

TOBACCO INSECT MANAGEMENT

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Several species of insects cause serious damage to tobacco in the field, the greenhouse, and in storage. Insects damage the roots, destroy the leaves and buds, and reduce leaf quality. Others transmit several important tobacco disease pathogens.

Integrated pest management (IPM) is the best way to manage insect pests on tobacco. It combines cultural, natural, and chemical controls to maintain insect pest populations below levels that cause economic damage to the crop. IPM promotes the use of insecticides only when needed. It emphasizes that a certain amount of insect damage does not reduce crop value enough to pay for the cost of treatment and that tobacco plants often compensate for insect damage. IPM helps to maximize profits, reduce pesticide residue levels, environmental contamination, and human exposure to pesticides. It also optimizes natural control provided by beneficial organisms.

Cultural controls

Several cultural practices help reduce insect infestations and decrease the need for insecticide applications. The following cultural practices aid in the management of insect pests on tobacco.

1. **Early land preparation.** Plowing at least 4 weeks before transplanting reduces cutworm infestations and may aid in wireworm control.
2. **Use of recommended nitrogen rates.** Excessive rates of nitrogen fertilizer may delay maturity and make tobacco a more favorable host for hornworms and aphids after topping.
3. **Adjustments in transplanting date.** This reduces tobacco susceptibility to insect pests. Early-planted tobacco is often less favorable for aphids and hornworms, and more favorable for budworms and flea beetles. Late-planted tobacco is highly susceptible to hornworm damage and may have reduced yield and quality. Aphid infestations are usually most serious on tobacco transplanted near the middle of the transplanting period.
4. **Destruction of greenhouse transplants as soon as practical after transplanting is completed.** This practice keeps aphids and other insects from developing high populations on the transplants and migrating to nearby tobacco fields.
5. **Management of field borders to reduce insect habitat.** Keep field margins clear of weeds and tall grass to reduce feeding, breeding, and

over wintering sites for grasshoppers and other insects that move from these sites into tobacco fields. After tobacco is established and growing, leave uncut barriers between tobacco fields and hay fields that are heavily infested with grasshoppers.

6. **Topping tobacco in the button or early flower stage.** This practice eliminates food sources for budworms and makes the crop a less desirable host for aphids and hornworms.
7. **Obtaining effective sucker control.** Sucker control reduces food sources for hornworms, budworms, and aphids.
8. **Destroying crop residues immediately after harvest is completed.** Stalk cutting and root destruction reduces feeding and overwintering sites for hornworms, budworms, and flea beetles. This practice is most effective when done on a community-wide basis.
9. **Use crop rotations that reduce infestations of soil-inhabiting insects.** Rotate tobacco with crops that are poor hosts of cutworms, white-fringed beetles, and wireworms. Beware of cutworm and wireworm infestations following established grass sods and soybeans.
10. **Conservation tillage.** Use conservation tillage practices to manage insect infestations. Conservation tillage strategies including no-till and strip-till reduce aphid and flea beetle populations, but may increase problems with cutworm, vegetable weevil, and slug infestations.

Natural Control

Beneficial organisms, including predators, parasites and pathogens, help control several insect pests on tobacco. For example, parasites often kill more than 80 percent of the budworms in tobacco fields, control similar to that obtained with the most effective foliar insecticides. These parasites include *campoletis sonorensis*, *microplitis corcepes* and the red-tailed wasp.

Hornworms are parasitized by the larvae of *Cotesia congregata*, which feed inside the caterpillars. When these larvae mature, they emerge and form egg-like cocoons on the backs of the hornworms. Tiny wasps emerge from these cocoons in a few days, mate, and lay eggs in other hornworms. Stilt bugs are long-legged, slender, brown bugs that feed on hornworm and budworm eggs, aphids, and even small amounts of tobacco sap.

Aphids are attacked by the adults and larvae of several species of lady beetles, lacewings, syrphid fly larvae, and a bright red midge larva. The pathogenic fungus, *Pandora neoaphids*, frequently controls aphids from July through September, especially in wet seasons. Although beneficial insects are usually abundant on aphid-infested tobacco, they often have trouble keeping aphid populations below economic threshold levels.

To preserve beneficial insects, scout fields, and use economic thresholds to time insecticide applications. Select insecticides with low impact on beneficials. These insecticides include: *Bacillus thuringiensis* (*Bt*), chloranthraniliprole (Coragen) emamectin benzoate (Denim), methomyl (Lannate), pymetrozine (Fulfil), and spinosad (Tracer). Transplant water and tray drench applications of imidacloprid (Admire Pro and various generics) and thiamethoxam (Platinum) have limited direct impact on beneficials.

Chemical control

Economic thresholds and field scouting are important tools in IPM. The economic threshold is that pest population or injury level that requires treatment with an insecticide to prevent economic damage to the crop. Fields are scouted at regular intervals (once a week) to determine when insect pests reach their thresholds. Foliar insecticides are applied when scouting indicates that one or more pests have reached their economic thresholds. Insecticides applied as foliar, transplant water, tray drench, and soil treatments are extremely important tools in an IPM program. Many cultural and natural controls help reduce insect outbreaks, but it is almost impossible to grow a top quality, high yielding tobacco crop without using some insecticides.

Insect Control on Transplants Produced in the Greenhouse

Almost all of the tobacco transplants (>99%) used in Virginia is produced in greenhouses. So far, insects have caused minor problems in greenhouses. However, if recommended cultural practices are not carried out, several of the following pests could become serious problems.

- **Ants** can remove seeds from greenhouse trays and cause poor stands.
- **Crickets and earwigs** often destroy newly emerged tobacco seedlings, reducing stands and initial growth.
- **Shoreflies**, tiny flies that look like small houseflies, are frequently numerous in greenhouses. Their larvae (tiny maggots) feed on young seedlings and may reduce stands during the first 2 weeks after germination.
- **Mice** remove the seeds from float trays seriously reducing plant stands. If stand loss is severe, the entire greenhouses may require reseeded.
- **Cutworms, crickets, vegetable weevils, and slugs** usually feed on stems and leaves at night. Cutworms also cut off and destroy plants.

- **Crickets, cutworms, slugs, and yellow-striped armyworms** may destroy individual leaves on larger seedlings; this damage appears to do little harm unless populations are very high.
- **Vegetable weevil** adults and larvae often feed on the leaves and stems destroying the buds of seedlings.
- **Aphids** often build up high populations on tobacco seedlings in the greenhouse reducing plant vigor, and they may be carried to the field on infested plants.

Cultural controls in the greenhouse

Sanitation is the most important practice for managing insect pests in tobacco greenhouses. The following practices reduce the potential for insect infestations in greenhouses.

- Discard all unused plants and clean out the greenhouse immediately after transplanting has been completed.
- Keep the area in and around the greenhouse clean and free of weeds, decaying plant material, plastic, rocks, wood, metal, and other items that provide food and shelter for insects and other pests.
- Do not plant fall and winter gardens near the greenhouse. Aphids can survive on various vegetables and related weed species during the winter and develop winged forms that fly into greenhouses and establish colonies on tobacco seedlings. Pests such as cutworms, armyworms, vegetable weevils, and slugs may hide in these sites, migrate into the greenhouse, and injure tobacco seedlings.
- If greenhouses are used to produce other crops, a fallow period should be followed to keep pests from moving from the other crops. Whiteflies or aphids may become problems when they move from earlier crops to tobacco.
- Use extreme temperatures to kill insects hiding in the greenhouse. Close the greenhouse to increase the temperature in the summer and promote cold temperatures in the winter.
- Seed the entire greenhouse at the same time. Do not seed tobacco in greenhouses that are already infested with large numbers of shore flies. Shore flies lay eggs on the media and the larvae injure emerging seedlings. This reduces stand and seedling uniformity.
- Clean the greenhouse thoroughly just before seeding in the spring.

- Produce a uniform crop.

Chemical control in the greenhouse

Acephate (Orthene or other generics) is the only effective insecticide labeled for use on tobacco transplants grown in greenhouses (Table 1). It should be applied as a foliar spray when insect infestations are observed. Acephate provides good to excellent control of aphids, yellow-striped armyworms, cutworms, flea beetles, and vegetable weevils. It should not be applied in the irrigation water or in the float water. Acephate also gives effective control of ants when applied in the greenhouse before the float beds are set up. Excessive rates of acephate can injure or kill young seedlings.

Metaldehyde (Deadline Bullets) bait controls slugs and snails in the greenhouse. In the early evening, apply methaldehyde along walkways and the outside margins of the float beds. Do not apply methaldehyde directly to seedlings or use it in float water.

Mice should be controlled with traps or baits approved for their control.

Table 1. Insecticides for use on Transplants Grown in Greenhouses

Insect	Insecticide and formulation	Rate per 1,000 sq ft
Aphids, cutworms, flea beetles	Acephate (Acephate AG) 75SP	1 tbs/3 gal of water (1 lb/acre)
	(Acephate) 97UP	¾ tbs/3 gal of water (¾ lb/acre)
	(Orthene) 97PE	¾ tbs/3 gal of water (¾ lb/acre)
Remarks and precautions: Apply as a spray. Excessive rates of acephate can injure tender young plants. Do not apply through an irrigation system or in the float water.		
Snails and slugs	Metaldehyde (Deadline Bullets) 4% bait	¼ to ½ lb
Remarks and precautions: Slug damage is usually associated with shiny slime trails. Apply to alleys, walkways and vacant areas in late afternoon. Do not apply to float water or directly on foliage. It is deactivated by water.		
Ants	Acephate (Acephate AG) 75SP	1 oz/5 gal of water
	(Acephate) 97UP	¾ oz/5 gal of water
	(Orthene) 97PE	¾ oz/5 gal of water
Remarks and precautions: Apply 1 gal of mix to each mound area by sprinkling the mound until it is wet. Treat a 4 ft diameter circle around the mound. Treat only once during the season.		

Insect Control on Newly Transplanted Tobacco

Wireworms

Wireworms are hard, white to yellowish-brown, wire-like larvae of click beetles. These pests live in the soil, feed on the roots, and tunnel the piths of young tobacco plants. This injury stunts plant growth, causing irregular stands and lower yields. Although wireworms feed throughout the growing season, the most serious damage occurs when the plants are becoming established during the first month after transplanting. Wireworms take 1 to 5 years to complete their life cycle. Most of this time is spent in the larval stage. The larvae emerge from eggs in the summer and fall, feed on the roots of various host plants, and overwinter into the next year. Larvae then feed on the newly transplanted tobacco seedlings. Pupation and emergence as adult click beetles occurs in late spring and early summer.

Wireworms are most common in fields with a history of wireworm problems, or in those previously planted after grass sod, weeds, corn, clover, or small grains. In these situations, apply an insecticide labeled for their control (Table 2). Apply soil insecticides as broadcast treatments and incorporate them at least 2 weeks before transplanting. Another option is to use Admire Pro, Platinum, or their generics applied at the wireworm rates as transplant water or transplant drench treatments. The most effective cultural practice is to use sturdy, healthy transplants that are less susceptible to wireworm damage than tender, young transplants. After wireworm damage has occurred, it is too late to apply an insecticide. Where damage is light to moderate, cultivation and irrigation may help injured plants recover and produce near normal yields. If wireworms seriously reduce the stand, replant after applying a recommended soil insecticide.

Cutworms

Cutworms are active at night feeding on roots or leaves or cutting off entire plants. This injury can cause enough damage and stand loss to require replanting. However, since tobacco compensates well, less than five percent stand loss usually has no impact on yield. Cutworm infestations are very sporadic and difficult to predict, but they are most likely to occur in low, wet areas, and weedy fields that are plowed less than a month before transplanting. Plowing fields in the early spring usually destroys the cover crop and weed hosts, and reduces cutworm populations. Scout fields for cutworm damage once or twice a week during the first month after transplanting to determine whether a remedial foliar treatment is needed (Table 10). For optimum control of this night-feeding pest, apply a foliar insecticide in late afternoon or early evening

when five percent or more of the plants in a field have recent cutworm damage.

Whitefringed beetles

Whitefringed beetle grubs sometimes cause serious problems in flue-cured and burley tobacco fields. Outbreaks usually occur in fields rotated with clover, soybeans, or alfalfa. Most legumes are excellent food plants for the grubs, while most grasses are unfavorable hosts. Grubs feed on the outer surface of the taproots and tunnel into the pith of newly transplanted tobacco killing or stunting the plants and causing serious yield reductions. Whitefringed beetles spread very slowly because all adult beetles are flightless female weevils. They can be transported to a new field, on farm equipment, water, hay, and other crops. No insecticides are currently registered for the control of whitefringed beetles on tobacco. The rotation of tobacco with good stands of grass containing few legumes or broadleaf weeds may help reduce grub damage. Tray drench and transplant water application of imidacloprid (Admire and generics) and thiamethoxam (Platinum and TMOXX) provide some control of whitefringed beetles.

Soil-incorporated insecticides

Pretransplant soil applications of insecticides can provide effective control of cutworms and wireworms on tobacco. Several factors should be considered before selecting a soil insecticide.

- If a tobacco field has been in sod, weeds, or small grains during the previous year or has a history of wireworm problems, apply an insecticide for wireworm control.
- Mocap, Brigade/Capture, and Lorsban are broadcast soil treatments for wireworm control (Tables 2 and 3).
- Admire Pro or Platinum applied as transplant water or transplant drench treatments may be better choices for wireworm control because they also control aphids, thrips, and flea beetles (Tables 2, 4, and 5).
- Soil fumigants applied at the nematicide rate provide little control of insects in the soil or on the foliage because many insects are below the zone being fumigated.

Table 2. Ratings of soil, greenhouse tray drench, and transplant water treatments for control of insects on flue-cured tobacco.

Insecticide	Application method ¹	Leaf feeding insects			Soil insects		
		Aphids	Bud-worms	Flea beetles	Horn-worms	Cut-worms	Wire-worms
Acephate/Acephate AG/Acephate UP; Orthene 97	TW	1	0	2	0	3-4	0
Imidacloprid (Admire Pro and generics) ²	TW	5	0	2	0	0	3
Imidacloprid (Admire Pro and generics) ²	TD	5	0	4	0	0	3
Bifenthrin (Brigade/Capture and generics) ²	TW	0	0	0	0	3	3
Chlorpyrifos (Lorsban)	PPI	0	0	1	0	3	4
Chlorantraniliprole (Coragen)	TPW	0	2	0	3	0	0
Lambda cyhalothrin (Karate, Warrior and others)	PPI	0	0	0	0	3	0
Ethoprop (Mocap) 6EC	PPI	0	0	1	0	3	4
Thiamethoxam (Platinum/TMOXX) 2F	TW	5	0	3	0	0	3
Thiamethoxam (Platinum/TMOXX) 2F	TD	5	0	4	0	0	3

Ratings are based on a scale of 0 to 5 where 0 = not labeled or no control, 1 = poor control, 2 = fair control, 3 = good control, 4 = very good control, and 5 = excellent control.

¹ TW = Transplant water, TD = Transplant drench, PPI=Preplant soil incorporated.

² There are many generic formulations of imidacloprid and bifenthrin.

Table 3. Insects on Field Tobacco - Pretransplant Soil Treatments

Insect	Insecticide and formulation	Rate per acre
Wireworms, Cutworms	Ethoprop	1 1/3 to
	(Mocap) 6EC	4 qt
	(Mocap) 15G	13 lb
	Chlorpyrifos (Lorsban) 15G	13 1/2 lb
	(Lorsban and generics) 4E	1 qt
	Lorsban Advance 3.755EW	1 qt
	Bifenthrin (Brigade/Capture and generics) 2EC	2.56 to 6.4 fl oz
Lambda cyhalothrin (Karate with Zeon and generics)	1.92 fl oz	
	2.1EC	

Remarks and precautions: Make broadcast applications at least 2 weeks before transplanting. Band applications are usually less effective than broadcast treatments. Use a suitable device to incorporate insecticides into the soil to a depth of at least 4 inches immediately after application. Chlorpyrifos and bifenthrin are also registered for cutworms and flea beetle larvae. **These chemicals are restricted use.**

Table 4. Insects on Field Tobacco - Transplant Water Treatments

Insect	Insecticide and formulation	Rate
Flea beetles, cutworms, thrips, suppression of aphids	Acephate (Acephate AG) 75SP	1 lb/acre
	(Acephate) 97UP	0.75 lb/acre
	(Orthene) 97PE	0.75 lb/acre
	Bifenthrin (Brigade/Capture) 2EC	2.56 to 6.4 fl oz/acre
Aphids, flea beetles	Imidacloprid (Admire Pro) 4.6SC	0.5 to 0.6 fl oz/1,000 plants
	(various generics) 2F	1.0 fl oz/1,000 plants
	Thiamethoxam (Platinum/TMOXX) 2SC	0.5 to 0.8 fl oz/1,000 plants or (3 to 5 fl oz/acre)
	(Platinum) 75SG	0.17-0.43 oz/1,000 plants
Budworms, hornworms	Chlorantraniliprole (Coragen) 1.67SC	5.0 to 7.5 fl oz/acre
Remarks and precautions: Apply in at least 100 gallons of water per acre. Coragen must be applied uniformly in the root zone for optimum performance.		
Wireworms, thrips for suppression of tomato spotted wilt virus	Imidacloprid (Admire Pro) 4.6SC	0.8 to 1.2 fl oz/1,000 plants
	(various generics) 2F	1.4 to 2.8 fl oz/1,000 plants
	Thiamethoxam (Platinum/TMOXX) 2SC	0.8 to 1.3 fl oz/1,000 plants or (5 to 8 fl oz/acre)
	(Platinum) 75SG	0.43 oz/1,000 plants
Remarks and precautions: Admire Pro and Platinum usually give excellent season-long control of aphids. Apply treatments in at least 100 gal of water/acre. Calibrate transplanters and allow tanks to run low before refilling.		

Table 5. Insects on Field Tobacco-Drench Application to Greenhouse Transplants

Insects	Insecticide and formulation	Rate per 1,000 plants
Aphids, flea beetles	Imidacloprid (Admire Pro) 4.6SC	0.5 to 0.6 fl oz
	(various generics) 2F	1.0 fl oz
	Thiamethoxam (Platinum) 2SC	0.5 to 0.8 fl oz
	(TMOXX) 2SC (Platinum) 75SG	0.5 to 0.8 fl oz 0.17-0.43 oz/1,000 plants
Wireworm,	Imidacloprid (Admire Pro) 4.6SC	0.6 to 1.2 fl oz
Thrips for	(various generics) 2F	1.4 to 2.8 fl oz
suppression of tomato spotted wilt virus	Thiamethoxam (Platinum) 2SC	0.6 to 1.3 fl oz
	(TMOXX) 2SC	0.6 to 1.3 fl oz
	(Platinum) 75SG	0.43 oz/1,000 plants

Remarks and precautions: Apply as a drench to plants in trays prior to transplanting. Mix with water before application. Keep agitated or mix regularly to avoid settling in tank. Water the plants in the trays before treatment and again immediately after application using enough water to wash the residue from the foliage into the media. Transplant within 3 days.

Remedial Control of Insects on Larger Tobacco

Scouting for Insects

Tobacco fields should be scouted at least once a week throughout the season to determine when insecticide applications are needed.

1. Take representative samples from the entire field except for the outside rows. Sample in a Z or N pattern across the field. Do not sample the same plants each week. Look for insect pests and their damage on at least 50 plants in a field (1 to 10 acres). By making counts and recording the data for 5 consecutive plants at 10 locations throughout the field. Select the plants before you see them. If a field is planted on two different dates or if there are great differences in plant size within the field, divide the field into two or more sections and sample each section separately. Sample an additional 10 plants for every two additional acres in fields larger than 10 acres.
2. During the first 4 weeks after transplanting, check tobacco for feeding holes or missing, stunted, or cut plants. Cutworms, flea beetles, wireworms, and other insects may have damaged these plants.
3. Beginning 3 to 4 weeks after transplanting, aphids, budworms, flea beetles, and hornworms are the primary targets of an insect scouting program.

4. When a field is being scouted for insects that feed on tobacco foliage, individual plants should be examined and the observations recorded in a notebook as follows:
 - a. Check the bud region for budworm damage. If damage is present, look carefully for budworms and the white cocoons of budworm parasites. If there is budworm damage, but no worm, do not count the plant as infested.
 - b. Examine the entire plant for hornworm damage, locate, and count the hornworms that are at least 1 inch long, and determine whether they are parasitized by *Cotesia congregata* (white egg-like cocoons on hornworm's back).
 - c. Check the undersides of the upper leaves for aphids and the upper surfaces of the middle and lower leaves for honeydew, flea beetles, flea beetle feeding holes, and the mines of the tobacco splitworm.
 - d. If you find an unidentified insect that appears to be damaging the crop, collect the insect and samples of its damage, and take them to a local Extension agent for identification. This is important because beneficial insects are often mistaken for pests. In addition, the misidentification of a pest may lead to the selection of the wrong insecticide for its control.
5. Tobacco fields should be treated when one or more insect pests meet or exceed the threshold levels shown in Table 6.

Table 6. Economic thresholds for various insects on tobacco.

Insect	Economic threshold	Time when insect is a problem
Aphids	50 or more aphids on any upper leaf of 5 of 50 plants.	4 weeks after transplanting to final harvest
Budworms	10 plants with one or more budworms per 50 plants until 1 week before topping.	3 weeks after transplanting to 1 week before topping
Cutworms	5 of 100 plants with recent cutworm damage.	1 to 4 weeks after transplanting
Flea beetles	4 beetles per plant on tobacco less than 2 weeks old, 8 to 10 beetles per plant on 2 to 4 week-old plants, 60 beetles per plant on plants more than 4 weeks old.	Transplanting to 4 weeks after transplanting and from topping to final harvest
Grasshoppers	10 grasshoppers per 50 plants.	4 weeks after transplanting to final harvest
Hornworms	5 larvae (worms) at least 1 inch long per 50 plants. Do not count parasitized worms with the egg-like cocoons on their backs. For hornworms $\frac{1}{2}$ to $\frac{3}{4}$ inch long, treat when there is 1 hornworm per plant.	3 weeks after transplanting to final harvest. Can be a problem on air-cured tobacco in curing structures
Wireworms	Not determined	1 to 6 weeks after transplanting

Tobacco Budworms

Tobacco budworms feed in the buds of young tobacco plants causing many holes in the tiny developing leaves. As the leaves grow, the feeding holes become larger and give the plants a ragged, distorted appearance. Tobacco plants usually compensate for this damage so yield and quality may not be affected. However, budworms sometimes top the plants prematurely causing early sucker growth that may stunt the plants and require extra labor to remove the suckers. After the button stage, budworms rarely cause economic damage although they may burrow into the stalk. Apply foliar sprays for budworm control with 1 or 3 solid-cone or hollow-cone nozzles over each row using 40 to 60 psi to deliver 10 to 25 gallons of spray mixture per acre. Control with foliar sprays rarely exceeds 80%. The tobacco rows must be planted evenly so that the nozzles can be oriented directly over the row. See insecticide performance ratings in Table 7 and insecticide options for budworm control in Table 10. When checking tobacco for budworms, look on the leaves near the bud for the

cocoons of two species of wasp that parasitize budworms. These cocoons are about ¼ inch long and white or grayish in color with two black bands or dots. These parasites provide good natural control of budworms on tobacco in Virginia.

Hornworms

Tobacco and tomato hornworms are large caterpillars (up to 4 inches long) that eat considerable amounts of tobacco leaf. Infestations may develop anytime from transplanting until harvest is completed, but damage is usually most severe during June, August, and September. Treat for hornworms when there are 5 or more hornworms 1 inch long or longer per 50 plants. Do not count parasitized hornworms that have the white egg-like cocoons of the parasitic wasp, *Cotesia congregata*, on their backs. Parasitized hornworms eat much less than healthy hornworms and they are a food source for parasites that help reduce the next generation of hornworms. Predators also kill large numbers of small larvae that are less than 1 inch long. For this reason, hornworms less than 1 inch long are not considered when determining the economic threshold because they cause very little damage and have no effect on yield or quality. However, if a field has large numbers of hornworms less than 1 inch long, the field should be rechecked in 3 to 4 days. For optimum hornworm control, direct insecticide sprays to the upper one-half of the plants. See the insecticide ratings in Table 7 and the labeled insecticides in Table 10. Several cultural practices help reduce the susceptibility of tobacco to hornworms. Early topping, early transplanting, effective sucker control, and fertilization with recommended rates of nitrogen help reduce late-season infestations. When used on an area-wide basis, stalk cutting and root destruction immediately after harvest reduces overwintering hornworm populations.

Aphids

The green peach aphid is a severe pest of tobacco in Virginia. Under favorable conditions, aphid populations increase rapidly, doubling in size about every two days. High populations of aphids can reduce tobacco yield by 5 to 25 % (100 to 500 lbs/acre) or more. As aphids feed, they excrete honeydew that contains the excess sugars obtained from the plant sap. This sticky, shiny honeydew and tiny white exoskeletons are deposited on the leaves below the feeding aphids. A dark, sooty mold often grows on the honeydew. The combination of sooty mold and honeydew interferes with curing, reduces leaf quality, and often remains on the leaves after aphids have been controlled. Aphids are most severe on field tobacco from late June to September. Tobacco plants become infested when winged aphids fly into fields and deposit wingless nymphs on the upper leaves. It is important to watch for increases in aphid populations from early June to the end of August. Examine the undersides

of leaves from all portions of tobacco plants to assess the extent of aphid infestation.

The following practices can be used to manage aphids on tobacco.

1. Preventive control

Apply systemic insecticides before or at transplanting.

Admire Pro or Platinum applied as transplant drench or transplant water treatments usually provide excellent season-long control of aphids (Table 2).

2. Remedial control of aphids

a. **Make remedial applications of a foliar insecticide at the economic threshold level** before populations become too high (Table 3). This will make aphid control much easier for the rest of the season.

b. **Rotate insecticides for resistance management.** The continuous use of the same insecticide year after year increases the chances that aphids and other pests will develop resistance to it. Rotating insecticides with different modes of action reduces the chances that resistance will develop. The insecticides available for aphid control on tobacco are in several different groups based on their modes of action (the way they kill aphids) (Table 9). When applying several insecticides for aphid control over the growing season, change from one group to another. Do not apply a neonicotinoid (group 4) such as Provado, Actara, or Assail to tobacco already treated with another neonicotinoid (group 4) such as Admire or Platinum. Instead, apply Orthene (group 1B) or Fulfill (group 9) because they are in different chemical groups.

c. **Assess control after 3 or 4 days.** It takes 1 to 3 days after application of most insecticides for the aphids to die. If control is not adequate, determine whether the weather conditions, spraying equipment, improper calibration, or other factors contributed to the poor control. If another application is needed, apply an insecticide in another group (Table 9).

d. **Higher gallonage, higher sprayer pressure, drop nozzles, and spreader-stickers can improve coverage.** For optimum aphid control with foliar insecticides, the sprays must come in contact with the aphids concentrated on the undersides of the leaves. Drop nozzles improve control if aphids are abundant on the undersides of the lower leaves.

e. **Continue to scout the crop** after satisfactory control is obtained. Aphid populations may return to damaging levels and require additional insecticide applications.

3. Cultural control of aphids

Most cultural practices do not keep aphid populations below the economic threshold, but they can improve the effectiveness of foliar insecticides and reduce the need for insecticide applications after topping. Useful cultural practices include:

a. **Avoid planting cole crops such as cabbage and turnips near greenhouses.** These plants are sources of aphids that can infest tobacco plants early in the growing season.

b. **Control aphids in greenhouses.** Make sure seedlings are aphid-free before they are transplanted. Destroy greenhouse transplants immediately after transplanting is completed.

c. **Transplant early.** Early planted tobacco may become infested with aphids earlier, but it matures earlier and the aphids have less impact on early-planted tobacco than they do on tobacco planted near the middle of the recommended planting period.

d. **Use recommended nitrogen rates on flue-cured tobacco.** Too much nitrogen fertilizer causes the leaves to remain green later in the year and it promotes excessive sucker growth that favors aphid infestations.

e. **Top early and control suckers.** Aphid populations often decline rapidly after topping, especially in hot, dry weather. However, aphids may still reach damaging levels that require insecticide treatment.

Tobacco Flea Beetle

Adult tobacco flea beetles feed on the leaves and stalks of tobacco, while the tiny grubs feed on the roots. Extensive feeding on newly set transplants by both beetle stages may cause stunting and uneven stands. When checking tobacco fields for flea beetles, look for the characteristic shot-hole feeding damage, and then count the beetles on 20 plants (2 per field-sample location). **Apply treatments for flea beetles on newly set tobacco when there are 4 or more beetles per plant.** Larger plants can tolerate very high flea beetle densities. Apply an insecticide when the base of the lower leaves have a netted appearance or densities exceed 60 beetles per plant. Flea beetle control ratings for systemic and foliar insecticides are listed in Tables 2 and 7, respectively. Insecticides for flea beetle control are listed in Tables 3, 4, 5, and 10. Harvesting at the normal time, and stalk cutting and root destruction immediately after the last harvest are the most effective cultural practices for reducing overwintering flea beetle

populations and the resulting damage the next year. Nitrogen deficient tobacco appears to be more susceptible to flea beetle damage after topping. Flea beetles are difficult to control after topping because most insecticides that can be used at this time provide only short residual control while flea beetles emerge from the soil over an extended period.

Managing thrips to control tomato spotted wilt virus

The tobacco thrips, *Frankliniella fusca*, is the primary vector of the tobacco pathogen, tomato spotted wilt virus (TSWV). TSWV caused moderate stand reductions in tobacco fields in parts of Virginia in 2002 but it has been a minor problem since then. Foliar treatments for thrips control are not effective for managing TSWV after the disease is observed in the field. However, tray drench or transplant water applications of Admire Pro or generic forms of imidacloprid and Platinum suppress TSWV. Tray drenches are more effective than transplant water treatments.

Tobacco splitworm

The tobacco splitworm or potato tuberworm, a leaf-mining caterpillar is sometimes a late season problem on tobacco. Splitworms live in tunnels or mines that appear as brown, tan, or grayish, translucent blotches on the leaves. Splitworms can also feed in the midvein and stalk. Old mines turn brown and brittle and may destroy over 50 percent of the leaf. Although the mines are most common on the lower leaves, they can occur on any leaf. Splitworm damage increases the amount of dead leaf tissue and may reduce crop yield and value. Since splitworms feed within the leaves, they are difficult to control with insecticides. Currently, only Coragen is registered for splitworm control on tobacco. However, Denim, Tracer, and acephate applied in high volumes of water provide fair to good control. Denim was the most effective treatment for splitworms in one trial.

Irish potatoes should not be planted or stored near tobacco fields because they can be an important source of this pest in tobacco. If splitworm mines are observed on the lower leaves, the leaves should be harvested and cured as soon as possible. Since splitworms continue to develop inside the leaves after they are harvested, removing infested leaves and dropping them on the ground will not reduce the problem and may make it worse. Air-cured and fire-cured tobacco stalks are also a source of overwintering splitworm moths so they should not be discarded near tobacco fields.

Insecticide Application Methods

Apply insecticides properly for optimum insect control. On small tobacco, obtain effective control by directing one solid-cone or hollow-cone nozzle per row to the bud. Operate equipment at 40 to 60 psi, do not exceed 5 miles per hour, and use at least 6 to 8 gallons of finished spray per acre. After tobacco is 2 ft. tall, use one or three nozzles per row. If three nozzles are used, orient the two side nozzles at 45 degree angles toward the upper

$\frac{1}{3}$ of the plant. Use 20 to 50 gallons of spray mixture per acre at 40 to 60 psi. Set the nozzles 8 to 12 inches above the tobacco. Drop nozzles oriented to the undersides of the leaves and used in combination with one or three nozzles over the row may improve aphid, splitworm, and flea beetle control. Plant tobacco uniformly so that the space between rows is constant. This makes it easier to orient the spray nozzles over the plants during the spraying operation.

Table 7. Rating of foliar insecticides for control of insect pests on flue-cured tobacco.

Insecticide	Aphid	BW ¹	CW ¹	FB ¹	G ¹	HW ¹
Actara/TMOXX	4	0	0	4	0	0
Assail	4	1	0	4	0	3*
<i>Bacillus thuringiensis</i>	0	2	0	0	0	5
Agree, Crymax/Dipel/Javelin/ Lepinox/XenTari						
Brigade/Capture	3	3	4	3	3	5
Coragen	0	4	0	0	0	5
Denim	0	4	0	0	0	4
Fulfill	3	0	0	0	0	0
Karate/Warrior	1	3	3	3	3	5
Lannate	2	3	0	2	0	5
Orthene/Acephate/ Acephate 97UP, 75SP	4	3	4	2	4	5
Provado/Nuprid	4	0	0	3	0	0
Tracer	0	4	0	0	0	4

¹BW = Budworm; CW = Cutworm; FB = Flea Beetle; G = Grasshopper; HW = Hornworm. Rating is as follows 0 = not labeled, 1 = poor, 2 = fair, 3 = good, 4 = very good, 5 = excellent.

*effective, but not labeled.

Table 8. Restricted entry intervals (REI) and preharvest intervals (PHI) for various insecticides used on flue-cured tobacco in Virginia.

Insecticide	Restricted entry Intervals (REI) (hours)	Preharvest interval (PHI) (days)
<u>Foliar treatments</u>		
Acephate (Orthene/Acephate AG/Acephate UP)	24	3
Acetamiprid (Assail) 70WP, 30WG	12	7
<i>Bacillus thuringiensis</i> (Agree/Crymax/Dipel/ Javelin/XenTari)	4	0
<i>Bacillus thuringiensis</i> (Lepinox)	12	0
Bifenthrin (Brigade/Capture)	12	Do not apply after layby
Bifenthrin + imidacloprid (Brigadier)	12	Do not apply after layby
Chlorantraniliprole (Coragen)	4	1
Imidacloprid (Nuprid/Provado) 1.6F	12	14
Lambda-cyhalothrin (Karate/Warrior 1CS)	24	40
Methomyl (Lannate)	48	7
Pymethozine (Fulfill)	12	14
Spinosad (Tracer)	4	3
Thiamethoxam (Actara/TMOXX)	12	14
<u>Soil treatments</u>		
Bifenthrin (Brigade/Capture)	12	Do not apply after layby
Chlorpyrifos (Lorsban/Lorsban Advance)	24	“
Ethoprop (Mocap)	48	“
Metaldehyde (Deadline Bullets)	12	“
<u>Greenhouse seedling drench or transplant water treatments</u>		
Acephate (Orthene/Acephate)	24	3
Bifenthrin (Brigade/Capture)	12	Do not apply after layby
Chlorantraniliprole (Coragen)	4	1
Imidacloprid (Admire Pro and various generics)	12	14
Lambda-cyhalothrin (Warrior/Karate)	12	40
Thiamethoxam (Platinum/TMOXX) 2F	12	14

Minimizing Insecticide Residues

Pesticide residues are an important factor in the quality of cured tobacco that can cause some contractors to reject your crop. The following points help to minimize pesticide residues on the marketed crop.

- **Do not use any insecticides not labeled for use on tobacco.**
- **Do not use endosulfan (Cekulfan, Endosulfan, Thiodan, Thiokill, Golden Leaf Tobacco Spray).** There are several insecticides that give equal or superior control. Some companies specify in their contacts that this chemical must not be used on the tobacco.
- **Follow the preharvest intervals closely.** The pyrethroids, bifenthrin (Brigade) and lambda-cyhalothrin (Karate/Warrior) have very long preharvest intervals. Bifenthrin should not be applied after layby and lambda-cyhalothrin has a 40-day preharvest interval.
- **Use insecticides with short preharvest intervals during the harvest period.** *Bt* and Tracer are good options for hornworms, Orthene provides effective control of aphids and some control of flea beetles, but there is usually no need for late-season applications.

Resistance Management

The Insecticide Resistance Action Committee (IRAC) has grouped insecticides into mode of action (MOA) groups that are listed on many of the insecticide labels (Table 9). Avoid using insecticides within the same mode of action group continuously time after time. Instead, switch to an insecticide in another MOA group. This reduces the chances that an insect will develop resistance to the insecticides registered for tobacco.

Table 9. Tobacco insecticides by group and mode of action (MOA) for resistance management.

Goup #	Mode of action	Chemical sub-group or active ingredient	Product name
1A	Acetylcholine esterase inhibitors	Carbamates	Lannate
1B	Acetylcholine esterase inhibitors	Organophosphates	Orthene
3	Sodium channel modulators	Pyrethroids, Pyrethrins	Brigade/Capture Karate/Warrior
4	Nicotinic Acetylcholine receptor agonists / antagonists	Neoicothinoids	Actara, Admire Pro, Assail, Platinum, Provado
5	Nicotinic Acetylcholine receptor agonists	Spinosyns	Tracer
6	Chloride channel activators	Avermectins	Denim
9	Selective feeding blockers	Pymetrozine	Fulfill
11	Microbial disruptors of insect midgut membranes	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> , <i>Bacillus thuringiensis</i> var. <i>tenebrionenses</i>	Dipel, etc.
28	Ryanodine receptor inhibitor	Chlorantraniliprole,	Coragen

Table 10. Insects on Field Tobacco - Foliar Treatments

Insect	Insecticide and formulation	Rate per acre
Aphids	Acephate (Acephate AG) 75SP	$\frac{2}{3}$ to 1 lb
	(Acephate) 97UP	$\frac{1}{2}$ to $\frac{3}{4}$ lb
	(Orthene) 97PE	$\frac{1}{2}$ to $\frac{3}{4}$ lb
Remarks and precautions: MOA = 1B. Apply as a spray in 10 to 50 gal/acre. Use highest rate for heavy. If tobacco is large and aphids are established on the lower leaves, drop nozzles that orient spray to undersides of leaves improve control. Prime before treating.		
	Acetamiprid (Assail) 70WP	0.6 to 1.7 oz
	(Assail) 30SG	1.5 to 4.0 fl oz
Remarks and precautions: MOA = 4. Apply as a spray in at least 20 gal/acre. Do not apply to tobacco already treated with imidacloprid (Admire Pro, Provado,) or thiamethoram (Platinum) (Actara). Also provides fair control of hornworms.		
	Bifenthrin (Brigade/Capture) 2EC	2.56 to 6.4 fl oz
Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.		
	Bifenthrin + imidacloprid (Brigadier) 1 + 1EC	3.8 to 6.4 fl oz
Remarks and precautions: MOA = 3 for bifenthrin and 4 for imidacloprid. Restricted use. Do not apply after layby.		
	Imidacloprid (Provado) 1.6F	2 to 4 fl oz
	(Nuprid and other generics) 1.6F	2 to 4 fl oz
Remarks and precautions: MOA = 4. Apply as spray. Do not apply to tobacco treated with Admire Pro, Assail, Platinum, Provado, or TMOXX.		
	Pymetrozine (Fulfill) 50WG	2 $\frac{3}{4}$ oz
Remarks and precautions: MOA = 9. Do not apply more than twice or 5 $\frac{1}{2}$ oz/acre/year. Allow 7 days between applications.		
	Thiamethoxam (Actara) 25WDG	2 to 3 oz
Remarks and precautions: MOA = 4. Do not apply to tobacco already treated with Platinum, TMOXX, Admire Pro, Assail, or Provado. Apply only once during the growing season.		

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Armyworms (beet, fall and yellowstripped)	Bifenthrin (Brigade/Capture) 2EC	4.0 to 6.4 fl oz
	Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.	
	Emamectin benzoate (Denim) 0.16EC	6 to 12 fl oz
	Remarks and precautions: MOA = 6. Restricted Use. Apply in sufficient water for through coverage.	
	Lambda-cyhalothrin (Warrior) 1CS (Karate with Zeon, Warrior II) 2.1SC	1.9 to 3.8 fl oz 0.96 to 1.92 fl oz
Remarks and precautions: MOA = 3. Restricted Use. Apply as a spray. Observe the 40-day preharvest interval.		
Budworms	Methomyl (Lannate) 90SP (Lannate) 2.4LV	¼ to ½ lb ¾ to 1 ½ pt
	Remarks and precautions: MOA = 1A. Restricted Use. Apply as spray. Make applications as needed. Direct the spray into the buds before buttoning. Orthene is labeled for armyworms on other crops.	
	Acephate (Acephate AG) 75SP (Acephate) 97UP (Orthene) 97PE	1 lb ¾ lb ¾ lb
	Remarks and precautions: MOA = 1B. Apply as a spray. When using hand sprayer apply in 10 to 50 gal/acre.	
	<i>Bacillus thuringiensis (Bt)</i>	
(Agree) WG (Crymax) WG (Dipel) DF (Dipel) ES (Javelin) WG (XenTari) WDG	1 to 2 lb ½ to 2 lb ½ to 1 lb 1 to 2 pt 1 to 1 ¼ lb ½ to 2 lb	
Remarks and precautions: MOA = 11. Apply as a spray. Do not allow diluted sprays to stand in the sprayer more than 12 hours. Bt sprays give fair control of budworms.		
Bifenthrin ((Brigade/Capture) 2EC	4.0 to 6.4 fl oz	
Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.		

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Budworms (cont'd)	Chlorantraniliprole (Coragen) 1.67SC	3.5 to 7.5 fl oz
	Remarks and precautions: MOA = 28. Make no more than 4 applications per acre per season. Do not use an adjuvant with coragen.	
	Emamectin benzoate (Denim) 0.16EC	8 to 12 fl oz
	Remarks and precautions: MOA = 6. Restricted Use. Apply in sufficient water for through coverage. Apply before damaging infestations occur.	
	Lambda-cyhalothrin (Karate/Warrior) 1CS	1.9 to 3.8 fl oz
	(Karate with Zeon, Warrior II) 2.1SC	0.96 to 1.92 fl oz
Remarks and precautions: MOA = 3. Restricted Use. Apply as a foliar spray after field scouting indicates the population has reached the economic threshold as indicated by field scouting. Observe the 40-day preharvest interval.		
	Methomyl (Lannate) 90SP	½ lb
	(Lannate) 2.4LV	1 ½ pt
Remarks and precautions: MOA = 1A. Restricted Use. Apply as a spray. Make applications as needed. Direct the spray into the buds before buttoning.		
	Spinosad (Tracer) 4F	1½ to 2 fl oz
	(Blackhawk) 36WG	1.6 to 3.2 oz
Remarks and precautions: MOA = 5. Use higher rates for large larvae or high infestations. Use at least 20 gal of water per acre.		

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Cut-worms	Acephate (Acephate AG) 75SP	1 lb
	(Acephate) 97UP	¾ lb
	(Orthene) 97PE	¾ lb
Remarks and precautions: MOA = 1B. Apply as a spray overtop of plants in affected areas when 5% of plants are injured by cutworms. Make application during late afternoon using at least 25 gal of spray per acre.		
Lambda-cyhalothrin		
	Karate (Warrior) 1CS	1.9 to 3.8 fl oz
	(Karate with Zion, Warrior II) 2.1SC	0.96 to 1.92 fl oz
Remarks and precautions: MOA = 3. Restricted Use. Apply in the late afternoon when cutworms are causing damage. Do not apply within 40 days of harvest.		
Flea beetles	Acephate (Acephate AG) 75SP	² / ₃ lb
	(Acephate) 97UP	½ lb
	(Orthene) 97PE	½ lb
Remarks and precautions: MOA = 1B. Apply as a spray. Prime before treating		
	Acetamiprid (Assail) 70WP	1.1 to 1.7 oz
	(Assail) 30SG	2.5 to 4.0 fl oz
Remarks and precautions: MOA = 4. Apply as a spray in at least 20 gal/acre. Do not apply to tobacco already treated with imidacloprid (Admire Pro, Provado,) or thiamethoram (Platinum) (Actara). Also provides fair control of hornworms.		
	Bifenthrin (Brigade/Capture) 2EC	4.0 to 6.4 fl oz
Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.		
	Imidacloprid (Provado) 1.6F	4 fl oz
Remarks and precautions: MOA = 4A. Apply as spray. Do not apply to tobacco already treated with imidacloprid, acetimiprid, or thiamethoxam.		
Lambda-cyhalothrin		
	Karate (Warrior) 1CS	1.9 to 3.8 fl oz
	(Karate with Zion, Warrior II) 2.1SC	0.96 to 1.92 fl oz
Remarks and precautions: MOA = 3. Restricted Use. Apply in sufficient water for coverage.		
	Methomyl (Lannate) 90SP	¼ to ½ lb
	(Lannate) 2.4LV	1 ½ pt
Remarks and precautions: MOA = 1A. Restricted Use. Apply as a spray.		
	Thiamethoxam (Actara) 25WDG	2 to 4 oz
Remarks and precautions: MOA = 4. Do not apply to tobacco already treated with Admire Pro, Assail, Platinum, Provado, or TMOXX. Apply only once during the growing season.		

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Grass-hoppers	Acephate (Acephate AG) 75SP	1/3 to 2/3 lb
	(Acephate) 97UP	1/4 to 1/2 lb
	(Orthene) 97PE	1/4 to 1/2 lb
	Bifenthrin (Brigade/Capture) 2EC	4.0 to 6.4 fl oz
Remarks and precautions: MOA is 1B for acephate and 3 for bifenthrin. Bifenthrin is restricted use. Do not apply bifenthrin after layby.		
Hornworms	Lambda-cyhalothrin (Warrior) 1CS	1.9 to 3.8 fl oz
	(Karate with Zion, Warrior II) 2.1SC	0.96 to 1.92 fl oz
	Remarks and precautions: MOA = 3. Restricted Use. Apply in sufficient water for coverage. There is a 40-day preharvest interval.	
Hornworms	Acephate (Acephate AG) 75SP	2/3 lb in water
	(Acephate) 97UP	1/2 lb
	(Orthene) 97PE	1/2 lb
	Remarks and precautions: MOA = 1B. Apply as a spray. Treat infested fields before worms are more than 1 1/2 inches long. Direct insecticides toward the upper half of the plants. Prime before treatment.	
<i>Bacillus thuringiensis</i>		
Hornworms	(Agree) WG	1 to 2 lb
	(Crymax) WG	1/2 to 2 lb
	(Dipel) DF	1/4 to 1 lb
	(Dipel) ES	1/2 to 1 pt
	(Javelin) WG	1/8 to 1 1/4 lb
Remarks and precautions: MOA = 11. Apply as a spray. Do not allow dilute sprays to stand in tank more than 12 hours. Dipel can be tank-mixed with maleic hydrazide (Royal MH-30).		
Hornworms	Bifenthrin (Brigade/Capture) 2EC	4.0 to 6.4 fl oz
	Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.	
Hornworms	Chlorantraniliprole (Coragen) 1.67SC	3.5 to 7.5 fl oz
	Remarks and precautions: MOA = 28. Make no more than 7 applications per acre per season. Do not use an adjuvant. More expensive than most treatments.	
Hornworms	Emamectin benzoate (Denim) 0.16EC	8 to 12 fl oz
	Remarks and precautions: MOA = 9. Restricted Use. Apply in sufficient water for through coverage before damaging infestations occur.	

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Hornworms cont'd	Emamectin benzoate (Denim) 0.16EC	8 to 12 fl oz
	Remarks and precautions: MOA = 9. Restricted Use. Apply in sufficient water for through coverage before damaging infestations occur.	
	Lambda-cyhalothrin (Warrior) 1EC	1.9-3.8 fl oz
	(Karate with Zion, Warrior II) 2.1SC	0.96 to 1.92 fl oz
	Remarks and precautions: MOA = 3. Restricted Use. Apply as a spray. There is a 40-day preharvest interval.	
	Methomyl (Lannate) 90SP (Lannate) 2.4LV	¼ to ½ lb ¾ to 1 ½ pt
	Remarks and precautions: MOA = 1A. Restricted Use. Apply as a spray.	
	Spinosad (Tracer) 4F Blackhawk 36WG	1 to 2 fl oz 1.6 to 3.2 oz
	Remarks and precautions: MOA = 5. Apply as a spray in at least 20 gal of water per acre.	
	Japanese beetles	Acephate (Acephate AG) 75SP (Acephate) 97UP (Orthene) 97PE
Remarks and precautions: MOA = 1B. Apply as a spray in 10 to 50 gal/acre. Prime before treating.		
Bifenthrin (Brigade/Capture) 2EC		4.0 to 6.4 fl oz
Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.		
Imidacloprid (Provado) 1.6F Thiamethoxam (Actara) 25WDG		4 fl oz 3 oz
Remarks and precautions: MOA = 4A. Apply as a spray. Damage is usually less severe than it appears.		
Lambda-cyhalothrin (Warrior) 1EC		1.9 to 3.8 fl oz
(Karate with Zion, Warrior II) 2.1SC		0.96 to 1.92 fl oz
Remarks and precautions: MOA = 3. Restricted Use. Apply as a spray. There is a 40-day preharvest interval.		

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Slugs	Metaldehyde (Dealine Bullets) 4 % Bait	12 to 40 lb
	Remarks and precautions: Apply as a broadcast treatment to the soil surface in the late evening. Metaldehyde is most effective after irrigation or a rain.	
Stink bugs	Acephate (Acephate AG) 75SP	$\frac{2}{3}$ to 1 lb
	(Acephate) 97UP	$\frac{1}{2}$ to $\frac{3}{4}$ lb
	(Orthene) 97PE	$\frac{1}{2}$ to $\frac{3}{4}$ lb
	Remarks and precautions: MOA = 1B. Apply as a spray. Stinkbug injury is usually much less severe than it appears.	
	Bifenthrin (Brigade/Capture) 2EC	4.0 to 6.4 fl oz
Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.		
Stink bugs	Lambda-cyhalothrin	
	(Warrior) 1EC	1.9 to 3.8 fl oz
	(Karate with Zion, Warrior II) 2.1SC	0.96 to 1.92 fl oz
	Remarks and precautions: MOA = 3. Restricted Use. Apply as a spray. There is a 40-day preharvest interval.	
Thrips	Acephate (Acephate AG) 75SP	$\frac{2}{3}$ to 1 lb
	(Acephate) 97UP	$\frac{1}{2}$ to $\frac{3}{4}$ lb
	(Orthene) 97PE	$\frac{1}{2}$ to $\frac{3}{4}$ lb
	Remarks and precautions: MOA = 1A. Apply as a spray in 10 to 50 gal/acre. Use highest rate for heavy infestations or if control was poor with previous application. Prime before treating. Foliar applications for thrips control are not effective for reducing tomato spotted wilt virus after the disease is observed.	

Table 10. Insects on Field Tobacco - Foliar Treatments (Cont'd)

Insect	Insecticide and formulation	Rate per acre
Thrips	Bifenthrin (Brigade/Capture) 2EC	4.0 to 6.4 fl oz
	Remarks and precautions: MOA = 3. Restricted use. Do not apply after layby.	
	Lambda-cyhalothrin (Warrior) 1EC	1.9 to 3.8 fl oz
	(Karate with Zion, Warrior II) 2.1SC	0.96 to 1.92 fl oz
	Remarks and precautions: MOA = 3. Restricted Use. Apply as a spray. Foliar applications for thrips control are not effective for reducing tomato spotted wilt virus after the disease is observed. There is a 40-day preharvest interval.	
Tobacco splitworm/ potato tuberworm	Chlorantraniliprole (Coragen) 1.67SC	3.5 to 7.5 fl oz
	Remarks and precautions: MOA = 28. Make no more than 4 applications per acre per season. Do not use an adjuvant.	
Whitefringed beetle	No chemicals are currently registered for whitefringed beetle control on tobacco. In one trial, imidacloprid and thiamethoxam applied as tray drench and transplant water treatments provided good control.	
	Remarks and precautions: Cultural control: Rotate tobacco with grass crops. Control legumes and broadleaf weeds. Do not plant tobacco after legumes in fields with a history of white-fringed beetle infestations.	