

INSECT CONTROL ON COTTON

J. S. BACHELER, Entomology Extension; J. W. VAN DUYN, Entomology Extension and Research

NOTE: A Mode of Action code has been added to the Insecticide and Formulation column of this chart. Use this designation by the Insecticide Resistance Action Committee, to combat the development of insecticide resistance.

TABLE 5-5A. INSECT CONTROL ON COTTON

Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre				Acres/gal (lb)		Pre-harvest interval (days)	Precautions and Remarks	
		Amount		Active lb		*	**			
		*	**	*	**					
BEET ARMYWORM	indoxacarb, MOA 22 (Steward) 1.25 SC	9.2 to 11.3 oz		0.09 to 0.11		14 to 11.5		14	Bollgard II and WideStrike varieties show high resistance to beet armworm damage.	
	methoxyfenozone, MOA 18A (Intrepid) 2F	4.0		0.06		33		14		
	spinosad, MOA 5 (Tracer) 4 SC	2.14 to 2.9 oz		0.067 to 0.089		60 to 45		28		
BOLLWORM* TOBACCO BUDWORM	Bollgard, MOA 11B2 (various varieties)								The CryIA(c) gene in Bollgard produces the delta endotoxin <i>Bacillus thuringiensis</i> (<i>Bt</i>). High activity against budworms and European corn borers; good activity against bollworms; poor activity against armyworms and loopers; no activity against cutworms. No activity against insects other than caterpillars.	
	Bollgard II, MOA 11B2 (various varieties)								CryIA(c) and Cry2A(b) genes in Bollgard II produce two <i>Bacillus thuringiensis</i> (<i>Bt</i>) delta endotoxins. High activity against all pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars.	
	WideStrike, MOA 11B2 (various varieties)								CryIA(c) and CryIF genes in WideStrike produce two <i>Bacillus thuringiensis</i> (<i>Bt</i>) delta endotoxins. Good to high activity against budworms and European corn borers; high activity against all pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars.	
	bifenthrin, MOA 3 (Brigade, Capture, Discipline) 2 EC	2.6 oz	6.4 oz	0.04	0.1	50	20	14	High pressure (50 to 70 psi) and low volume (6 to 10 gpa) advised.	
	cyfluthrin, MOA 3 (Baythroid XL) 1.0 EC	1.6 oz	2.6 oz	0.013	0.021	77	47.6	0		
	cypermethrin, MOA 3 (Ammo) 2.5 EC	2 oz	5 oz	0.04	0.1	62.5	25	14		
	deltamethrin, MOA 3 (Decis) 1.5 EC	1.6 oz	2.6 oz	0.019	0.03	79	50	14		
	esfenvalerate, MOA 3 (Asana XL) 0.66 EC	5.8 oz	9.6 oz	0.03	0.05	22	13.2	21		
	gamma-cyhalothrin, MOA 3 (Prolex) 1.25 EC	1.28	2.05	0.0125	0.02	100	62.5	21		
	lambda-cyhalothrin, MOA 3 (Karate Z) 2.08 CS (Karate) 1.0 EC	1.6 oz 3.2	2.56 oz 5.12	0.025 0.025	0.04 0.04	83 40	52 25	21 21		
	zetamethrin, MOA 3 (Mustang Max) 0.8 EC	2.64 oz	3.6 oz	0.0165	0.0225	48.5	35.5	14		
	spinosad, MOA 5 (Tracer) 4 SC	1.4 oz	2.9 oz	0.045	0.089	90	45	28		For second generation tobacco budworms, 0.045 lb active per acre Tracer is adequate; for post-bloom bollworms, use the 0.067 to 0.089 lb Tracer rate. Tracer must be applied to early stage larvae for effective control.
	indoxacarb, MOA 22 (Steward) 1.25 SC	9.2	11.3 oz	0.09	0.11	13.9	11.4	14		Steward must be applied to early stage larvae for effective control. Use lower rate for <i>Bt</i> cottons.
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	24 oz (1.5 pt) 0.5 lb		0.45 0.45		5.3 2		15 15		Curacron, Larvin, and Lannate are best suited for mixed populations of bollworms and fall armyworms. Do not apply more than 1.8 lb active of Lannate per acre.
	profenophos, MOA 1B (Curacron) 8 EC	16 oz (1 pt)		1		8		14		
thiodicarb, MOA 1A (Larvin) 3.2F	30 oz (1.875 pt)		0.75		4.3		28			
COTTON APHID	acetamiprid, MOA 4A (Assail) 70 WP	0.6 to 1.1 oz		0.025 to 0.05		28 to 14		28		Due to a high potential for cotton aphid resistance to insecticides, treat for cotton aphids only as a last resort.
	flonicamid, MOA 9C (Carbine) 50 WG	1.4 to 2.8 oz		0.044 to 0.089		22.7 to 11.2		30		
	imidacloprid, MOA 4A (Trimax) 4.0 F	1 to 1.5 oz		0.03 to 0.047		128 to 85		14		
	thiamethoxam, MOA 4A (Centric) 40 WG	1.25 to 2 oz		0.03 to 0.05		13.3 to 8		21		
COTTON APHID and BOLLWORM	imidacloprid, MOA 4A + cyfluthrin, MOA 3 (Leverage) 2.7 SE	3 to 3.75 oz		0.037 to 0.05		42.7 to 34.1		14	May be used with threshold levels of both cotton aphids and bollworms.	
	thiamethoxam, MOA 4A + lambda-cyhalothrin, MOA 3 (Endigo ZC) 2.06 SE	3.5 to 5.5 oz		0.03 to 0.05		37 to 23		21		

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Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre				Acres/gal (lb)		Pre-harvest interval (days)	Precautions and Remarks
		Amount		Active lb		*	**		
		*	**	*	**				
EUROPEAN CORN BORER	Bollgard, MOA 11B2 (various varieties)							The CryIA(c) gene in Bollgard produces the delta endotoxin <i>Bacillus thuringiensis</i> (Bt). High activity against budworms and European corn borers; good activity against bollworms; poor activity against armyworms and loopers; no activity against cutworms. No activity against insects other than caterpillars.	
	Bollgard II, MOA 11B2 (various varieties)							CryIA(c) and Cry2A(b) genes in Bollgard II produce two <i>Bacillus thuringiensis</i> (Bt) delta endotoxins. High activity against all pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars.	
	WideStrike, MOA 11B2 (various varieties)							CryIA(c) and CryIF genes in WideStrike produce two <i>Bacillus thuringiensis</i> (Bt) delta endotoxins. Good to high activity against budworms and European corn borers; high activity against all pest caterpillar species on cotton except cutworms. No activity against insects other than caterpillars.	
	bifenthrin, MOA 3 (Capture) 2 EC	3.2 oz		0.05		40		14	European corn borers are generally more of a problem in rank cotton. Multiple applications may be necessary. Other bollworm materials may provide some control
	cyfluthrin, MOA 3 (Baythroid) 2 EC	1.8 to 2.1 oz		0.028 to 0.033		71.4 to 60.6		0	
	cypermethrin, MOA 3 (Ammo) 2.5 EC	3.1 to 4.1 oz		0.06 to 0.08		41.7 to 31.3		14	
	deltamethrin, MOA 3 (Decis) 1.5 EC	1.6 to 2.6 oz		0.019 to 0.030		79 to 50		14	
	lamda-cyhalothrin, MOA 3 (Karate Z) 2.08 CS	1.6 oz		0.025		80		21	
tralomethrin, MOA 3 (Scout X-tra) 0.9 EC	2.6 to 3.4 oz		0.018 to 0.024		50 to 37.5		28		
zetamethrin, MOA 3 (Fury) 1.5 EC (Mustang Max) 0.8 EC	3.2 to 3.8 oz 2.9 to 3.55 oz		0.0375 to 0.045 0.018 to 0.025 oz		40 to 33 44.4 to 32		14		
FALL ARMYWORM	chlorpyrifos, MOA 1B (Lorsban) 4 E	1 to 2 pt		0.5 to 1		8 to 4		14	
	indoxacarb, MOA 22 (Steward) 1.25 SC	9.2 to 11.3 oz		0.09 to 0.11		14 to 11.5		14	
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	1.5 pt 0.5 lb		0.45 0.45		5.3 2		15 15	
	methoxyfenozide, MOA 1BA (Intrepid) 2F	4 to 10		0.06 to 0.16		33 to 12.5		14	
	profenofos, MOA 1B (Curacron) 8 EC	0.5 to 1 pt		0.5 to 1		16 to 8		14	
	spinosad, MOA 5 (Tracer) 4 SC	2.14 to 2.9 oz		0.067 to 0.089		60 to 45		28	
	thiodicarb, MOA 1A (Larvin) 3.2 F	24 to 36 oz		0.6 to 0.9		5.3 to 3.6		28	
PLANT BUG	acephate, MOA 1B (Orthene and other brands) 75 S 90 S 97 ST	0.3 to 1.3 lb 0.25 to 1 lb 0.25 to 1 lb		0.25 to 1 0.225 to 0.9 0.24 to 0.97		3.3 to 0.77 4 to 1 4 to 1		21 21 21	Prebloom 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. Postbloom treatment more likely in low-spray environment, such as with Bollgard Cotton. Fields adjacent to Irish potatoes, weed fields, and other sources of plant bugs may be at higher risk of plant bug injury.
	acetamiprid, MOA 4A (Assail) 70 WP	1.1 oz		0.5		14		28	
	chlorpyrifos, MOA 1B (Lorsban) 4 EC	6.1 oz		0.19		21		14	
	dicrotophos, MOA 1B (Bidrin) 8 EC	4 to 8 oz		0.25 to 0.5		32 to 16		10	
	imidacloprid, MOA 4A (Trimax) 4 F	1 to 1.5 oz		0.03 to 0.047		128 to 85		14	
	methomyl, MOA 1A (Lannate) 2.4 LV (Lannate) 90 SP	12 oz 0.25 lb		0.225 0.225		10.7 4		15 15	
	methyl parathion, MOA 1B 4 EC	8 oz		0.25		16		7	
	oxamyl, MOA 1A (Vydate) 3.77 C-LV	8.5 oz		0.25		15		21	
	profenofos, MOA 1B (Curacron) 8 EC	4 oz		0.25		32		7	
	thiamethoxam, MOA 4A (Centric) 40 WP	2 oz		0.047		8		21	

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Insect	Insecticide, Mode of Action (MOA), and Formulation	Per Acre				Acres/gal (lb)		Pre-harvest interval (days)	Precautions and Remarks	
		Amount		Active lb		*	**			
		*	**	*	**					
SOYBEAN and CABBAGE LOOPER	emamectin benzoate, MOA 6 (Denim) 0.16 EC	6 to 12 oz		0.01 to 0.015		10.6 to 16		21	Cabbage loopers usually controlled by naturally occurring diseases. Bollgard II and WideStrike varieties show high resistance to looper damage.	
	indoxacarb, MOA 22 (Steward) 1.25 SC	6.7 to 9.2 oz		0.065 to 0.09		19 to 14		14		
	methoxyfenozide, MOA 18A (Intrepid) 2F	4 to 10		0.06 to 0.16		33 to 12.5		14		
	spinosad, MOA 5 (Tracer) 4 SC	2.14 to 2.9 oz		0.067 to 0.089		60 to 45		28		
SPIDER MITE	bifenthrin, MOA 3 (Brigade, Capture, Discipline) 2 EC	3.8 oz		0.06		33		14	Control rarely necessary because of beneficial arthropods and fungi. Apply with 20-plus gal of water.	
	dicofol, MOA UNC (Dicofol) 4 E	0.8 to 1.6 qt		0.8 to 1.6		5 to 2.5		14		
	entoxazole, MOA 10B (Zeal) 72 WP	0.66 to 1 oz		0.03 to 0.045		45 to 30		28		
	fenproprathrin, MOA 3 (Danitol) 2.4 EC	10.7 to 16 oz		0.2 to 0.3		12 to 8		21		
	propargite, MOA 12C (Comite) 6.55 L	1 qt		1.6		4		14		
	methidathion, MOA 1B (Supracide) 2E	2 qt		1		2		60		Do not apply after bolls begin to open. Use 20+ gal of water.
	spiromesifen, MOA 23 (Oberon) 2 SC	6 to 16 oz		0.094 to 0.25		21.3 to 8		30		Use 6 oz only in early season to control low populations.
STINK BUG	acephate, MOA 1B (Orthene) 75 S (Orthene) 97 S	1 0.75		0.75 0.75		1 1.3		21	Stink bugs may be more prevalent on unsprayed or less sprayed Bollgard cotton. Bidrin and methyl parathion are more effective against brown stink bugs than other products. PennCap-M is highly toxic to bees. Do not apply this product or allow to drift to blooming cotton if bees are in treated areas. Pyrethroids control green stink bugs, but are less effective against brown stink bugs.	
	dicrotophos, MOA 1B (Bidrin) 8 EC	4 to 8 oz 0.25 to 0.5		32 to 16				10		
	methyl parathion, MOA 1B 4 EC (PennCap-M) 2 FM	1 pt 2 pt		0.5 0.5		8 4		7 7		
	oxamyl, MOA 1A (Vydate) 3.77 SL	17 oz		0.5		7.5		21		
	pyrethroids, MOA 3	(see bollworms above for rates)				—		—		
	THRIPS (at planting treatment)	aidicarb, MOA 1A (Temik) 15 G	3 to 5 lb		0.45 to 0.75		—			—
imidacloprid, MOA 4A (Gaucho Grande) 600		—		0.375 mg/seed		—		—		
thiamethoxam, MOA 4A (Cruiser) 5 FS		—		0.320 mg/seed		—		—		
THRIPS (post-emergence)	acephate, MOA 1B (Orthene) 75 S (Orthene) 90 S (Orthene) 97 S (Orthene) 97 ST***	3 to 4 oz 0.2 lb 2.5 to 3 oz 6 oz		0.14 to 0.19 0.18 0.15 to 0.18 0.375		5.3 to 4 (lb) 5 (lb) 6.4 to 5.3 (lb) 2.67 (lb)		21	Not suggested to replace at-plant insecticides in conventional cotton. In ultra-narrow row cotton, foliar treatment for thrips may be primary control measure. With the high thrip populations often found in North Carolina, consider 0.25 lb a.i. per acre the standard rate for Orthene.	
	dicrotophos, MOA 1B (Bidrin) 8 EC	4 oz		0.25		32		10		
	dimethoate, MOA 1B 4 EC	8 oz		0.25		16		10		
	methamidophos, MOA 1B (Monitor) 4 EC	6.4 oz		0.2		20		50		
	phosphorothioate, MOA 1B (Metasystox-R)	16 oz		0.25		8		14		

Dosages may need to be increased during heavy infestations or in extremely rank cotton. Do not exceed full labeled rate.

* Lowest labeled rates for bollworms and budworms

** Highest labeled rates for bollworms and budworms

*** 2 (ee) state local need label for higher rates

NOTE: Upper or lower rate ranges do not indicate equivalent activity.

COTTON INSECT RESISTANCE MANAGEMENT

J. S. BACHELER, Entomology Department

Resistance occurs when some insects in a population survive a chemical treatment and are therefore able to pass on an inherited reason for this survival to its offspring. Because these offspring are better able to survive the insecticide than those that are not resistant, the resistant individuals increase their numbers faster in the presence of the insecticide. After several generations, the resistant insects can outnumber the susceptible ones, and the insecticide becomes ineffective. Because the genes that allow insects to survive an insecticide are often initially present in a few individuals out of a very large population of susceptible insects, resistance development may take years. One to 20 years would be a common range for effectiveness of many insecticides.

Insects vary greatly in their “ability” to develop resistance to insecticides. For example, cotton aphids have been able to develop resistance to various classes of chemicals rapidly, while the boll weevil remains susceptible to several organophosphate insecticides after more than 50 years.

Insects develop resistance to insecticides in several ways. Some are able to break down (metabolize) insecticides, while others are able eliminate the toxins. Some can sequester insecticides (move them to a less harmful place in or on the body), and still others can avoid the toxin (behavioral resistance). The above are examples of different modes of action (MOA). Unfortunately, once an insect develops resistance to one insecticide, in most

cases the insect is also resistant to others in the same class or group of insecticides. For example, if tobacco budworms are resistant to the pyrethroid Baythroid, they are also resistant to the pyrethroid Karate. To make matters worse, some insects may be resistant to several classes of insecticides, such as is presently the case with plant bugs in the Midsouth.

As you can see from the table below, many different kinds possible insecticide resistance have been identified. Most have complicated, hard-to-remember names. To make it easy to recognizing different classes or modes of actions that can lead to resistance development, each chemical has been identified with a number, and occasionally subdivided with a letter. Products sharing the same number or letter and number combination have the same mode of action.

One major strategy in managing resistance is to avoid using products with the same mode of action (sharing the same number in the table) in the same year. Also, tank mixing insecticides with different modes of action may delay resistance development. Additionally, if only a single class of insecticides is listed for control of an insect (e.g., Assail, Centric, and Trimax Pro – all chloronicotinoids – for cotton aphids), one should try to either limit insecticide use to a single spray or try to avoid treatment.

Listed below are the economically important cotton pests found in North Carolina, followed by the chemical and brand names and mode of action.

Table 5-5B. Cotton Insecticide Modes of Action (MOA); Insecticide Resistance Action Committee Designations

Insect	Chemical Name (Brand Name)	Mode of Action
BEET ARMYWORM	indoxacarb (Steward)	22
	methoxyfenozide (Intrepid)	18A
	spinosad (Tracer)	5
BOLLWORM/TOBACCO BUDWORM	<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> (Bollgard, Bollgard II, and Widestrike: delta endotoxin expressed by various varieties)	11B2
	bifenthrin (Brigade, Capture, Discipline, others)	3
	cyfluthrin (Baythroid)	3
	cypermethrin (Ammo)	3
	deltamethrin (Decis)	3
	esfenvalerate (Asana XL)	3
	gamma-cyhalothrin (Prolex)	3
	lambda-cyhalothrin (Karate, Karate Z)	3
	zetamethrin (Mustang Max)	3
	spinosad (Tracer)	5
	indoxacarb (Steward)	22
	methomyl (Lannate)	1A
	COTTON APHID	acetamiprid (Assail)
flonicamid (Carbine)		9C
imidacloprid (Trimax Pro)		4A
thiamethoxam (Centric)		4A
COTTON APHID & BOLLWORM	imidacloprid + cyfluthrin (Leverage)	4A + 3
EUROPEAN CORN BORER	Bollgard (various varieties)	11B2
	Bollgard II (various varieties)	11B2
	Widestrike (various varieties)	11B2
	bifenthrin (Brigade, Capture, Discipline, others)	3
	cyfluthrin (Baythroid)	3
	cypermethrin (Ammo)	3
	deltamethrin (Decis)	3
	esfenvalerate (Asana XL)	3
	gamma-cyhalothrin (Prolex)	3
	lambda-cyhalothrin (Karate, Karate Z)	3
	zetamethrin (Mustang Max)	3
	spinosad (Tracer)	5
	indoxacarb (Steward)	22
methomyl (Lannate)	1A	

Table 5-5B. Cotton Insecticide Modes of Action (MOA); Insecticide Resistance Action Committee Designations

Insect	Chemical Name (Brand Name)	Mode of Action
FALL ARMYWORM	chloryprofos (Lorsban)	1B
	indoxacarb (Steward)	22
	methomyl (Lannate)	1A
	methoxyfenozone (Intrepid)	18A
	profenofos (Curacron)	1B
	spinosad (Tracer)	5
	thiodicarb (Larvin)	1A
PLANT BUG	acephate (Orthene, and others)	1B
	acetamiprid (Assail)	4A
	chloryprofos (Lorsban)	1B
	dicrotophos (Bidrin)	1B
	imidacloprid (Trimax Pro)	4A
	methomyl (Lannate)	1A
	methyl parathion (Methyl parathion)	1B
	oxamyl (Vydate)	1A
	thiamethoxam (Centric)	4A
SOYBEAN & CABBAGE LOOPER	emamectin benzoate (Denim)	6
	indoxacarb (Steward)	22
	methoxyfenozone (Intrepid)	18A
	spinosad (Tracer)	5
SPIDER MITE	bifenthrin (Brigade, Capture, Discipline, others)	3
	dicofol (Dicofof)	UNC*
	entoxazole (Zeal)	10B
	fenpropathrin (Danitol)	3
	propargate (Comite)	12C
	methidathion (Supracide)	18
	spiromesfen (Oberon)	23
STINK BUG	acephate (Orthene, and others)	1B
	dicrotophos (Bidrin)	1B
	methyl parathion (Methyl parathion)	1B
	oxamyl (Vydate)	1A
	pyrethroids	3
THRIPS (at-planting)	aldicarb (Temik)	1A
	imidacloprid (Gaucho Grande)	4A
	thiamethoxam (Cruiser)	4A
THRIPS (postemergence)	acephate (Orthene, and others)	1B
	dicrotophos (Bidrin)	1B
	dimethoate (Dimethoate)	1B
	methamidophos (Monitor)	1B
	phosphorothioate (Metasystox-R)	1B

*UNC: Compound with unknown mode of action.