA
Methiocarb	Mesurol	C	130	Moderate	Low	*	High	High	High
Methomyl	Lannate, Nudrin	C	17	High	Moderate	*	Low	NA	NA
Microencapsulated methyl parathion	Penncap-M	OP	270	Low	Low	*	High	High	High
Permethrin	Ambush, Pounce	P	4,000	Low	Low	*	NA	High	High
Phorate	Thimet	OP	1	High	High	*	Moderate	NA	Moderate
Phosmet	Imidan	OP	147	Moderate	Low	*	Moderate	NA	NA
Terbufos	Counter	OP	4	High	High	*	High	High	NA
Thiodicarb	Larvin	C	66	Moderate	Low	*	NA	NA	Moderate

*Worker cannot enter a treated field without protective clothing until the spray has dried or the dust has settled.
[1]C = carbamate; CH = chlorinated hydrocarbon; LO = living organism; OP = organophosphate; P = pyrethroid.
[2]Based on technical product.
[3]NA = Not available

Table 4.2 - Restricted and General-use Pesticides

Insecticide	Restricted (R)[1] or general (G) use	Insecticide	Restricted (R)[1] or general (G) use
Acephate	G	Malathion	G
Azinphosmethyl	R 3	Methidathion	R 6
Bacillus thuringiensis	G	Methiocarb	G
Carbaryl	G	Methomyl	R 4, 8
Chlorpyrifos	G	(microencapsulated)	R 2, 4, 6, 8
Diazinon	G	Monocrotophos	R 6, 8
Dimethoate	G	Parathion	R 2, 3, 6, 7, 8
Disulfoton	R 2, 3	Permethrin	R 7
Ethion	G	Phorate	R 2, 6, 8
Ethoprop	R 2	Phosmet	G
Fenvalerate	R 7	Thiodicarb	G

[1]Reasons for restrictions are as follows: R 1 = acute oral toxicity; R 2 = acute dermal toxicity; R 3 = acute inhalation toxicity; R 4 = accident history; R 5 = possible oncogenicity; R 6 = effects on birds; R 7 = effects on fish or other aquatic life; and R 8 = effects on terrestrial wildlife.

Forages: Alfalfa and Other Legumes

Curt Laub, Research Associate, Virginia Tech

Alfalfa Weevil

Sampling to Determine Whether Control Measures Are Needed

When the alfalfa starts growing in the spring, walk through the field at least once a week and closely inspect alfalfa tips for feeding injury. When damage and weevil larvae are observed, systematic sampling should be conducted (using the procedure described below) at least once weekly (or more frequently if weevil populations are approaching the action threshold) until the fields are sprayed, harvested, or the weevil season is over. If you are required to spray early and you use a short-residual insecticide, wait 2 to 3 weeks after spraying and resume the sampling program.

Equipment needed to sample a field includes a 3- to 5-gallon bucket, a shallow dishpan, a clipboard with pencil and paper, and tape measure or folding rule. Mentally divide the field into 6 equal sections and walk to the approximate center of the first section. Randomly pull 10 entire stems and place them, tip end first, into the bucket. Be careful to hold the bucket under each stem tip as it is pulled to catch any weevil larvae that may fall off. When the ten stems are collected, grasp them firmly by the base and shake them vigorously against the sides of the bucket for 5 to 10 seconds. As you are shaking the stems, hold the clipboard over the top of the bucket to prevent larvae from being thrown out. Pour the contents of the bucket into the shallow dishpan and count the total number of all weevil larvae.

Randomly select two of the stems from your sample and measure their lengths. Record the number of larvae and the two stem lengths on your clipboard. Walk to the approximate center of the other 5 sections of field and repeat the sampling procedure. Note: in a fairly large field (greater than 20 acres) you may wish to take a few extra samples to improve your sampling accuracy. When you have finished the field, total the larvae and stem lengths for all six sample sites. Determine the average number of larvae/stem by dividing the total by 60 (10 stems at 6 sites) and the average stem length by dividing by 12. Then refer to the decision-making chart, Fig. 4.1. Plot your average number of larvae/stem against stem height. If the point falls near or above the economic threshold line, either harvest or treat the field with a short-residual insecticide. If the point falls below the threshold line, no control measures are recommended; sample again in 5 to 7 days. More frequent sampling may be desired if population levels are approaching the threshold and daily temperatures are above 70° F. **Note: these thresholds are intended for alfalfa growing under adequate fertility and soil moisture conditions. Under drought stress conditions, when alfalfa is growing slowly, the threshold should be lowered by about 0.5 weevil per stem.**

FIG 1. **Alfalfa Weevil Decision Making Chart**

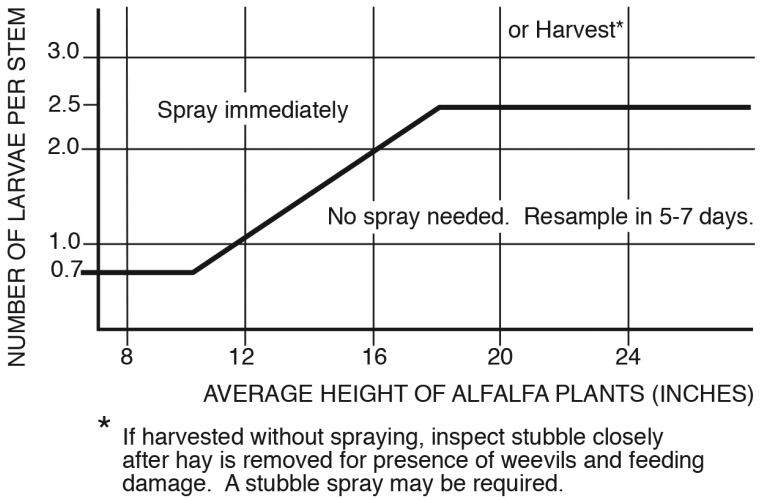


Fig. 4.1. Decision-making chart for determining the need to apply insecticides for alfalfa weevil control.

Spray or Harvest for Weevil Control?

In weevil control zone A, roughly east of the Blue Ridge Parkway, (Fig. 4.2), good survival of overwintering weevil eggs and warm temperatures often result in early larval hatch, causing damage when alfalfa is less than 6 inches tall. Population surveys should be initiated early. If 50 percent of the tips have been damaged and the alfalfa is less than 6 inches tall, spray as soon as possible. In zones B and C, however, the need to control alfalfa weevil varies from year to year, and field sampling should be conducted to determine population levels. Harvesting often can be used as an effective weevil control tactic, if enough growth is present to justify the harvesting process. Yield sacrificed in the first cutting by early harvest will be compensated in 2nd and subsequent cuttings. Cutting alfalfa early assures high quality hay with high protein and TDN, and reduces chance of losing hay to rainy weather later in the season. Early cutting also gives the second growth of alfalfa a head start before the potato leafhopper adults appear in early June. The decision to cut or spray should be based on favorable hay-making weather and time scheduling with other farm operations. If hay is cut before the bud stage in the first cutting, second and subsequent cuttings should be allowed to reach 0.10 bloom before cutting to insure adequate storage of root carbohydrates. Alfalfa may be harvested early only once during the growing season without reducing stand density or longevity.

Determining the Need for Stubble Sprays

If insecticide sprays are used prior to harvest of the first cutting, stubble sprays are seldom necessary. However, if no sprays have been used, or if the field has been cut early because of a heavy weevil infestation, stubble sprays **may** be necessary. Within a week after the hay has been removed from the field, closely inspect the growing shoots of the alfalfa for the presence of larvae or signs of feeding. No formal sampling plan or economic thresholds are available for this crop stage, but, generally, if weevil larvae are easily found, shoot damage is occurring, or regrowth appears delayed, a stubble spray should be applied. Adult weevils can occasionally cause severe damage to regrowth, but because the adult weevils usually hide under the alfalfa crown during the day, they are not easily seen.

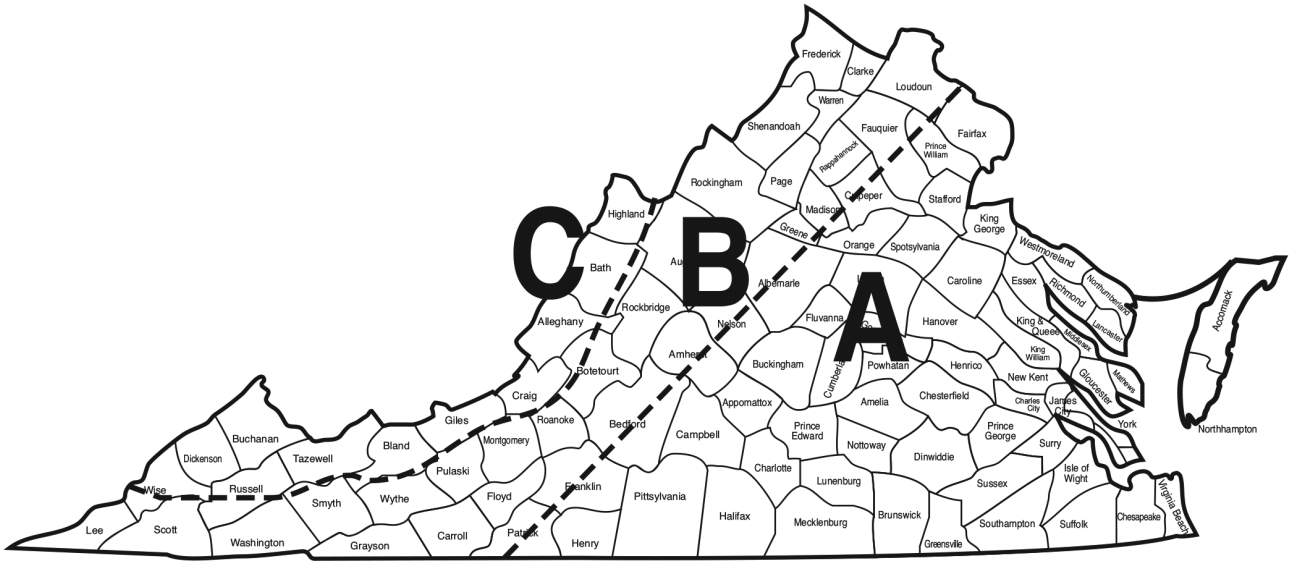


Fig. 4.2. Alfalfa Weevil Control Zones

The dividing line between Zone A and Zone B is roughly the Blue Ridge Parkway.

The line dividing Zone B and Zone C roughly follows the county lines.

Table 4.3 - Recommended Insecticides for Control of Alfalfa Weevil

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	hay harvest: 7 grazing: 7	**RESTRICTED USE.** Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
chlorpyrifos (Lorsban 4E)	0.5-1 lb	1.0-2.0 pt	1 pt: 14 > 1 pt: 21	Some temporary yellowing may occur after application, but this will disappear within a week and not cause yield loss. Do not apply if nearby bees are clustered outside of hives and bees are foraging in the area to be treated. Do not apply more than 4 times/year or more than once/cutting.
chlorpyrifos, zeta-cypermethrin (Stallion [3.03 lb AI/ gal prod])	—	9.25-11.75 oz	7 cutting, grazing, or harvesting seed	**RESTRICTED USE.** Do not make applications of Stallion or other products containing chlorpyrifos <10 days apart. Maximum 32.5 oz product/A/season. Product is highly toxic to bees if exposed to direct application to alfalfa.
indoxacarb (Steward EC)	0.065-0.11 lb	6.7-11.3 oz	7	Apply no more than once per cutting. A total of 45 oz/A may be applied/season.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	forage harvest: 1 hay harvest: 7	**RESTRICTED USE.** Apply as required by scouting. **Ground application**: use 10 to 20 gal water/A. **Aerial application:** use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/ season.
methomyl (Lannate LV 2.4)	0.9 lb	3.0 pt	7	**RESTRICTED USE.** 48 hour re-entry interval. Also labeled for beet armyworm.
phosmet (Imidan 70-W)	1.0 lb	1-1.3 lb	7	**RESTRICTED USE.** Follow safety precautions on label. Do not apply more than once/cutting. Five day restricted entry interval.
permethrin (Pounce 25WP) (Ambush 25WP)	 0.1-0.2 lb 0.1-0.2 lb	 6.4-12-8 oz 6.4-12.8 oz	 ≤ 0.1 lb AI/A: 0 > 0.1 lb AI/A: 14	**RESTRICTED USE.** Do not apply more than 0.2 lb AI/A per cutting. When honey bees are foraging, apply during early morning or evening.
zeta-cypermethrin (Mustang Max)	0.014-0.025 lb	2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	**RESTRICTED USE.** Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

Note: to avoid injury to honey bees, do not apply insecticides during bloom.

Potato Leafhopper

Sampling Methods and Action Thresholds

Although several natural enemies prey upon potato leafhoppers in alfalfa, damaging levels of leafhopper are often reached, requiring insecticide application or harvest management. Leafhopper infestations are highly variable from field to field and from year to year; therefore, monitoring of individual fields is required for effective pest management decision-making. Leafhoppers are most easily sampled using a standard 15-inch diameter sweep net. At each of 6 randomly selected sites in a field, take 10 pendular sweeps with the net (swinging it back and forth in front of you) as you walk. One sweep equals one stroke of the net. After the last sweep, quickly grab the net to prevent insects from escaping. Carefully unfold the net, working your way toward the bottom. Count the number of leafhopper adults and nymphs as they emerge and leafhoppers in the bottom of the net. In fields with high leafhopper infestations, many leafhopper nymphs can be seen on the top and edge of the sweep net before the net is opened to examine the contents. Include these in your count. At each sample site, also measure and record the lengths of two randomly selected stems.

Record the total number of leafhoppers for all 6 sites and divide by 60 to determine the number of leafhoppers per sweep. Divide the total stem length by 12 to estimate average stem length. Then go to the Decision Making Chart shown in Fig. 4.3.

Using the Decision Making Chart

(Fig. 4.3) From the average number of leafhoppers per sweep and the average height of the plants, draw horizontal and vertical lines until they intersect. If the intersection point is above the treatment line, spray or harvest (see below) as soon as possible; if the intersection falls below the line, resample in 5 to 7 days. As can be seen from this chart, the economic threshold is variable, depending on plant height.

For example, if you collected 30 leafhoppers in 60 sweeps for an average of 0.5 leafhoppers per sweep, and your average plant height was 4 inches, spraying would be indicated by the chart. If your average plant height was 12 inches for the same leafhopper count, no spray would be indicated. Keep in mind that this decision-making chart is intended for general use, and individual fields may vary considerably in plant response to the leafhopper feeding depending on soil moisture, fertility, and cultivar.

Spray or Harvest?

Alfalfa should be harvested whenever the crop is in 10 percent or more flower regardless of leafhopper levels. Insecticidal control is most effective if applied early in the crop's growth (assuming leafhopper densities are above the economic threshold), since the spray will protect the alfalfa during the most susceptible stage of growth. As the alfalfa grows in height, the economic return on investment for insecticidal control is reduced but can still be justified if damaging population levels are present. Beyond a crop height of 14 inches, the value of insecticidal control becomes marginal, since considerable clogging of the plant's vascular tissue will have already occurred.

If plants are greater than 14 inches tall and leafhopper numbers are above the treatment threshold (see Decision-Making Chart), two management options are recommended. If the leafhopper count is above the treatment line but less than 2.3 per sweep, and the crop is showing 80 percent or more bud and less than 10 percent flower, harvest as soon as weather conditions are favorable. If the crop is not yet flowering, wait 7 to 10 days, then harvest. If the leafhopper count is greater than 2.3 per sweep, harvest as soon as the alfalfa shows 25 percent bud. Harvest as soon as possible if considerable damage has already occurred.

Harvesting will remove the damaged stems and allow new growth to begin. Newly-planted fields established in the spring are often so severely stunted by potato leafhoppers that harvesting would not produce a significant amount of hay. The crop should still be clipped to remove weeds and the damaged plants.

Determining the Need for Stubble Sprays

Harvesting alfalfa has been shown to kill most potato leafhopper nymphs and many adults. The adults are highly mobile and most adult leafhoppers surviving harvest will leave the field. Even though high numbers of leafhoppers may be present in the field prior to cutting, stubble sprays are not necessarily needed to protect the next cutting. Ideally, the alfalfa should be sampled with a sweep net (as described above) about a week after harvest, or as soon as the alfalfa starts to grow back. If leafhoppers are present at levels greater than 0.4/sweep, spraying is recommended. If sampling the regrowth is not feasible, and high numbers of leafhoppers were present before harvest, a stubble spray on the regrowth may be a good protective measure, especially if green alfalfa was left in the field following harvest. For best results, wait about 5 to 7 days after harvest, or until 4 to 6 inches of new growth has appeared.

Table 4.4 - Recommended Insecticides for Control of Potato Leafhopper

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	hay harvest: 7 grazing: 7	**RESTRICTED USE.** Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
dimethoate (Dimethoate 4EC)	0.25-0.5 lb	0.5-1.0 pt	10	Dimethoate also will control aphids and grasshoppers. Make only one application/ cutting.
carbaryl (Sevin 80 Solpak) (Sevin 4F)	 1.0 lb 1.0 lb	 1.25 lb 2.0 pt	 7 7	Highly toxic to bees; avoid spraying weeds in bloom or alfalfa beyond 10 percent bloom.
chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	0.5 pt: 7 1 pt: 14	Some temporary yellowing may occur after application, but this will disappear within a week and not cause yield loss. Do not apply if nearby bees are clustered outside of hives and bees are foraging in the area to be treated. Do not apply more than 4 times/ year or more than once/cutting.
chlorpyrifos, zeta-cypermethrin (Stallion [3.03 lb AI/ gal prod])	—	5.0-11.75 oz	7 cutting, grazing, or harvesting seed	**RESTRICTED USE.** Do not make applications of Stallion or other products containing chlorpyrifos <10 days apart. Maximum 32.5 oz product/A/season. Product is highly toxic to bees if exposed to direct application to alfalfa.
lambda-cyhalothrin			ge harvest: 1 harvest: 7	**RESTRICTED USE.** Apply as required by scouting. **Ground application**: use 10 to 20 gal water/A. **Aerial application**: use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
				Follow safety precautions on label. Do not apply more than once/cutting. Five day restricted entry interval.
			1 lb AI/A: 0 1 lb AI/A: 14	**RESTRICTED USE.** Do not apply more than 0.2 lb AI/A/ cutting. When honey bees are foraging, apply during early morning or evening.
			ing/grazing: 3 d harvest: 7	**RESTRICTED USE.** Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.
				used as a preventative treatment after leafhoppers first appear.

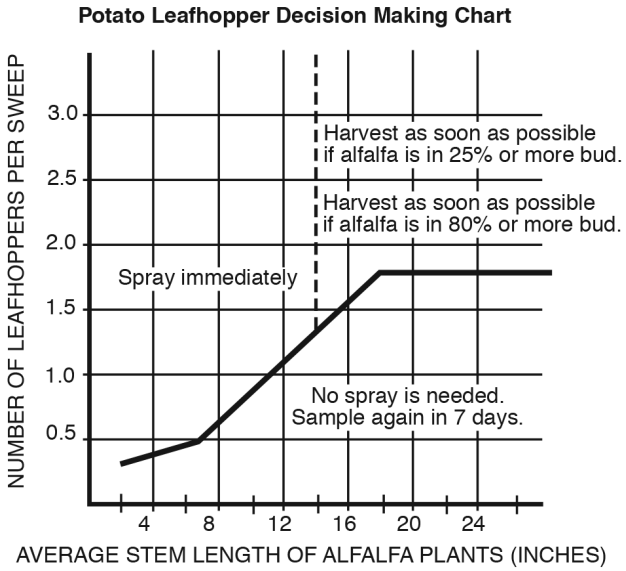


Fig. 4.3. Decision-making chart for determining the need to apply insecticides for potato leafhopper control.

Grasshopper

Table 4.5 - Grasshopper

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.0155-0.022 lb	2.0-2.8 oz	hay harvest: 7 grazing: 7	**RESTRICTED USE.** Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
carbaryl (Sevin 80 Slopak) (Sevin 4F)	0.5-1.5 lb 0.5-1.5 lb	0.67-1.875 lb 0.5-1.5 qt	7	Grasshoppers usually cause problems only during drought and in new fall seedlings. Use the lower rate for nymphs on small plants or sparse vegetation. Use the higher rate for adults or applications to dense vegetation.
chlorpyrifos, zeta-cypermethrin (Stallion [3.03 lb AI/ gal prod])	—	9.25-11.75 oz	7 cutting, grazing, or harvesting seed	**RESTRICTED USE.** Do not make applications of Stallion or other products containing chlorpyrifos <10 days apart. Maximum 32.5 oz product/A/season. Product is highly toxic to bees if exposed to direct application to alfalfa.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	forage harvest: 1 hay harvest: 7	**RESTRICTED USE.** Apply as required by scouting. **Ground application**: use 10 to 20 gal water/A. **Aerial application:** use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
malathion (Malathion 5EC, Malathion 57EC)	1.0-1.5 lb	1.5-2.0 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.
zeta-cypermethrin (Mustang Max)	0.017-0.025 lb	2.8-4.0 oz	cutting/grazing: 3 seed harvest: 7	**RESTRICTED USE.** Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

Armyworm, Cutworm

Table 4.6 - Armyworm (AW), Cutworm (CW)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	AW 0.0125-0.022 lb CW 0.0065-0.0125 lb	1.6-2.8 oz 0.8-1.6 oz	hay harvest: 7 grazing: 7	**RESTRICTED USE.** Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A. Effective against small armyworm larvae up to 2nd instar.
carbaryl (Sevin 80 Solpak) (Sevin 4F)	1.0-1.5 lb 1.0-1.5 lb	1.25-1.875 lb 1.0-1.5 qt	7 7	Apply when insects begin to cause injury. A 5% Sevin bait at 20 lb/A also is effective against cutworms.
chlorpyrifos, zeta-cypermethrin (Stallion [3.03 lb AI/ gal prod])	—	AW 9.25-11.75 oz CW 2.5-11.75 oz	7 cutting, grazing, or harvesting seed	**RESTRICTED USE.** Do not make applications of Stallion or other products containing chlorpyrifos <10 days apart. Maximum 32.5 oz product/A/season. Product is highly toxic to bees if exposed to direct application to alfalfa.

lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC]) armyworm use: cutworm use:	 0.02-0.03 lb 0.015-0.025 lb	 1.28-1.92 oz 0.96-1.60 oz	 forage harvest: 1 hay harvest: 7	**RESTRICTED USE**. Apply as required by scouting. **Ground application**: use 10 to 20 gal water/A. **Aerial application**: use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
permethrin (Pounce 25WP) (Ambush 25WP)	 0.05-0.2 lb 0.05-0.2 lb	 3.2-12.8 oz 3.2-12.8 oz	 ≤0.1 lb AI/A: 0 >0.1 lb AI/A: 14	**RESTRICTED USE.** Do not apply more than 0.2 lb AI/A/cutting. When honey bees are foraging, apply during early morning or evening.
methomyl (Lannate LV) (Lannate SP)	0.225 - 0.9 lb	AW 1.5-3.0 pt CW 0.75-3.0 lb AW 0.5-1.0 pt CW 0.25-2.0 pt	7	**RESTRICTED USE.** Do not apply to dormant or semi- dormant alfalfa when minimum daily temp. is ≤50°F. Wait 7 days after application before grazing or feeding livestock.
zeta-cypermethrin (Mustang Max)	0.014-0.025 lb	AW 2.8-4.0 oz CW 2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	**RESTRICTED USE.** Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

Pea Aphid

Sampling/Decision Making

The need to treat for pea aphids is rare (1 year in 10) in Virginia, Maryland, and Delaware because lady bird beetles, wasp parasites, and other beneficial insects usually control this pest. The best sampling technique requires the same 15-inch sweep net used for potato leafhoppers. Ten sweeps at 10 random locations should be used to sample both the aphids and beneficials. If 50 or more aphids per sweep are collected and no beneficials are present, it is recommended that the field be cut early. Avoid spraying first crop because sprays will kill alfalfa weevil parasites.

Table 4.7 - Recommended Insecticides for Controlling Pea Aphids

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	hay harvest: 7 grazing: 7	**RESTRICTED USE.** Maximum product allowed per cutting is 5.6 oz/A. Maximum product allowed per crop season is 22.4 oz/A.
chlorpyrifos, zeta-cypermethrin (Stallion [3.03 lb AI/ gal prod])	—	9.25-11.75 oz	7 cutting, grazing, or harvesting seed	**RESTRICTED USE.** Do not make applications of Stallion or other products containing chlorpyrifos <10 days apart. Maximum 32.5 oz product/A/season. Product is highly toxic to bees if exposed to direct application to alfalfa.
dimethoate (Dimethoate 4EC)	0.25-0.5 lb	0.5-1.0 pt	10	Make only one application/ cutting.
malathion (Malathion 5EC) (Malathion 57EC)	1.0-1.5 lb	1.5-2.0 pt	0	**RESTRICTED USE.** Warm weather favors parasites and predators of aphids; thus control may not be required if the weather forecast predicts a warm trend. 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.

Table 4.7 - Recommended Insecticides for Controlling Pea Aphids (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	forage harvest: 1 hay harvest: 7	**RESTRICTED USE.** Apply as required by scouting. **Ground application**: use 10 to 20 gal water/A. **Aerial application**: use 2 to 10 gal water/A. Apply in sufficient water for full coverage. Do not apply >0.12 pt/A/cutting. Do not apply >0.48 pt/A/season.
methomyl (Lannate LV) (Lannate SP)	0.45 - 0.9 lb	 1.5-3.0 pt 0.5-1.0 pt	7	**RESTRICTED USE.** Do not apply to dormant or semi- dormant alfalfa when minimum daily temp. is ≤50°F. Wait 7 days after application before grazing or feeding livestock.
permethrin (Pounce 25WP) (Ambush 25WP)	 0.05-0.2 lb 0.05-0.2 lb	 3.2-12.8 oz 3.2-12.8 oz	 ≤0.1 lb AI/A: 0 >0.1 lb AI/A: 14	**RESTRICTED USE.** Do not apply more than 0.2 lb AI/A per cutting. When honey bees are foraging, apply during early morning or evening. When pea aphid densities are heavy, use maximum rate. A second application may be necessary if pest densities remain above the economic threshold.
zeta-cypermethrin (Mustang Max)	0.014-0.025 lb	2.24-4.0 oz	cutting/grazing: 3 seed harvest: 7	**RESTRICTED USE.** Minimum 7 days between applications. Maximum 0.025 lb AI/cutting. Maximum 0.075 lb AI/season.

Orchardgrass, Timothy, and Bermudagrass

Curt Laub, Research Associate, Virginia Tech

The immature stage of white grubs (i.e., Japanese beetle grubs and other related species) and billbug grubs (i.e., bluegrass billbug, hunting billbug, etc.) are the most important root-feeding pests on orchardgrass hay in Virginia. With the exception of Karate and Warrior (billbug supression), none of the insecticides labeled for orchardgrass hay include these insects on their labels. The products listed below target surface feeders and insects found in the thatch layer. Ongoing research in Virginia is working to address this problem for billbugs. Recent research conducted in Virginia showed that conspicious "paired" feeding-holes on young orchardgrass leaves in April indicate the presence of billbugs moving into fields. More importantly, these paired feeding holes, which are found within the first 15-20 feet of a field's border, begin showing up at about the same time or several days earlier than the first billbug adults are found in pitfall traps. **Be sure your crop is listed on the product label before you spray.**

Table 4.8 - Orchardgrass Hay

Pests	Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
armyworms, cutworms, army cutworm, cereal leaf beetle, green cloverworm, meadow spittlebug	beta-cyfluthrin (Baythroid XL)	0.0125-0.015 lb	1.6-1.9 oz	grass for pasture, rangeland and seed: 0 grazing grass for hay: 0 harvest grass in mixed stands with alfalfa: 7 harvest 7 grazing	**RESTRICTED USE.** For grass grown for hay, pasture, seed, or rangeland, the maximum Baythroid XL allowed per 5-day interval is 0.022 lb AI/A (2.8 oz/A). The maximum Baythroid XL allowed per crop season or cutting is 0.089 lb AI/A (11.3 oz/A) For grass in mixed stands with alfalfa, the maximum Baythroid XL allowed per cutting is 0.022 lb AI/A (2.8 oz/A). The maximum Baythroid XL allowed per crop season is 0.089 lb AI/A (11.3 oz/A). Check label for additional details.
fall armyworm (1st & 2nd instar) yellowstriped armyworm (1st & 2nd instar) Lygus bug, stink bugs, leafhoppers, Japanese beetle (adult), June beetle (adult), grasshoppers, grass thrips, tarnished plant bug (refer to label for additional pests)	beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	2.6-2.8 oz		
armyworm, fall armyworm, striped grass looper, chinch bugs, thrips, range caterpillar, range crane fly, essex skipper, ticks	carbaryl (Sevin XLR Plus and Sevin SL)	1.0-1.5 lb	1.0-1.5 qt	14 harvest or grazing	**Caution.** Apply as needed by scouting. Up to 2 applications per year may be made but not more often than once every 14 days. Do not exceed a total of 3 qts/A/year.
	carbaryl (Sevin 80 Solpak)	1.0-1.5 lb	1.25-1.875 lb	14 harvest or grazing	**Caution.** Up to 2 applications per year may be made but not more often than once every 14 days. Do not exceed a total of 3.75 lbs product/A/year.

Table 4.8 - Orchardgrass Hay (cont.)

Pests	Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
army cutworm, cutworms, Essex skipper, range catepillar, striped grasslooper	lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.015-0.025 lb	0.96-1.6 oz	0 grazing 0 cut for forage 7 harvest after last application	**RESTRICTED USE.** Apply as required by scouting. Timing and frequency of applications should be based on locally determined economic thresholds. Use sufficient water for full coverage. Use ≥2 gal by air and ≥7 gal by ground.
billbug species (suppression only), beet armyworm, blue stem midge, cereal leaf beetle, chinch bug, crickets, true armyworm, yellowstriped armyworm, fall armyworm, English grain aphid, bird cherry-oat aphid, Russian wheat aphid, sugarcane aphid, greenbug [aphid] (for aphid species best control is obtained before insects begin to roll leaves), flea beetles, leafhoppers, spittlebugs, stink bugs, thrips, grasshoppers, green June beetle (adult), Japanese beetle (adult), webworms	lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz		Do not apply >0.03 lb AI (1.92 oz product)/A/cutting for pastures, rangeland, and grass grown for seed. A minimum retreatment interval of 30 days is required for pastures and rangeland receiving 0.03 lb AI/A which have not been cut between applications. Do not apply >0.09 lb AI (5.76 oz product)/A/season. Check label for further details.
armyworms, aphids, cereal leaf beetle, grasshoppers, leafhoppers	malathion (Malathion 5EC)	15.0-20.0 oz	1.5-2.0 pt	0 harvest or grazing	**Warning.** REI = 12 hours. Maximum 1 application per cutting

Table 4.8 - Orchardgrass Hay (cont.)

Pests	Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
cutworms, flea beetles, meadow spittlebug, potato leafhopper, webworms, blue alfalfa aphid, green peach aphid (Refer to label for additional pests.)	zeta-cypermethrin (Mustang Max)	0.014-0.025 lb	2.24-4.0 oz	0 forage or hay	**RESTRICTED USE.** Apply minimum 2 gal/A by air or 10 gal/A by ground. Use sufficient water to ensure thorough coverage of foliage. Applications ≥7 days apart for hay and forage. Maximum of 0.025 lb AI/A/ cutting. Maximum 0.10 lb AI/A/season.
armyworms, cereal leaf beetle, grasshoppers, plant bugs (including *Lygus* spp. and stinkbugs) (Refer to label for additonal pests.)	zeta-cypermethrin (Mustang Max)	0.0175-0.025 lb	2.8-4.0 oz	0 forage or hay	**RESTRICTED USE.** Apply minimum 2 gal/A by air or 10 gal/A by ground. Use sufficient water to ensure thorough coverage of foliage. Applications ≥7 days apart for hay and forage. Maximum of 0.025 lb AI/A/ cutting and Maximum 0.10 lb AI/A/ season.

Table 4.9 - Timothy Hay[1]

Pests	Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
cereal rust mite[2]	carbaryl (Sevin XLR Plus)	1.0-1.5 lb	1.0-1.5 qt	14 harvest or grazing	**Caution.** Apply with ground equipment only with adequate water for complete coverage (10-50 gal by ground). *Apply at approximately 4 weeks after green-up in the spring.* Treatment is recommended in fields with a previous history of cereal rust mite and/or when 25% of the plant tillers exhibit curled tips of the new leaf blades within several weeks of green-up. In general, one application at 1.0-1.5 qt/A should provide control. If needed, a second application can be made at least 14 days after the first application. A maximum of 2 applications/year may be made. Do not exceed a total of 3.0 qt/A/cutting.

[1] Note: The following recommendation for timothy hay is made as permitted under FIFRA Section 2(ee).

[2] The cereal rust mite, *Abacarus hystrix*, is a very small eriophyid mite (approximate length of an adult mite is 0.008 inch) that infests several grass species, with timothy being a preferred host. The deeply grooved timothy blades seem to be preferred over the smoother leaf blades of orchardgrass and other forage grasses. In Maryland, populations of more than 3,220 cereal rust mites per square inch (i.e., 500 mites per square cm) have been reported. Initial damage symptoms include lengthwise curling-up (or 'piping-up') of the leaf blade followed by the distal ends of the grass blades turning yellow then brown with the lower leaves drying out.

Cultural control option: Maryland research has shown that cereal rust mite may be controlled culturally by removing most of the aboveground growth immediately before or after the first fall frost. This action removes potential egg-laying sites.

Table 4.10 - Bermudagrass Pasture

Pests	Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
fall armyworm, armyworm, striped grass looper	methomyl (Lannate LV)	3.6-14.4 oz	0.75-3.0 pt	7 grazing 3 cutting for hay	**RESTRICTED USE.** **(Danger Poison)** 48 hour restricted entry interval. Refer to label for proper handling and application instructions. Do not apply more than 3 pt product/A/crop. Do not make more than 4 applications/crop.

Corn

Curt Laub, Research Associate, Virginia Tech

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)	0.022 lb AI/A (based on 30-inch row spacing)	0.12-0.16 oz/1,000 row ft 2.0-2.8 oz/A	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)	0.04-0.16 lb AI/A	3.4-13.6 oz/A 0.2-0.78 oz/1000 row ft	—	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 600)	0.25-0.5 mg AI/ kernel	1.13-2.26 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.
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 is frequently 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. 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)	0.022 lb AI/A (based on 30-inch row spacing)	0.12-0.16 oz/1,000 row ft 2.0-2.8 oz/A	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)	0.04-0.16 lb/ AI/A	3.4-13.6 oz/A 0.2-0.78 oz/ 1000 row ft	—	Apply 5- to 7-inch band (T-band) over ope fur-row or in-furrow with the seed. Maximum 0.1 lb/ A/season as an at-plant application. Max-imum 0.3 lb/A/season of at-plant plus foliar applica-tions of other bifenthrin products.Use of Capture LFR is prohibited in all coastal counties.
chlorpyrifos (Lorsban 15G)	2.4 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 the presswheel and incorporate the granules into the top 1 inch of soil. Can also be applied in-furrow.
clothianidin (Poncho 250)	0.25-0.5 mg AI/ kernel	1.13-2.26 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 15G Lock'N Load)	1.2 oz	8.0 oz	—	**RESTRICTED USE.** 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.**
phorate (Thimet 20G) Lock & Load, SmartBox, EZLoad	1.2 oz	4.5-6.0 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	4.5-5.0 oz	30	**RESTRICTED USE.** Apply in-furrow at planting for best control. Rotational crops may be planted 30 days after application.

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
terbufos (Counter 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 oz	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 makepostemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter applications may result in 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

Spring planting into former soybean fields or old sod fields are often at risk for white grubs and, to a lesser extent, wireworms. In most years, white grub species stop feeding to pupate in mid- to late May in Virginia. Late-planted corn and conventional-tilled corn are at lower risk from white grubs.

Insecticidal seed treatments for seed and root feeders like white grubs are now applied by the manufacturer and must be ordered at the time the seed order is placed; usually from late fall to early winter. A fall soil sampling method for predicting spring-planted cornfields with economic infestations of white grubs is described below.

Compact Method (CM) Soil Sampling Strategy: Fall and spring research-based action thresholds in corn

The CM is a soil sampling strategy for white grubs that provides timely and useful information for pest management decision-making. The CM is based on an 8-inch square by 6-inch deep volume of soil that is hand-sifted for white grubs on a green plastic leaf collection bag placed on the ground next to the sample site. The CM is as accurate as the traditional 12-inch square/ standard method, but is about 57% faster, with much lower sample fatigue. The CM soil sampling strategy was designed for fall sampling as a means to provide producers with a field-specific pest management tool for better managing white grubs on their farms. Using the CM for spring soil sampling of white grubs before planting corn is as useful as fall sampling with the CM. However, keep in mind that sampling in the fall gives you more time to make a decision about white grub management than sampling in the spring.

Definition of Action Threshold (AT): Levels of pest populations at which control should be implemented to avoid significant damage to the crop (determined from research-based relationship of pest levels on yields).

Thresholds: The fall AT is ≥1.6 white grubs per CM soil sample. The spring AT is ≥1.04 white grubs per CM soil sample.

The following represents the minimum number of compact method samples needed per field to be 95 percent confident your sample average is within the specified percentage of the actual field mean:

25% 3 to 4 samples/field (about 10-15 minutes)
20% 5 to 6 samples/field (about 20-25 minutes)
15% 10 samples/field (about 30-40 minutes)
10% 22 samples/field (about ≥1.5 hours)

One point of caution, although soil sampling for white grubs works well in most soils: it is easier to hand sift lighter, sandier soils than heavier soils which do not break apart easily. No data is available for muck soils.

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)	0.022 lb AI/A (based on 30-inch row spacing)	0.14-0.16 oz/1,000 row ft 2.5-2.8 oz/A	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)	0.04-0.16 lb AI/A	3.4-13.6 oz/A 0.2-0.78 oz/1000 row ft	—	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.
chlorpyrifos (Lorsban 15G)	2.4 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 the presswheel and incorporate the granules into the top 1 inch of soil. Can also be applied in-furrow.
clothianidin (Poncho 250)	0.25-0.5 mg AI/ kernel	1.13-2.26 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: Research conducted in Virginia, with partial funding from the VCB, has indicated that the lowest rate of this product gives inconsistent control of white grubs.
phorate (Thimet 20G) Lock & Load, SmartBox, EZLoad	1.2 oz	4.5-6.0 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	—	**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 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 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. 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 applications may result in crop injury.
thiamethoxam (Cruiser 5FS)	0.25 mg AI/ kernel	1.13 oz/80,000 seeds	—	See previous remarks. Note: Research conducted in Virginia, with partial funding from the VCB, has indicated that the lowest rate of this product gives inconsistent control of white grubs.

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 image below). 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

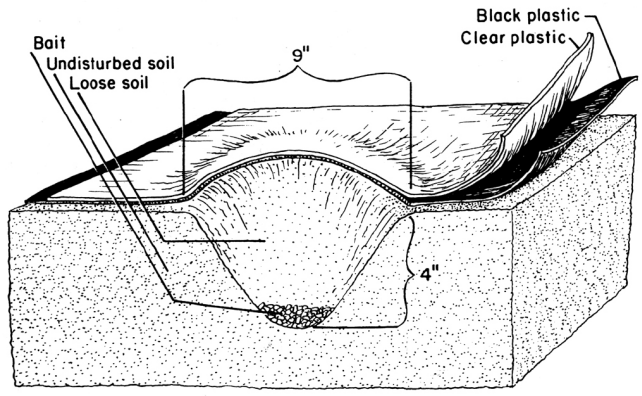
If you are unable to discern which pest is responsible for damaging the corn seeds in the baited wire traps, and if the average number of seeds damaged in the baited wire traps is **5 percent** or more, then a granular insecticide may be needed at planting to prevent serious stand loss.

Exceptions

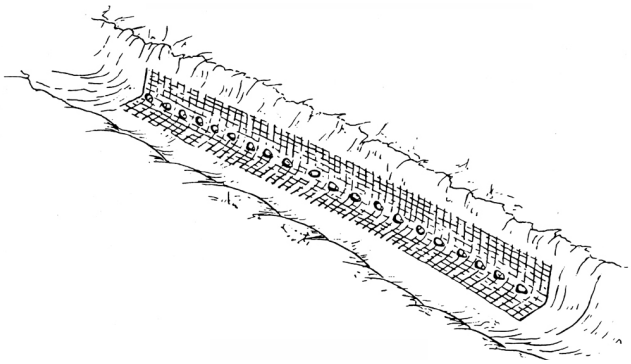
Cropping situations in which the producer is encouraged to make an in-furrow, T-band, or banded over-the-row application of a granular insecticide when planting field corn (**and not just rely on an insecticidal seed treatment**) are the following:

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

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



Bait Station (Cross Section)



Baited Wire Trap

Corn Root Aphid

Corn root aphids are a sporadic pest of field corn in Virginia. Planting field corn no-till in fields with a history of corn root aphid problems can lead to serious root injury if a proper soil insecticide has not been applied at planting. Corn root aphids injure 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 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 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 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. 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 applications may result in 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 lb/A	2.0 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
Optimum® AcreMax™ 1				Product allows growers to reduce their corn rootworm refuge by placing it in the bag. An in-the-bag product that contains 90% of a Pioneer® brand hybrid with Herculex® XTRA (CRW/CB/LL/RR2) insect protection, and 10% of a Pioneer hybrid – same genetic family – with the Herculex 1 trait (CB/LL/RR2), which serves as the corn rootworm refuge. AcreMax, or some other suitable corn borer refuge corn, allows growers the flexibility to plant their corn borer refuge up to 1/2 mile away.
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)	0.04-0.16 lb	3.4-13.6 oz 0.2-0.78 oz/ 1000 row ft	—	**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.
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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	3.75-11.75 oz	30 grain and storage, 60 forage	**RESTRICTED USE.** For grain, silage, seed. Make only one at-plant application in-furrow, band, or T-band treatment; minimum 4-inch band.
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 25WP)	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.

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
permethrin (Pounce 25WP)	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	3.0-4.0 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)	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.
bifenthrin zeta-cypermethrin (Hero [1.24 lbs AI/ gal prod])	0.025-0.06 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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)	2.0 lb	2.0 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 lb	2.0 qt	0	See previous remarks.
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.

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 zeta-cypermethrin (Stallion [3.03 lbs AI/ gal prod])	—	3.75-11.75 oz	30 grain and fodder (stover), 60 forage	**RESTRICTED USE.** Do not make second application of Stallion or any other product containing chlorpyrifos within 10 days of first application. Do not apply in tank mixes with Steadfast or Lighting herbicides.
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.
methomyl (Lannate LV) (Lannate 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.
permethrin (Ambush 25WP)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** See previous remarks.
permethrin (Pounce 25WP)	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.
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.

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
Optimum® AcreMax™ 1				Product allows growers to reduce their corn rootworm refuge by placing it in the bag. An in-the-bag product that contains 90% of a Pioneer® brand hybrid with Herculex® XTRA (CRW/CB/LL/RR2) insect protection, and 10% of a Pioneer hybrid – same genetic family – with the Herculex 1 trait (CB/LL/RR2), which serves as the corn rootworm refuge. AcreMax, or some other suitable corn borer refuge corn, allows growers the flexibility to plant their corn borer refuge up to 1/2 mile away.
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)	0.04-0.16 lb	3.4-13.6 oz 0.2-0.78 oz/1000 row ft	—	**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 25WP)	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 25WP)	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
Bacillus thuringiensis (Biobit WP)	—	0.5-2.0 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.
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)	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.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed 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)	1.0-2.0 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.
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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	9.25-11.75 oz	30 grain and fodder (stover), 60 forage	**RESTRICTED USE.** Do not make second application of Stallion or any other product containing chlorpyrifos within 10 days of first application. Do not apply in tank mixes with Steadfast or Lighting herbicides.
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.** 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 (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
methomyl (Lannate LV) (Lannate 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.
permethrin (Pounce 25WP)	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 25WP)	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.
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.

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 - Postemergence 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.

Table 4.20 - Postemergence Use of Insecticides to Control Slugs and Snails (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
methomyl[1] (Lannate LV)	0.45 lb	1.5 pt	21	**RESTRICTED USE.** Maximum number of applications per season: 10. Maximum product per crop season: 7.5 pts. Apply at 5-7 day intervals to maintain control. Slugs mainly feed in the early evening, at night, or in cool morning hours. Slugs are most active when weather conditions are moist and cool. It is recommended to apply product in early evening through early morning when slugs are active and feeding.

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)	0.04 lb	3.4 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.
bifenthrin (Capture LFR)	0.04-0.16 lb AI/A	3.4-13.6 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.

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
bifenthrin zeta-cypermethrin (Hero [1.24 lbs AI/ gal prod])	0.04-0.10 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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.
chlorpyrifos (Lorsban 4E)	1.0 lb	2.0 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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/ gal prod])	—	9.25-11.75 oz	30 grain and fodder (stover), 60 forage	**RESTRICTED USE.** For foliar use only. Do not make second application of Stallion or any other product containing chlorpyrifos within 10 days of first application. Do not apply in tank mixes with Steadfast or Lighting herbicides.
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.
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 25WP)	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 25WP)	0.1-0.2 lb	6.4-12.8 oz	30 grain and fodder (stover), 0 forage	**RESTRICTED USE.** See previous remarks.
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.

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 - Postemergence 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 20G SmartBox®)	0.9-1.2 oz oz/1,000 row ft	4.5-6.0 oz oz/1,000 row ft	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 applications may result in crop injury.
chlorpyrifos (Lorsban 15G)	1.2 oz/1,000 row ft	8.0- 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

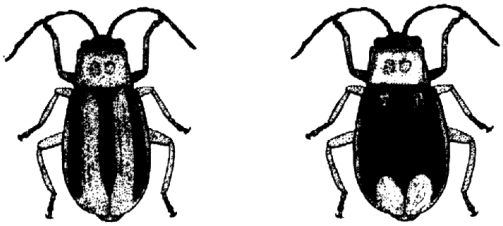


Fig. 4.5 Western Corn Rootworm Adults

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.

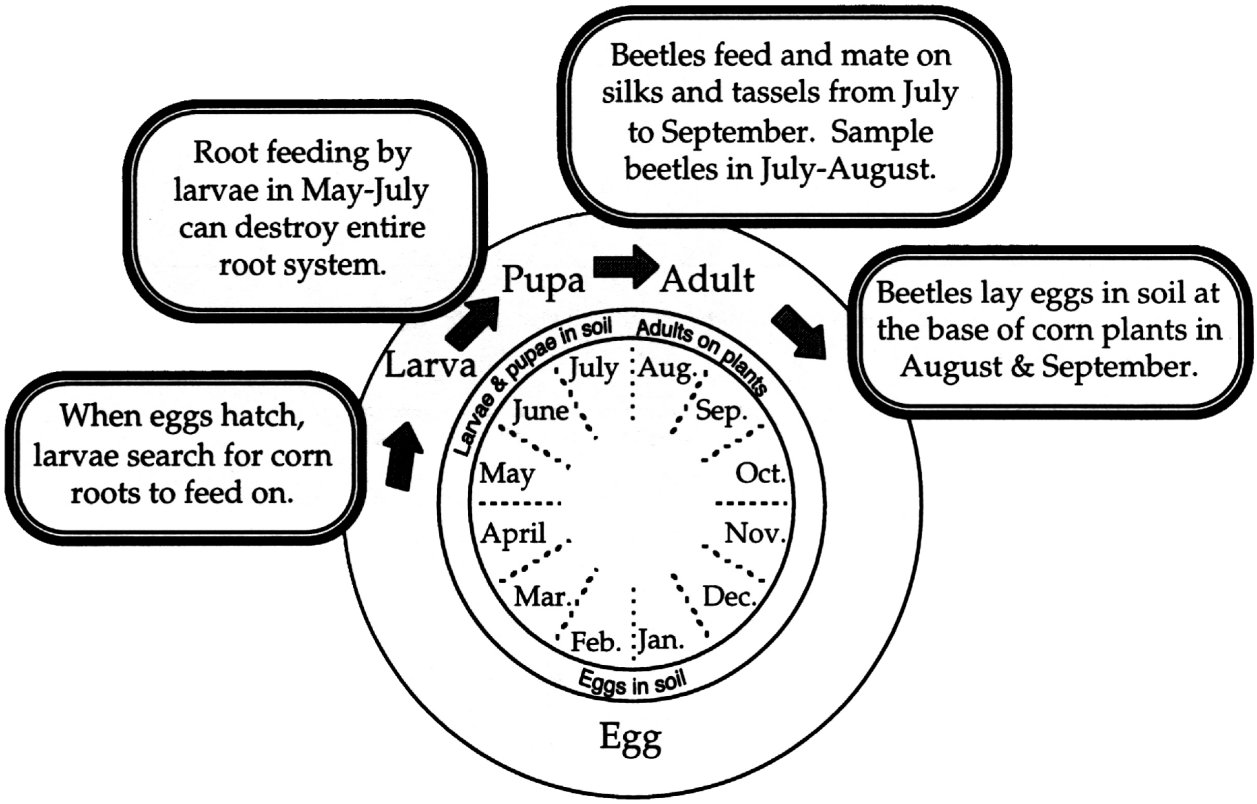


Fig. 4.6 Western corn rootworm life cycle in Virginia

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 here.

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.

Syngenta recently received EPA registration for two trait stacks:

Agrisure Viptera® 3220 E-Z Refuge® ™ trait stack offers dual modes of action for control of multiple above-ground lepidopteran pests and corn borer.

Agrisure® 3122 E-Z Refuge trait stack is intended for use in areas where corn rootworm and lepidopteran pest management are primary concerns.

What the two products have in common: Products feature 5 percent blended refuge in a bag for convenience and easy compliance, glyphosate tolerance, and, in cotton-growing regions, you will need to plant a supplemental 20 percent refuge.

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
Optimum® AcreMax™ 1				Product allows growers to reduce their corn rootworm refuge by placing it in the bag. An in-the-bag product that contains 90% of a Pioneer® brand hybrid with Herculex® XTRA (CRW/CB/LL/RR2) insect protection, and 10% of a Pioneer hybrid – same genetic family – with the Herculex 1 trait (CB/LL/RR2), which serves as the corn rootworm refuge. AcreMax, or some other suitable corn borer refuge corn, allows growers the flexibility to plant their corn borer refuge up to 1/2 mile away.
bifenthrin Capture 1.15 G	0.006 lb	8.0 oz (8.7 lbs/ac)	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.
Capture LFR (see label for details)	0.08-0.2	0.39-0.98 oz (6.8-17.0 oz/ac)		
terbufos (Counter 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 oz	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 make postemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter applications may result in 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.
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.

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
thiamethoxam (Cruiser 5FS)	1.25 mg AI/ kernel	5.64 oz/80,000 seeds	–	See previous remarks.
Optimum® AcreMax™ 1 (corn rootworm larvae, cutworms, fall armyworm, suppression of true armyworm) 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 Marlin 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 following 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 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. Check weekly or more frequently.

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."

Syngenta receives EPA registration for two convenient refuge in a bag trait stacks featuring top performing insect control.

Agrisure Viptera® 3220 E-Z Refuge® ™ trait stack offers dual modes of action for control of multiple above-ground lepidopteran pests and corn borer.

Agrisure® 3122 E-Z Refuge trait stack is intended for use in areas where corn rootworm and lepidopteran pest management are primary concerns.

What the two products have in common: Products feature 5 percent blended refuge in a bag for convenience and easy compliance, glyphosate tolerance, and, in cotton-growing regions, you will need to plant a supplemental 20 percent refuge.

The traits will be available from Syngenta's Garst®, Golden Harvest® and NK® seed brands for the 2013 planting season.

Table 4.26 - European Corn Borer (ECB)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
Optimum® AcreMax™ 1				Product allows growers to reduce their corn rootworm refuge by placing it in the bag. An in-the-bag product that contains 90% of a Pioneer® brand hybrid with Herculex® XTRA (CRW/CB/LL/RR2) insect protection, and 10% of a Pioneer hybrid – same genetic family – with the Herculex 1 trait (CB/LL/RR2), which serves as the corn rootworm refuge. AcreMax, or some other suitable corn borer refuge corn, allows growers the flexibility to plant their corn borer refuge up to 1/2 mile away.
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.
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.
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.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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.
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 within 14 days of last treatment.
chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 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.

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
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	9.25-11.75 oz	30 grain and storage, 60 forage	**RESTRICTED USE.** For grain, silage, seed. Make only one at-plant application in-furrow band or T-band treatment; minimum 4-inch band.
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.
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.
permethrin (Ambush 25WP)	0.1-0.2 lb	6.4-12.8 oz	—	**RESTRICTED USE.** See previous remarks.
permethrin (Pounce 1.5G)	0.1-0.15 lb	6.7-10.0 lb	—	**RESTRICTED USE.** Foliar use—direct granules into the whorl. Do not apply more than 0.4 lb AI/A after brown silk stage.
permethrin (Pounce 25WP)	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.
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

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.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.025-0.026 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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)	1.0-2.0 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)	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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	9.25-11.75 oz	30 grain and storage, 60 forage	**RESTRICTED USE.** For grain, silage, seed. Make only one at-plant application in-furrow band or T-band treatment; minimum 4-inch band.
clothianidin (Poncho 600)	0.25-0.5 mg AI/kernel	1.13-2.26 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.
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) (Lannate 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.
permethrin (Ambush 25WP)	0.1-0.2 lb	6.4-12.8 oz	30 grain and stover, 0 forage	**RESTRICTED USE.** See previous remarks.
permethrin (Pounce 25WP)	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.

Table 4.27 - Flea Beetle (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
terbufos (Counter 20G SmartBox®)	0.9-1.2 oz	4.5-6.0 oz	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 make postemergence or cultivation time treatments of Counter.** Use of Accent or Beacon herbicides following Counter applications may result in crop injury.
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

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.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.025-0.026 lb	2.6-6.1 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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)	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.
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.

Table 4.28 - Grasshoppers (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
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.
esfenvalerate (Asana XL)	0.03-0.05 lb	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.
malathion (Malathion 8EC)	0.61 lb	0.61 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.
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.

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
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.1 lb	10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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.
dimethoate (Dimethoate 4EC)	0.33-0.5 lb	0.67-1.0 pt	14	Do not make more than 3 applications/year. Do not feed or graze within 14 days of last application.

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
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	9.25-11.75 pt	30 grain and storage, 60 forage	**RESTRICTED USE.** For grain, silage, seed. Make only one at-plant application in-furrow band or T-band treatment; minimum 4-inch band.
malathion (Malathion 5EC)	1.0 lb	1.5 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.
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.

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.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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 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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	9.25-11.75 oz	30 grain and storage, 60 forage	**RESTRICTED USE.** For grain, silage, seed. Make only one at-plant application in-furrow band or T-band treatment; minimum 4-inch band.
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.

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
Optimum® AcreMax™ 1				Product allows growers to reduce their corn rootworm refuge by placing it in the bag. An in-the-bag product that contains 90% of a Pioneer® brand hybrid with Herculex® XTRA (CRW/CB/LL/RR2) insect protection, and 10% of a Pioneer hybrid – same genetic family – with the Herculex 1 trait (CB/LL/RR2), which serves as the corn rootworm refuge. AcreMax, or some other suitable corn borer refuge corn, allows growers the flexibility to plant their corn borer refuge up to 1/2 mile away.
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.
bifenthrin zeta-cypermethrin (Hero [1.24 lb AI/gal prod])	0.04-0.1 lb	4.0-10.3 oz	30 grain and stover, 60 forage	**RESTRICTED USE.** For grain, silage, and seed. 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)	1.0-2.0 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.
chlorpyrifos zeta-cypermethrin (Stallion [3.03 lbs AI/gal prod])	—	9.25-11.75 oz	30 grain and storage, 60 forage	**RESTRICTED USE.** For grain, silage, seed. Make only one at-plant application in-furrow band or T-band treatment; minimum 4-inch band.
methomyl (Lannate LV) (Lannate 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.
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.

Small Grains

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Armyworm

Sampling

Armyworms should be detected while they are still small and easier to control. Check fields once each week starting the 2nd week of May. Examine first the debris and undergrowth on the ground surface along field margins and lodged areas. Small worms usually are found curled in a C-shape around the bases of the plants or under the debris and winter annual weeds. Armyworm frass or droppings also may be found on the soil surface. If small armyworms are present in these areas, obtain 10 to 20 worm counts at 50-pace intervals throughout the field. Note the average size of the worms, and whether any defoliation of the flag leaf and/or head clipping has occurred.

Decision Making

Parasites, diseases, insect predators, and birds usually keep armyworms under control in small grains. However, the effectiveness of these natural control agents is reduced during cool, wet springs and during growing seasons that follow years of drought.

As a general rule, barley should be treated if the number of armyworms exceeds one per linear foot between rows and most of the worms are greater than 0.75-inch long. In wheat, armyworms tend to nibble on the tips of kernels rather than clip heads; thus, populations of two to three worms per linear foot between rows are required to justify control. In high management wheat fields with 4-inch rows, treatment is recommended when armyworm levels exceed 3 to 5 per square foot of surface area, or per linear foot of row.

Note that wheat fields with mixed infestations of armyworms and sawfly caterpillars may need treatment even if worm counts of each pest do not exceed threshold levels. Also, if the grain crop is close to harvest or the majority of armyworms are longer than 1.5 inches and no head clipping has occurred, control may not be needed.

Table 4.33 - Recommended Insecticides for Armyworm Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.014-0.019 lb	1.8-2.4 oz	30	Do not graze or forage within 7 days.
carbaryl				Apply to wheat only. No time limits on use as pasture or forage.
(Sevin XLR PLUS)	1.0-1.5 lb	2.0-3.0 pt	21	
(Sevin 80S)	1.0-1.5 lb	1.25-1.88 lb	21	
(Sevin 4F)	1.0-1.5 lb	2.0-3.0 pt	21	
chlorantraniliprole (Prevathon)		14.0-20.0 oz	14	
lambda-cyhalothrin				**RESTRICTED USE.**
(Kaiso 24WG)	0.015-0.25 lb	1.0-1.67 oz	30	Do not apply more than 7.68 oz per acre per season.
(Karate Z)	0.02-0.03 lb	1.28-1.92 oz	30	
(Warrior T)	0.02-0.03 lb	2.56-3.84 oz	30	Wheat, wheat hay, and triticale only (Kaiso).
lambda-cyhalothrin + thiamethoxam (Endigo ZC)	0.023+0.03 lb - 0.031+0.04 lb	3.5-4.5 oz	30	**RESTRICTED USE.** Barley only. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 30 days after treatment.
methomyl				**RESTRICTED USE.**
(Lannate LV)	0.225-0.45 lb	0.75-1.5 pt	7	Do not graze or feed treated forage or hay to livestock within 10 days of last treatment.
(Lannate SP)	0.225-0.45 lb	0.25-0.5 lb	7	

Table 4.33 - Recommended Insecticides for Armyworm Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	15	**RESTRICTED USE.** Do not apply within 15 days of harvest or grazing.
spinetoram (Radiant SC)	0.023-0.047 lb	3.0-6.0 oz	21	Do not apply within 21 days of grain or straw harvest or within 3 days of forage, fodder, or hay harvest.
spinosad (Blackhawk) (fall armyworm)	0.025-0.074 lb 0.038-0.074 lb	1.1-3.3 oz 1.7-3.0 oz	21 21	Barley, buckwheat, oats, rye, triticale, wheat. Do not apply within 21 days of grain or straw harvest or within 3 days of forage, fodder, or hay harvest.
zeta-cypermethrin (Mustang Max)	0.011-0.025 lb	1.76-4.0 oz	14	**RESTRICTED USE.** Wheat and triticale only.

Aphids

Grain Aphids at Tillering during Fall and Early Spring

Sampling

Grain aphids usually are held in check by their natural enemies, which include predators, parasites, and fungal diseases. When looking for aphids, it is important to recognize these natural enemies. Check grain fields each week starting in the fall or early spring if damage symptoms are evident. Infestations of aphids, particularly the greenbug and corn leaf aphid, occasionally build up in the fall. Symptoms are often first noticed as circular, yellow to brown spots with dead plants in the center. These spots may increase in size if the infestation is allowed to persist. To determine aphid activity on tillering grain, examine 20 sites throughout the field. Each site should consist of at least 5 linear feet of a row. Look at areas in the field that are showing plant stress symptoms. Aphid damage may be confused with moisture stress and/or nitrogen deficiency. Count the number of aphids on small plants and, if aphids are numerous, estimate the numbers per linear foot of a row of larger plants. Make a tally of the proportion of each species, particularly if greenbugs are present.

Decision Making

Treatment during the fall and early spring is not often necessary, but may be needed if infestations are threatening and the weather is unusually mild. Treatment is suggested if aphid counts exceed 150 per linear foot of row throughout the majority of the field and a low degree of beneficial insect activity is present. The greenbug can be the most destructive because of the toxic substances it secretes during feeding, so maintain close surveillance of fields if this aphid is the predominate species. One exception to the treatment threshold applies to wheat under intensive-management practices grown in Virginia, where the transmission of virus diseases by aphids is more prevalent. Treatment of intensive management wheat in Virginia is suggested based on the following threshold table:

Table 4.34 - Aphid Numbers

Time of year	Suggested number needed to treat
Fall	
Plant until spring growth begins	15-25/row-foot and yellowing areas scattered throughout the field.
Spring	
After spring growth resumes until hard-dough stage	100/row-foot, plants 3-6 inches tall 200/row-foot, plants 7-10 inches tall 300/row-foot, plants 11+ inches tall
Heading	20-25/grain head

Grain Aphids During the Grain Head Stage

Sampling

To determine aphid activity after the grain heads form, count the number of aphids on 100 heads throughout the field. Do not bias sampling by checking a few heads along the field margins where infestations usually are higher. Check for natural enemies at the same time that aphids are being counted. Aphids usually are clustered as colonies among bracts of the grain head and may move slightly when disturbed. Anything that actively moves when disturbed is probably a predator. Make a note of the ratio of predators to aphids.

Decision Making

The need for treatment depends primarily on the number of aphids, plant maturity, and the presence of natural enemies. Treatment during the grain head stage is generally considered when aphid numbers exceed more than 25 per head, especially if the crop is late, when cool weather is forecast and the natural enemy complex is lacking. Control is not advised if the crop is approaching the hard dough stage where there is good predator/parasite activity. Ratios of one or more predators to every 50 to 100 aphids are sufficient to achieve biological control.

Table 4.35 - Recommended Insecticides for Aphid Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
Seed Treatments				
imidacloprid (Gaucho XT) + metalaxyl + tebuconazole	0.43 oz 0.03 oz 0.02 oz	3.4 oz/cwt – –	N/A – –	For wheat and barley. Do not graze or feed livestock on treated areas for 45 days after planting.
thiamethoxam (Cruiser 5FS)	0.47-0.83 oz	0.75-1.33 oz/cwt	N/A	For wheat and barley. 120-day plantback restriction on certain non-labeled crops.
Foliar Treatments				
beta-cyfluthrin (Baythroid XL)	0.014-0.019	1.8-2.4 oz	30	Do not graze or forage within 7 days.
carbofuran (Furadan 4F)	0.25 lb	0.5 pt	7	**RESTRICTED USE.** Apply before heads emerge from boot. Do not make more than two applications/season. Do not feed treated forage to livestock. For waterfowl protection, do not apply on fields in proximity of waterfowl nesting areas and/or on fields where waterfowl are known to repeatedly feed.
dimethoate (Dimethoate 4EC) (Dimethoate 2.67EC)	0.25-0.38 lb 0.25-0.33 lb	0.5-0.75 pt 0.75-1.0 pt	35 35	May not give acceptable control below 60°F. Do not apply within 14 days of grazing. Labeled for use on wheat only. Do not make more than 2 applications/season.
lambda-cyhalothrin (Kaiso 24WG)	0.02-0.03 lb	1.33-2.0 oz	30	**RESTRICTED USE.** Wheat, wheat hay, and triticale only.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.02-0.03 lb 0.02-0.03 lb	1.28-1.92 oz 2.56-3.84 oz	30 30	**RESTRICTED USE.** Do not apply more than 7.68 oz per acre per season.
lambda-cyhalothrin + thiamethoxam (Endigo ZC)	0.023+0.03 lb - 0.031+0.04 lb	3.5-4.5 oz	30	**RESTRICTED USE.** Barley only. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 30 days after treatment.

Table 4.35 - Recommended Insecticides for Aphid Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
Malathion 57 EC	1.0 lb	1.5 pt	7	Barley and wheat.
microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	15	**RESTRICTED USE.** Do not apply within 15 days of harvest or grazing**.**
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	14	**RESTRICTED USE.** Wheat and triticale only. Aids in control.

Cereal Leaf Beetle

Sampling

In many areas of the mid-Atlantic states, cereal leaf beetle eggs are heavily parasitized; thus, the larval stage is the best indicator of the potential yield loss. Once a week, make field inspections of wheat starting in early May and of spring oats starting by mid-May. Examine the flag leaf of wheat or the entire tiller of oats on 5 plants at each of 10 locations in the field. Count the number of larvae per flag leaf or tiller and note any defoliation.

Decision Making

A number of introduced parasites have been instrumental in keeping cereal leaf beetle populations below economic damage levels. Also, favorable planting dates may help suppress populations. Wheat planted early in the fall immediately after the Hessian fly-free date will be more advanced in growth the next spring than late-planted small grains. These early plantings will be less attractive to and more tolerant of the beetles when they peak in the spring. Cereal leaf beetle infestations on spring-planted oats cannot be avoided by means of planting date. Generally, barley is more advanced in maturity and thus less attractive when beetles are active.

Cereal leaf beetle infestations have become more widespread in the last few years. Adults move into small grain in late February and early March and deposit eggs which hatch into larvae. Larvae feed on grain stripping leaves of valuable photosynthetic tissue. New research indicated that damage to both flag and stem leaves reduces yield. New research showed that the best control is achieved if treatments are applied when larvae are small. Treatment should be considered if 25, total, eggs and small larvae are found on 100 stems. Of that 25, at least 1/2 should be larvae. Once wheat reaches the hard dough stage, beetle damage has little effect on yield and controls are not needed.

Table 4.36 - Recommended Insecticides for Cereal Leaf Beetle Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.008-0.014 lb	1.0-1.8 oz	30	Do not graze or forage within 7 days.
carbaryl (Sevin XLR PLUS) (Sevin 80S) (Sevin 4F)	 1.0 lb 1.25 lb 1.0 lb	 2.0 pt 1.0 lb 2.0 pt	 21 21 21	Apply to wheat only. No time limits on use as pasture or forage.
carbofuran (Furadan 4F)	0.25 lb	0.5 pt	7	**RESTRICTED USE.** Apply before heads emerge from boot. Do not make more than two applications/season. Do not feed treated forage to livestock. For waterfowl protection, do not apply on fields in proximity of waterfowl nesting areas and/or on fields where waterfowl are known to repeatedly feed.

Table 4.36 - Recommended Insecticides for Cereal Leaf Beetle Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
lambda-cyhalothrin + thiamethoxam (Endigo ZC)	0.023+0.03 lb - 0.031+0.04 lb	3.5-4.5 oz	30	**RESTRICTED USE.** Barley only. Do not allow livestock to graze in treated areas or harvest treated forage as feed for meat or dairy animals within 30 days after treatment.
lambda-cyhalothrin (Kaiso 24WG)	0.02-0.03 lb	1.33-2.0 oz	30	**RESTRICTED USE.** Wheat, wheat hay, and triticale only.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.02-0.03 lb 0.02-0.03 lb	1.28-1.92 oz 2.56-3.84 oz	30 30	**RESTRICTED USE.** Do not apply more than 7.68 oz per acre per season.
Malathion 57EC	1.0 lb	1.5 pt	7	Barley and wheat.
methomyl (Lannate LV) (Lannate SP)	0.225-0.45 lb 0.225-0.45 lb	0.75-1.5 pt 0.25-0.5 lb	7 7	**RESTRICTED USE.** Do not graze or feed treated forage or hay to livestock within 10 days of last treatment.
spinetoram (Radiant SC)	0.016-0.047 lb	2.0-6.0 oz	21	Do not apply within 21 days of grain or straw harvest or within 3 days of forage, fodder, or hay harvest.
zeta-cypermethrin (Mustang Max)	0.011-0.025 lb	1.76-4.0 oz	14	**RESTRICTED USE.** Wheat and triticale only.

Hessian Fly

The Hessian fly is not a major pest in the mid-Atlantic states because small grains normally are planted after the adult flies occur ("fly-safe" date). There are no insecticidal control measures that can be applied once the field becomes infested. Control is based entirely upon prevention. The important components of preventative fly management include: planting wheat only after the fly-safe planting date; destroying volunteer wheat plants by tillage methods; and planting resistant varieties, especially when planting very early. Check the following tables for the fly-safe dates in your area and contact your local Extension agent for information on resistant varieties. In Virginia, it is generally thought that the fly-safe date is around Oct. 20. However, flies can infest fields planted after that date by moving from volunteer grain plants in or from nearby fields.

Table 4.37 - Safe Planting Dates

Maryland counties					
Anne Arundel	Oct. 7	Dorchester	Oct. 9	Queen Anne's	Oct. 7
Allegany	Sept. 27	Frederick	Oct. 2	St. Mary's	Oct. 9
Baltimore	Oct. 2	Garrett	Sept. 20	Somerset	Oct. 10
Calvert	Oct. 8	Harford	Oct. 1	Talbot	Oct. 8
Caroline	Oct. 7	Howard	Oct. 2	Washington	Oct. 1
Carroll	Sept. 28	Kent	Oct. 6	Wicomico	Oct. 10
Cecil	Oct. 3	Montgomery	Oct. 4	Worcester	Oct. 11
Charles	Oct. 8	Prince George's	Oct. 7		
Delaware counties					
New Castle	Oct. 3	Kent	Oct. 8	Sussex	Oct. 10

Sorghum

Curt Laub, Research Associate, Virginia Tech

Greenbug Aphid

Sampling/Decision Making

A minimum of 40 randomly selected plants per field should be examined each week. Aphids are seldom evenly distributed across a field, so examine plants from all parts of the field. Avoid examining only field borders. Examine a greater number of plants in fields larger than 80 acres or if making a control decision is difficult.

Consider these factors when making a control decision: the estimates for aphids per plant, leaf damage, percentage parasitized aphids (mummies), and appropriate number of greenbug predators per plant.

Table 4.38 - Greenbug Aphid Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
malathion (Malathion 5EC = 57% EC)	0.94 lb	1.5 pt	7	
dimethoate (Dimethoate 4E)	0.25-0.5 lb	0.5-1.0 pt	28	48 hour restricted entry interval. Do not feed or graze within 28 days of last application. Make no more than 3 applications/ season. Do not apply after heading. **Ground application**: use 25 to 40 gal water/A. **Aerial application**: use ≥1 gal water/A.
chlorpyrifos (Lorsban 4E)	0.25-1 lb	0.5-2.0 pt	30	**RESTRICTED USE.** 24 hour restricted entry interval. Do not apply to sweet sorghum. To minimize chemical injury, do not apply Lorsban 4E to drought stressed grain sorghum within 3 days following irrigation or rain except where the product is applied in irrigation water.

Table 4.39 - Greenbug, English Grain Aphid, Bird Cherry-Oat Aphid Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
clothianidin (Poncho 600) Seed treatment	–	5.1-6.4 oz/100 lbs seed	–	Apply prior to planting to provide early season protection of seedlings. Avoid breathing dust and contact with skin and eyes. Poncho aids in control of greenbug, yellow sugarcane aphid, corn leaf aphid, English grain aphid, chinch bugs, white grubs, and wireworms.
thiamethoxam (Cruiser 5FS) Seed treatment	–	5.1-7.6 oz/100 lbs seed	–	Apply prior to planting to provide early season protection of seedlings. Avoid breathing dust and contact with skin and eyes. Cruiser aids in control of greenbug, yellow sugarcane aphid, corn leaf aphid, chinch bugs, fire ants, seedcorn maggot, and wireworms.
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	14 grain and stover 45 forage	**RESTRICTED USE.** Minimum 10 days between applications. Do not apply >0.125 lb active ingredient/A/ season.

Table 4.40 - Treatment Thresholds for Greenbug Aphids

Plant size	When to treat
Emergence to about 6 in	Visible damage (plants beginning to yellow) with colonies of greenbugs on plants.
Larger plant to boot	Aphid colonies causing red spotting or yellowing of leaves. Before any entire leaves are killed.
Boot to heading	Before the death of one functional leaf.
Heading to hard-dough	When aphid numbers cause death of two normal-sized leaves.

If more than 20% of the greenbugs appear brown and swollen from being parasitized, and lady bird beetles, lacewing larvae, and syrphid fly larvae are active, then treatment generally is not necessary

Fall Armyworm (in Whorls)

Table 4.41 - Fall Armyworm (in Whorls) Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.010-0.022 lb	1.3-2.8 oz	14	**RESTRICTED USE.** Effective against first and second instars only. Maximum allowed per 10-day interval: 2.8 oz/a. Maximum allowed per crop season: 8.4 oz/a. Minimum application volume (water) is 10 GPA by ground and 2 GPA by air.
methomyl (Lannate LV) (Lannate SP)	 0.225-0.45 lb 0.225-0.45 lb	 0.75-1.5 pt 0.25-0.5 lb	 14 14	**RESTRICTED USE.** Fall armyworm can be difficult to control. Use ground application or application from helicopter only with high volume. Direct spray into whorls. Treat at 80% infestation (one worm/plant) or 40% infestation (multiple worms/plant). Treat when caterpillars are small.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	30	**RESTRICTED USE.** For control of first and second instars only. Apply as required by scouting, usually at intervals of 5 or more days. Apply by ground or air using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A. Do not apply >0.32 pt/A per season. In soft dough stage, do not apply >0.08 pt/A per season

Corn Earworm and Fall Armyworm

Sampling/Decision Making

Pre-headed sorghum: ragged shothole damage may be evident and at times 40-60% of plant will have dramatic heavy leaf damage, but worm control in the whorl stage is rarely justified. Late-whorl heading: begin to sample heads soon after flowering and continue until the soft dough stage is reached. Sample minimum of 200 plants at 20 sites within a small field of 10 acres or less. Treat only when larvae damage the head or the developing growing point and worms average 2 or more per head. Open-headed hybrids are damaged less than the compact or closed-headed types.

Sorghum Webworm Sampling

Decision Making

Make frequent head inspections when sorghum is beginning to flower and continue at 5-day intervals until hard dough. To examine heads for sorghum webworm, beat heads on a piece of paper or white handkerchief. Small larvae (less than 1/8-inch long) commonly overlooked during head inspections, will be detected with this method.

Application of an approved insecticide is suggested when five or more small larvae are found per head.

Table 4.42 - Corn Earworm, Fall Armyworm, and Sorghum Webworm (in Seed Heads)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.010-0.022 lb	1.3-2.8 oz	14	**RESTRICTED USE.** For fall armyworm, product is only effective against first and second instars. Maximum allowed per 10-day interval: 2.8 oz/a. Maximum allowed per crop season: 8.4 oz/a. Minimum application volume (water) is 10 GPA by ground and 2 GPA by air.
carbaryl				Direct spray into forming heads for optimum insect control.
(Sevin XLR Plus)	1.0-2.0 lb	2.0-4.0 pt	21 grain, 14 grazing or silage	
(Sevin 4F)	1.0-2.0 lb	2.0-4.0 pt		
(Sevin 80 Solpak)	1.0-2.0 lb	1.25-2.5 lb		
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.02-0.03 lb	1.28-1.92 oz	30	**RESTRICTED USE.** Apply as required by scouting, usually at intervals of 5 or more days. Apply by ground or air, using sufficient water for full coverage. **Aerial application**: use ≥2 gal water/A Do not apply >0.32 pt/A per season. In soft dough stage, do not apply >0.08 pt/A per season.
methomyl				**RESTRICTED USE.**
(Lannate LV)	0.225-0.45 lb	0.75-1.5 pt	14	48 hour restricted entry interval. Methomyl is product of choice for fall armyworm control. Apply at 50% bloom and 3 to 5 days later if needed. Use higher rates for serious infestations and for aerial applications. Threshold is 1 medium-to-large earworm or armyworm/head or 3 webworms/head.
(Lannate SP)	0.225-0.45 lb	0.25-0.5 lb	14	
zeta-cypermethrin (Mustang Max)	0.011-0.025 lb	1.76-4.0 oz	14 grain and fodder 21 forage/ silage	**RESTRICTED USE.** Minimum 10 days between applications. Do not apply >0.125 lb active ingredient/A/season.

Sorghum Midge Sampling

Decision Making

Adult midges do not damage sorghum, but midge larvae feed on and destroy developing seeds during the bloom period. To determine the presence of sorghum midge, fields should be inspected during midmorning until shortly after noon when midges are most active. During the sorghum bloom period, inspect fields daily or every other day to detect sorghum midges. Midge adults can be detected crawling on or flying about flowering grain heads. Use of a clear plastic bag as a trapping device quickly slipped over sorghum heads is helpful in detecting and counting midge adults. Windy weather conditions make midges more difficult to locate and sample accurately.

To determine the need for chemical control, an assessment of crop development, yield potential and midge density is required. Daily evaluation of these factors is encouraged during flowering.

Midge resistant sorghum hybrids are available commercially and, within limits, provide an additional management tool. At similar infestation levels of ovipositing midge females, resistant hybrids generally suffer one-third the damage that susceptible sorghum hybrids suffer. The antibiosis resistance increases the economic threshold level to five adults per head during flowering compared with one midge per head for susceptible hybrids. When adult midge densities exceed five per panicle during flowering in resistant hybrids, insecticide applications at 5-day intervals are required.

Table 4.43 - Sorghum Midge Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL)	0.008-0.01 lb	1.0-1.3 oz	14	**RESTRICTED USE.** Maximum number of applications per season is 6. Minimum application volume (water) is 10 GPA by ground and 2 GPA by air.
lambda-cyhalothrin (Karate [2.08EC]) (Warrior II [2.08EC])	0.015-0.02 lb	0.96-1.28 oz	30	**RESTRICTED USE.** Apply as required by scouting, usually at intervals of 5 or more days. Apply by ground or air, using sufficient water for full coverage. **Aerial Application**: Use ≥2 gal water/A. Do not apply >0.32 pt/A/season. In soft dough stage, do not apply >0.08 pt/A per season.
chlorpyrifos (Lorsban 4E)	0.25 lb	0.5 pt	30	**RESTRICTED USE.** 24 hour restricted entry interval. Apply when 30 to 50% of the seed heads are in bloom, repeat at 3-day intervals if needed. Do not apply to sweet sorghum. To minimize chemical injury, do not apply Lorsban 4E to drought stressed grain sorghum within 3 days following irrigation or rain except where the product is applied in irrigation water.
dimethoate (Dimethoate 4E)	0.125-0.25 lb	0.25-0.5 pt	28	48 hour restricted entry interval. Do not feed or graze within 28 days of last application. Make no more than 3 applications/ season. Do not apply after heading. **Ground application**: use 25 to 40 gal water/A. **Aerial application**: use ≥1 gal water/A.
methomyl (Lannate LV) (Lannate SP)	 0.225-0.45 lb 0.225-0.45 lb	 0.75-1.5 pt 0.25-0.5 lb	 14 14	**RESTRICTED USE.** 48 hour restricted entry interval. Apply at 50% bloom and 3 to 5 days later if needed.
zeta-cypermethrin (Mustang Max)	0.008-0.025 lb	1.28-4.0 oz	14 grain and fodder 21 forage/ silage	**RESTRICTED USE.** Minimum 10 days between applications. Do not apply >0.125 lb active ingredient/A/ season.

Soybeans

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Essentials of a Good Soybean Insect Pest Management Program

Know Soybean Insect Pests

It is very important that you know how to identify common soybean insect pests, and when they are most likely to occur. Different pest species have different economic thresholds and can require different insecticides for effective control. Various Virginia Cooperative Extension publications are available that can be useful in identifying insect pests. Also, consult your local Extension agent.

Know Pest Economic Thresholds

An economic threshold is the number of a particular insect pest that must be controlled to prevent economic loss to the crop. Thresholds have been established through many scientific studies. A treatment before a pest has reached its economic threshold usually will not pay and may cause an increase in other pests, requiring a second insecticide treatment.

Know What Crop Growth Stages Are Most Susceptible to Insect Attack

Leaf feeding insects can attack soybeans at almost any time during the season. Usually leaf feeding occurs continually throughout the season resulting in cumulative leaf damage. New research is showing that full-season and double-crop planting systems may react differently to this leaf damage. Soybean yield appears to be highly related to total leaf area, as measured by LAI (leaf area index). To achieve maximum yield potential, soybeans must develop an LAI of 3.5 to 4.0 or above. An easy way to visualize LAI is to think of a field with an LAI of 4 and having 4 acres of leaf area for every acre of ground. Any leaf canopy above that can be removed (for example: by insect leaf feeders) without reducing the yield potential. Most full-season plantings achieve larger leaf canopies and LAIs, regardless of the climatic conditions (temperature, cloud cover, or rainfall) during the season and are much more tolerant of leaf feeding. However, double-crop plantings do not always achieve as large a leaf canopy and therefore can be more sensitive to defoliation by insects. Until our research is completed, we feel that the "traditional" percent defoliation thresholds (40% prior to bloom, 15% from flowering to pod fill, 35% after pod fill) should only be applied to full-season plantings, or double-crop plantings that, because of good growing conditions, achieve large canopies. Be more conservative with double-crop plantings that do not achieve large canopies due to very late planting, dry conditions, poor soil, or other factors that result in less than optimal growth. With these plantings, allow lower levels of leaf loss before making insecticide treatments. Suggested thresholds for poor growth double-crop plantings are: 20% prior to bloom, 10% from flowering to pod fill, 15% after pod fill.

Know What Conditions Predispose Soybeans to Insect Injury

Corn earworm damage is typically most severe in fields with open leaf canopies, ones having flowers or young pods, or fields under some degree of drought or nematode stress. Therefore, soybeans planted late after small grain or planted in fields affected by drought or nematodes should be watched more closely. In dry seasons, all fields should be watched more closely.

Stay Informed of Current Pest Status

A corn earworm advisory is issued weekly to Virginia Cooperative Extension agents and to some local newspapers from August through September when most soybeans in Virginia are in stages susceptible to corn earworm attack. These advisories summarize current moth activity as monitored by a system of blacklight and pheromone traps. Earworm infestations, if they occur, will most likely follow peak moth activity periods by 8 to 10 days. Stay informed about the moth situation in your area and intensify your scouting efforts during critical periods.

Scout Field Regularly

Scouting (described below) is an essential part of successful economic management of insect pests. You must know what kind and how many insects are in your fields before making treatment decisions. **Do not apply insecticides unless you have confirmed that a real problem exists in your fields.**

Mexican Bean Beetle, Green Cloverworm, Bean Leaf Beetle

Sampling

Check for overwintered Mexican bean beetles as soon as the plants emerge, and first examine the field margins next to overwintering areas. Determine the extent of the infestation because feeding injury usually is not evenly distributed during the early season. Count the number of beetles over a 3-foot section of row in at least five locations in the infested area. Estimate the level of stand reduction if seedlings are killed, or estimate the percentage of defoliation on older plants. Bean leaf beetles also may cause damage to young soybean plants. These insects prefer tender plant tissue and leave rounded holes on leaves. This type of leaf injury is distinguishable from the lacelike injury caused by Mexican bean beetles.

Mexican bean beetle and green cloverworm infestations usually do not reach economic levels before August. Early-planted, full-season soybeans usually attract more colonizing beetles than do later fields. However, double-crop fields may become infested with adults that are moving out of maturing fields late in the season in search of more succulent foliage. Start scouting for both insect pests at least weekly during late July through September. Examine the entire field because larval populations may be localized. Check the undersides of leaves on plants and keep a tally of the number of egg masses, young larvae, older larvae, pupae, and adults. When possible, use a drop cloth to determine numbers in fields with wide rows. Estimate defoliation to the nearest 10 percent on 20 to 30 plants selected throughout the field. Each plant should be pulled up to examine the total leaf area; not just the upper canopy leaves.

When sampling, remember to check for diseased or parasitized larvae because the natural enemies play an important role in controlling these pests. Mexican bean beetles may be suppressed if you release parasitic wasps. The State Departments of Agriculture and grower cooperatives sponsor parasite release programs in several states in the mid-Atlantic area. These tiny parasites, released at carefully managed nursery plots each year, attack the older larvae and help to keep Mexican bean beetle populations below damaging levels. Clover worms are killed by a fungal disease which causes larvae to become hard, mummified, and covered with powdery white to light green spores. The presence of diseased worms usually signals the decline of the pest population.

Decision Making

Spray only when Mexican bean beetles and/or leaf-feeding caterpillars are actively feeding. At seedling, spray when defoliation reaches 40 percent with 2 to 3 beetles per plant throughout the field. At prebloom, spray when defoliation exceeds 30 percent, with 20 or more adults and/or larvae per 3-foot row. At bloom and podset, spray when defoliation exceeds 15 percent, with 16 or more adults and/or larvae per 3-foot of row. Consider the relative size and age composition of the population. If eggs and pupae of the Mexican bean beetle are the predominant stages it is advisable to wait until egg hatch or adult emergence before treating. Also consider the presence of natural controls, such as cloverworms infected with fungal disease or parasitized Mexican bean beetle larvae (mummies).

Table 4.44 - Recommended Insecticides for Mexican Bean Beetle, Green Cloverworm, and Bean Leaf Beetle Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.73-0.97 lb	0.75-1.0 lb	14	
Bacillus thuringiensis (Lepinox WDG) green cloverworm	0.15-0.3 lb	1.0-2.0 lb	0	Use for cloverworms and other caterpillar pests. More effective with small larvae, is slower acting, but one of the safest options—oral LD_{50} is 20,000 milligrams/kilogram. Will not control beetles or sucking insects.

Table 4.44 - Recommended Insecticides for Mexican Bean Beetle, Green Cloverworm, and Bean Leaf Beetle Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin (Baythroid XL) (Mexican bean and bean leaf beetle) (green cloverworm)	0.0125-0.022 lb 0.0065-0.0125 lb	1.6-2.8 oz 0.8-1.6 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02-0.04 lb	2.8 oz	45	**RESTRICTED USE.**
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
carbaryl (Sevin 4F) (Sevin 80S) (Sevin XLR PLUS)	0.5-1.0 lb 0.5 lb 0.5-1.0 lb	1.0-2.0 pt 0.66 lb 1.0-2.0 pt	0 0 0	Bee caution. Application to wet foliage or during periods of high humidity may cause injury to tender foliage.
chlorantraniliprole (Prevathon)	0.047-0.066 lb	14.0-20.0 oz	21	
chlorpyrifos (Lorsban 4E) (bean leaf beetle) (green cloverworm) (Mexican bean beetle)	0.5-1.0 lb 0.25-0.5 lb 0.5-0.75 lb	1.0-2.0 pt 0.5-1.0 pt 1.0-1.5 pt	28	Do not feed or graze livestock on treated plants.
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced) (green cloverworm) (Mexican bean beetle and bean leaf beetle)	0.12 + 0.006 – 0.25 + 0.013 lb 0.31 + 0.016 – 0.74 + 0.038 lb	6.0-13.0 oz 16.0-38.0 oz	30	**RESTRICTED USE.**
esfenvalerate (Asana XL) (bean leaf beetle)	0.015-0.03 lb 0.03-0.05 lb	2.9-5.8 oz 5.8-9.6 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai per acre per season. Extremely toxic to fish.
flubendiamide (Belt SC) (green cloverworm)	0.0625 lb	2.0 oz	14	
indoxacarb (Steward EC) (green cloverworm)	0.045-0.11 lb	4.6-11.3 oz	21	
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 +0.033lb- 0.026 + 0.052 lb	5.0-8.0 oz	30	**RESTRICTED USE**
lambda-cyhalothrin (Kaiso 24WG)	0.015-0.025 lb	1.0-1.67 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Table 4.44 - Recommended Insecticides for Mexican Bean Beetle, Green Cloverworm, and Bean Leaf Beetle Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
lambda-cyhalothrin (Karate Z) (Warrior T)	 0.015-0.025 lb 0.015-0.025 lb	 0.96-1.6 oz 1.92-3.2 oz	 45 45	**RESTRICTED USE**. Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
Malathion 57EC	1.9 lb	3.0 pt	0	
methomyl (Lannate LV) (green cloverworm and Mexican bean beetle) (Lannate SP) (green cloverworm and Mexican bean beetle) (Lannate LV) (bean leaf beetle) (Lannate SP) (bean leaf beetle)	 0.12-0.225 lb 0.11-0.225 lb 0.225-0.3 lb 0.225-0.34 lb	 0.4-0.75 pt 0.125-0.25 lb 0.75-1.0 pt 0.25-0.375 lb	 14 14 14 14	**RESTRICTED USE.** Wait 3 days to feed or graze as forage or 7 days for hay. Up to 2 applications may be used.
methoxyfenozide (Intrepid 2F) (green cloverworm)	 0.06-0.12 lb	 4.0-8.0 oz	 7 (hay/forage) 14 (seed)	
microencapsulated methyl parathion (Penncap-M 2F)	 0.5-0.75 lb	 2.0-3.0 pt	 20	**RESTRICTED USE.** Do not make more than two applications per year. Do not apply within 20 days of harvest or grazing.
permethrin (Ambush 25WP) (Pounce 3.2 EC) (Pounce 25 WP)	 0.05-0.1 lb 0.05-0.1 lb 0.05-0.1 lb	 3.2-6.4 oz 2.0-4.0 oz 3.2-6.4 oz	 60 60 60	**RESTRICTED USE.** Do not make more than two applications per season. Do not graze or harvest for forage. Extremely toxic to fish.
spinetoram (Radiant SC)	 0.15-0.31 lb	 2.0-4.0 oz	 28	
spinosyn (Blackhawk) (green cloverworm)	 0.025-0.05 lb	 1.1-2.2 lb	 28	Do not feed treated forage or hay to meat or dairy animals.
tralomethrin (Scout X-Tra)	 0.012-0.016 lb	 1.71-2.28 oz	 28	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
thiamethoxam + lambda-cyhalothrin (Endigo ZC) (bean leaf beetle)		4.0-4.5 oz	30	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
zeta-cypermethrin (Mustang Max)	 0.0175-0.025 lb	 2.8-4.0 oz	 21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Thrips

Sampling/Decision Making

Thrips rarely require treatment; however, early season injury to drought-stressed plants may occasionally reduce yields. Both nymphs and adults feed on the undersides of the leaves, causing small, silvery streaks and whitish or yellowish discoloration. Treatment may be required when injury appears on drought-stressed plants and more than eight thrips per leaflet are found. Treatment is not recommended in non-stressed fields because soybeans can tolerate thrips injury.

Table 4.45 - Recommended Insecticides for Thrips Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.24-0.49 lb	0.25-0.5 lb	14	
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	0.31 + 0.016 – 0.74 + 0.038 lb	16.0-38.0 oz		**RESTRICTED USE.**
clothianidin + ipconazole + metalaxyl (Inovate - Nipsit Inside + Rancona Xxtra)	—	4.78 oz/cwt		Seed treatment. Do not graze or feed soybean forage and hay to livestock.
imidacloprid (Gaucho 600)	1.0 oz/cwt	1.6 oz/cwt	N/A	Seed treatment.
lambda-cyhalothrin (Kaiso 24WG)	0.015-0.025 lb	1.0-1.67 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Karate Z) (Warrior T)	 0.015-0.025 lb 0.015-0.025 lb	 0.96-1.6 oz 1.92-3.2 oz	 45 45	**RESTRICTED USE**. Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
methomyl (Lannate LV) (Lannate SP)	 0.225-0.3 lb 0.225-0.34 lb	 0.75-1.0 pt 0.25-0.375 lb	 14 14	**RESTRICTED USE.** Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	**RESTRICTED USE.** Do not make more than two applications per year. Do not apply within 20 days of harvest or grazing.
thiamethoxam (Cruiser 5FS)	0.8 oz/cwt	1.28 oz/cwt	N/A	Seed treatment.
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	21	**RESTRICTED USE.** Aids in control. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Potato Leafhopper

Sampling/Decision Making

Leafhoppers attack soybeans during late June through July but rarely reach population levels that affect yields. Using a standard 15-in sweep net, take five sweeps in each of five locations in the field. Count the number of leafhoppers and empty the net before proceeding to the next location. A single sweep consists of a swath of the net along the row in the top one-third of the plant in one direction only.

The symptoms of leafhopper injury include localized stippling, curling, and yellowing of leaf margins. Treatment is suggested when injury appears and infestations exceed four leafhoppers per sweep in stressed beans or eight leafhoppers per sweep in normal growing fields. Dense pubescent varieties are less susceptible.

Table 4.46 - Recommended Insecticides for Potato Leafhopper Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.49-0.97 lb	0.5-1.0 lb	14	
beta-cyfluthrin (Baythroid XL)	0.0065-0.0125 lb	0.8-1.6 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	0.31 + 0.016 – 0.74 + 0.038 lb	16.0-38.0 oz	30	**RESTRICTED USE.**
esfenvalerate (Asana XL)	0.015-0.03 lb	2.9-5.8 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai per acre per season. Extremely toxic to fish.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb – 0.026 + 0.052 lb	5.0-8.0 oz	30	**RESTRICTED USE.**
lambda-cyhalothrin (Kaiso 24WG)	0.015-0.025 lb	1.0-1.67 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.015-0.025 lb 0.015-0.025 lb	0.96-1.6 oz 1.92-3.2 oz	45 45	**RESTRICTED USE**. Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	**RESTRICTED USE.** Do not make more than two applications per year. Do not apply within 20 days of harvest or grazing.
permethrin (Ambush 25WP) (Pounce 3.2EC) (Pounce 25WP)	 0.05-0.1 lb 0.05-0.1 lb 0.05-0.1 lb	 3.2-6.4 oz 2.0-4.0 oz 3.2-6.4 oz	 60 60 60	**RESTRICTED USE.** Do not make more than two applications per season. Do not graze or harvest for forage. Extremely toxic to fish.
tralomethrin (Scout X-Tra)	0.012-0.016 lb	1.71-2.28 oz	28	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
thiamethozam + lambda-cyhalothrin (Endigo ZC)		3.5-4.0 oz	30	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.

Table 4.46 - Recommended Insecticides for Potato Leafhopper Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
zeta-cypermethrin (Mustang Max)	0.0175-0.025 lb	2.8-4.0 oz	21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Spider Mites

Sampling/Decision Making

Mite outbreaks usually are associated with hot, dry weather, which accelerates reproduction and development. During periods of high humidity and field moisture, a fungal disease can reduce populations but high temperatures can nullify these effects. Outbreaks also are associated with the application of certain insecticides that kill natural enemies and/or seem to make the soybean plant more nutritionally suitable for mites.

Check weekly for mites, starting in early July through August, especially during a hot, dry season. Concentrate on the field borders and look for the early signs of white stippling at the bases of the leaves. Do not confuse mite damage with dry weather injury, mineral deficiencies, and herbicide injury. If feeding injury is evident, press the undersides of a few damaged leaves on white paper to reveal any crushed mites. Determine the extent of the infestation and assess the level of injury by examining 20 to 30 plants in the infested area. Field infestations often show defoliated or injured plants at some localized point, with injury becoming less evident and extending in a widening arc into the field.

If isolated spots of mite activity are confined to the perimeter of the field, spot-treatment using ground equipment is recommended to prevent further spread of mites into the field. If the infestation is distributed throughout the interior of the field, treatment of the entire field is suggested if live mites are numerous (20 to 30 per leaflet) and more than 50 percent of the plants show stippling, yellowing, or defoliation over more than one-third of the leaves. If rains come, mite development and survival will decrease but may not drop to economic levels if heavy populations are developing under high temperatures.

Table 4.47 - Recommended Insecticides for Spider Mite Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
bifenthrin (Brigade 2EC)	0.08-0.1 lb	5.12-6.4 oz	18	**RESTRICTED USE.**
chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	28	**RESTRICTED USE**. May need second spray 4 to 5 days after initial treatment to control newly hatched mites. Do not graze or feed forage within 14 days after application. Use of vegetable oil as an adjuvant may improve control during hot weather.
dimethoate (Dimethoate 2.67EC) (Dimethoate 4EC)	 0.5 lb 0.5 lb	 1.5 pt 1.0 pt	 21 21	Do not feed or graze within 5 days of the last application. Do not store above 90° F or below 32° F.
lambda-cyhalothrin (Karate Z) (Warrior T)	 0.03 lb 0.03 lb	 1.92 oz 3.84 oz	 45 45	**RESTRICTED USE**. **Suppression only.** Do not apply more than 7.68 oz per acre per season Do not graze or harvest treated soybean forage, straw or hay for livestock feed.

Corn Earworm

Sampling

Outbreaks often follow a midsummer drought, which causes the corn to ripen earlier and become less attractive to the moths. Female moths prefer to lay eggs in open-canopied, late-blooming soybean fields. Drought conditions also delay soybean maturity and prevent normal canopy growth, so peak moth activity is more coincidental with blooming of open-canopied fields.

Sampling for corn earworm should be done on a weekly basis from mid-August through September. If row spacing is 30 inches or greater any of the techniques described below can be used to sample for insects. Narrow-row beans, 21 inches or less, are best sampled with either the sweep net or rigid beat cloth. Concentrate on high-risk fields, such as ones that have open canopies, are late flowering, or were previously treated with insecticides.

Standard Beat or Ground Cloth

For each sample, place a standard 3-foot ground cloth on the ground between rows and shake the plants bordering both sides vigorously. The number of insects shaken onto the cloth will be the number per 6 feet of row, so divide by 6 to get the number per row-foot. About ten samples should be taken in each 40 acre area. Thresholds are based on number or earworms per row-foot.

Rigid Beat Cloth

The RBC works on the same principle as a standard beat cloth but the RBC is not flexible. Samples are taken by placing the sampler on its side between two rows of plants (plants cannot be seriously lodged) and beating or vigorously shaking adjacent plants into the sampler while it is leaned away from those plants at about a 45° angle. Two 7-inch rows are beaten and one 14-inch or 21-inch row is beaten per sample. Thresholds are based on the number of earworms ***per sample***.

Sweep Net

Each sample should consist of 15 net sweeps with a 15-inch diameter sweep net done continuously one after the other. Each sweep consists of swinging the net in one direction through the foliage so that the top of the net passes 2 or 3 inches below the tops of plants. Fifteen consecutive sweeps are done from one side to the other while walking down a middle row. Swing the net with enough force to dislodge insects into the net. If some leaves are not broken off and in the net after the sample, the sampler is not using enough force. Each swing should pass through the tops of 5, 3, or 2 rows in 7-inch, 14-inch, or 21-inch row-space plantings, respectively. After each sample, stop and count how many earworms are in the net. Thresholds are based on the number of earworms **per sample**.

Decision Making

Treatment is suggested if sample counts exceed economic thresholds. Thresholds are presented at the end of this chapter. Visit the website *http://soybeans.ces.ncsu.edu/thresholds/* for access to the new threshold calculator.

Table 4.48 - Recommended Insecticides for Corn Earworm Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
Bacillus thuringiensis (DiPel ES)	8.0-16.0 BCLUs	1.2 pts	0	For pyrethroid resistant corn earworms when tank-mixed with a pyrethroid at a labeled rate.
Bacillus thuringiensis (Lepinox WDG)	see labels 0.15-0.3 lb	1.0-2.0 lb	0	More effective with small larvae. Suppression only of large larvae. Is slower acting, but one of the safest options—oral LD_{50} is 20,000 mg/kg.
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.

Table 4.48 - Recommended Insecticides for Corn Earworm Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02 + 0.04 lb	2.8 oz	45	**RESTRICTED USE.**
bifenthrin (Brigade 2EC)	0.033-1.0 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
chlorantraniliprole (Prevathon)	0.047-0.066 lb	14.0-20.0 oz	21	
chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	28	**RESTRICTED USE.** Do not feed or graze livestock on treated plants.
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	0.31 + 0.016 – 0.74 + 0.038 lb	16.0-38.0 oz	30	**RESTRICTED USE.**
esfenvalerate (Asana XL)	0.02-0.03 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb per acre per season. Extremely toxic to fish.
flubendiamide (Belt SC)	0.0625-0.09375 lb	2.0-3.0 oz	14	
indoxacarb (Steward EC)	0.045-0.11 lb	4.6-11.3 oz	21	
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb –0.026 + 0.052lb	5.0-8.0 oz	30	**RESTRICTED USE.**
lambda-cyhalothrin (Kaiso 24WG)	0.015-0.025 lb	1.0-1.67 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.015-0.025 lb 0.015-0.025 lb	0.96-1.6 oz 1.92-3.2 oz	45 45	**RESTRICTED USE**. Do not apply more than 7.68 oz per acre per season Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
methomyl (Lannate LV) (Lannate SP)	0.12-0.225 lb 0.11-0.225 lb	0.4-0.75 pt 0.125-0.25 lb	14 14	**RESTRICTED USE.** Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used/season.
permethrin (Ambush 25WP) (Pounce 3.2 EC) (Pounce 25 WP)	0.1-0.2 lb 0.1-0.2 lb 0.1-0.2 lb	6.4-12.8 oz 4.0-8.0 oz 6.4-12.8 oz	60 60 60	**RESTRICTED USE.** Do not make more than two applications per season. Do not graze or harvest for forage. Use high rates when the majority of infestations is composed of older larvae. Extremely toxic to fish.
spinetoram (Radiant SC)	0.15-0.31 lb	2.0-4.0 oz	28	
spinosad + gamma-cyhalothrin (Consero)	0.0625 + 0.02 lb 0.09375 + 0.03 lb	2.0 oz 3.0 oz	45	**RESTRICTED USE.** Do not feed treated forage or hay to meat or dairy animals. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Table 4.48 - Recommended Insecticides for Corn Earworm Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
spinosyn (Blackhawk)	0.038-0.05 lb	1.7-2.2 oz	0	Do not feed treated forage or hay to meat or dairy animals.
tralomethrin (Scout X-Tra)	0.012-0.016 lb	1.71-2.28 oz	21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
thiamethozam + lambda-cyhalothrin (Endigo ZC)		3.5-4.0 oz	30	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
zeta-cypermethrin (Mustang Max)	0.0175-0.025 lb	2.1-6.4 oz	18	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Grasshopper

Table 4.49 - Recommended Insecticides for Grasshopper Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.24-0.49 lb	0.25-0.5 lb	14	
beta-cyfluthrin (Baythroid XL)	0.0155-0.022 lb	2.0-2.8 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02 + 0.04 lb	2.8 oz	45	**RESTRICTED USE.**
bifenthrin (Brigade 2EC)	0.033-1.0 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
carbaryl (Sevin 4F) (Sevin XLR PLUS)	0.5-1.5 lb 0.5-1.5 lb	1.0-3.0 pt 1.0-3.0 pt	0 0	Bee caution. Applications to wet foliage or during periods of high humidity may cause injury to tender foliage.
chlorpyrifos (Lorsban 4E)	0.25-0.5 lb	0.5-1.0 pt	28	**RESTRICTED USE**. Do not feed or graze livestock on treated plants.
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	0.12 + 0.006 – 0.25 + 0.013 lb	6.0-13.0 oz		**RESTRICTED USE.**
dimethoate (Dimethoate 2.67EC) (Dimethoate 4EC)	0.5 lb 0.5 lb	1.5 pt 1.0 pt	21 21	**RESTRICTED USE**. Do not feed or graze within 5 days of the last application. Do not store above 90°F or below 32°F.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai per acre per season. Extremely toxic to fish.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.026 + 0.052 lb – 0.033 + 0.065 lb	8.0-10.0 oz	30	**RESTRICTED USE.**

Table 4.49 - Recommended Insecticides for Grasshopper Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
lambda-cyhalothrin (Kaiso 24WG)	0.025-0.03 lb	1.67-2.0 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.025-0.03 lb 0.025-0.03 lb	1.6-1.92 oz 3.2-3.84 oz	45 45	**RESTRICTED USE.** Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
microencapsulated methyl parathion (Penncap-M 2F)	0.5-0.75 lb	2.0-3.0 pt	20	**RESTRICTED USE.** Do not make more than two applications/ year. Do not apply within 20 days of harvest or grazing.
tralomethrin (Scout X-Tra)	0.016-0.024 lb	2.28-3.41 oz	28	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Armyworms

Table 4.50 - Recommended Insecticides for Fall, Yellowstriped, and Beet Armyworm

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97) (except beet)	0.73-0.97 lb	0.75-1.0 lb	14	
beta-cyfluthrin (Baythroid XL) (fall armyworm and beet armyworm - 1st and 2nd instars only)	0.0125-0.022 lb	1.6-2.8 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
bifenthrin (Brigade 2EC)	0.033-0.10 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
chlorantraniliprole (Prevathon)	0.047-0.066 lb	14.0-20.0 oz	21	
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)				**RESTRICTED USE.**
(beet)	0.43 + 0.022 lb – 0.74 + 0.038 lb	22.0-38.0 oz		
(yellowstriped)	0.215 + 0.01 – 0.51 + 0.026 lb	11.0-26.0 oz		
flubendiamide (Belt SC)	0.0625-0.09375 lb	2.0-3.0 oz	14	

Table 4.50 - Recommended Insecticides for Fall, Yellowstriped, and Beet Armyworm (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
indoxacarb (Steward 1.25SC)	0.045-0.11 lb	4.6-11.3 oz	21	
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.026 + 0.052 lb 0.033 + 0.065 lb	8.0-10.0 oz	30	**RESTRICTED USE.**
lambda-cyhalothrin (Kaiso 24WG) (beet) (yellowstriped and fall)	 0.03 lb 0.025-0.03 lb	 2.0 oz 1.67-2.0 oz	 45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
methomyl (Lannate LV) (Lannate SP)	 0.225-0.3 lb 0.225-0.34 lb	 0.75-1.0 pt 0.25-0.375 lb	 14 14	**RESTRICTED USE.** Wait 3 days to feed or graze as forage or 7 days for hay. Up to two applications may be used per season.
methoxyfenozide (Intrepid 2F)	 0.06-0.12 lb	 4.0-8.0 oz	7 (hay/forage) 14 (seed)	
permethrin (beet armyworm only) (Ambush 25WP) (Pounce 3.2) (Pounce 25 WP)	 0.1-0.2 lb 0.1-0.2 lb 0.1-0.2 lb	 6.4-12.8 oz 4.0-8.0 oz 6.4-12.8 oz	 60 60 60	**RESTRICTED USE.** Do not make more than two applications/ season. Do not graze or harvest for forage. Use high rates when the majority of infestations is composed of older larvae. Extremely toxic to fish.
spinetoram (Radiant SC)	 0.15-0.31 lb	 2.0-4.0 oz	 28	
spinosyn (Blackhawk)	 0.038-0.05 lb	 1.7-2.2 oz	 28	Do not feed treated forage or hay to meat or dairy animals.
tralomethrin (Scout X-Tra)	 0.016-0.024 lb	 2.28-3.41 oz	 28	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
thiamethozam + lambda-cyhalothrin (Endigo ZC) (bean leaf beetle)		4.0-4.5 oz	30	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
zeta-cypermethrin (Mustang Max) (beet and fall) (yellowstriped)	 0.02-0.025 lb 0.0175-0.025 lb	 3.2-4.0 oz 2.8-4.0 oz	 21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Stinkbugs

Table 4.51 - Recommended Insecticides for Stinkbug Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 97)	0.49-0.97 lb	0.5-1.0 lb	14	
beta-cyfluthrin (Baythroid XL)	0.0125-0.022 lb	1.6-2.8 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
beta-cyfluthrin + imidacloprid (Leverage 360)	0.02 + 0.04 lb	2.8 oz	45	**RESTRICTED USE.**
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
chlorpyrifos (Lorsban 4E)	1.0 lb	2.0 pt	28	**RESTRICTED USE.** Do not feed or graze livestock on treated plants.
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	0.31 + 0.016 – 0.74 + 0.038 lb	16.0-38.0 oz		**RESTRICTED USE.**
clothianidin (Belay)	0.05-0.067 lb	3.0-4.0 oz	21	Do not graze or feed soybean forage and hay to livestock.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb ai/A/season. Extremely toxic to fish.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.026 + 0.052 lb – 0.033 + 0.065 lb	8.0-10.0 oz	30	**RESTRICTED USE.**
lambda-cyhalothrin (Kaiso 24WG)	0.025-0.03 lb	1.67-2.0 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.025-0.03 lb 0.025-0.03 lb	1.6-1.92 oz 3.2-3.84 oz	45 45	**RESTRICTED USE**. Do not apply more than 7.68 oz/A per season. Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
microencapsulated methyl parathion (Penncap-M 2F)	0.25-0.75 lb	1.0-3.0 pt	20	**RESTRICTED USE.** Do not make more than two applications per year. Do not apply within 20 days of harvest or grazing.
tralomethrin (Scout X-Tra)	0.016-0.024 lb	2.28-3.41 oz	21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
thiamethozam + lambda-cyhalothrin (Endigo ZC) (bean leaf beetle)		4.0-4.5 oz	30	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
zeta-cypermethrin (Mustang Max)	0.02-0.025 lb	3.2-4.0 oz	21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Soybean Looper

Table 4.52 - Recommended Insecticides for Soybean Looper Control

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	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
chlorantraniliprole (Prevathon)	0.047-0.066 lb	14.0-20.0 oz	21	
flubendiamide (Belt)	0.06-0.09 lb	2.0-3.0 oz	14	
indoxacarb (Steward 1.25SC)	0.055-0.11 lb	5.6-11.3 oz	21	
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.033 + 0.065 lb	10.0 oz	30	
methoxyfenozide (Intrepid 2F)	0.06-0.12 lb	4.0-8.0 oz	7 (hay/forage) 14(seed)	
spinetoram (Radiant SC)	0.15-0.31 lb	2.0-4.0 oz	28	
spinosad + gamma-cyhalothrin (Consero)	0.09375 + 0.03 lb	3.0 oz	45	**RESTRICTED USE.** Do not feed treated forage or hay to meat or dairy animals. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
spinosyn (Blackhawk)	0.025-0.05 lb	1.1-2.2 oz	28	Do not feed treated forage or hay to meat or dairy animals.

Soybean Aphid

Table 4.53 - Recommended Insecticides for Soybean Aphid Control

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
acephate (Orthene 90S) (Orthene 97)	 0.5 -1.0 lb 0.73-0.97 lb	 0.56-1.1 lb 0.75-1.0 lb	 14 14	Do not graze or cut vines for hay or forage.
bifenthrin (Brigade 2EC)	0.033-0.1 lb	2.1-6.4 oz	18	**RESTRICTED USE.**
chlorpyrifos (Lorsban 4E)	0.5-1.0 lb	1.0-2.0 pt	28	**RESTRICTED USE.** Do not feed or graze livestock on treated plants.
chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	0.21 + 0.01 – 0.51 + 0.026 lb	11.0-26.0 oz		**RESTRICTED USE.**
clothianidin (Belay)	0.05-0.067 lb	3.0-4.0 oz	21	Do not graze or feed soybean forage and hay to livestock.

Table 4.53 - Recommended Insecticides for Soybean Aphid Control (cont.)

Insecticide (Formulation)	Amount active ingredient per acre	Amount product per acre	Time limits: days before harvest	Remarks
cyfluthrin (Baythroid XL)	0.044 lb	2.0-2.8 oz	45	**RESTRICTED USE.** Green forage may be fed 15 days after last application.
esfenvalerate (Asana XL)	0.03-0.05 lb	5.8-9.6 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated plants. Do not exceed 0.2 lb per acre per season. Extremely toxic to fish.
imidacloprid (Gaucho 600)	1.0 oz/cwt	1.6 oz/cwt	N/A	Seed treatment.
lambda-cyhalothrin + chlorantraniliprole (Besiege)	0.016 + 0.033 lb – 0.026 + 0.052 lb	5.0-8.0 oz	30	**RESTRICTED USE.**
lambda-cyhalothrin (Kaiso 24WG)	0.015-0.025 lb	1.0-1.67 oz	45	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
lambda-cyhalothrin (Karate Z) (Warrior T)	0.015-0.025 lb 0.015-0.025 lb	0.96-1.6 oz 1.92-3.2 oz	45 45	**RESTRICTED USE.** Do not apply more than 7.68 oz per acre per season. Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.
thiamethoxam (Cruiser 5FS)	0.8 oz/cwt	1.28 oz/cwt	N/A	Seed treatment.
thiamethozam + lambda-cyhalothrin (Endigo ZC)		3.5-4.0 oz	30	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw or hay for livestock feed.
zeta-cypermethrin (Mustang Max)	0.0175-0.025 lb	2.8-4.0 oz	21	**RESTRICTED USE.** Do not graze or harvest treated soybean forage, straw, or hay for livestock feed.

Pest Thresholds

Table 4.54 - Corn Earworm Thresholds in Soybeans[1]

Sampling Tool	Row Width	Rows Sampled	Threshold
Sweep Net[2]	7"	5	2.5
	14"	3	2.4
	21"	2	3.1
	36"	1	3.1
	7"	2	0.9
Rigid Beat Cloth[3]	14"	1	0.7
	21"	1	1.2
Beat Cloth	30"	1 or 2	1.0
Standard or Rigid[4]	36"	1 or 2	1.2

[1] Only count worms 3/8 inch or longer.
[2] Based on a 15-sweep sample.
[3] Number per sample.
[4] Number per row foot rather than number per sample.

The timing strategy is to wait until most of the larvae are three-eights of an inch or more in length and then treat when pod damage is first evident. This allows for most egg laying and hatching to occur before treatment and thus reduces the chances of a second spray being needed later. Some defoliation may occur before it is time to treat and this injury should be evaluated just like that of any defoliator. If other defoliating pests are present when pod damage is first evident, then adjustments should be made in the treatment thresholds for earworms. For example, if green cloverworms are actively feeding and have already caused 15 percent defoliation, then insecticide treatment would be justified at lower earworm infestations, about one-half the normal threshold. Finally, treatment may not be necessary if the majority of worms are infected with the fungus disease. This white to greenish white fungus can have a significant impact on earworm populations. Access the web (*www.ipm.vt.edu/cew*) to calculate thresholds based on your estimated cost of control (product cost plus application cost) and today's bushel value.

Table 4.55 - Other Soybean Insect Pest Thresholds

	# per row-foot row-spacing		# per 15 sweeps row-spacing		
Pest species	**7"-21"**	**above 21"**	**7"-21"**	**above 21"**	**Other comments**
Full-season plantings					
Mexican bean beetle	4	6	24	36	40% defoliation - pre-bloom, 15% defoliation - pod-fill, 35+% defoliation - fully developed seeds.
Spider mite	Damage occurring and live mites present				Live mites on 50% of leaves and 50% leaves showing white spotting or premature leaf drop.
Other defoliators[1]					40% defoliation - pre-bloom, 15% defoliation - pod-fill, 35+% defoliation - fully developed seeds.
Double-crop plantings with poor growth					
Mexican bean beetle	2	4	12	24	20% defoliation - pre-bloom, 15% defoliation - fully developed seeds.
Spider mite	Damage occurring and live mites present				Live mites on 50% of leaves and 50% leaves showing white spotting or premature leaf drop.
Other defoliators[1]					20% defoliation - pre-bloom, 10% defoliation - pod-fill, 15% defoliation - fully developed seeds.

[1]Other defoliators include any combinations of green cloverworm, bean leaf beetle, blister beetle, Japanese beetle, soybean looper, yellowstriped armyworm, grasshoppers, or fall armyworm.

Table 4.56 - Revised Stink Bug Thresholds for Soybean (all stink bug species combined)

	# per row foot		# per 15 sweeps	
Row spacing	7-21" rows	Above 21"	7-21" rows	Above 21"
New (Grain)	1-2	1-2	5	5
New (Seed)	0.5	0.5	2.5	2.5

Apply from R3-4 to R7, double after R7

Soybean aphid

The current economic threshold for aphids is an average of 250 aphids per plant, on two consecutive field visits spaced about 5-7 days apart. This is because aphid populations can "crash" quickly due to heavy pressure by natural enemies like lady beetles, parasitic wasps, and fungal diseases. When scouting, choose a "Z" or "W" shaped pattern to cover the entire field and sample at least 20 to 30 plants per field by examining the entire plant, including stems and upper and lower leaf surfaces. Use the aphid/plant average for determining the need for treatment. The threshold applies to soybeans through the R5 growth stage (3 mm long seed in the pod at one of the four uppermost nodes on the main stem), after which time plants can tolerate 1,000+ aphids with no threat to yield.

Peanuts

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Thrips

Seedling peanut plants are usually attacked by thrips within the first 6-8 weeks after planting, and thrips may complete several generations per season under favorable conditions. These tiny, spindle-shaped insects feed primarily within the developing, unfolded leaflets causing crinkling of the leaflets and stunting of the plants. Blackening of the small leaflets occurs with severe infestations and can be mistaken for chemical injury. Under favorable conditions, plants normally outgrow this injury with no reduction in yield or grade. However, the delay in vine growth from early season thrips injury may retard maturity. This in combination with other injury, such as herbicide burn, can reduce yield.

Thrips can be controlled with either systemic or with foliar-applied insecticides. Systemics can be incorporated in the furrow with the seed at planting. Foliar treatments can be applied as needed after crop emergence. During dry seasons or seasons with excessive rains, the systemic insecticides may not give adequate thrips control due to poor systemic uptake by the plants or leaching of chemicals from the soil. Foliar treatments may be warranted to allow more rapid plant growth to assist in weed control if systemics are ineffective, or if injury appears excessive. Foliar treatment is recommended when 25 percent of the leaves show thrips damage and pest populations are still active.

Table 4.57 - Recommended Insecticides for Thrips Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97) band rate broadcast rate	 3.0-6.0 oz 6.0-12.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	beta-cyfluthrin (Baythroid XL)	2.8 oz	14	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	5.12-6.4 oz	14	**RESTRICTED USE.** Do not feed immature plants and peanut hay to livestock.
	methomyl (Lannate LV) (Lannate SP)	 1.5-3.0 pt 0.5-1.0 lb	 21 21	**RESTRICTED USE.** Do not feed treated vines.
On-seed	acephate (Acephate 90SP)	3.5 oz/100 lbs seed	–	Mix in the planter to obtain good coverage of ALL seed by layering seed and product. Fill the planter box 1/3 full of seed with 1/3 of the product,add the next 1/3 of the seed and product, then add the last 1/3 of the seed and product. Gently stir each layer before adding the next. **Caution:** Do not use with seed inoculants. Not recommended for air planters. Do not use treated seed for food or feed purposes, or process for oil.
	thiamethoxam (CruiserMaxx Peanut)	3.0-4.0 oz/100 lbs seed	0	
In-furrow	imidacloprid (Admire Pro)	7.0-10.5 oz	14	Apply as an in-furrow spray during planting directed on or below seed.
	phorate (Thimet 20G)	5.0 lb	90	**RESTRICTED USE.** Distribute granules evenly in the furrow. Do not graze or feed treated hay or forage to livestock.

Potato Leafhopper

The potato leafhopper is a common "above-ground" pest of peanuts in Virginia. This small, wedge-shaped, light green to yellow insect damages the peanut plant by feeding on the undersides of leaves in a piercing-sucking manner. Injured leaf tips turn yellow first then brown and tend to curve downward. Apparently, during feeding, toxins are also passed into plants at feeding sites. If enough damage is done, toxins can stop vine growth resulting in reductions in yield and grade. Injury may occur at any time from early June until the middle of August or later in some years. It is important to note that although late-season damage appears worse in some years, damage done early in the season probably affects plant vigor and yield more. Systemic insecticides applied at planting time will usually control potato leafhoppers that occur early, but if no pegging-time insecticide is applied, it may be necessary to make one or two foliar applications in July or early August. Pegging time applications of rootworm insecticides will usually control leafhoppers from that time until harvest.

Foliar treatments should be made only on a basis of need. When 25% of the leaves show tip yellowing typical of leafhopper damage, and active adult and immature leafhoppers are seen, treat with an effective chemical. When foliar treatments are required, the first application usually is made about the middle of July, and the second about the first of August (if needed). If scheduled treatments are being made for control of leafspot, insecticides may be tank mixed. Do not include insecticides with all leafspot treatments as a matter of course. Too many insecticide applications, or applications later in the season, could cause spider mite populations to increase, especially in dry years after adjacent corn and weedy areas have been cut. Make leafhopper applications only when problems have been identified.

Table 4.58 - Recommended Insecticides for Potato Leafhopper Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	6.0-12.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	beta-cyfluthrin (Baythroid XL)	1.0-1.8 oz	14	**RESTRICTED USE.**
	beta-cyfluthrin + imidacloprid (Leverage 360)	2.8 oz	14	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	**RESTRICTED USE.** Do not feed immature plants and peanut hay to livestock.
	esfenvalerate (Asana XL)	2.9-5.8 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated vines. Do not exceed 29 oz/ season.
Foliar (cont.)	fenpropathrin (Danitol 2.4EC)	6.0-10.6 oz	14	**RESTRICTED USE.** Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	lambda-cyhalothrin (Kaiso 24WG)	1.0-1.67 oz	14	**RESTRICTED USE.**
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	 1.92-3.2 oz 0.96-1.6 oz 1.92-3.2 oz	 14 14 14	**RESTRICTED USE.** Do not apply more than 15.36 oz/ A/season. Do not graze livestock in treated areas, or use treated vines or hay for animal feed.
	methomyl (Lannate LV) (Lannate SP)	 0.75- 3.0 pt 0.25- 1.0 lb	 21 21	**RESTRICTED USE.** Do not feed treated vines.

[1]**General -** Apply pegging treatments in 10- to 18-inch bands on row during the first 2 weeks in July after pegging begins and before vines close in middles. Effectiveness of treatments is increased if insecticides are covered by shallow cultivation to avoid exposure to sunlight and lateral movement with heavy rains.

Table 4.58 - Recommended Insecticides for Potato Leafhopper Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
	spinosad + gamma-cyhalothrin (Consero)	2.0-2.8 oz	14	**RESTRICTED USE.** Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.
	zeta-cypermethrin (Mustang Max)	1.28-4.0 oz	7	**RESTRICTED USE.** Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.
Pegging[1]	chlorpyrifos (Lorsban 15G)	—	—	Lorsban 15G is not labeled for use against leafhopper but will provide suppression if applied for soil insects.
	phorate (Thimet 20G)	10.0 lb	90	**RESTRICTED USE.** Distribute granules as a band over the fruiting zone at pegging. Work into the top few inches of soil immediately. Do not graze or feed treated hay or forage to livestock.
	phorate (Thimet 20G)	5.0 lb	90	**RESTRICTED USE.** Distribute granules evenly in the furrow. Do not graze or feed treated hay or forage to livestock.

[1]**General -** Apply pegging treatments in 10- to 18-inch bands on row during the first 2 weeks in July after pegging begins and before vines close in middles. Effectiveness of treatments is increased if insecticides are covered by shallow cultivation to avoid exposure to sunlight and lateral movement with heavy rains.

Southern Corn Rootworm

The southern corn rootworm, which is the immature stage of the spotted cucumber beetle, can cause extensive injury to the Virginia peanut crop. Rootworm larvae develop in the soil and feed directly on pegs and pods. Finding rootworms in the soil is very difficult and injury is often not detected until after peanuts are dug, when it is too late for control measures. A preventive treatment is the best strategy. After an infestation is established, control is difficult and often ineffective. Determining the need to treat for southern corn rootworm should be done on a field-by-field basis. Decisions can be based on both adult populations and past history of peanut fields. Adult beetles can be readily detected in peanut fields. Their presence in moderate to high numbers from mid-July to early August should be a warning that a problem could develop. Adults will lay eggs that could develop into the damaging larval stage. Early detection of adults can thus allow for timely treatment and prevention of injury.

Knowledge of the past history of rootworm injury can also be useful in determining the need for treatment. If injury has ever occurred in a field, it will likely occur in other years. Keep field records on the extent of pod and peg injury noticed at harvest time. Pay particular attention to fields with higher levels of organic matter and clay. Rootworms have a higher survival rate in those soils due to higher moisture holding capacity, and injury will typically be more severe than in "light" soils. Use the "Southern Corn Rootworm Risk Index" to aid you in deciding which fields need insecticide treatment.

If rootworm treatments are necessary, they should be applied as 10-18 inch bands on the row during early pegging. Usually, this period occurs during the first 2 weeks of July. Treatment effectiveness is increased if materials are lightly incorporated using shallow cultivation. If vine growth and pegging are in an advanced stage, do not cultivate, as vine "dirting," which leads to disease development and injury to pegs, may offset the gain from insect control. Carefully calibrate equipment to deliver recommended insecticide rates. Using more than is recommended will not increase effectiveness and using less could result in a complete insecticide failure.

Table 4.59 - Recommended Insecticides for Southern Corn Rootworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Pegging[1]	chlorpyrifos (Lorsban 15G)	13.0 lb	21	Do not apply more than 13.3 lb/ season. Do not feed peanut forage or hay to meat or dairy animals.
	phorate (Thimet 20G[2])	10.0 lb	90	**RESTRICTED USE.** Distribute granules as a band over the fruiting zone at pegging. Work into the top few inches of soil immediately. Do not graze or feed treated hay or forage to livestock.

[1]**General -** Apply pegging treatments in 10-18 inch bands on row during the first 2 weeks in July after pegging begins and before vines close in middles. Effectiveness of treatments is increased if insecticides are covered by shallow cultivation to avoid exposure to sunlight and lateral movement with heavy rains.
[2]Labels stipulate light incorporation.

Corn Earworm

Annual infestations of the corn earworm and fall armyworm occur in most Virginia peanut fields. Usually there is a single generation of each species per season. Worms feed on leaf tissue causing peanuts to look ragged; however, research has shown that one-third of peanut foliage can be lost at the normal time of corn earworm infestations (mid-August to early September) without loss of yield or grade. Scouting fields is the only way to determine if treatment is needed. Scout by reaching halfway across 2 row-feet of plants and shaking foliage vigorously towards the row middle. Repeat on the opposite row. Count the worms on the ground and repeat the sample in several spots in the field. Treatment is recommended if an average of 8 or more worms are found per sample, or 4 per row-foot.

If treatment is necessary, apply sprays using systems that provide good canopy penetration and coverage. If spider mites are already present in the field, use of some insecticides may allow for rapid build-up. Scout fields for treatment effectiveness and for possible increases in spider mite activity soon after applications.

Table 4.60 - Recommended Insecticides for Corn Earworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar[1]	acephate (Orthene 97)	12.0-16.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	Bacillius thuringiensis (DiPel ES)	1.0-2.0 pt	0	For pyrethroid resistant corn earworm when tank mixed with a pyrethroid at a labeled use rate.
	beta-cyfluthrin (Baythroid XL)	1.8-2.4 oz	14	**RESTRICTED USE.**
	beta-cyfluthrin + imidacloprid (Leverage 360)	2.8 oz	14	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	**RESTRICTED USE.** Do not feed immature plants and peanut hay to livestock.

[1]**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

Table 4.60 - Recommended Insecticides for Corn Earworm Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar[1] (cont.)	carbaryl (Sevin 4F) (Sevin 80S) (Sevin XLR PLUS)	 2.0-3.0 pt 1.25-1.87 lb 2.0-3.0 pt	 0 0 0	To avoid possible injury to foliage, do not apply to wet foliage or during periods of high humidity.
	chlorantraniliprole (Prevathon)	14.0-20.0 oz	1	
	esfenvalerate (Asana XL)	2.9-5.8 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated vines. Do not exceed 29.0 oz/season.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	14	**RESTRICTED USE.** Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	flubendiamide (Belt SC)	2.0-4.0 oz	3	
	indoxacarb (Steward EC)	6.7-11.3 oz	14	Do not feed or graze livestock on treated fields.
	lambda-cyhalothrin (Kaiso 24WG)	2.0 oz	14	**RESTRICTED USE.**
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	 2.56-3.84 oz 1.28-1.92 oz 2.56-3.84 oz	 14 14 14	**RESTRICTED USE.** Do not apply more than 15.36 oz/A/ season. Do not graze livestock in treated areas, or use treated vines or hay for animal feed.
	methomyl (Lannate LV) (Lannate SP)	 0.75-3.0 pt 0.25-1.0 lb	 21 21	**RESTRICTED USE.** Do not feed treated vines.
	spinetoram (Radiant SC)	3.0-8.0 oz	3	Do not allow grazing of peanut hay.
	spinosad + gamma-cyhalothrin (Consero)	2.0-2.8 oz	14	**RESTRICTED USE.** Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.
	spinosyn (Blackhawk)	1.7-3.3 oz	3	Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.
	zeta-cypermethrin (Mustang Max)	3.2-4.0 oz	7	**RESTRICTED USE.** Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.

[1]**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

Table 4.61 - Recommended Insecticides for Fall Armyworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
Foliar[1]	acephate (Orthene 97)	12.0-16.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	Bacillius thuringiensis (DiPel ES)	1.0-2.0 pt	0	For pyrethroid resistant corn earworm when tank mixed with a pyrethroid at a labeled use rate.
	beta-cyfluthrin (Baythroid XL)	2.4-2.8 oz	14	**RESTRICTED USE.**
	beta-cyfluthrin + imidacloprid (Leverage 360)	2.8 oz	14	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	**RESTRICTED USE.** Do not feed immature plants and peanut hay to livestock.
	chlorantraniliprole (Prevathon)	14.0-20.0 oz	1	
	esfenvalerate (Asana XL)	9.6 oz	21	**RESTRICTED USE.** Suppression only. Do not feed or graze livestock on treated vines. Do not exceed 29.0 oz/season.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	14	**RESTRICTED USE.** Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	flubendiamide (Belt SC)	2.0-4.0 oz	3	
	indoxacarb (Steward EC)	9.2-11.3 oz	14	
Foliar[1] (cont.)	lambda-cyhalothrin (Kaiso 24WG)	2.0 oz	14	**RESTRICTED USE.**
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	2.56-3.84 oz 1.28-1.92 oz 2.56-3.84 oz	14 14 14	**RESTRICTED USE.** Do not apply more than 15.36 oz/A/season. Do not graze livestock in treated areas, or use treated vines or hay for animal feed.
	methomyl (Lannate LV) (Lannate SP)	0.75-1.5 pt 0.25-0.5 lb	21 21	**RESTRICTED USE.** Do not feed treated vines. 2 pints may be required for good control.
	methoxyfenozide (Intrepid 2F) (beet armyworm only)	6.0-10.0 oz	7	
	spinetoram (Radiant SC)	3.0-8.0 oz	3	Do not allow grazing of peanut hay.
	spinosad + gamma-cyhalothrin (Consero)	2.8 oz	14	**RESTRICTED USE.** Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.

[1]**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

Table 4.61 - Recommended Insecticides for Fall Armyworm Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remark
	spinosyn (Blackhawk)	1.7-3.3 oz	3	Do not allow grazing of crop residue or harvest of crop residue for hay until 14 days after the last application.
	zeta-cypermethrin (Mustang Max)	3.2-4.0 oz	7	**RESTRICTED USE.** Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.

[1]**General** - Treat only if foliage loss is heavy (1/3 or more). Earworms are easier to control when they are less than 1/2 inch long.

Spider Mite

Mites, which have become more numerous during the past several years, are especially injurious during hot, dry weather. While insecticides are very valuable in controlling leafhoppers, thrips, and worms, they may be responsible for destroying some of the natural enemies of spider mites and thus promoting the build-up of mite populations. Insecticides should be used **only when needed** for insect control. Tank mixes that include both fungicides and insecticides are more likely to allow spider mite build-up than when either material is used separately.

Spider mites feed mainly on the undersides of the leaves. They suck the juice from the foliage and cause the leaves to turn brown and eventually drop off. Heavy infestations usually occur first around the borders of peanut fields; then they spread inward throughout the fields. Avoid harvesting spider mite infested cornfields or mowing weedy areas next to peanut fields until peanuts are harvested. Spider mites will readily move into peanuts when corn dries down or is harvested. Be prepared to treat peanuts if adjacent corn is infested.

Important: If you are going to treat, calibrate your equipment to deliver the right amount of pesticide per acre. Arrange and adjust the nozzles or spouts in a manner that will direct the chemical into the desired area to be treated. Adequate sprayer pressure (40 to 60 psi) will aid in getting chemicals in contact with the undersides of leaves and within denser foliage. Penetration of foliage with 20 to 30 gallons of water per acre is very important for the control of spider mites.

Table 4.62 - Recommended Insecticides for Spider Mite Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	bifenthrin (Brigade 2EC)	5.12-6.4 oz	14	**RESTRICTED USE.** Do not feed immature plants and peanut hay to livestock.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	14	**RESTRICTED USE.** Do not graze or feed treated peanut vine forage or dried hay within 14 days of the last application. Do not exceed 2.6 pints total application/A/season.
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	 3.84 oz 1.92 oz 3.84 oz	 14 14 14	**RESTRICTED USE.** **Suppression only.** Do not apply more than 15.36 oz/A/season. Do not graze livestock in treated areas, or use treated vines or hay for animal feed.
	propargite (Comite 6.5EC) (Omite 30W)	 2.0 pt 3.0-5.0 lb	 14 14	Use a minimum of 20 gallons/A with ground equipment or 5 gallons by air. Make no more than 2 applications/year (either Comite OR Omite). Do not plant rotational crops within 6 months of last application. Do not feed hay to livestock.

Lesser Cornstalk Borer

Lesser cornstalk borer is typically not a problem in Virginia peanut fields. However, it does thrive under hot dry conditions and can become a problem when those conditions continue for 3-4 weeks. Infestations will be most severe where soils are sandy and in high, well drained areas within fields. Larvae are 0.5 to 0.75 inch long and are banded with alternating brown and blue stripes. They wiggle vigorously when disturbed. Larvae feed by burrowing into main stems, lateral limbs, plant crowns, and pods and can do extensive damage, even kill plants. Larvae produce silk-and-sand web tubes, which are attached to pods or stems at the point of feeding. Evidence of web tubes is a sure sign of borer activity.

If weather conditions become favorable for borers, survey fields for damaged plants and larvae. If damage is obvious and active larvae are still present in 10% or more of the plants, treatment is recommended.

Table 4.63 - Recommended Insecticides for Lesser Cornstalk Borer Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Granular	chlorpyrifos (Lorsban 15G)	6.7-13.3 lb	21	Apply in 10-18 inch band on row at first sign of borer. Do not feed peanut forage or hay to meat or dairy animals. Do not apply more than 13.3 lb/season. 10.0-13.0 lb may be broadcast by air as a rescue treatment.

Grasshopper

Table 4.64 - Recommended Insecticides for Grasshopper Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	4.0-8.0 oz	14	Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	beta-cyfluthrin (Baythroid XL)	1.8-2.4 oz	14	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	2.1-6.4 oz	14	**RESTRICTED USE.** Do not feed immature plants and peanut hay to livestock.
	carbaryl (Sevin 80S) (Sevin XLR PLUS)	1.5 lb 1.0-2.0 pt	0 0	To avoid possible injury to foliage, do not apply to wet foliage or during periods of high humidity.
	esfenvalerate (Asana XL)	5.8-9.6 oz	21	**RESTRICTED USE.** Do not feed or graze livestock on treated vines. Do not exceed 29.0 oz/season.
	zeta-cypermethrin (Mustang Max)	3.2-4.0 oz	7	**RESTRICTED USE.** Do not graze livestock in treated areas. Do not use treated vines or hay for animal feed.

Pesticide Usage Charts

Many pesticides control more than one pest. The three tables below summarize the effectiveness of some popular pesticides used at time of planting, at time of pegging, or as foliar treatments for the control of major insect pests which attack peanuts.

Table 4.65 - Insecticide Activity of Products Applied at Time of Planting

	Pests			
Chemical	**Thrips**	**Leafhopper**	**Rootworm**	**Spider Mite**
Orthene	E	Early	No	No
Thimet	G	Early	P	No

P=poor control, F=fair control, G=good control, E=excellent control, No=not labeled or no activity expected.

Table 4.66 - Insecticide Activity of Granules Applied at Time of Pegging

	Pests			
Chemical	**Rootworm**	**Leafhopper**	**Spider Mite**	**Corn Earworm**
Lorsban[1]	E	G	No	No
Thimet	G	Aids	No	No

P=poor control, F=fair control, G=good control, E=excellent control, No=not labeled or no activity expected.
[1] **NOT SYSTEMIC.** Do not apply in the furrow.

Table 4.67 - Insecticide Activity of Foliar Treatments Applied when Pests Are Present

		Pest Species Controlled						
Insecticide	**Formulation[1]**	**Thrips**	**Leaf-hopper**	**Root-worm**	**Corn earworm**	**Fall army-worm**	**Lesser corn stalk borer**	**Spider mite**
Asana	XI	No	E	No	E	G	No	No[2]
Comite, Omite	6.5EC, 30W	No	No	No	No	No	No	E
Danitol	2.4EC	No	E	No	E	G	No	E
Karate	Z	E	E	No	E	G	No	F
Lannate	L	P	G	No	E	G	No	No[2]
Malathion	57% EC	P	G	No	P	P	No	P
Orthene	97	E	E	No	G	F	No	No[2]
Sevin	4F, 80s, XLR Plus	P	E	No	F	F	No	No[2]
Steward	1.25SC	No	No	No	E	E	No	No
Blackhawk		No	No	No	E	E	No	No

P=poor control, F=fair control, G=good control, E=excellent control, No=not labeled or no activity expected.
[1]There are other insecticides and other formulations which have federal registration for use on peanuts.
[2]Use of these insecticides may allow rapid build-up of spider mites. Use with caution during extended periods of dry weather.

Cotton

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Thrips

Insect pests such as aphids, spider mites, cutworms, plant bugs and thrips affect cotton in the early stages of development. At present, only thrips must be controlled annually. These tiny, spindle-shaped insects complete several generations per season under favorable conditions and feed primarily by puncturing and rasping the outer cells of the young leaves and buds. Damage results in ragged looking plants with crinkled or "possum-eared" leaves. The damage associated with thrips feeding can stunt growth resulting in fruiting at higher positions and delayed maturity. Damage is most severe if young cotton is subjected to adverse growing conditions such as cool or dry weather or when alternate thrips hosts such as small grains dry down prematurely forcing large numbers of thrips to seek other hosts. Adverse growing conditions during the early stages of cotton development may reduce the uptake of systemic insecticides, therefore early inspection of the crop is important due to the length of the growing season in most of Virginia.

Orthene 97 in furrow - Orthene 97 can be dribbled or sprayed in furrow during the planting operation. Orthene provides good thrips control for up to five weeks if applied at 12-16 oz of product per acre. Applications are usually made at 5 to 10 gallons per acre and are compatible with several liquid fungicides.

Gaucho and Cruiser seed treatment - Gaucho- and Cruiser-treated seed provide good thrips control. May need foliar treatment to provide season-long control.

There is no formal threshold for thrips based on insect numbers or plant injury. Treatment is thought to be justified if the following conditions are met: 1) thrips injury is common, 2) 10% or more plants show extensive bud damage, 3) immature thrips can be easily found, and 4) plant growth is poor.

Table 4.68 - Recommended Insecticides for Thrips Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
In-furrow or seed	acephate (Orthene 97)	12.0-16.0 oz	21	Apply as a liquid into the seed furrow in 5-10 gal of water/A with a system that insures good seed coverage. Do not feed treated forage or hay to livestock or allow animals to graze treated areas.
	imidacloprid (Admire Pro)	7.4-9.2 oz	—	Apply as an in-furrow spray during planting directed on or below seed. Do not graze treated fields after any application of Admire Pro.
	imidacloprid (Gaucho Grande, Aeris)	0.375 mg ai/ seed	—	—
	phorate (Thimet 20G)	6.0-9.0 oz/1,000 row ft	—	**RESTRICTED USE.** Do not graze or feed treated hay or forage to livestock.
	thiamethoxam (Cruiser 5FS, Avicta CP)	0.30-0.375 mg ai/seed	—	—
Foliar	acephate (Orthene 97)	2.5-3.0 oz	21	May be tank mixed with Roundup Ultra or Roundup Ultra Max (for use on Roundup ready cotton), Buctril (for use on BXN cotton), or Staple.
	beta-cyfluthrin (Baythroid XL)	0.8-1.6 oz	0	**RESTRICTED USE**

Table 4.68 - Recommended Insecticides for Thrips Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (cont.)	bifenthrin (Brigade 2EC)	1.3-6.4 oz	14	**RESTRICTED USE.**
	chlorpyrifos+ lambda-cyhalothrin (Cobalt Advanced)	16.0-38.0 oz	21	**RESTRICTED USE.** Do not allow meat or dairy animals to graze in treated areas. Do not feed gin trash or treated forage to meat or dairy animals.
	spinetoram (Radiant SC)	4.25-8.0 oz	28	1.5-3.0 oz for early season suppression.
	zeta-cypermethrin (Mustang Max)	1.28-1.92 oz	14	**RESTRICTED USE.** Do not graze or feed cotton for forage.

Plant Bugs

Prebloom: Prior to bloom, plant bugs, or Lygus, damage cotton by feeding on tender terminals and small squares causing squares to turn black and abort. Excessive square loss can reduce yields or slow plant maturity. In pre-blooming cotton, Lygus has required treatment on an average of only 6 percent of the cotton acreage in North Carolina over the past 8 years, and on only a few hundred acres in Virginia. The best way to determine the need for pre-bloom plant bug control is to assess square retention rates (percent missing squares). Treatment should be considered if square retention drops below 80% (see threshold table below) and plant bugs are still active.

After blooming: Once blooming begins, plant bugs continue feeding on smaller squares and blooms, both of which can cause 'dirty blooms' (white blooms with brown pollen anthers or brown-streaked petals). The presence of dirty blooms indicates that plant bugs are, or have very recently been, active. Levels at or above 15% dirty bloom indicate a large and active plant bug population and the need for sampling of bolls for damage (see threshold table below).

Boll damage: Once bolls are formed, plant bugs prefer feeding on small bolls up to 3 weeks old. Damage to bolls can range from warts or calluses on the insides of boll walls, to small areas of stain lint, to deformed and rotting fruit that is due to direct feeding on seed. This damage is identical to damage caused by stink bugs. Virginia studies indicate that treatments may be justified if boll damage by plant bugs (and/or stink bugs) exceeds 15% of a random sample of quarter-sized bolls (see threshold table below).

Untreated or minimally treated cotton, such as Bollgard cotton, is most susceptible to plant bug damage. Also, fields treated later in the season are open to invasion for a longer period of time.

Table 4.69 - Sampling for Plant Bugs and Thresholds in Cotton

Prebloom	below 80% square retention and plant bugs active
After blooming	15% dirty blooms indicates the presence of an active population 8 plant bugs per 100 sweeps indicates a large, active population
Boll damage	15% or more damaged quarter-sized bolls (up to 14 days old) and plant bugs active

Table 4.70 - Recommended Insecticides for Plant Bug Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	4.0-16.0 oz	21	**General** Treatment not recommended if square retention is in excess of 80%. If square retention is less than 80%, confirmation of threshold levels of plant bugs should be met prior to treatment. Although cotton fields exceeding the treatment threshold for plant bugs are relatively rare, fields adjacent to Irish potatoes, weed fields, and other sources of plant bugs in eastern counties may be at higher risk of plant bug injury.
	acetamiprid (Assail 70WP)	1.1-2.3 oz	28	
	beta-cyfluthrin (Baythroid XL)	1.6-2.6 oz	0	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	2.6-6.4 oz	14	**RESTRICTED USE.**
	chlorpyrifos (Lorsban 4EC)	6.1 oz	14	
	chlorpyrifos+ lambda-cyhalothrin (Cobalt Advanced)	16.0-38.0 oz	21	**RESTRICTED USE.** Do not allow meat or dairy animals to graze in treated areas. Do not feed gin trash or treated forage to meat or dairy animals.
	clothianidin (Belay)	3.0-4.0 oz	21	
	dicrotophos (Bidrin XP)	4.0-6.0 oz	30	**RESTRICTED USE.**
	dinotefuran (Venom 20SG)	0.44-0.67 lb	14	
	esfenvalerate (Asana XL 0.66EC)	5.8-9.6 oz	21	**RESTRICTED USE.**
	imidacloprid (Admire Pro)	0.9-1.7 oz	14	
	lambda-cyhalothrin (Kaiso 24WG)	1.33-2.0 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	2.56-3.84 oz 1.28-1.92 oz 2.56-3.84 oz	21 21 21	**RESTRICTED USE.**
	lambda-cyhalothrin + thiamethoxam (Endigo ZC)	3.5-5.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.

Table 4.70 - Recommended Insecticides for Plant Bug Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (cont.)	methyl parathion			**RESTRICTED USE.**
	(4EC)	0.5-2.0 pt	7	
	(Penncap-M 2F)	0.5-1.0 pt	7	
	methomyl			**RESTRICTED USE.**
	(Lannate 2.4 LV)	0.75 pt	15	
	(Lannate 90SP)	0.5 lb	15	
	oxamyl			**RESTRICTED USE.**
	(Vydate C-LV)	12.7-17.0 oz	14	
	thiamethoxam			
	(Centric 40WG)	1.25-2.0 oz	21	
	zeta-cypermethrin			**RESTRICTED USE.**
	(Mustang Max)	2.64-3.6 oz	14	
	sulfoxaflor			
	(Transform WG)	1.5-2.25 oz	14	

Tobacco Budworm/Cotton Bollworm

Bollworms (corn earworms) occur primarily on field corn during their first two generations. Third generation moths usually emerge in large numbers from mid-July to early August when corn is drying and fly to more attractive blooming cotton.

Regular weekly scouting for the bollworm and its cousin, the tobacco budworm, should begin in early to mid-June. Weekly scouting is adequate until egg laying or light-trap catches increase. Fields should then be scouted twice a week, with the emphasis placed upon finding eggs, until insecticide treatments begin. After that, a 4- to 7-day scouting schedule will usually suffice. A 4- to 5-day scouting schedule is suggested for conventional pyrethroid rates and a 6- to 7-day schedule for high rates. Once the egg threshold has been met and treatments made, the primary focus of scouting shifts toward finding small bollworms feeding on squares and bolls, including those under bloom tags.

Tobacco budworm adults are not readily attracted to blacklight traps and sometimes begin laying eggs on cotton prior to the time at which the bollworm egg threshold has been met; occasional fields may reach a 3 percent larval threshold prior to bollworm treatment initiation. Under these circumstances, tobacco budworm pheromone trap deployment and correct sight identification of adult tobacco budworms can assist in recognition of this situation.

After the upper bolls that will be harvested have become difficult to cut with a pocket knife (approximately three weeks after bloom), they are normally safe from bollworm attack. Bollworm scouting can normally be stopped at that time—usually in late August to early September. Spot scouting for fall armyworms and European corn borers should continue through early September, especially in fields of late maturing cotton or in green areas.

Table 4.71 - Bollworm and Tobacco Budworm Thresholds in Cotton

Cotton Type	Threshold	Remarks
Conventional Cotton		
Prebloom	8 bollworms/100 terminals or 6 bollworms/100 squares	Limiting this treatment to one well-timed pyrethroid application is strongly recommended.
Egg	10+ eggs/100 terminals or 2 eggs/100 fruiting forms	After the onset of the major (third generation) bollworm moth flight.
Post-bloom larval	3 live worms/100 terminals, or 3 percent fresh damage to squares, blooms,or bolls	Usually after the egg threshold has been employed; also used after blooming begins and before major bollworm flight, particularly if tobacco budworms are present.

Table 4.71 - Bollworm and Tobacco Budworm Thresholds in Cotton (cont.)

Cotton Type	Threshold	Remarks
Bollgard Cotton		
Egg	75 to 100 eggs/100 terminals 15 to 20 eggs/100 blooms or bloom tags	Applies only following a period of high egg deposition. Should not be used within 1 week of an insecticide application.
Larval	3 second-stage (1/8 inch or larger) bollworms/100 squares or bolls or 2 second-stage bollworms on 2 consecutive scouting trips or 1 second-stage bollworm on 3 consecutive scouting trips	Use against the major bollworm generation. Pay particular attention to bollworms in or under yellow, pink, or dried blooms, but only sample in proportion to their occurrence.
Damage	3 to 6 percent significantly damaged squares (would cause squares to abort) or bolls	

Table 4.72 - Recommended Insecticides for Bollworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (pyrethroids)	beta-cyfluthrin (Baythroid XL)	1.6[1]-2.6[2] oz	0	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	3.2[1]-6.4[2] oz	14	**RESTRICTED USE.**
	cypermethrin (Ammo 2.5EC)	3.1[1]-5.1[2] oz	14	**RESTRICTED USE.** High pressure (50 - 70 psi) and low volume (6-10 gpa) advised for pryethroid application.
	deltamethrin (Decis 1.5EC)	1.9[1]-2.56[2] oz	21	**RESTRICTED USE.**
	esfenvalerate (Asana XL 0.66EC)	5.8[1]-9.7[2] oz	21	**RESTRICTED USE.**
	fenpropathrin (Danitol 2.4EC)	10.6[1]-16.0[2] oz	21	**RESTRICTED USE.**
	lambda-cyhalothrin (Kaiso 24WG)	1.67[1]-2.67[2] oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	 3.2[1]-5.1[2]oz 1.6[1]-2.56[2] oz 3.2[1]-5.1[2] oz	 21 21 21	**RESTRICTED USE.**
	lambda-cyhalothrin + thiamethoxam (Endigo ZC)	3.5-5.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	tralomethrin (Scout X-Tra 0.9EC)	2.6[1] - 3.4[2] oz	28	**RESTRICTED USE.**

[1]Standard rate
[2]High rate

Table 4.72 - Recommended Insecticides for Bollworm Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar (pyrethroids) (cont.)	zeta-cypermethrin (Mustang Max)	2.64[1]-3.6[2] oz	14	**RESTRICTED USE.**
Foliar (others)	*Bacillus thuringiensis* (DiPel ES)	1.0-2.0 pt	0	For pyrethroid resistant corn earworms (bollworms) when tank mixed with a pyrethroid at a labeled use rate.
	chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	16.0-38.0 oz	21	**RESTRICTED USE.** Do not allow meat or dairy animals to graze in treated areas. Do not feed gin trash or treated forage to meat or dairy animals.
	emamectin benzoate (Denim)	8.0-12.0 oz	21	**RESTRICTED USE.** Do not allow livestock to graze treated areas.
	flubendiamide (Belt SC)	2.0-3.0 oz	28	
	indoxacarb (Steward EC)	11.3 oz	14	
	methomyl (Lannate 2.4LV) (Lannate 90SP)	1.5 pt 0.5 lb	15 15	**RESTRICTED USE.**
	profenophos (Curacron 8EC)	1.0 pt	14	**RESTRICTED USE.**
	rynaxypyr (Coragen)	3.5-7.0 oz	21	
	spinetoram (Radiant SC) (prebloom) (postbloom)	2.8-8.0 oz 4.25-8.0 oz	28	
	spinosyn (Blackhawk)	1.6-3.2 oz	28	For second-generation tobacco budworms, 1.6 oz is adequate; for post-bloom bollworms, use the 3.2 oz rate.
	chlorantraniliprole (Prevathon)	14.0-27.0 oz	21	

[1]Standard rate
[2]High rate

European Corn Borer

European Corn Borer (ECB) larvae damage cotton by feeding on large bolls from early August through mid-September. In rank or late-maturing cotton, this damage can be significant. An earlier tunneling type of damage may occur within stems and leaf petioles, usually in mid-July through late August. Although this damage looks serious, with wilting and eventual death of the tissue above the feeding site, it causes no known economic loss. The major moth flight for the ECB often occurs a few days to three weeks later than the major bollworm flight. The female moths lay egg masses that contain 15-75 eggs each. These small, flat, scale-like masses are deposited on the underside of cotton leaves deep within the canopy. At first, early instars feed within the leaf petioles and stems, but they begin to enter and feed upon large bolls, sometimes within 48 hours, particularly after mid-August. Although the caterpillars of this species generally do not feed as extensively within the bolls as do bollworms, most bolls are destroyed.

Controlling ECB damage presents an unusual problem. The flat egg masses are almost impossible to find, even by the trained scouts searching heavily infested fields. By the time the larvae are found feeding on or within bolls, insecticide treatments are usually ineffective. Thus scouting for this pest benefits the producer little during the present year. However, scouting to detect the caterpillars is advised. If small larvae are present (3 percent or more), treatment may be prescribed if an active flight is confirmed. This situation may indicate a late, rank cotton crop that should be avoided in the future.

No control threshold has been developed since finding the egg masses is virtually impossible, and live caterpillars are spotted too late to achieve effective control. Growers must depend on another observation as a trigger for directing insecticide against the pest. Fortunately, because egg laying of the corn earworm usually occurs somewhat earlier than the ECB flight, employing the egg threshold for bollworm control usually works well for ECB if treatments are extended into the ECB infestation period. An insecticide should be selected that is effective against both insects. If the major part of the ECB flight occurs after the bollworm flight has subsided and spraying has been completed, fields can be particularly susceptible. Under this condition, 3-6 total applications may be required for adequate suppression. This approach is recommended only where late rank growth points toward a high probability of ECB damage. Finding moths of this species in local light or pheromone traps, or flushing the adults from around or within cotton fields can help confirm the need for this extended treatment.

Table 4.73 - Recommended Insecticides for European Corn Borer Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	beta-cyfluthrin (Baythroid XL)	1.6-2.6 oz	0	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	1.3-6.4 oz	14	**RESTRICTED USE.**
	chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	16.0-38.0 oz	21	**RESTRICTED USE.** Do not allow meat or dairy animals to graze in treated areas. Do not feed gin trash or treated forage to meat or dairy animals.
	cypermethrin (Ammo 2.5EC)	3.1-4.1 oz	14	**RESTRICTED USE.** European corn borer populations are generally higher in rank cotton. Multiple applications may be necessary for control. Other bollworm materials may provide some control.
	deltamethrin (Decis 1.5EC)	1.9-2.56 oz	14	**RESTRICTED USE.**
	flubendiamide (Belt SC)	2.0-3.0 oz	28	
	lambda-cyhalothrin (Kaiso 24WG)	1.67-2.67 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	3.2 oz 1.6 oz 3.2 oz	21 21 21	**RESTRICTED USE.**
	lambda-cyhalothrin + thiamethoxam (Endigo ZC)	3.5-5.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	rynaxypyr (Coragen)	3.5-7.0 oz	21	
	spinetoram (Radiant SC)	2.8-8.0 oz	28	
	tralomethrin (Scout X-Tra 0.9EC)	2.6-3.4 oz	28	**RESTRICTED USE.**
	zeta-cypermethrin (Mustang Max)	2.64-3.6 oz	14	**RESTRICTED USE.**

Stink Bugs

Stink bugs typically begin invading cotton fields in mid-July and build to damaging levels in August. The insecticide applications for the bollworm usually keep stink bug numbers below damaging levels. Problems with stink bugs usually only develop where the bollworm applications are limited or not applied at all. Stink bugs damage cotton by puncturing the carpal walls of bolls and feeding on the soft developing seeds. If bolls are small when feeding occurs, the boll will dry up, turn brown and either remain on the plant or be shed. Bollrot pathogens are sometimes introduced when feeding is concentrated on medium and larger bolls, resulting in portions of the boll being destroyed, hard-lock, and lower grades. External feeding damage appears as small round purplish depressions about the size of a pencil point. The feeding sites are slightly larger but closely resemble the spots that naturally appear on maturing bolls. Stink bug feeding sites can be confirmed by slicing the bolls open under the depressions. The damaged bolls will have a brown stain (bollrot organisms) in the seed area under these spots.

Stink bugs often occur in a clumped distribution within a cotton field; therefore, at least 10 samples should be taken throughout a field to determine if a problem exists. Both sweep nets and shake cloths can be used to sample for stink bugs, but our research is showing that of the two, shake cloths tend to do a better job. A sweep net sample should consist of 25 hard sweeps using a pendulum-like motion with enough speed and force to end up with some leaves and small bolls in the net. An average of one stink bug per 25 sweeps could indicate a problem. A shake cloth sample should consist of placing a 3-foot long cloth on the ground between the rows, bending the bordering plants on either side (first one side, then the other) and vigorously shaking those plants to dislodge any insects. An average of one plant bug per 6 row feet (one 3-foot long shake cloth sample, both sides of the cloth) could indicate a problem.

Research in the southeast has resulted in a dynamic threshold based on percent of bolls injured by stink bug feeding, that changes with week after first bloom (see below).

Table 4.74 - Sampling for Stink Bugs and Thresholds in Cotton

Indicates presence	an average of 1 per 6 row feet using a 3-foot shake cloth
	an average of 1 per 25 sweeps using a 15-inch diameter sweep net
Boll damage	Week of bloom 1 = 50% internal boll damage; week 2 = 30%; weeks 3, 4 and 5 = 10%; week 6 = 20%; week 7 =30%; week 8 = 50%.

Table 4.75 - Recommended Insecticides for Stink Bug Control

Treatment	Insecticide (Formulation)	Amount per acre product	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	8.0-12.0 oz	21	Do not feed treated forage or hay to livestock or allow animals to graze treated areas. For brown and green stink bugs.
	chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	22.0-38.0 oz	21	**RESTRICTED USE.** Do not allow meat or dairy animals to graze in treated areas. Do not feed gin trash or treated forage to meat or dairy animals.
	clothianidin (Belay)	3.0-4.0 oz	21	Suppression only
	dicrotophos (Bidrin XP)	4.0-6.0 oz	30	**RESTRICTED USE.** For brown and green stink bugs.
	imidacloprid (Admire Pro)	0.9-1.8 oz	14	Suppression only
	imidacloprid + beta-cyfluthrin (Leverage 360)	3.2 oz	14	**RESTRICTED USE.** Do not graze treated fields after application.

Table 4.75 - Recommended Insecticides for Stink Bug Control (cont.)

Treatment	Insecticide (Formulation)	Amount per acre product	Time limits: days before harvest	Remarks
	lambda-cyhalothrin + thiamethoxam (Endigo ZC) (brown stink bug) (green stink bug)	5.5 oz 3.5-5.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	methyl parathion (4EC) (Penncap-M 2F)	1.0 pt 1.0-3.0 pt	7 7	**RESTRICTED USE.** Penncap is highly toxic to bees. Do not apply this product or allow to drift to blooming cotton if bees are in treated area.
	pyrethroids (see product labels)			**RESTRICTED USE.** Pyrethroids, when applied two or more times against bollworms, usually provide adequate suppression of green stink bugs.
	thiamethoxam (Centric 40WG)	2.0 oz	21	

Aphids

A number of beneficial insects and fungal diseases can hold aphid numbers below economic threshold levels. By limiting early season insecticide applications, the grower is allowing beneficial insect populations to build, decreasing the chances of developing resistant aphid populations (observed in North Carolina and Virginia), and possibly reducing or eliminating the need for insecticide applications later in the season. An aphid rating level of four or more just before boll opening, plus the presence of honeydew, is probably a good indicator of the need to treat.

Table 4.76 - Aphid Rating Scale

0	No aphids
1	Occasional plants with low numbers of aphids
2	Plants with low numbers common; heavily infested plants rare; honeydew visible occasionally
3	Most plants with some aphids; occasional plants heavily infested; honeydew easily visible in most areas of the field
4	Heavily infested plants common; aphids clumped on upper leaves
5	Many heavily infested plants

Table 4.77 - Recommended Insecticides for Aphid Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acetamiprid (Assail 70WP)	0.6-1.1 oz	28	
	bifenthrin (Brigade 2EC)	2.6-6.4 oz	14	**RESTRICTED USE.**
	clothianidin (Belay)	3.0-4.0 oz	21	
	dicrotophos (Bidrin 8)	4.0 oz	30	**RESTRICTED USE.**
	imidacloprid (Admire Pro)	0.9-1.7 oz	14	Aphid control with insecticides should be attempted only as a last resort, particularly in early season (before major bollworm moth flight).
	thiamethoxam (Centric 40WG)	1.25-2.0 oz	21	
	sulfoxaflor (Transform WG)	0.75-1.0 oz	14	

Table 4.78 - Recommended Insecticides for Aphid/Bollworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	cyfluthrin + imidacloprid (Leverage 2.7)	3.0-3.75 oz	21	**RESTRICTED USE.**
	lambda-cyhalothrin + thiamethoxam (Endigo ZC)	3.5-5.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.

Spider Mites

Spider mites can occur during any time of the season but are favored by dry weather and/or the removal of alternative hosts. Mite damage first appears as a slight yellowing of the leaves, which later changes to a purplish or bronze color and is usually associated with webbing. Damage occurs especially in spots or on field edges but widespread defoliation is not uncommon if favorable conditions persist.

Spider mites can be checked while scouting for other insect pests. Active mite populations should be confirmed before applications are made. Delaying treatment should also be considered if rainy, humid conditions are predicted in the near future. Rainy, humid conditions favor a fungus that preys upon mites and may greatly reduce mite numbers.

Table 4.79 - Recommended Insecticides for Spider Mite Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	bifenthrin (Brigade 2EC)	3.8-6.4 oz	14	**RESTRICTED USE.**
	dicofol (Kelthane MF 4E)	1.5-3.0 pt	30	Do not make more than 2 applications/season. Do not feed cotton stalks or trash to meat or dairy animals.
	etoxazole (Zeal)	0.66-1.0 oz	28	Zeal is predominantly an ovicide (egg activity) and larvicide and should be applied early in the life cycle of mites.
	fenpropathrin (Danitol 2.4EC)	10.6-16.0 oz	21	**RESTRICTED USE.**
	methidathion (Supracide 2E[1])	2.0 qt	60	**RESTRICTED USE.**
	propargite (Comite 6.55EC[1])	1.0-2.0 pt	14	
	spiromesifen (Oberon 4SC)	3.0 oz (early season) 4.0-8.0 oz (mid-late season)	30	

[1]not after bolls begin to open

Loopers

Cabbage and soybean loopers rarely damage cotton because they prefer foliage, are prone to virus attack and occur sporadically. Scouting for this pest, which normally appears late season, is done by observing foliage during scouting for other pests. As a general rule, if defoliation exceeds 30% in cotton with a significant portion (25% or more) of the bolls still immature and filling out, treatment may be needed. Soybean loopers are difficult to control with insecticides. Because foliage feeding typically begins at the bottom of the cotton plant and proceeds upward and outward, foliage feeding may be beneficial in preharvest cotton that has begun to open. The brownish larval frass (droppings) can be plentiful and temporarily stain opening cotton; however, this is not thought to be an economic problem. Since loopers are usually controlled by naturally occurring diseases and chemical controls are sometimes not effective due to resistance, recommendations will be available on a year to year basis through your local extension office.

Fall Armyworms

The presence of fall armyworms (FAW) and their damage is recorded as part of bollworm scouting. Additional samples are unnecessary. FAW migrate into Virginia from the south so numbers are generally highest in the southern part of the state. FAW prefer blooms and bolls of all sizes. These caterpillars can be extremely damaging if present in moderate numbers and can become established late in the season. They can feed on mature bolls normally resistant to bollworm penetration. Because FAW are not always controlled effectively by the same insecticides as bollworms, it is very important that they be identified correctly. Also, because fall armyworms are difficult to control with insecticides, treatments are best applied at an early boll bract feeding stage. Fall armyworms have a more difficult time becoming established under a bollworm spray regime with certain pyrethroids.

Table 4.80 - Recommended Insecticides for Fall Armyworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	chlorpyrifos (Lorsban 4E)	1.0-2.0 pt	14	Various rates and combinations may be recommended for armyworm control, depending upon the phenology and the age distribution and population levels of larvae. Pyrethriods will provide some control of fall armyworms hatching from egg masses. Fall armyworms may have more difficulty becoming established following Karate or Capture treatments used for bollworm control.
	chlorpyrifos + lambda-cyhalothrin (Cobalt Advanced)	16.0-38.0 oz	21	**RESTRICTED USE.** Do not allow meat or dairy animals to graze in treated areas. Do not feed gin trash or treated forage to meat or dairy animals.
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	emamectin benzoate (Denim)	6.0-12.0 oz	21	**RESTRICTED USE.** Do not allow livestock to graze in treated areas.
	flubendiamide (Belt SC)	2.0-3.0 oz	28	
	indoxacarb (Steward EC)	9.2-11.3 oz	14	Various rates and combinations may be recommended for armyworm control, depending upon the phenology and the age distribution and population levels of larvae. Pyrethriods will provide some control of fall armyworms hatching from egg masses. Fall armyworms may have more difficulty becoming established following Karate or Capture treatments used for bollworm control.
	lambda-cyhalothrin + thiamethoxam (Endigo ZC)	3.5-5.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	methomyl (Lannate 2.4LV) (Lannate 90SP)	1.5 pt 0.5 lb	15 15	Various rates and combinations may be recommended for armyworm control, depending upon the phenology and the age distribution and population levels of larvae. Pyrethriods will provide some control of fall armyworms hatching from egg masses. Fall armyworms may have more difficulty becoming established following Karate or Capture treatments used for bollworm control.
	methoxyfenozide (Intrepid 2F)	4.0-10.0 oz	14	
	rynaxypyr (Coragen)	3.5-7.0 oz	21	
	spinetoram (Radiant SC)	4.25-8.0 oz	28	
	spinosad + gamma-cyhalothrin (Consero)	2.8-4.0 oz	28	**RESTRICTED USE.** Do not graze livestock in treated areas.

Table 4.80 - Recommended Insecticides for Fall Armyworm Control (cont.)

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
	spinosyn (Blackhawk)	2.4-3.2 oz	28	Various rates and combinations may be recommended for armyworm control, depending upon the phenology and the age distribution and population levels of larvae. Pyrethriods will provide some control of fall armyworms hatching from egg masses. Fall armyworms may have more difficulty becoming established following Karate or Capture treatments used for bollworm control.
	chlorantraniliprole (Prevathon)	14.0-27.0 oz	21	

Table 4.81 - Recommended Insecticides for Beet Armyworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	emamectin benzoate (Denim)	6.0-12.0 oz	21	**RESTRICTED USE.** Do not allow livestock to graze in treated areas.
	flubendiamide (Belt SC)	2.0-3.0 oz	28	
	indoxacarb (Steward EC)	9.2-11.3 oz	14	
	methoxyfenozide (Intrepid 2F)	4.0-10.0 oz	14	
	rynaxypyr (Coragen)	3.5-7.0 oz	21	
	spinetoram (Radiant SC)	4.25-8.0 oz	28	
	chlorantraniliprole + lambda-cyhalothrin (Besiege)	6.5-12.5 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	spinosad + gamma-cyhalothrin (Consero)	4.0 oz	28	**RESTRICTED USE.** Do not graze livestock in treated areas.
	spinosyn (Blackhawk)	2.4-3.2 oz	28	
	chlorantraniliprole (Prevathon)	14.0-27.0 oz	21	

Table 4.82 - Recommended Insecticides for Cutworm Control

Treatment	Insecticide (Formulation)	Amount product per acre	Time limits: days before harvest	Remarks
Foliar	acephate (Orthene 97)	12.0 oz	21	Control is most effective when ground application is made in the evenings and sprays are directed toward the base and lower portion of plants.
	beta-cyfluthrin (Baythroid XL)	0.8-1.6 oz	14	**RESTRICTED USE.**
	bifenthrin (Brigade 2EC)	2.6-6.4 oz	14	**RESTRICTED USE.**
	cypermethrin (Ammo 2.5EC)	1.3-5.0 oz	14	**RESTRICTED USE.**
	deltamethrin (Decis 1.5EC)	1.1-1.6 oz	21	**RESTRICTED USE.**
	esfenvalerate (Asana XL 0.66EC)	5.8 oz	21	**RESTRICTED USE**.
	fenpropathrin (Danitol 2.4EC)	8.0 oz	21	**RESTRICTED USE.**
	gamma-cyhalothrin (Proaxis) (Prolex)	1.92-2.56 oz 0.77-1.02 oz	21 21	**RESTRICTED USE.**
	lambda-cyhalothrin (Kaiso 24WG)	1.0-1.33 oz	21	**RESTRICTED USE.** Do not graze livestock in treated areas.
	lambda-cyhalothrin (Karate EC) (Karate Z) (Warrior T)	1.92 oz 0.96 oz 1.92 oz	21 21 21	**RESTRICTED USE.**
	tralomethrin (Scout X-Tra 0.9EC)	2.28-2.84 oz	28	**RESTRICTED USE.**
	zeta-cypermethrin (Mustang Max)	1.28-1.92 oz	14	**RESTRICTED USE.**

Beneficial Insects

About a dozen beneficial insects are common in Virginia cotton. Ambush bugs, big-eyed bugs, minute pirate bugs, green lacewings, two species of ladybird beetles, and several types of spiders are examples. They are of two types: 1) predators that prey upon an insect pest, or 2) parasites that live within the host insect. These insects, particularly the predators, reduce the number of eggs and larvae of bollworms, caterpillars and aphids. Because these allies lessen the impact of pest insects, common sense dictates that producers use them as a management tool. Their presence often means that growers can delay and, on occasion, eliminate some insecticide applications.

Many complex factors are involved in determining just how many of each beneficial insect species are needed to influence a given level of pests. Therefore, it is usually not possible to asses the value of these insects except in a very general way. If relatively high numbers of beneficial insects are eating a large portion of aphids or bollworm eggs and larvae, the treatment threshold will be reached later than would otherwise be the case, reducing the number of insecticide applications needed. However, the rapid increase in pest populations, the third generation of bollworms, will often overwhelm the beneficial population and applications become necessary. The careful observation of sound economic thresholds offers the producer the best odds of balancing beneficial insect numbers against damaging insects.