UNIVERSITY OF MISSOURI
Cotton Insect Management Guide - 2005

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Insects

Aphids	**Bandedwing Whitefly**	**Beet Armyworm**
Boll Weevil	**Cotton Bollworm / Tobacco Budworm**	
Cutworms	**European Corn Borer**	**Fall Armyworm**
Loopers	**Plant Bugs**	**Spider Mites**
Stink bugs	**Thrips**	

Objectives:

The following University of Missouri (MU) recommendations are to aid Missouri cotton growers in the production of an early-maturing, high-yielding crop. We encourage the use of all practical Integrated Pest Management (IPM) practices so growers can maximize crop production while minimizing economic and environmental costs. The philosophy of IPM is to incorporate and utilize different control practices without relying on one method. Regular field scouting is crucial to identify the pests damaging cotton, and to determine if an economic pest infestation is present to warrant insecticide applications.

Insect Identification:

A new MU cotton scouting manual (IPM 1025) is available as of 2005 to assist in the identification of pests (except weeds) present in Missouri cotton fields. The manual contains 76 photos plus information on pest descriptions and plant injury symptoms. Copies of this manual are available at the MU Delta Center (573-379-5431), local MU extension offices, and through MU Extension Publications (800-292-0969).

Variety Selection:

1) Early-maturing, smoothleaf varieties reduce the risk of late-season infestations by cotton bollworms and tobacco budworms, but these varieties are susceptible to plant bugs.

2) First (= Bollgard I) and second (= Bollgard II, WideStrike) generation, *Bacillus thuringiensis* (Bt)-transgenic cotton varieties do not control piercing-sucking insect (ex. aphids, plant bugs, thrips) pests. Second generation, Bt cotton varieties have improved resistance to most caterpillar pests except cutworms compared to Bollgard I varieties.

Cultural Practices:

1) Timely destruction, three or more weeks before planting, of weeds and/or cover crops will lessen the risk of cutworm and stalk borer infestations.

2) Optimize planting densities [2-4 plants / row foot (30- to 38-inch rows)] so individual plants are not crowded and maturity is not delayed.

3) Minimize the risk of plant bug infestations by mowing border vegetation BEFORE the cotton plants begin to square, and maintain a vegetative free zone (>10 feet in width) around the field to minimize the risk of spider mite infestations.

4) Timely termination of insecticide applications will help minimize control costs and insect resistance to these chemicals.

Insecticide Resistance Guidelines:

The potential risk of insecticide resistance is an important aspect to managing insect pests and harvesting a profitable cotton crop. The tobacco budworm is the key pest because of resistance to carbamate, organophosphate (OP), and pyrethroid insecticides. Plant bugs also have been documented to become resistant to OP's, and control failures were previously reported in Missouri when tarnished plant bugs had sustained infestations in many cotton fields. Insecticide resistance also has been reported for aphids, beet armyworms, and other pests. The following guidelines are primarily directed at tobacco budworms, but they also are useful to slow resistance by other pest species like plant bugs. The intent of these guidelines is to discourage the use of a single class of insecticide for managing cotton pests.

These guidelines are not intended to limit the professional judgement of qualified individuals dealing with unique pest situations. Because certain pest species (i.e. tobacco budworm) are highly mobile, the effectiveness of resistance management programs is maximized when adopted by every producer in a geographic area. The program's goals are to provide economic, season-long control of resistant pest species and minimize flaring of secondary pest outbreaks.

1) Optimize crop earliness by planting early-maturing varieties during April 20 to May 20. Soil temperatures of greater than 60 degrees F will lessen the chance of delayed seedling emergence and growth, and help reduce mortality caused by insects and the weather.

2) At-planting fungicides and insecticides will minimize plant stand loss and help promote seedling growth and early crop maturity.

3) Avoid excessive nitrogen rates and late-season applications that delay crop maturity.

Phase I (Planting to Pre-bloom)

- Avoid using pyrethroid insecticides when possible, and limit the use of organophosphates (ex. Curacron).
- Avoid automatic insecticide applications.
- Maintain beneficial insect populations that help suppress aphid and bollworm/tobacco budworm infestations.
- Strive for >80% first position fruit retention.

Phase II (Post-bloom to end-of-season)

- Scout fields once and preferably twice a week when pest populations are peaking.
- Bollworm/tobacco budworm treatments should be targeted at the egg and small larval (<1/4-inch in length) stages. Selection of insecticides should be based on the species composition of the bollworm/tobacco budworm complex. Agricultural consultants and producers can utilize pheromone trap data, moth flushing counts, etc. to determine the species complex.
- A minimum of two applications four to five days apart may be necessary for satisfactory control of moderate to heavy budworm infestations.
- Evaluate potential reasons (ex. population level and age structure, application timing, environmental conditions, and levels of insecticide resistance) in the event of a control failure with tobacco budworms. Avoid consecutive applications of insecticides from the same chemical class.

These insecticide management guidelines were partially adapted from those drafted by entomologists in Arkansas, Louisiana, Mississippi, and Tennessee.

Insect Control Termination:

Once cotton is at the "cutout" stage, the crop becomes less attractive to many late-season pests. Insecticide applications often can be discontinued when a majority of the harvestable bolls are past the economic loss stage caused by insects (ex. cotton bollworms, tobacco budworms). But, aphid, European corn borer, fall armyworm, and whitefly infestations may still pose a threat late in the season. European corn borers and fall armyworms can damage relatively mature bolls, and aphids plus whiteflies produce honeydew that can lower the lint quality and crop prices if not controlled.

An effective decision-making guide to determine when insecticide termination can occur is using heat unit accumulation to measure boll maturity. Current research suggests that the accumulation of 350-450 heat units (DD60s) from the "cutout" stage [Nodes Above White Flower (NAWF) = 5] is enough time for yield-producing bolls to mature beyond the stage that cotton bollworm and tobacco budworm feeding damage could cause economic losses. This generally corresponds to a calendar date of around August the 10th. Bolls should be protected for approximately 21 days.

Bacillus thuringiensis (Bt) Cotton Guidelines:

1) Current Bt-transgenic varieties are recommended for areas with a high risk for tobacco budworm and cotton bollworm infestations.

2) Do not trigger insecticide treatments for tobacco budworm and cotton bollworm infestations based on egg counts because larvae must first ingest a toxic dose of the Bt toxin.

3) Monitor fields weekly and examine blooms and under bloom tags of Bollgard I and II varieties for larvae feeding on developing bolls. Flower pollen has a lower expression of the Bt toxins in the Bollgard I and II technologies. Thus, larvae feeding on flowers are less

likely to die and may damage developing bolls beneath bloom tags. With the WideStrike technology, newer leaf tissue (ex. terminal) may have a lower expression of the Bt toxins than older tissue; therefore, more terminal damage may be observed with the WideStrike versus Bollgard technologies.

4) For 2005 there are three approved refuge options for planting Bt cotton. **Option 1:** With the 20% acreage refuge all Bollgard fields must lie within 1-mile of the refuge area, and this refuge area cannot be treated with foliar Bt sprays for control of tobacco budworms or cotton bollworms. Foliar insecticide treatments are recommended when 4 or more surviving larvae (¼-inch or greater in length) per 100 plants and/or 2% boll damage is present. **Option 2:** With the 5% refuge option, do not control tobacco budworms or cotton bollworms in these areas with any product specially targeted at these insects. This unsprayed refuge must be at least 150 feet wide. All Bollgard fields must lie within ½-mile of this unsprayed refuge option. **Option 3:** A third option is a non-Bt embedded 5% refuge. The refuge area can be embedded within a larger field or field unit (1-mile by 1-mile), and can be treated with any insecticide used to treat the Bollgard fields within the same 24-hour period. It also can serve as a community refuge area provided the distance and other requirements are met. Whether you chose the 5% or 20% refuge option, you should still control all non-caterpillar pests.

Second Generation Bt Cotton:

Bollgard II and WideStrike cotton each are a combination of two Cry toxins that provide a wider range of control of other caterpillar (ex. armyworms, cotton bollworm, loopers) pests than that obtained with the original Bollgard I cotton technology. Research indicates that both Bollgard II and WideStrike cotton probably will not require insecticide applications for caterpillar infestations except at high population levels. New thresholds and scouting procedures are still being developed at this time for second generation Bt cotton technologies; therefore, you should consider using thresholds originally developed for Bollgard I cotton unless otherwise advised. Do not expect control of cutworm infestations, nor do these new Bt cotton technologies control aphids, plant bugs, stink bugs, and other non-caterpillar pests. Refuge requirements for Bollgard II and WideStrike will remain the same as those recommended for Bollgard I cotton.

Insecticide Use:

Once-a-week scouting is usually sufficient to determine insecticide use; however, in areas with high insect pressure or rapidly increasing populations (ex. plant bugs), twice-a-week scouting may be required. Economic thresholds (ET), the pest density when treatment is needed to prevent pest populations from reaching economically damaging levels, have been established for most cotton pest species. Total fruit loss, nodes incurring loss, and the status of fruit positions on each node should be considered when utilizing an ET. Apply insecticides only when needed to preserve beneficial insect populations and prevent secondary pest outbreaks.

Precautions: All insecticides are poisons and should be handled with caution. Carefully follow manufacturer label directions before you buy, mix, apply, store, or dispose of any insecticide. Protective clothing and proper safety precautions are needed when applying an

insecticide. Growers, scouts, and farm laborers should communicate about when, where, and what insecticide was applied. Reentry periods vary by product, and scouts should not enter fields until the reentry interval has expired. Reentry and preharvest intervals for some insecticides are listed in Table 1. Do not apply long residual or highly toxic insecticides immediately adjacent to or over fish-bearing waters. An insecticide-free zone (50-100 feet) should be in place between the treated crop and bodies of open water.

Table 1. Reentry and preharvest intervals for selected insecticides used in cotton. This list does not include all insecticides labeled for cotton. Reentry and preharvest intervals for insecticides not listed can be found on the insecticide label.

Insecticide[1]	Reentry Interval (hours)	Preharvest Interval (days)
Ammo (P)	12	14
Asana (P)	12	21
Baythroid (P)	12	<1
Bidrin (OP)	48	30
Capture (P)	12	14
Centric (CN)	12	21
Comite (OS)	48	Do not apply after bolls open
Confirm (IGR)	4	14
Curacron (OP)	48	14
Decis (P)	12	21
Denim (SA)	48	21
Diamond (IGR)	12	30
dimethoate (OP)	48	14
Discipline (P)	12	14
Intrepid (IGR)	4	14
Intruder (CN)	12	28
Karate (P)	24	21
Kelthane MF (OC)	12	30
Lannate (CA)	72	15
Larvin (CA)	12	28
Lorsban (OP)	24	14
malathion (OP)	12	0
methyl parathion (OP)	4 days	7
Monitor (OP)	48	Do not apply after bolls open
Mustang Max (P)	12	14
Orthene (OP)	24	21
Ovasyn (F)	Wait until dry	21
Prolex (P)	24	21
Steward (Ox)	12	14
Tracer (SP)	4	28
Trimax (CN)	12	14
Vydate (CA)	48	21
Zephyr (SA)	12	20

[1] Classes of insecticides in this table are identified by the following abbreviations:

Carbamate - (CA)	Chloro-nicotinyl - (CN)	
Formamidine - (F)	Insect Growth Regulators - (IGR)	Organochlorine - (OC)
Organophosphate - (OP)	Organosulfur - (OS)	Oxadiazine (Ox)
Pyrethroid - (P)	Synthetic Avermectin – (SA)	Spinosyns - (SP)

Insects

Thrips: Cotton plants at the four-leaf stage or younger can be stunted by thrips feeding damage, and this injury can delay crop maturity. In-furrow systemic insecticide or seed treatments are recommended for preventive control; whereas, foliar sprays are for rescue treatments. In-furrow systemic insecticides (ex. aldicarb) also may suppress early-season aphid infestations. **Damage Symptoms: foliage brown, crinkled, and curled upward.**

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
In-furrow Granules:			In-order of preference for treating thrips by application types: 1. In-furrow 2. Seed treatments 3. Foliar In-furrow treatments can increase disease susceptibility; therefore, it is recommended to use an in-furrow fungicide at planting. Treat when 1 or more thrips per plant are present and before noticeable foliar damage has occurred on seedling plants.
aldicarb (Temik 15G)	3.33-5 lbs	0.5-0.75	
disulfoton (DiSyston 15G)	4-6.7 lbs	0.6-1	
In-furrow Systemic Sprays:			
acephate (Orthene 90S)	0.56-1.1 lb	0.50-1	
(Orthene 97G)	8-16 oz	0.49-0.97	
disulfoton (DiSyston 8E)	12-16 oz	0.75-1	
Foliar Sprays:			
acephate (Orthene 90S)	3.2 oz	0.18	
(Orthene 97G)	2.5-3.0 oz	0.15-0.18	
dicrotophos (Bidrin 8E)	3.2 oz	0.2	
dimethoate (4.0)	4-8 oz	0.05-0.2	
(2.67)	9.6 oz	0.2	
Seed Treatments:			
acephate (Orthene)	2.5-3.25 oz / 100 lbs. seed		
imidacloprid (Gaucho Grande)	12.8 oz / 100 lbs. seed		
thiamethoxam (Cruiser 5FS)	7.75 oz / 100 lbs. seed		

Cutworms: Damage to seedling cotton is greatest during normal to warm weather, and particularly in conventional-tillage fields with heavy cover vegetation or in reduced-tillage fields. **Damage Symptoms: Seedlings girdled at soil level or leaves clipped off.**

Insecticide (trade name)	Formulation Per Acre	Rate (lbs AI/Acre)	Comments
acephate (Orthene 90S)	12.8 oz	0.72	Destroy all green vegetation 14-21 days prior to planting to minimize the risk of cutworm attack. Spot treat when stands are reduced to <3 plants/ row ft.
(Orthene 97G)	12 oz	0.73	
bifenthrin (Capture 2E, Discipline 2E, Fanfare 2E)	2.6-6.4 oz	0.04-0.1	
chlorpyrifos (Lorsban 4E)	16-32 oz	0.5-1.0	
cyfluthrin (Baythroid 2E)	0.8-1.6 oz	0.0125-0.025	
cypermethrin (Ammo 2.5E)	1.3-5.0 oz	0.025-0.1	
deltamethrin (Decis 1.5E)	1.11-1.62 oz	0.013-0.019	
esfenvalerate (Asana XL 0.66E)	5.8-9.6 oz	0.03-0.05	
gamma-cyhalothrin (Prolex 1.25CS)	1.02-1.54 oz	0.01-0.015	
lambda-cyhalothrin (Karate 2.08CS)	0.96-1.28 oz	0.015-0.02	
thiodicarb (Larvin 3.2F)	24 oz	0.6	
zeta-cypermethrin (Mustang Max 0.8E)	1.28-1.92 oz	0.008-0.012	

Plant Bugs / Cotton Fleahoppers: There are two plant bug species (clouded and tarnished plant bug) plus cotton fleahoppers commonly found in Missouri. Plant bugs cause injury by extracting plant juices, and these plants will abort damaged squares and small bolls. Cotton fleahopper damage also can cause plants to develop spindly branches. The most severe injury from these insects occurs during the first four weeks of the fruiting season. Environmental conditions that lead to carbohydrate stress also cause square shedding; therefore, be sure insects are causing this fruit shed before applying insecticides. Scouting efforts should be intensified for plant bugs and other pests if square retention drops below 80% at first position sites before bloom. Examine border vegetation to determine the extent of plant bug populations in an area. Fields treated for plant bugs should be closely monitored until harvest for subsequent aphid and/or bollworm infestations. **Damage Symptoms: square shed; deformed and brownish-colored blooms; young bolls stunted with reddish-brown specks, bolls eventually turn yellow and fall off the plant.**

Insecticide (trade name)	Formulation Per Acre	Rate (lbs AI/Acre)	Comments
acephate (Orthene 90S)	5-16 oz	0.28-0.90	Treat once squaring begins:
(Orthene 97G)	5-16 oz	0.30-0.97	
dicrotophos (Bidrin 8E)	4-8 oz	0.25-0.5	1st week: 6-8 per 100 row feet
dimethoate (4.0)	8-16 oz	0.25-0.5	2nd week: 8-10 per 100 row feet
(2.67)	9.6 oz	0.2	3rd week: 10-12 per 100 row feet
imidacloprid (Trimax 4SC)	1.5 oz	0.047	4th week: 15 or more per 100 row feet
oxamyl (Vydate C-LV 3.77)	8-16 oz	0.24-0.47	
thiamethoxam (Centric 40WG)	2 oz	0.05	To minimize control failures associated with plant bug resistance, rotate insecticide chemistries after two applications.

Boll Weevil: The Missouri Boll Weevil Eradication Program was initiated in August of 2001, and Southeastern Boll Weevil Eradication Foundation personnel are now responsible for eliminating boll weevil infestations in Missouri. **Any evidence of boll weevil infestations should be immediately reported to Missouri Boll Weevil Eradication Program personnel (866-310-8502). Ultra low volume (ULV) Malathion sprays are specifically targeted at weevil infestations.**

***Aphids*:** These are tiny, variable colored (green, yellow, or black), soft-bodied insects. **Damage symptoms: leaf margins curl downward and honeydew present on leaves.** Honeydew in turn serves as a growing medium for black mold that can stain the cotton lint. An insecticide treatment may become necessary when numerous aphids are present per leaf, honeydew is present, and natural control agents are absent or ineffective in suppressing aphid populations.

Insecticide (trade name)	Formulation Per Acre	Rate (lbs AI/Acre)	Comments
acetamiprid (Intruder 70WP)	0.7-1 oz	0.031-0.047	Use another class of insecticide for aphids once a class has been previously used in a field.
dicrotophos (Bidrin 8E)	4-8 oz	0.25-0.5	
dimethoate (4.0)	4-8 oz	0.125-0.25	
(2.67)	12-20 oz	0.25-0.4	

methamidophos (Monitor 4) imidacloprid (Trimax 4SC) thiamethoxam (Centric 40WG)	16-24 oz 1.0-1.5 oz 1.25-2 oz	0.5-0.75 0.031-0.047 0.031-0.05	Utilize 5 gal volume by air and as much volume as possible by ground with hollowcone nozzles.

***Spider Mites*:** These animals are not insects but relatives of spiders. Spider mites typically feed on the underside of leaves and cause damage by removal of plant fluids. If damage is severe and defoliation occurs, there can be a reduction in both lint quantity and quality.

Infestations generally start along field margins where the spider mites migrate from overwintering vegetation. Generally, the most severe damage occurs mid- to late-season during periods of hot, dry weather. Spider mites can be easily transported across fields by animals, equipment, and/or people. A useful cultural control practice is to maintain a vegetation-free zone (10-20 feet wide) between the cotton and border vegetation. Should a miticide application become necessary, spot treating border areas can help slow the spread of mite infestations. To obtain proper control of spider mites, a miticide must be thoroughly applied onto both sides of the leaf. Two miticide applications 5-7 days apart are necessary to control large spider mite infestations. **Damage symptoms: leaves with reddish discoloration, complete defoliation.**

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
abamectin (Zephyr 0.15E)	4-16 oz	0.00465-0.0093	Spot treatments of infested border areas may help prevent the spread of spider mites across the entire field.
bifenthrin (Capture 2E, Discipline 2E, Fanfare 2E)	4-6 oz	0.06-0.09	
dicofol (Kelthane MF 4E)	32-48 oz	1-1.5	
emamectin benozate (Denim 0.16E)*	8-12 oz	0.01-0.015	
profenofos (Curacron 8E)*	12-16 oz	0.75-1	*Products may only suppress spider mite populations.
propargite (Comite 6.55)	24-32 oz	1.2-1.6	

***Cotton Bollworm and Tobacco Budworm*:** Both insects feed on cotton fruiting structures, but bollworms are more frequently observed than tobacco budworms in Missouri. Adult females singly deposit 1000 or more eggs onto the plant's terminal, foliage, blooms, and/or squares. **Damage symptoms: terminals, squares, blooms, and bolls with holes.**

When scouting for bollworm eggs and larvae it is important to examine the whole plant and its fruiting structures (particularly underneath the bloom tags). Generally, the biggest threat from bollworm infestations begins when corn stops silking. Bollworm moths are attracted to cotton that is blooming, and fields must be scouted one to two times each week until the last effective boll population matures. If armyworms or tobacco budworms also are present, you will need to tank-mix pyrethroids with other classes of insecticides. Pyrethroids are less effective because of budworm resistance and armyworm tolerance.

Cotton Bollworm			
Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
Carbamates: methomyl (Lannate 1.8L) thiodicarb (Larvin 3.2F)	 2-3 pt 24-32 oz	 0.45-0.675 0.6-0.8	Treat when 10 small larvae (less than 1/4 inch) per 100 plants are present.

Organophosphates:			For Bt cotton, treat when 4 or more larvae (greater than 1/4 inch) per 100 plants are present.
acephate (Orthene 90S)	16 oz	0.90	
(Orthene 97G)	16 oz	0.97	
profenofos (Curacron 8E)	12-16 oz	0.75-1	
Pyrethroids:			Avoid use of pyrethroids before July the 1st.
bifenthrin (Capture 2E, Discipline 2E, Fanfare 2E)	2.6-6.4 oz	0.04-0.1	
cyfluthrin (Baythroid 2E)	1.6-3.2 oz	0.025-0.05	
cypermethrin (Ammo 2.5E)	2 oz	0.04	
deltamethrin (Decis 1.5E)	1.62-2.56 oz	0.019-0.03	
esfenvalerate (Asana XL 0.66E)	5.8-9.6 oz	0.03-0.05	
gamma-cyhalothrin (Prolex 1.25CS)	1.28-2.05 oz	0.0125-0.02	
lambda-cyhalothrin (Karate 2.08CS)	1.6-2.56 oz	0.025-0.04	
zeta-cypermethrin (Mustang Max 0.8E)	2.64-3.6 oz	0.0165-0.0225	
Other classes:			
emamectin benozate (Denim 0.16E)	8-12 oz	0.01-0.015	
indoxacarb (Steward 1.25SC)	9.2-11.3 oz	0.09-0.11	
spinosad (Tracer 4SC)	2.14-2.87 oz	0.067-0.089	
Ovicides:			Ovicides are not stand alone materials, and should be tank mixed with other insecticides. Do not apply greater than 1.0 lb. AI/A of Ovasyn.
amitraz (Ovasyn 1.5)	21 oz	0.25	
methomyl (Lannate LV 2.4)	12 oz	0.23	
profenofos (Curacron 8E)	4 oz	0.25	
thiodicarb (Larvin 3.2F)	10 oz	0.25	
Bacillus thuringiensis Bollgard I, Bollgard II, WideStrike	---	---	

Tobacco Budworm

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
Carbamates:			For conventional cotton treat when 10 small larvae (less than 1/4 inch) per 100 plants are present.
methomyl (Lannate 1.8L)	2-3 pt	0.45-0.675	
thiodicarb (Larvin 3.2F)	24-32 oz	0.6-0.8	
Organophosphates:			
profenofos (Curacron 8E)	12-16 oz	0.75-1	
Other classes:			
emamectin benozate (Denim 0.16E)	8-12 oz	0.01-0.015	
indoxacarb (Steward 1.25SC)	9.2-11.3 oz	0.09-0.11	
spinosad (Tracer 4SC)	2.14-2.87 oz	0.067-0.089	
Ovicides:			Do not apply >1.0 lb. AI/A of Ovasyn. Ovicides are not stand alone materials, and should be tank mixed with other insecticides.
amitraz (Ovasyn 1.5)	21 oz	0.25	
methomyl (Lannate LV 2.4)	12 oz	0.23	
profenofos (Curacron 8E)	4 oz	0.25	
thiodicarb (Larvin 3.2F)	10 oz	0.25	

Bacillus thuringiensis Bollgard I, Bollgard II, WideStrike	---	---	

European Corn Borer: This caterpillar species is an infrequent cotton pest, and infestations usually occur once nearby host plants (ex. corn) mature and dry down. A female moth typically lays 5 to 50 eggs in masses on the underside of leaves. Since European corn borer larvae only feed on the boll exterior for a few days after hatching, insecticides must be applied before they enter the boll (near the calyx) so to obtain adequate control. **Damage symptoms: bolls and/or stems with holes and sawdust-like droppings.**

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
Bacillus thuringiensis Bollgard I, Bollgard II, WideStrike	---	---	Examine 5 plants / location (10 / field) for larvae and feeding damage. Missouri currently has no threshold for this pest. In North Carolina, the threshold is 3% or more of the plants infested with young live larvae.
bifenthrin (Capture 2E, Discipline 2E, Fanfare 2E)	3.2 oz	0.05	
cyfluthrin (Baythroid 2E)	1.8-2.1 oz	0.028-0.033	
cypermethrin (Ammo 2.5E)	3.1-4.1 oz	0.06-0.08	
deltamethrin (Decis 1.5E)	1.6-2.6 oz	0.019-0.03	
gamma-cyhalothrin (Prolex 1.25CS)	2.05 oz	0.02	
lambda-cyhalothrin (Karate 2.08CS)	2.56 oz	0.04	
zeta-cypermethrin (Mustang Max 0.8E)	2.64-3.6 oz	0.0165-0.0225	

***Fall Armyworm*:** Generally, fall armyworms are only a sporadic pest in Missouri; however, they can cause significant boll damage when present in large numbers. Because fall armyworm larvae only feed on the boll exterior for a few days after hatching, insecticides must be applied before the larvae enter the bolls to obtain adequate control. **Damage symptoms: bolls with holes at the base of the leaf bracts.**

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
Bacillus thuringiensis Bollgard II, WideStrike	---	---	Be sure fall armyworm infestations are economic (more than 4 larvae per 100 bolls and blooms) before treating fields.
chlorpyrifos (Lorsban 4E)	1 qt	1.0	
emamectin benozate (Denim 0.16E)	8-12 oz	0.01-0.015	
indoxacarb (Steward 1.25SC)	9.2-11.3 oz	0.09-0.11	
methomyl (Lannate 1.8L)	1 qt	0.45	
methoxyfenozide (Intrepid 2F)	4-10 oz	0.06-0.16	
profenofos (Curacron 8E)	16 oz	1.0	
spinosad (Tracer 4SC)	2.14-2.87 oz	0.067-0.089	
tebufenozide (Confirm 2F)	8-16 oz	0.012-0.25	
thiodicarb (Larvin 3.2F)	24-36 oz	0.6-0.9	

Beet Armyworm: This armyworm species is an infrequent pest in Missouri. Initially, larvae attack the foliage before feeding on the squares, blooms, or bolls. Fields most at risk from beet armyworm infestations are ones where beneficials were eliminated with insecticides or in weedy ones (particularly with pigweed). An established beet armyworm infestation is

extremely difficult to control with currently labeled insecticides; therefore, maximize use of existing beneficial insects. High beet armyworm infestations may require multiple, close interval (3-5 days) applications of insecticides. Optimize insecticidal control by targeting small larvae (less than 1/4-inch in length) and applying insecticides to the underside of leaves. **Damage symptoms: 'skeletonized' foliage.**

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
Bacillus thuringiensis Bollgard II	---	---	Treat pre-August 15 at 5-6 hits (egg masses and/or larval clusters) per 300 row ft.; post-August 15 treat at 10 hits per 300 row ft.
emamectin benozate (Denim 0.16E)	6-8 oz	0.0075-0.01	
indoxacarb (Steward 1.25SC)	9.2-11.3 oz	0.09-0.11	
methoxyfenozide (Intrepid 2F)	4-10 oz	0.06-0.16	
spinosad (Tracer 4SC)	2.14-2.87 oz	0.067-0.089	
tebufenozide (Confirm 2F)	8-16 oz	0.012-0.25	

Bandedwing Whiteflies: These small (<1/16-inch in length) insects remove sap from plants and cause premature defoliation and poor boll development. Economic infestations are rare in Missouri, but closely monitor infestations after detection (visual or flushing adults) because of their rapid (<2 weeks) generation turnover. Thorough coverage of the entire plant is necessary for adequate control. **Damage symptoms: honeydew deposits on foliage.**

Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
acephate (Orthene 90S)	8-16 oz	0.45-0.90	Treat when 50% of terminals are infested with adults.
(Orthene 97G)	8-16 oz	0.49-0.97	
acetamiprid (Intruder 70WP)	1 oz	0.031-0.047	
methamidophos (Monitor 4)	8-16 oz	0.25-0.5	
thiamethoxam (Centric 40WG)	2 oz	0.05	

Loopers: Both species (cabbage and soybean) may infest cotton but soybean looper infestations are extremely rare in Missouri. **Damage symptoms: ragged holes in foliage.**

Insecticide (trade name)	Formulation Per Acre	Rate (lbs AI/Acre)	Comments
acephate (Orthene 90S)	16 oz	0.90	Treat when defoliation reaches 25% and developing bolls are present.
(Orthene 97G)	16 oz	0.97	
Bacillus thuringiensis Bollgard II, WideStrike	---	---	
indoxacarb (Steward 1.25SC)	9.2-11.3 oz	0.09-0.11	
methoxyfenozide (Intrepid 2F)	4-10 oz	0.06-0.16	
spinosad (Tracer 4E)	2.14-2.87 oz	0.067-0.089	
tebufenozide (Confirm 2F)	8-16 oz	0.125-0.25	
thiodicarb (Larvin 3.2F)	24-36 oz	0.6-0.9	

Stink bugs: Both green and several species of brown stink bugs may feed on cotton, but economic infestations of these piercing-sucking insects are uncommon in Missouri. Proper

identification is important because not all stink bug species are pests, nor are the pest species equally susceptible to different insecticides. Because stink bugs eggs are laid in masses, infestations are sporadically clumped in the field. **Damage symptoms: bolls (outside) small, sunken, black spots; (inside) 'warty' growth on the inner boll wall, seeds discolored.**

Brown Stink Bugs			
Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
acephate (Orthene 90S)	12.8 oz	0.72	Use a drop cloth and take 10 samples / field. Also, open and inspect a few bolls for stained lint and seeds. Treat when 1 or more large nymph or adult per 6 row feet are present, or when 20% of thumb-sized bolls display internal warts and/or stained lint plus stink bugs are observed.
(Orthene 97G)	12 oz	0.73	
dicrotophos (Bidrin 8E)	4-8 oz	0.25-0.5	
methyl parathion (4E)	16 oz	0.5	
(Penncap-M 2)	32 oz	0.5	
oxamyl (Vydate C-LV 3.77)	10.9-17 oz	0.32-0.50	

Green Stink Bugs			
Insecticide (trade name)	Formulation per Acre	Rate (lbs AI/Acre)	Comments
acephate (Orthene 90S)	12.8 oz	0.72	See above
(Orthene 97G)	12 oz	0.73	
dicrotophos (Bidrin 8E)	4-8 oz	0.25-0.5	
gamma-cyhalothrin (Prolex 1.25CS)	1.28-2.05 oz	0.0125-0.02	
lambda-cyhalothrin (Karate 2.08CS)	1.6-2.56 oz	0.025-0.04	
methyl parathion (4E)	16 oz	0.5	
(Penncap-M 2)	32 oz	0.5	
oxamyl (Vydate C-LV 3.77)	10.9-17 oz	0.32-0.50	
zeta-cypermethrin (Mustang Max 0.8E)	2.64-3.6 oz	0.0165-0.0225	

Pesticides recommended in this publication were only registered for prescribed uses when printed. Should registration of a recommended pesticide be canceled, the University of Missouri will no longer recommend it. Use of trade or brand names in this publication is for clarity and information purposes. It does not imply approval of the product to the exclusion of others with similar composition, nor does it guarantee the standard of the product.