Mode of Action Classification

IRAC

Insecticide Resistance Management

Third Edition

The Insecticide Resistance Action Committee

Mode of Action Classification Brochure

Third Edition – February 2012

Foreword

Effective insecticide resistance management (IRM) in conjunction with integrated pest management (IPM) is vital to global crop protection, sustainable agriculture and improved public health, and it is an essential element of responsible product stewardship.

The Insecticide Resistance Action Committee (IRAC) was formed in 1984 and works as a specialist technical group of the industry association, CropLife International, to provide a coordinated crop protection industry response to prevent or delay the development of resistance in insect and mite pests. There are now IRAC country group committees in many parts of the world researching, and responding to local resistance issues, as well as the parent IRAC International group that provides a coordinating and supporting role at the global level (see also www.irac-online.org).

Developing new insecticides is becoming increasingly difficult and costly, so it is vital to protect those effective products in the marketplace from the development of resistance. Moreover, with fewer new insecticides being discovered and regulatory pressures reducing the number of older commercial chemistries available, the 'toolbox' of usable insecticides is being reduced, making effective IRM more important than ever. The Mode of Action Classification Scheme is a key part of IRAC's global IRM strategy.

Mode of Action Classification

IRAC promotes the use of a Mode of Action (MoA) Classification of insecticides and acaricides as the basis for effective and sustainable resistance management. Actives are allocated to specific groups based on their target site. Reviewed and re-issued periodically, the IRAC MoA Classification Scheme provides farmers, growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of acaricides and insecticides in resistance management programs. Effective resistance management of this type preserves the utility and diversity of available insecticides and acaricides. A complete list of the different MoA groups is shown in the following pages, followed by a breakdown of MoAs available for lepidopteran, aphids, whitefly, hoppers, mites and mosquitoes. For further information, please refer to the full IRAC MoA Classification Scheme available from the IRAC website (www.irac-online.org).

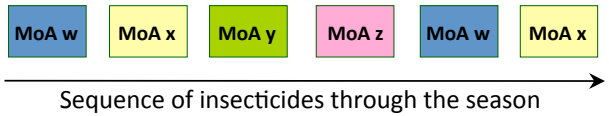
What is Resistance?

Resistance to insecticides may be defined as '*a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species*' (IRAC). Resistance arises through the over-use or misuse of an insecticide or acaricide against a pest species, and results in the selection of resistant forms of the pest and the consequent evolution of populations that are resistant to that insecticide or acaricide.

Effective IRM Strategies: Sequences or Alternations of MoA

All effective insecticide resistance management (IRM) strategies seek to minimise the selection of resistance to any one type of insecticide. In practice, alternations, sequences or rotations of compounds from different MoA groups provide sustainable and effective IRM for insect and mite pests. This ensures that selection from compounds in the same MoA group is minimised, and resistance less likely to evolve.

Example:



Applications are often arranged into MoA spray windows or blocks that are defined by the stage of crop development together with the biology and phenology of the species of concern. Local expert advice should always be followed with regard to spray windows and timing. Several sprays may be possible within each spray window, but it is generally essential that successive generations of the pest are not treated with compounds from the same MoA group. IRAC also offers specific recommendations for some MoA groups. Metabolic resistance mechanisms may give cross-resistance between MoA groups; where this is known to occur, the above advice should be modified accordingly. For further information on the use of MoA groups and sub-groups, please see the notes at the end of the brochure and in the full MoA Classification Scheme.

IRAC Mode of Action Classification Scheme (Version 7.2)

Main Group/Primary Site of Action	Chemical Subgroup or Exemplifying active	Active Ingredients
1 Acetylcholinesterase (AChE) inhibitors Nerve action *See footnotes for further information on use of compounds between sub-groups.*	**1A** Carbamates	Alanycarb, Aldicarb, Bendiocarb, Benfuracarb, Butocarboxim, Butoxycarboxim, Carbaryl, Carbofuran, Carbosulfan, Ethiofencarb, Fenobucarb, Formetanate, Furathiocarb, Isoprocarb, Methiocarb, Methomyl, Metolcarb, Oxamyl, Pirimicarb, Propoxur, Thiodicarb, Thiofanox, Triazamate, Trimethacarb, XMC, Xylylcarb
	1B Organophosphates	Acephate, Azamethiphos, Azinphos-ethyl, Azinphos-methyl, Cadusafos, Chlorethoxyfos, Chlorfenvinphos, Chlormephos, Chlorpyrifos, Chlorpyrifos-methyl, Coumaphos, Cyanophos, Demeton-S-methyl, Diazinon, Dichlorvos/ DDVP, Dicrotophos, Dimethoate, Dimethylvinphos, Disulfoton, EPN, Ethion, Ethoprophos, Famphur, Fenamiphos, Fenitrothion, Fenthion, Fosthiazate, Heptenophos, Imicyafos, Isofenphos, Isopropyl *O*-(methoxyaminothio-phosphoryl) salicylate, Isoxathion, Malathion, Mecarbam, Methamidophos, Methidathion, Mevinphos, Monocrotophos, Naled, Omethoate, Oxydemeton-methyl, Parathion, Parathion-methyl, Phenthoate, Phorate, Phosalone, Phosmet, Phosphamidon, Phoxim, Pirimiphos- methyl, Profenofos, Propetamphos, Prothiofos, Pyraclofos, Pyridaphenthion, Quinalphos, Sulfotep, Tebupirimfos, Temephos, Terbufos, Tetrachlorvinphos, Thiometon, Triazophos, Trichlorfon, Vamidothion
2 GABA-gated chloride channel antagonists Nerve action	**2A** Cyclodiene organochlorines	Chlordane, Endosulfan
	2B Phenylpyrazoles (Fiproles)	Ethiprole, Fipronil

3 Sodium channel modulators Nerve action *See footnotes for further information on use of compounds between sub-groups.*	**3A** Pyrethroids Pyrethrins	Acrinathrin, Allethrin, d-*cis*-trans Allethrin, d-*trans* Allethrin, Bifenthrin, Bioallethrin, Bioallethrin S-cylclopentenyl, Bioresmethrin, Cycloprothrin, Cyfluthrin, *beta*-Cyfluthrin, Cyhalothrin, *lambda*-Cyhalothrin, *gamma*-Cyhalothrin, Cypermethrin, *alpha*-Cypermethrin, *beta*-Cypermethrin, *theta*-cypermethrin, *zeta*-Cypermethrin, Cyphenothrin [(1*R*)-*trans*- isomers], Deltamethrin, Empenthrin [(*EZ*)- (1*R*)- isomers], Esfenvalerate, Etofenprox, Fenpropathrin, Fenvalerate, Flucythrinate, Flumethrin, *tau*-Fluvalinate, Halfenprox, Imiprothrin, Kadethrin, Permethrin, Phenothrin [(1*R*)-*trans*-isomer], Prallethrin, Pyrethrins (pyrethrum), Resmethrin, Silafluofen, Tefluthrin, Tetramethrin, Tetramethrin [(1*R*)-isomers], Tralomethrin, Transfluthrin
	3B DDT Methoxychlor	DDT Methoxychlor
4 Nicotinic acetylcholine receptor (nAChR) agonists Nerve action	**4A** Neonicotinoids	Acetamiprid, Clothianidin, Dinotefuran, Imidacloprid, Nitenpyram, Thiacloprid, Thiamethoxam
	4B Nicotine	Nicotine
	4C Sulfoxaflor	Sulfoxaflor
5 Nicotinic acetyl-choline receptor (nAChR) allosteric activators Nerve action	Spinosyns	Spinetoram, Spinosad
6 Chloride channel activators Nerve and muscle action	Avermectins, Milbemycins	Abamectin, Emamectin benzoate, Lepimectin, Milbemectin

Main Group/Primary Site of Action	Chemical Subgroup or Exemplifying active	Active Ingredients
7 Juvenile hormone mimics Growth regulation	**7A** Juvenile hormone analogues	Hydroprene, Kinoprene, Methoprene
	7B Fenoxycarb	Fenoxycarb
	7C Pyriproxyfen	Pyriproxyfen
8 Miscellaneous non-specific (multi-site) inhibitors	**8A** Alkyl halides	Methyl bromide and other alkyl halides
	8B Chloropicrin	Chloropicrin
	8C Sulfuryl fluoride	Sulfuryl fluoride
	8D Borax	Borax
	8E Tartar emetic	Tartar emetic
9 Selective homopteran feeding blockers Nerve action	**9B** Pymetrozine	Pymetrozine
	9C Flonicamid	Flonicamid
10 Mite growth inhibitors Growth regulation	**10A** Clofentezine Hexythiazox Diflovidazin *See footnotes for further sub-grouping information*	Clofentezine, Hexythiazox, Diflovidazin
	10B Etoxazole	Etoxazole

11 Microbial disruptors of insect midgut membranes	***11A*** *Bacillus thuringiensis* and the insecticidal proteins they produce *See footnotes for further sub-grouping information*	*Bacillus thuringiensis* subsp. *israelensis* *Bacillus thuringiensis* subsp. *aizawai* *Bacillus thuringiensis* subsp. *kurstaki* *Bacillus thuringiensis* subsp. *tenebrionis* *Bt* crop proteins: (see footnote) Cry1Ab, Cry1Ac, Cry1Fa, Cry1A.105, Cry2Ab, Vip3A, mCry3A, Cry3Ab, Cry3Bb, Cry34Ab1/Cry35Ab1
	11B *Bacillus sphaericus*	*Bacillus sphaericus*
12 Inhibitors of mitochondrial ATP synthase Energy metabolism	**12A** Diafenthiuron	Diafenthiuron
	12B Organotin miticides	Azocyclotin, Cyhexatin, Fenbutatin oxide
	12C Propargite	Propargite
	12D Tetradifon	Tetradifon
13 Uncouplers of oxidative phosphorylation via disruption of the proton gradient Energy metabolism	Chlorfenapyr DNOC Sulfluramid	Chlorfenapyr DNOC Sulfluramid
14 Nicotinic acetylcholine receptor (nAChR) channel blockers Nerve action	Nereistoxin analogues	Bensultap, Cartap hydrochloride, Thiocyclam, Thiosultap-sodium

Main Group/Primary Site of Action	Chemical Subgroup or Exemplifying active	Active Ingredients
15 Inhibitors of chitin biosynthesis, type 0 Growth regulation	Benzoylureas	Bistrifluron, Chlorfluazuron, Diflubenzuron, Flucycloxuron, Flufenoxuron, Hexaflumuron, Lufenuron, Novaluron, Noviflumuron, Teflubenzuron, Triflumuron
16 Inhibitors of chitin biosynthesis, type 1 Growth regulation	Buprofezin	Buprofezin
17 Moulting disruptor, Dipteran Growth regulation	Cyromazine	Cyromazine
18 Ecdysone receptor agonists Growth regulation	Diacylhydrazines	Chromafenozide, Halofenozide, Methoxyfenozide, Tebufenozide
19 Octopamine receptor agonists Nerve action	Amitraz	Amitraz
20 Mitochondrial complex III electron transport inhibitors Energy metabolism	**20A** Hydramethylnon	Hydramethylnon
	20B Acequinocyl	Acequinocyl
	20C Fluacrypyrim	Fluacrypyrim
21 Mitochondrial complex I electron transport inhibitors Energy metabolism	**21A** METI acaricides and insecticides	Fenazaquin, Fenpyroximate, Pyrimidifen, Pyridaben, Tebufenpyrad, Tolfenpyrad
	21B Rotenone	Rotenone (Derris)

22 Voltage-dependent sodium channel blockers Nerve action *See footnotes for further information on sub-grouping*	**22A** Indoxacarb	Indoxacarb
	22B Metaflumizone	Metaflumizone
23 Inhibitors of acetyl CoA carboxylase. Lipid synthesis, growth regulation	Tetronic and Tetramic acid derivatives	Spirodiclofen, Spiromesifen, Spirotetramat
24 Mitochondrial complex IV electron transport inhibitors Energy metabolism	**24A** Phosphine	Aluminium phosphide, Calcium phosphide, Phosphine, Zinc phosphide
	24B Cyanide	Cyanide
25 Mitochondrial complex II electron transport inhibitors Energy metabolism	Beta-ketonitrile derivatives	Cyenopyrafen, Cyflumetofen
28 Ryanodine receptor modulators Nerve and muscle action	Diamides	Chlorantraniliprole, Cyantraniliprole, Flubendiamide

Main Group/Primary Site of Action	Chemical Subgroup or Exemplifying active	Active Ingredients
UN Compounds of unknown or uncertain mode of action	Azadirachtin	Azadirachtin
	Benzoximate	Benzoximate
	Bifenazate	Bifenazate
	Bromopropylate	Bromopropylate
	Chinomethionat	Chinomethionat
	Cryolite	Cryolite
	Dicofol	Dicofol
	Pyridalyl	Pyridalyl
	Pyrifluquinazon	Pyrifluquinazon

General Notes:

- Mode of action assignments will usually involve identification of the target protein responsible for the biological effect, although groupings can be made where compounds share distinctive physiological effects and have related chemical structures.
- A compound with an unknown or controversial mode of action or an unknown mode of toxicity will be held in category 'UN' until evidence becomes available to enable that compound to be assigned to a more appropriate mode of action class.
- Inclusion of a compound in the list above does not necessarily signify regulatory approval.
- This booklet has been prepared using the most up-to-date information available to IRAC (Based on the IRAC Classification Scheme version 7.2). It is provided to user groups, grower organisations, extension personnel, regulatory authorities such as the US EPA and all those involved in resistance management, as an agreed definitive statement by the agrochemical industry on the mode of action of insecticides currently in use.
- Information is accurate to the best of our knowledge but IRAC and its member companies cannot accept responsibility for how this information is used or interpreted. Advice should always be sought from local experts or advisors and health and safety recommendations followed.

Notes on Sub-Groups:
In the absence of other alternatives, it may be possible to rotate compounds between sub-groups if it is clear that cross resistance mechanisms do not exist in the target populations. By definition, subgroups are established to represent distinct chemical classes with a common mode of action. Whether they should be rotated or not will depend on knowledge and experience of cross-resistance patterns, resistance mechanisms, and on the pest, crop and region considered.

Sub-groups represent distinct structural classes believed to have the same mode of action. In principle, they provide a useful level of differentiation between compounds that may bind at the same target site but are nevertheless structurally different enough that the risk of metabolic cross-resistance is lower than for close chemical analogs. Subgroups are likely to be metabolized by different enzymes and may bind differently enough within the target site that the chance of selection for either metabolic or target-site resistance is reduced compared to close analogs.

Sub-group	Notes
1A, 1B	If there are no other alternatives, compounds from groups 1A and 1B may be rotated in situations where cross-resistance mechanisms are known to be absent in the insect populations to be treated.
3A, 3B	If there are no other alternatives, compounds from groups 3A and 3B may be rotated in situations where cross-resistance mechanisms (e.g., kdr) are known to be absent in the insect populations to be treated. Because DDT is no longer used in agriculture, this is only applicable for the control of human disease vectors such as mosquitoes, because of a lack of alternatives.
4A, 4B, 4C	Although these compounds are believed to have the same target site, current evidence indicates that the risk of metabolic cross-resistance between groups 4A and 4C is low. If there are no other alternatives, compounds from groups 4A and 4C may be rotated in situations where cross-resistance mechanisms are known to be absent in the insect populations to be treated.
10A	Clofentezine, and Hexythiazox have been grouped because they commonly exhibit cross-resistance even though they are structurally distinct, and the target site for neither compound is known. Diflovidazin has been added to this group because it is a close analogue of Clofentezine and expected to have the same mode of action.
11A	Different *Bacillus thuringiensis* products that target different insect orders may be used together without compromising their resistance management. Rotation between certain specific *Bacillus thuringiensis* microbial products may provide resistance management benefits for some pests. Consult product-specific recommendations. ***B.t.* Crop Proteins:** Where there are differences among the specific receptors within the midguts of target insects, transgenic crops containing certain combinations of the listed proteins provide resistance management benefits.
22A, 22B	Although these compounds are believed to have the same target site, they have been sub-grouped because they are chemically distinct, and current evidence indicates that the risk of metabolic cross-resistance is low.

Lepidoptera - Mode of Action Classification by Target Site

Nerve & Muscle Targets

1. Acetylcholinesterase (AChE) inhibitors
1A Carbamates, 1B Organophosphates

2. GABA-gated chloride channel antagonists
2A Cyclodiene Organochlorines
2B Phenylpyrazoles

3. Sodium channel modulators
3A Pyrethrins, Pyrethroids

4. Nicotinic acetylcholine receptor (nAChR) agonists
4A Neonicotinoids

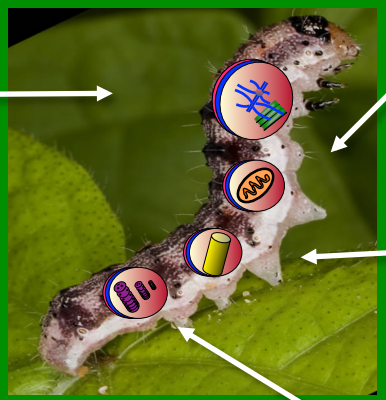
5. Nicotinic acetylcholine receptor (nAChR) allosteric activators
5 Spinosyns

6. Chloride channel activators
6 Avermectins, Milbemycins

14. Nicotinic acetylcholine receptor (nAChR) channel blockers
14 Nereistoxin analogues

22. Voltage-dependent sodium channel blockers
22A Indoxacarb, 22B Metaflumizone

28. Ryanodine receptor modulators
28 Diamides



Unknown or uncertain MoA
Azadirachtin, Pyridalyl

Respiration Targets

13. Uncouplers of oxidative phosphorylation via disruption of the proton gradient
13 Chlorfenapyr

21. Mitochondrial complex I electron transport inhibitors
21A Tolfenpyrad

Midgut Targets

11. Microbial disruptors of insect midgut membranes
11A Bacillus thuringiensis,
11B Bacillus sphaericus

Growth & Development Targets

7. Juvenile hormone mimics
7B Juvenile hormone analogues

15. Inhibitors of chitin biosynthesis, Type 0
15 Benzoylureas

18. Ecdysone receptor agonists
18 Diacylhydrazines

Aphids, Whiteflies & Hoppers - Mode of Action Classification by Target Site

Nerve and Muscle Targets

1. Acetylcholinesterase (AChE) inhibitors
1A Carbamates, 1B Organophosphates

2. GABA-gated chloride channel antagonists
2A Cyclodiene Organochlorines
2B Phenylpyrazoles

3. Sodium channel modulators
3A Pyrethrins, Pyrethroids

4. Nicotinic acetylcholine receptor (nAChR) agonists
4A Neonicotinoids, 4C Sulfoxaflor

9. Selective homopteran feeding blockers
9B Pymetrozine 9C Flonicamid

22. Voltage-dependent sodium channel blockers
22A Indoxacarb

28. **Ryanodine receptor modulators**
28 Cyantraniliprole



MoA Group	Aphids	Whiteflies	Hoppers
1A	X	X	X
1B	X	X	X
2A	X	X	X
2B			X
3A	X	X	X
4A	X	X	X
4C	X	X	X
7A	X	X	
7C		X	
9B	X	X	X
9C	X	X	X
12A	X	X	
15		X	
16		X	X
21A		X	
22A			X
23	X	X	
28	X	X	X
UN *	X	X	

Respiration Targets

12. Inhibitors of mitochondrial ATP synthase
12A Diafenthiuron

21. Mitochondrial complex I electron transport inhibitors
21A Tolfenpyrad, Pyridaben

Growth and Development Targets

7. Juvenile hormone mimics
7A Kinoprene, 7C Pyriproxyfen

15. Inhibitors of chitin biosynthesis, Type 0
15 Benzoylureas

16. Inhibitors of chitin biosynthesis, Type 1
16 Buprofezin

23. Inhibitors of lipid synthesis
23 Tetronic & Tetramic acid derivatives

Unknown or uncertain MoA
*UN Pyrifluquinazon **

The table above lists the main mode of action groups for the control of aphids, whiteflies and hoppers. However, the availability may differ regionally due to registration status.

Mites - Mode of Action
Classification by Target Site

Nerve & Muscle Targets

1. Acetylcholinesterase (AChE) inhibitors
1A Carbamates, 1B Organophosphates

2. GABA-gated chloride channel antagonists
2A Cyclodiene Organochlorines

3. Sodium channel modulators
3A Pyrethrins, Pyrethroids

6. Chloride channel activators
6 Avermectins, Milbemycins

19. Octopamine receptor agonists
19 Amitraz

Growth & Development Targets

10. Mite growth inhibitors
10A Clofentezine, Hexythiazox
10B Etoxazole

15. Inhibitors of chitin biosynthesis, Type 0
15 Benzoylureas

23. Inhibitors of lipid synthesis
23 Tetronic & Tetramic acid derivatives

Respiration Targets

12. Inhibitors of mitochondrial ATP synthase
12A Diafenthiuron
12B Organotin miticides
12C Propargite.

13. Uncouplers of oxidative phosphorylation via disruption of the proton gradient
13 Chlorfenapyr

20. Mitochondrial complex III electron transport inhibitors
20B Acequinocyl, 20C Fluacrypyrim

21. Mitochondrial complex I electron transport inhibitors
21A METI acaricides

25. Mitochondrial complex II electron transport inhibitors
25 Cyenopyrafen, Cyflumetofen

Unknown or uncertain MoA
Benzoximate, Bifenazate, Dicofol, Chinomethionat

Mosquitoes - Mode of Action Classification by Target Site

Nerve & Muscle Targets (larvae)

1. Acetylcholinesterase (AChE) inhibitors
1A Carbamates, 1B Organophosphates

3. Sodium channel modulators
3A Pyrethrins, Pyrethroids
3B DDT

5. Nicotinic acetylcholine receptor (nAChR) allosteric activators
5 Spinosyns

Growth & Development Targets (larvae)

7. Juvenile hormone mimics
7A Juvenile Hormone mimics
7C Pyriproxyfen

15. Inhibitors of chitin biosynthesis, Type 0
15 Benzoylureas

17. Moulting disrupter, Dipteran
17 Cyromazine

Midgut Targets (larvae)

11. Microbial disruptors of insect midgut membranes
11A Bacillus thuringiensis,
11B Bacillus sphaericus

Nerve & Muscle Targets (adults)

1. Acetylcholinesterase (AChE) inhibitors
1A Carbamates, 1B Organophosphates

3. Sodium channel modulators
3A Pyrethrins, Pyrethroids
3B DDT

Active Ingredients (Alphabetical Order) with MOA Classification

Abamectin	6
Acephate	1B
Acequinocyl	20B
Acetamiprid	4A
Acrinathrin	3A
Alanycarb	1A
Aldicarb	1A
Allethrin	3A
alpha-Cypermethrin	3A
Aluminium phosphide	24A
Amitraz	19
Azadirachtin	UN
Azamethiphos	1B
Azinphos-ethyl	1B
Azinphos-methyl	1B
Azocyclotin	12B
Bacillus thuringiensis	11A
Bacillus sphaericus	11B
Bendiocarb	1A
Benfuracarb	1A
Bensultap	14
Benzoximate	UN
beta-Cyfluthrin	3A
beta-Cypermethrin	3A
Bifenazate	UN
Bifenthrin	3A
Bioallethrin	3A
Bioallethrin S-cyclopentenyl isomer	3A
Bioresmethrin	3A
Bistrifluron	15
Borax	8D
Bromopropylate	UN
Buprofezin	16
Butocarboxim	1A
Butoxycarboxim	1A
Cadusafos	1B
Calcium phosphide	24A
Carbaryl	1A
Carbofuran	1A
Carbosulfan	1A
Cartap hydrochloride	14
Chinomethionat	UN
Chlorantraniliprole	28
Chlordane	2A
Chlorethoxyfos	1B
Chlorfenapyr	13
Chlorfenvinphos	1B
Chlorfluazuron	15
Chlormephos	1B
Chloropicrin	8B
Chlorpyrifos	1B
Chlorpyrifos-methyl	1B
Chromafenozide	18
Clofentezine	10A
Clothianidin	4A
Coumaphos	1B
Cryolite	UN
Cyanide	24B
Cyanophos	1B
Cyantraniliprole	28
Cycloprothrin	3A
Cyenopyrafen	25
Cyflumetofen	25
Cyfluthrin	3A
Cyhalothrin	3A
Cyhexatin	12B
Cypermethrin	3A
Cyphenothrin (1*R*)-*trans*- isomers]	3A
Cyromazine	17
d-*cis*-*trans* Allethrin	3A
DDT	3B
Deltamethrin	3A
Demeton-S-methyl	1B
Diafenthiuron	12A
Diazinon	1B
Dichlorvos/ DDVP	1B
Dicofol	UN
Dicrotophos	1B
Diflovidazin	10A
Diflubenzuron	15
Dimethoate	1B
Dimethylvinphos	1B
Dinotefuran	4A
Disulfoton	1B
DNOC	13
d-*trans* Allethrin	3A
Emamectin benzoate	6
Empenthrin [(EZ)-(1*R*)-isomers]	3A
Endosulfan	2A
EPN	1B
Esfenvalerate	3A
Ethiofencarb	1A
Ethion	1B
Ethiprole	2B
Ethoprophos	1B
Etofenprox	3A
Etoxazole	10B
Famphur	1B
Fenamiphos	1B
Fenazaquin	21A
Fenbutatin oxide	12B
Fenitrothion	1B
Fenobucarb	1A
Fenoxycarb	7B
Fenpropathrin	3A
Fenpyroximate	21A
Fenthion	1B
Fenvalerate	3A
Fipronil	2B
Flonicamid	9C
Fluacrypyrim	20C
Flubendiamide	28
Flucycloxuron	15
Flucythrinate	3A
Flufenoxuron	15

Flumethrin	3A
Formetanate	1A
Fosthiazate	1B
Furathiocarb	1A
gamma-Cyhalothrin	3A
Halfenprox	3A
Halofenozide	18
Heptenophos	1B
Hexaflumuron	15
Hexythiazox	10A
Hydramethylnon	20A
Hydroprene	7A
Imicyafos	1B
Imidacloprid	4A
Imiprothrin	3A
Indoxacarb	22A
Isofenphos	1B
Isoprocarb	1A
Isopropyl O-(methoxyaminothio-phosphoryl) salicylate	1B
Isoxathion	1B
Kadethrin	3A
Kinoprene	7A
lambda-Cyhalothrin	3A
Lufenuron	15
Lepimectin	6
Malathion	1B
Mecarbam	1B
Metaflumizone	22B
Methamidophos	1B
Methidathion	1B

Methiocarb	1A
Methomyl	1A
Methoprene	7A
Methoxychlor	3B
Methoxyfenozide	18
Methyl bromide	8A
Metolcarb	1A
Mevinphos	1B
Milbemectin	6
Monocrotophos	1B
Naled	1B
Nicotine	4B
Nitenpyram	4A
Novaluron	15
Noviflumuron	15
Omethoate	1B
Oxamyl	1A
Oxydemeton-methyl	1B
Parathion	1B
Parathion-methyl	1B
Permethrin	3A
Phenothrin [(1*R*)-*trans*-isomer]	3A
Phenthoate	1B
Phorate	1B
Phosalone	1B
Phosmet	1B
Phosphamidon	1B
Phosphine	24A
Phoxim	1B
Pirimicarb	1A
Pirimiphos-methyl	1B

Prallethrin	3A
Profenofos	1B
Propargite	12C
Propetamphos	1B
Propoxur	1A
Prothiofos	1B
Pymetrozine	9B
Pyraclofos	1B
Pyrethrins (pyrethrum)	3A
Pyridaben	21A
Pyridalyl	UN
Pyridaphenthion	1B
Pyrimidifen	21A
Pyrifluquinazon	UN
Pyriproxyfen	7C
Quinalphos	1B
Resmethrin	3A
Rotenone (Derris)	21B
Silafluofen	3A
Spinetoram	5
Spinosad	5
Spirodiclofen	23
Spiromesifen	23
Spirotetramat	23
Sulfotep	1B
Sulfoxaflor	4C
Sulfuramid	13
Sulfuryl fluoride	8C
Tartar emetic	8E
tau-Fluvalinate	3A
Tebufenozide	18
Tebufenpyrad	21A

Tebupirimfos	1B
Teflubenzuron	15
Tefluthrin	3A
Temephos	1B
Terbufos	1B
Tetrachlorvinphos	1B
Tetradifon	12D
Tetramethrin	3A
Tetramethrin [(1*R*)-isomers]	3A
theta-cypermethrin	3A
Thiacloprid	4A
Thiamethoxam	4A
Thiocyclam	14
Thiodicarb	1A
Thiofanox	1A
Thiometon	1B
Thiosultap-sodium	14
Tolfenpyrad	21A
Tralomethrin	3A
Transfluthrin	3A
Triazamate	1A
Triazophos	1B
Trichlorfon	1B
Triflumuron	15
Trimethacarb	1A
Vamidothion	1B
XMC	1A
Xylylcarb	1A
zeta-Cypermethrin	3A
Zinc phosphide	24A

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