

Insecticide Resistance Management and Quality Cotton

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The cotton industry in California is dedicated to producing high quality cotton, not only in fiber characteristics but also in cleanliness. For cotton produced in the San Joaquin Valley, preventing sticky cotton is Job #1. Maintaining an effective tool box of control products against aphid and whitefly must also be a priority if growers and PCAs are to meet these quality goals.

The chart on the backside of this leaflet summarizes cotton insecticides and their modes of action (MoA) as defined by the Insecticide Resistance Action Committee (IRAC). IRAC is a collection of crop protection representatives, University researchers and regulators whose goal is to educate about insecticide resistance management (IRM) and assist in the implementation of insecticide resistance management practices. More information from IRAC is available at: <http://www.irc-online.org/index.asp>

This leaflet is designed to assist in making good IRM decisions. The suggestions presented are practices based on the best approaches suggested by IRAC and others working to maintain the efficacy of insecticides. These are not definitive guidelines but rather general suggestions in designing an IRM program.

Using the MoA index:

The Mode of Action (MoA) classification can form the basis for an effective and sustainable IRM program. Insecticides are assigned to specific groups based on their target site. For example, organophosphates and carbamates are assigned to Group 1 whose primary target sites of action are acetylcholine esterase inhibitors. However, the mechanism that OPs attack this target site is different from carbamates. Thus OPs are assigned a 1B while carbamates are assigned 1A. Pyrethroids affect the sodium channel modulators and are classified in Group 3. **Any two insecticides classified by the same MoA index have the same mode of action, whereas unique numbers indicate that these products could be rotated as part of an IRM plan.** For example, if Centric™ (Group 4A) were used against aphids and another application was needed several weeks later, utilizing Lorsban™ (Group 1B) would be a better IRM choice than Provado which is in the same 4A group as Centric.

General IRM Guidelines:

MoA rotation is an important component of an IRM approach. However, an overall IPM approach is required for a robust program and should consider:

- Scout regularly, twice weekly or at least weekly;
- Treat only when necessary based on action thresholds (if available), considering the natural enemies and other pests present
- Include effective biological and cultural controls to suppress pest populations
- Rotate between different mode of actions; understand which products use which mode of action
- Do not use products from the same MoA index more than twice per season;
- Consider the best placement of a product based on pest (or pests), time of year, pest pressure and potential secondary consequences;
- Use products at their recommended rates. Reduced doses quickly select populations with average levels of tolerance;
- Keep application equipment in a well-maintain operating condition.

May 04

Insecticides Associated with Cotton Production

Chemical name	Trade name	Class	IRAC MoA	Signal Word	Comment
aldicarb	Temik	Carbamate	1A	Poison/danger	
carbaryl	Sevin	Carbamate	1A	Caution	
carbofuran	Furadan	Carbamate	1A	Poison/danger	At planting
methomyl	Lannate	Carbamate	1A	Poison/danger	
oxamyl	Vydate	Carbamate	1A	Poison/danger	
thiodicarb	Larvin	Carbamate	1A	Warning	
acephate	Orthene	Organophosphate	1B	Caution	
chlorpyrifos	Lorsban	Organophosphate	1B	Warning	
dimethoate	Dimethoate	Organophosphate	1B	Warning	
malathion	Malathion	Organophosphate	1B	Caution	
methamidophos	Monitor	Organophosphate	1B	Poison/danger	
methidathion	Supracide	Organophosphate	1B	Warning	
methyl parathion	PennCap-M	Organophosphate	1B	Warning	
naled	Dibrom	Organophosphate	1B	Danger	
oxydemeton	Metasystox - R	Organophosphate	1B	Warning	
phorate	Thimet	Organophosphate	1B	Poison/danger	
profenofos	Curacron	Organophosphate	1B	Warning	
endosulfan	Thionex, Phaser	Organochlorine	2A	Poison/danger	
bifenthrin	Capture	Pyrethroid	3	Warning	
cyfluthrin	Baythroid	Pyrethroid	3	Danger	
cypermethrin	Ammo	Pyrethroid	3	Caution	
cypermethrin zeta	Mustang	Pyrethroid	3	Warning	
esfenvalerate	Asana	Pyrethroid	3	Warning	
fenpropathrin	Danitol	Pyrethroid	3	Warning	
lambda-cyhalothrin	Warrior	Pyrethroid	3	Warning	
permethrin	Pounce	Pyrethroid	3	Caution	
pyrethrins	Pyrethrin	Pyrethroid	3	Caution	
imidacloprid	Provado, Gaucho, Admire	Chloronicotinyl	4A	Caution	
thiamethoxam	Centric, Cruiser	Chloronicotinyl	4A	Caution	
acetamiprid	Assail	Chloronicotinyl	4A	Caution	
spinosad	Success		5	Caution	
avermectin	Zephyr		6	Warning	Mites
pyriproxyfen	Knack		7C	Caution	
pymetrozine	Fulfill		9B	Caution	
hexythiazox	Onager		10A	Caution	Mites
bacillus thuringiensis kurstaki HD-1	Dipel		11B2	Caution	
bacillus thuringiensis aizawai	Xentari		11B1	Caution	
bacillus thuringiensis kurstaki SA-11	Javelin		11B2	Caution	
propargite	Comite		14	Danger	Mites
buprofezin	Courier		16	Caution	
tebufenozide	Confirm		18	Caution	
methoxyfenozide	Intrepid		18	Caution	
dicofol	Kelthane		20	Caution	Mites
indoxocarb	Steward		22	Caution	
cyfluthrin (12%), imidacloprid (17%)	Leverage	mixture	3, 4A	Warning	

Updates can be found at cottoninfo.ucdavis.edu

MoA is Mode of Action classification assigned by IRAC.

View Complete Mode of Action List at Insecticide Resistance Action Committee (IRAC)

<http://www.irac-online.org/>

PB Goodell - Rev June 17 04

UC Cooperative Extension

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IRAC

Insecticide Mode of Action Classification: Diversity is a key to successful resistance management



INSECTICIDE RESISTANCE ACTION COMMITTEE

IRAC website: www.plantprotection.org/irac

Moulting & Metamorphosis

Group 18 Ecdysone agonist / disruptor

Tebufenozide

Group 7 Juvenile hormone mimics

Fenoxycarb, Methoprene, etc

Midgut

Group 11 Microbial disruptors of insect midgut membranes

Toxins produced by the bacterium *Bacillus thuringiensis* (Bt): Bt sprays and Cry proteins expressed in transgenic Bt crop varieties (specific cross-resistance sub-groups)

Nervous System

Group 1 Acetylcholinesterase (AChE) inhibitors

Carbamates and Organophosphates

Group 2 GABA-gated chloride channel antagonists

Cyclodienes and Fiproles

Group 3 Sodium channel modulators

DDT, pyrethrins, pyrethroids

Group 4 Acetylcholine receptor agonists

Neonicotinoids

Group 5 Acetylcholine receptor modulators

Spinosyns

Group 6 Chloride channel activators

Avermectin, Emamectin Benzoate and Milbemycin

Group 22 Voltage dependent sodium channel blocker

Indoxacarb

Non-specific MoA

Group 9 Compounds of non-specific mode of action

(selective feeding blockers)
Cryolite, Pymetrozine

Cuticle Synthesis

Groups 15, 16 and 17

Inhibitors of chitin biosynthesis

Benzoylureas

(Lepidoptera and others),
Buprofezin (Homoptera)
and Cyromazine (Diptera)

Metabolic Processes

Acting on a wide range of metabolic processes including:

Group 12 Inhibitors of oxidative phosphorylation, disruptors of ATP
Diafenthiuron & Organotin miticides

Group 12 Uncoupler of oxidative phosphorylation via disruption of H proton gradient –
Chlorfenapyr

Non-specific MoA

Group 10 Compounds of non-specific mode of action (mite growth inhibitors)

Clofentezine, Hexythiazox,
Etoazole

Metabolic processes

Group 20 Site II electron transport inhibitors

Hydramethylon and Dicofol

Group 21 Site I electron transport inhibitors

Rotenone, METI acaricides

