UNIVERSITY OF MARYLAND
AGRICULTURE LAW
EDUCATION INITIATIVE
MPOWERING THE STATE

Panel Discussion

Chlorpyrifos and the Legal Landscape of Pesticide Regulation

2018 Agricultural and Environmental Law Conference

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UNIVERSITY OF MARYLAND EASTERN SHORE
UNIVERSITY OF MARYLAND EXTENSION

Mode of Action Classification

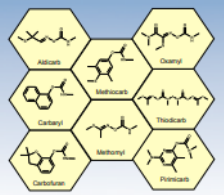
IRAC

Insecticide Resistance Action Committee

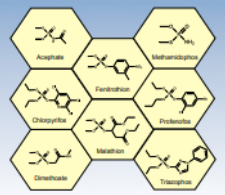
The Key to Resistance Management

- Successive generations of a pest should not be treated with compounds from the same MoA Group.
- Not all of the current groupings are based on knowledge of a shared target protein. For further information, please refer to the IRAC Mode of Action Classification document.
- The color scheme used here associates modes of action into broad categories based on the physiological functions affected, as an aid to understanding symptomology, speed of action and other properties of the insecticides, and not for any resistance management purpose. Rotations for resistance management should be based only on the numbered mode of action groups.

Group 1: Acetylcholinesterase (AChE) inhibitors (Only major representatives of the groups are shown)

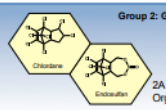


1A Carbamates

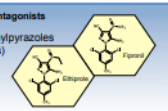


1B Organophosphates

Group 2: GABA-gated chloride channel antagonists

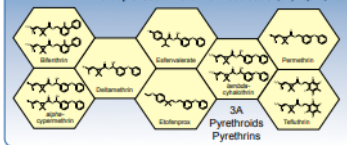


2A Cyclodiene Organochlorines

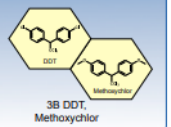


2B Phenylpyrazoles (Fiproles)

Group 3: Sodium channel modulators (Only major representatives of group 3A are shown)

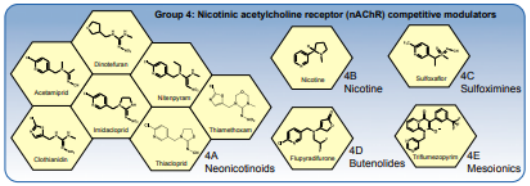


3A Pyrethroids Pyrethrins



3B DDT, Methoxychlor

Group 4: Nicotinic acetylcholine receptor (nAChR) competitive modulators



4A Neonicotinoids

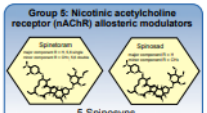
4B Nicotine

4C Sulfoximines

4D Butenolides

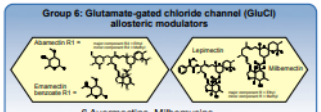
4E Mesoionics

Group 5: Nicotinic acetylcholine receptor (nAChR) allosteric modulators



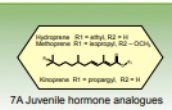
5 Spinosyns

Group 6: Glutamate-gated chloride channel (GluCl) allosteric modulators

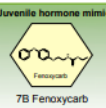


6 Avermectins, Milbemycins

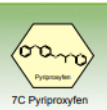
Group 7: Juvenile hormone mimics



7A Juvenile hormone analogues

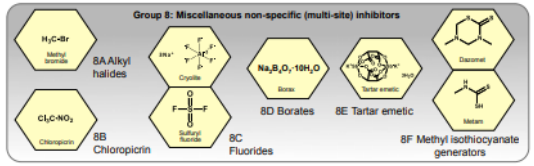


7B Fenoxycarb



7C Pyriproxyfen

Group 8: Miscellaneous non-specific (multi-site) inhibitors



8A Alkyl halides

8B Chloropicrin

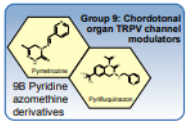
8C Fluorides

8D Borates

8E Tartar emetic

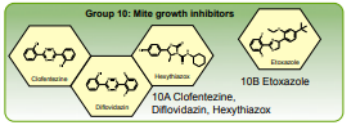
8F Methyl isothiocyanate generators

Group 9: Chordotonal organ TRPV channel modulators



9B Pyridine azomethine derivatives

Group 10: Mite growth inhibitors



10A Clofentezine, Diflovidazin, Hexythiazox

10B Etoxazole

Group 11: Microbial disruptors of insect midgut

[Includes transgenic crops expressing *Bacillus thuringiensis* toxins (however, specific guidance for resistance management of transgenic crops is not based on rotation of modes of action)]

Different *B.t.* products that target different insect orders may be used together without compromising their resistance management.

Rotation between certain specific *B.t.* microbial products may provide resistance management benefits for some pests. Consult product-specific recommendations.

* Where there are differences among the specific receptors within the midgute of target insects, transgenic crops containing certain combinations of these proteins provide resistance management benefits.

Bacillus thuringiensis and the insecticidal proteins produced: *B.t. israelensis*, *B.t. aizawai*, *B.t. kurstaki*, *B.t. tenebrionis*

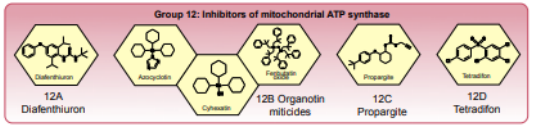
Bt crop proteins *: Cry1Ab, Cry1Ac, Cry1Fa, Cry1A.105, Cry2Ab, Vip3A, mCry3A, Cry3Aa, Cry3Bb, Cry34Ab1/Cry35Ab1

11A *Bacillus thuringiensis*

Bacillus sphaericus

11B *Bacillus sphaericus*

Group 12: Inhibitors of mitochondrial ATP synthase



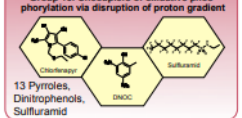
12A Diafenthiuron

12B Organotin miticides

12C Propargite

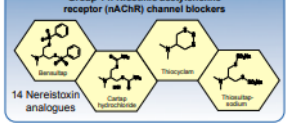
12D Tetradifon

Group 13: Uncouplers of oxidative phosphorylation via disruption of proton gradient



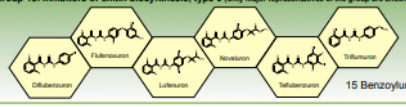
13 Pyrroles, Dinitrophenols, Sulfluramid

Group 14: Nicotinic acetylcholine receptor (nAChR) channel blockers



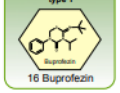
14 Nereistoxin analogues

Group 15: Inhibitors of chitin biosynthesis, type 0 (Only major representatives of the group are shown)



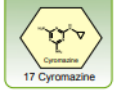
15 Benzoylureas

Group 16: Inhibitors of chitin biosynthesis, type 1



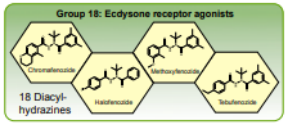
16 Buprofezin

Group 17: Moulting disruptors, Dipteran



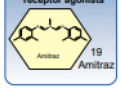
17 Cyromazine

Group 18: Ecdysone receptor agonists



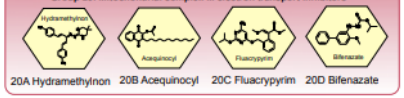
18 Diacylhydrazines

Group 19: Octopamine receptor agonists



19 Amitraz

Group 20: Mitochondrial complex III electron transport inhibitors



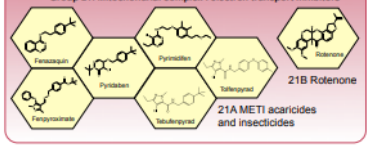
20A Hydramethylnon

20B Acequinocyl

20C Fluacrypyrim

20D Bifenazate

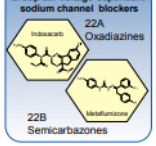
Group 21: Mitochondrial complex I electron transport inhibitors



21A METI acaricides and insecticides

21B Rotenone

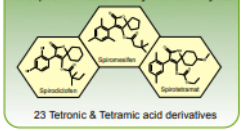
Group 22: Voltage-dependent sodium channel blockers



22A Oxadiazines

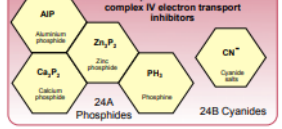
22B Semicarbazones

Group 23: Inhibitors of acetyl CoA carboxylase



23 Tetronic & Tetramic acid derivatives

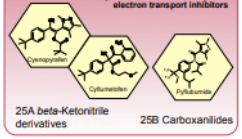
Group 24: Mitochondrial complex IV electron transport inhibitors



24A Phosphides

24B Cyanides

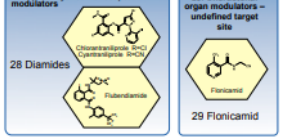
Group 25: Mitochondrial complex II electron transport inhibitors



25A *beta*-Ketonitrile derivatives

25B Carboxanilides

Group 28: Ryanodine receptor modulators



28 Diamides

Group 29: Chordotonal organ modulators – undefined target site

29 Flonicamid

Group UN: Compounds of unknown or uncertain mode of action

Targeted Physiology

- Nerve & Muscle
- Growth & Development
- Respiration
- Midgut
- Unknown or Non-specific

Use of Groups and Sub-Groups:

- Alternations, sequences or rotations of compounds between MoA groups reduces selection for target site resistance.
- Applications are arranged into MoA spray windows defined by crop growth stage and pest biology.
- Several sprays of a compound may be possible within each spray window, but successive generations of a pest should not be treated with compounds from the same MoA group.
- Local expert advice should always be followed with regard to spray windows and timing.
- Actives in groups 8 (Miscellaneous non-specific multi-site inhibitors), 13 (Uncouplers) and UN are thought not to share a common target site and therefore may be freely rotated with each other unless there is reason to expect cross-resistance.
- Sub-groups represent distinct structural classes believed to have the same mode of action.
- Sub-groups provide differentiation between compounds that may bind at the same target site but are structurally different enough that risk of metabolic cross-resistance is lower than for close chemical analogs.
- Cross-resistance potential between sub-groups is higher than between groups, so rotation between sub-groups should be considered only when there are no alternatives, and only if cross-resistance does not exist, following consultation with local expert advice. These exceptions are not sustainable, and alternative options should be sought.
- Sub-group 3B: DDT is no longer used in agriculture and therefore this is only applicable for the control of insect vectors of human disease, such as mosquitoes, because of a lack of alternatives.
- Sub-group10A: Hexythiazox is grouped with clofentezine because they exhibit cross-resistance even though they are structurally distinct, and the target site for these compounds is unknown. Diflovidazin has been added to this group because it is a close analogue of clofentezine and is expected to have the same mode of action.

Poster Notes:

- Groups 26 and 27 are unassigned.
- The poster is for educational purposes only. Information presented is accurate to the best of our knowledge at the time of publication, but IRAC or 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.
- Representative compounds are shown. Please visit www.irac-online.org for the complete IRAC classification.

CropLife

Poster Edition 6.1, April 2016. Based on the MoA Classification Version 8.1

Insecticide Mode of Action Classification:
A key to effective insecticide resistance management

IRAC
Insecticide Resistance Action Committee

CropLife INTERNATIONAL

IRAC website: www.irac-online.org

Introduction

IRAC promotes the use of a Mode of Action (MoA) classification of insecticides as the basis for effective and sustainable insecticide resistance management (IRM). Insecticides are allocated to specific groups based on their target site. Reviewed and re-issued periodically, the IRAC MoA classification list provides farmers, growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of insecticides or acaricides in IRM programs. Effective IRM of this type preserves the utility and diversity of available insecticides and acaricides. A selection of MoA groups is shown below.

Effective IRM strategies: Alternations or sequences of MoA

All effective insecticide (and acaricide) resistance management (IRM) strategies seek to minimise the selection for resistance from any one type of insecticide or acaricide. In practice, alternations, sequences or rotations of compounds from different MoA groups provide sustainable and effective IRM. This ensures that selection from compounds in the same MoA group is minimised. Applications are often arranged into MoA spray windows or blocks that are defined by the stage of crop development and the biology of the pest(s) of concern. Local expert advice should always be followed with regard to spray windows and timings. Several sprays of a compound may be possible within each spray window but it is generally essential to ensure that successive generations of the pest are not treated with compounds from the same MoA group. Metabolic resistance mechanisms may give cross-resistance between MoA groups, and where this is known to occur, the above advice must be modified accordingly.

Moulting & Metamorphosis

Group 18 Ecdysone agonist / disruptor
Diacylhydrazines (e.g. Tebufenozide)
Group 7 Juvenile hormone mimics
JH analogues, Fenoxycarb, Pyriproxyfen, etc

Midgut

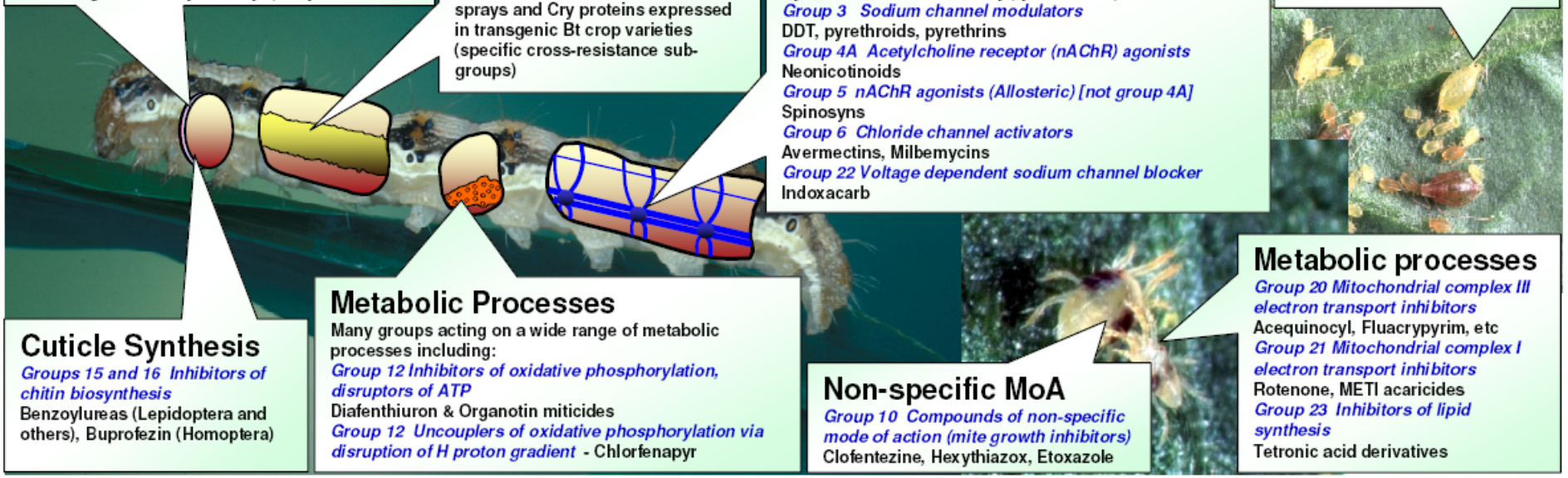
Group 11 Microbial disruptors of insect midgut membranes
Toxins produced by the bacterium *Bacillus thuringiensis* (Bt): Bt sprays and Cry proteins expressed in transgenic Bt crop varieties (specific cross-resistance sub-groups)

Nervous System

Groups 1A & B Acetylcholinesterase (AChE) inhibitors
Carbamates and Organophosphates
Group 2 GABA-gated chloride channel antagonists
Cyclodienes OCs and Phenylpyrazoles (Fiproles)
Group 3 Sodium channel modulators
DDT, pyrethroids, pyrethrins
Group 4A Acetylcholine receptor (nAChR) agonists
Neonicotinoids
Group 5 nAChR agonists (Allosteric) [not group 4A]
Spinosyns
Group 6 Chloride channel activators
Avermectins, Milbemycins
Group 22 Voltage dependent sodium channel blocker
Indoxacarb

Non-specific MoA

Group 9 Compounds of non-specific mode of action (selective feeding blockers)
Pymetrozine, Flonicamid, etc.



Cuticle Synthesis

Groups 15 and 16 Inhibitors of chitin biosynthesis
Benzoylureas (Lepidoptera and others), Buprofezin (Homoptera)

Metabolic Processes

Many groups acting on a wide range of metabolic processes including:
Group 12 Inhibitors of oxidative phosphorylation, disruptors of ATP
Diafenthiuron & Organotin miticides
Group 12 Uncouplers 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, Etoxazole

Metabolic processes

Group 20 Mitochondrial complex III electron transport inhibitors
Acequinocyl, Fluacrypyrim, etc
Group 21 Mitochondrial complex I electron transport inhibitors
Rotenone, METI acaricides
Group 23 Inhibitors of lipid synthesis
Tetronic acid derivatives

v4, October 2005

IRAC
Insecticide Resistance Action Committee

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Resistance Management for Sustainable Agriculture and Improved Public Health

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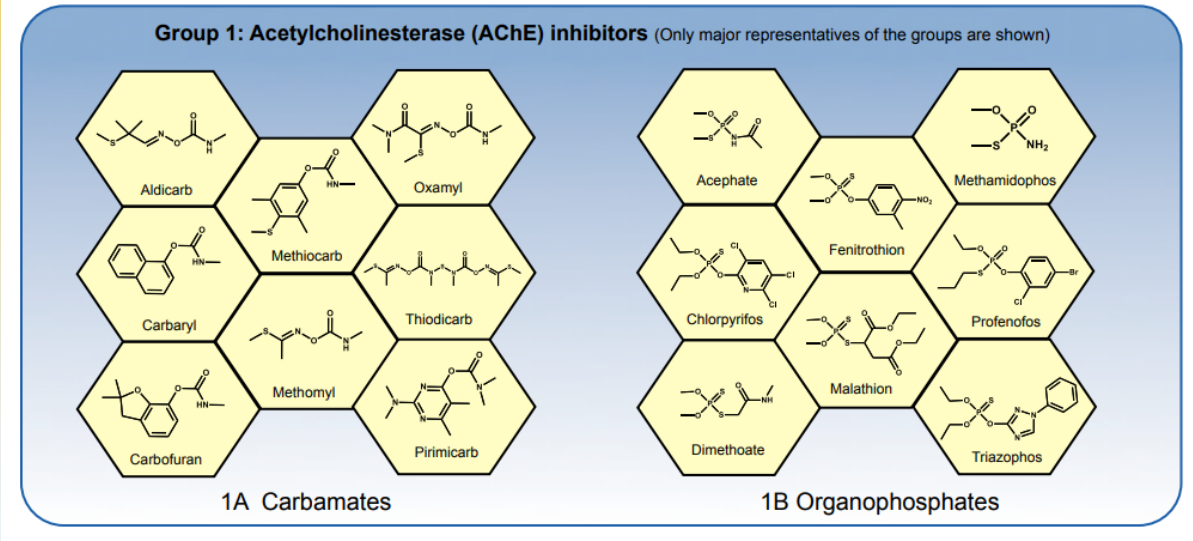

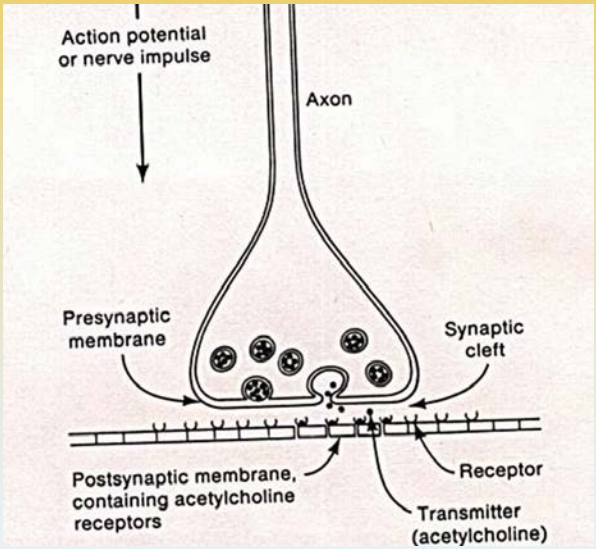

Nervous System

Groups 1A & B Acetylcholinesterase (AChE) inhibitors
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Neonicotinoids
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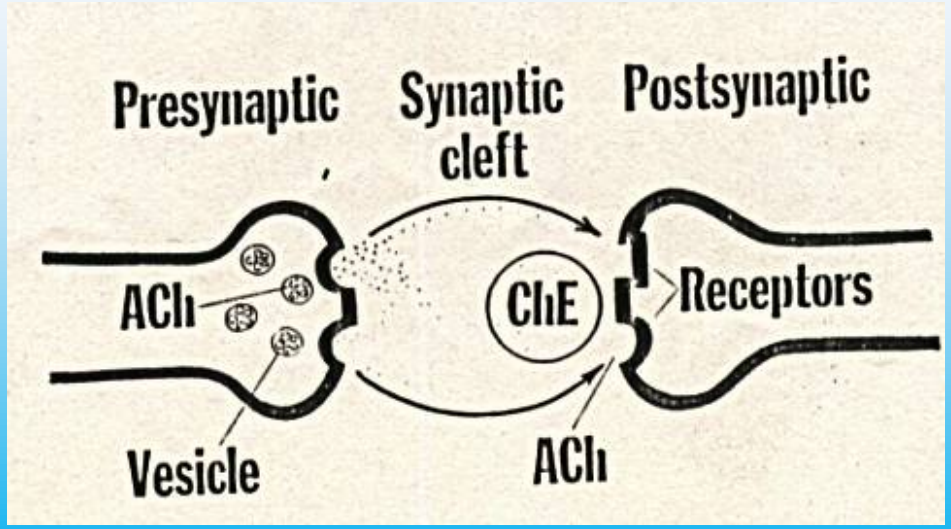
Group 22 Voltage dependent sodium channel blocker
Indoxacarb



Specimen Label

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

DOW® Dow AgroSciences

Lorsban®-4E

INSECTICIDE

®Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

For control of listed insects infesting certain field, fruit, nut, and vegetable crops.

Group	1B	INSECTICIDE

Active Ingredient:
chlorpyrifos: O,O-diethyl-O-(3,5,6-trichloro-2-pyridinyl) phosphorothioate 44.9%
Other Ingredients 55.1%
Total 100.0%

Contains 4 lb of chlorpyrifos per gallon.
Contains petroleum distillates.

Precautionary Statements

Hazard to Humans and Domestic Animals

EPA Reg. No. 62719-220

WARNING

May Be Fatal If Swallowed • Harmful If Absorbed Through Skin • Causes Moderate Eye Irritation

Avoid contact with skin, eyes or clothing.

Table 2. **EPA Screening Level Estimates of Agricultural Uses of Chlorpyrifos (059101).****

	Crop	Lbs.A.I.		Crop	Lbs.A.I.
1	Alfalfa	400,000	32	Oranges	300,000
2	Almonds	500,000	33	Peaches	70,000
3	Apples	400,000	34	Peanuts	200,000
4	Apricots +	4,000	35	Pears	30,000
5	Artichokes +	<500	36	Peas, Green	<500
6	Asparagus	20,000	37	Pecans	300,000
7	Avocados +	3,000	38	Peppers	2,000
8	Beans, Green	3,000	39	Pistachios	10,000
9	Broccoli	90,000	40	Plums	10,000
10	Brussels Sprouts *	6,000	41	Potatoes +	4,000
11	Cabbage	10,000	42	Prunes	30,000
12	Cantaloupes +	3,000	43	Pumpkins	2,000
13	Carrots	1,000	44	Seed Crops (NPUD'02)	1,000
14	Cauliflower	20,000	45	Sod (NPUD'02)	2,000
15	Cherries	60,000	46	Sorghum	30,000
16	Chicory * +	<500	47	Soybeans	700,000
17	Corn	3,000,000	48	Spinach +	1,000
18	Cotton	200,000	49	Squash +	1,000
19	Cranberries (NPUD'02)	50,000	50	Strawberries	9,000
20	Cucumbers	3,000	51	Sugar Beets	100,000
21	Dry Beans/Peas	4,000	52	Sunflowers	20,000
22	Figs *	5,000	53	Sweet Corn	100,000
23	Grapefruit	60,000	54	Sweet Potatoes (NPUD'02)	100,000
24	Grapes	100,000	55	Tangelos	2,000
25	Hazelnuts (Filberts)	7,000	56	Tangerines	6,000
26	Lemons	90,000	57	Tobacco	100,000
27	Lettuce +	4,000	58	Tomatoes +	1,000
28	Mint (NPUD'02)	50,000	59	Walnuts	400,000
29	Nectarines	20,000	60	Watermelons +	1,000
30	Olives * +	<500	61	Wheat	300,000

SLUA data sources include:
USDA-NASS (United States Department of Agriculture's National Agricultural Statistics Service)- 2001 to 2006.
Private Pesticide Market Research - 2001 to 2006.
NPUD 2002 (National Pesticide Use Database) of the CropLife America Foundation
California DPR data – 2000 - 2006.
These results reflect amalgamated data developed by the Agency and are releasable to the public.
N/C = Not Calculated.
+ = These crops were not known to be listed on active end use product registrations when this report was run.

**Source: EPA Registration Review Docket, March 18, 2009

Dow AgroSciences

SAFETY DATA SHEET

DOW AGROSCIENCES LLC

Product name: LORSBAN™ 4E Insecticide

Issue Date: 05/15/2015
Print Date: 06/04/2015

11. TOXICOLOGICAL INFORMATION

Toxicological information appears in this section when such data is available.

Acute toxicity

Acute oral toxicity
Moderate toxicity if swallowed. Small amounts swallowed incidentally as a result of normal handling operations are not likely to cause injury; however, swallowing larger amounts may cause injury. Observations in animals include: Tremors.

As product: Single dose oral LD50 has not been determined.
LD50, Rat, 300 mg/kg Estimated.

Acute dermal toxicity
Prolonged or widespread skin contact may result in absorption of potentially harmful amounts.

As product: The dermal LD50 has not been determined. Based on information for component(s):
LD50, Rabbit, > 1,000 mg/kg

Hazard Indicators / Signal Words

Signal Word	DANGER-POISON	WARNING	CAUTION
Oral LD 50	0 - 50	50 - 500	>500

Lorsban 4E $LD_{50} = 300$

$LD_{50} = 300^{mg/kg}$

I weigh 185^{lbs} – What's a lethal dose of Lorsban?

$185^{lbs.}/2.2^{kgs/lb.} = 84^{kgs}$

$300^{mg/kg} \times 84^{kgs} = 25{,}200^{mgs}$ *(50+ Tylenol size tablets)*

$25.20^{gms}/28.35^{gms/oz.} = .889^{ozs}$

$.17ozs = 1^{tsp}$ *(6 tsp/oz.)*

$.889^{ozs}/.17^{ozs/tsp} = 5.23^{tsp}$

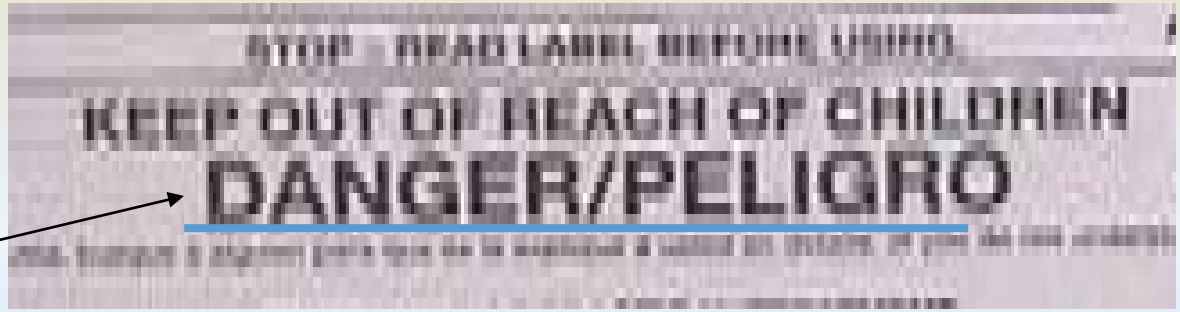
Acute Oral LD50 of Common Insecticides

Acephate (Orthane)	980
Bifenthrin (Capture)	375
Cyfluthrin (Baythroid)	826
Chlorpyrifos (Lorsban)	300 (96-270)
Carbaryl (Sevin)	246-283
Imidacloprid (Admire)	450
Malathion	2800
Permethrin (Pounce)	2215

Hazard Indicators / Signal Words

Signal Word	DANGER-POISON	WARNING	CAUTION
Oral LD 50	0 - 50	50 - 500	>500

Signal Words



Dow AgroSciences

SAFETY DATA SHEET

DOW AGROSCIENCES LLC

Product name: LORSBAN™ 4E Insecticide

Issue Date: 05/15/2015
Print Date: 06/04/2015

Chlorpyrifos

Biodegradability: Biodegradation under aerobic laboratory conditions is below detectable limits (BOD20 or BOD28/ThOD < 2.5%).
10-day Window: Fail
Biodegradation: 22 %
Exposure time: 28 d
Method: OECD Test Guideline 301D or Equivalent

Biological oxygen demand (BOD)

Incubation Time	BOD
5 d	0.000 %

Water solubility *Literature* emulsifiable

Stability in Water (1/2-life)
Hydrolysis, half-life, 72 d

Photodegradation
Test Type: Half-life (indirect photolysis)
Sensitizer: OH radicals
Atmospheric half-life: 1.4 Hour
Method: Estimated.

Mobility in soil

Chlorpyrifos

Expected to be relatively immobile in soil (Koc > 5000).
Partition coefficient(Koc): 8151

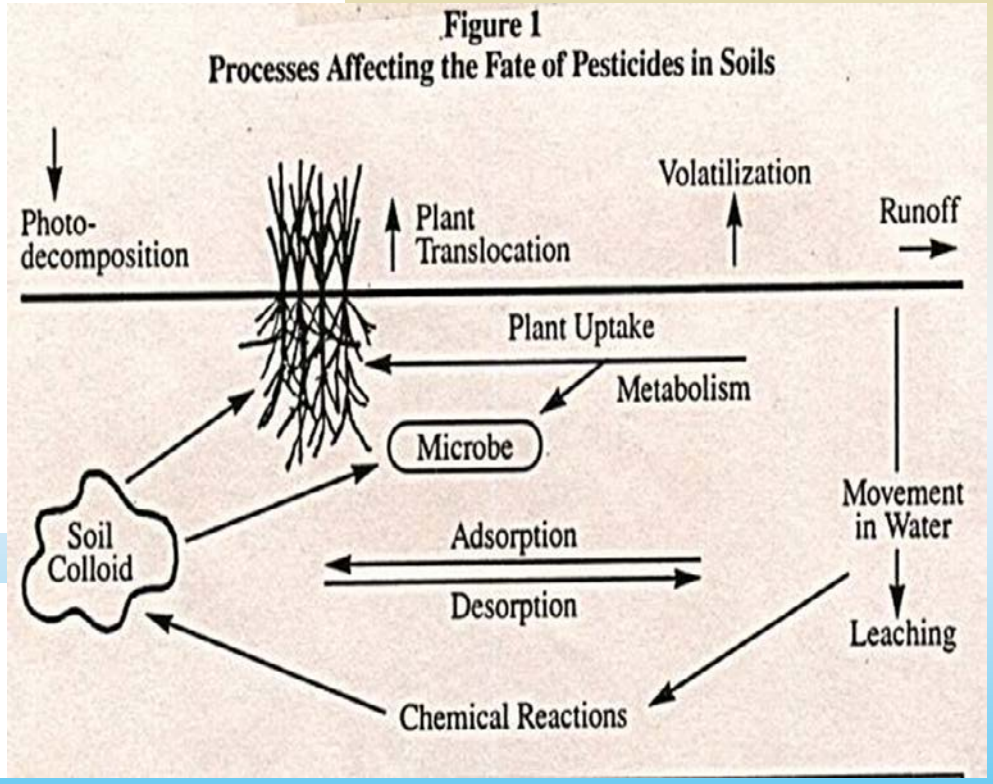


Table 3.4. Most Commonly Used Conventional Pesticide Active Ingredients in the Agricultural Market Sector in 2012, and their Rankings and Usage Rate Range in 2012, 2009, 2007, and 2005 Estimates (Ranked by Range‡ in Millions of Pounds of Active Ingredient)

Active Ingredient	Type	2012		2009		2007*		2005*	
		Rank	Range	Rank	Range	Rank	Range	Rank	Range
Glyphosate	H	1	270-290	1	209-229	1	170-190	1	147-167
Atrazine	H	2	64-74	2	59-69	2	70-80	2	66-76
Metolachlor-S	H	3	34-44	6	24-34	4	27-37	5	25-35
Dichloropropene	Fum	4	32-42	4	27-37	6	24-34	4	28-38
2,4-D	H	5	30-40	5	24-34	7	22-32	7	21-31
Metam	Fum	6	30-40	3	30-40	3	48-58	3	36-46
Acetochlor	H	7	28-38	7	23-33	5	25-35	6	24-34
Metam Potassium	Fum	8	16-26	8	14-24	13	6-10	—	0-3
Chloropicrin	Fum	9	8-18	9	6-16	9	5-15	10	5-15
Chlorothalonil	F	10	6-16	11	6-10	12	6-10	13	6-10
Pendimethalin	H	11	6-16	10	6-16	10	6-10	9	5-15
Ethephon	PGR	12	7-11	12	6-10	11	6-10	11	7-11
Mancozeb	F	13	5-9	16	3-7	19	3-7	16	5-9
Chlorpyrifos	I	14	4-8	13	5-9	14	6-10	15	5-9
Metolachlor	H	15	4-8	22	1-5	—	0-4	—	0-3
Hydrated Lime	F	16	3-7	15	4-8	20	2-6	—	1-5
Propanil	H	17	3-7	17	3-7	18	3-7	18	3-7
Dicamba	H	18	3-7	25	1-5	—	1-5	22	1-5
Trifluralin	H	19	3-7	18	3-7	17	4-8	14	6-10
Decan-1-ol	PGR	20	3-7	—	1-5	—	1-5	—	0-4
Copper Hydroxide	F	21	3-7	20	2-6	15	5-9	12	7-11
Acephate	I	22	2-6	—	1-5	22	1-5	23	1-5
Paraquat	H	23	2-6	—	1-5	25	1-5	24	1-5
Methyl Bromide	Fum	24	2-6	14	5-9	8	8-18	8	9-19
Glufosinate	H	25	2-6	—	1-5	—	1-5	—	0-4

Sources: Agricultural Market Research Proprietary Data, (2007, 2009, and 2012).
USDA/NASS Quick Stats (*http://www.nass.usda.gov/Quick_Stats/*)

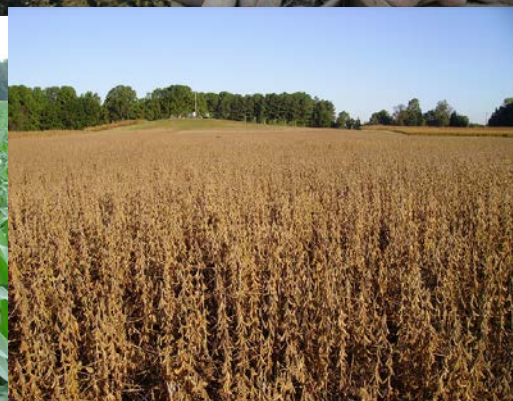
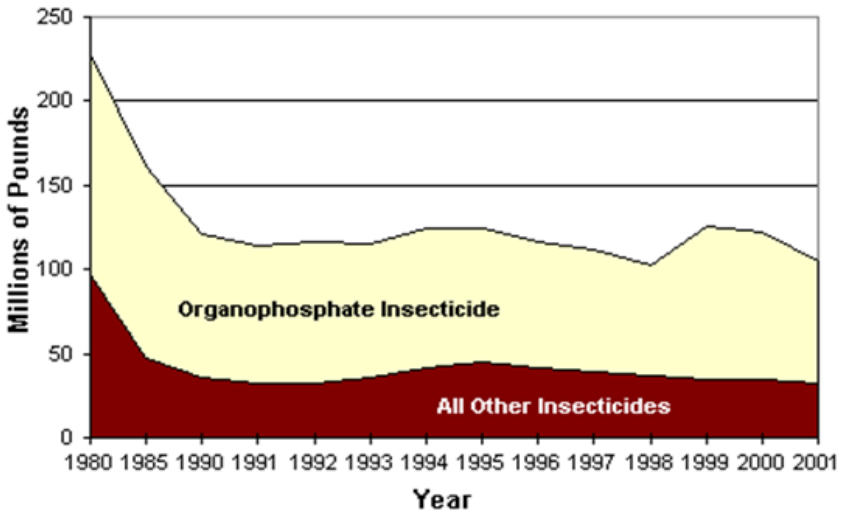


Table 3.7. Organophosphate Insecticide Active Ingredients Usage in the United States All Market Sectors, 2000–2012 Estimates

Year	All Insecticides[1]	Organophosphate Insecticides	
	Mil lbs	Mil lbs	% of All Insecticides
2000	99	70	71
2001	102	54	53
2002	90	47	52
2003	84	41	48
2004	77	40	52
2005	69	33	48
2006	66	30	46
2007	64	27	42
2008	65	28	43
2009	60	23	38
2010	56	21	38
2011	56	22	39
2012	60	20	33

Source: Agricultural Market Research Proprietary Data (2000-2012).
Non-Agricultural Market Research Proprietary Data (2000-2012)
USDA/NASS Quick Stats (*http://www.nass.usda.gov/Quick_Stats/*)



U.S. Environmental Protection Agency 3. 2008 - 2012 Usage

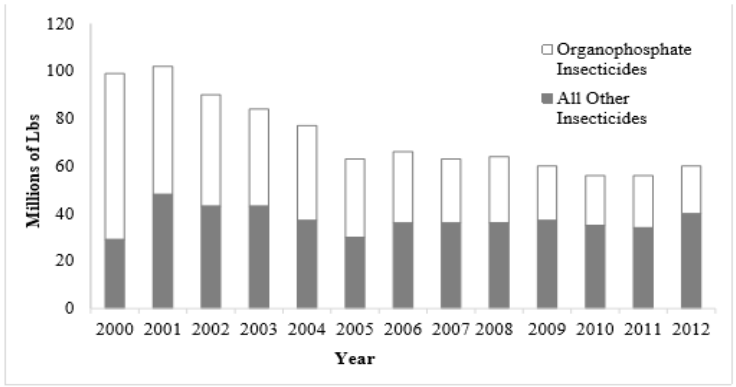
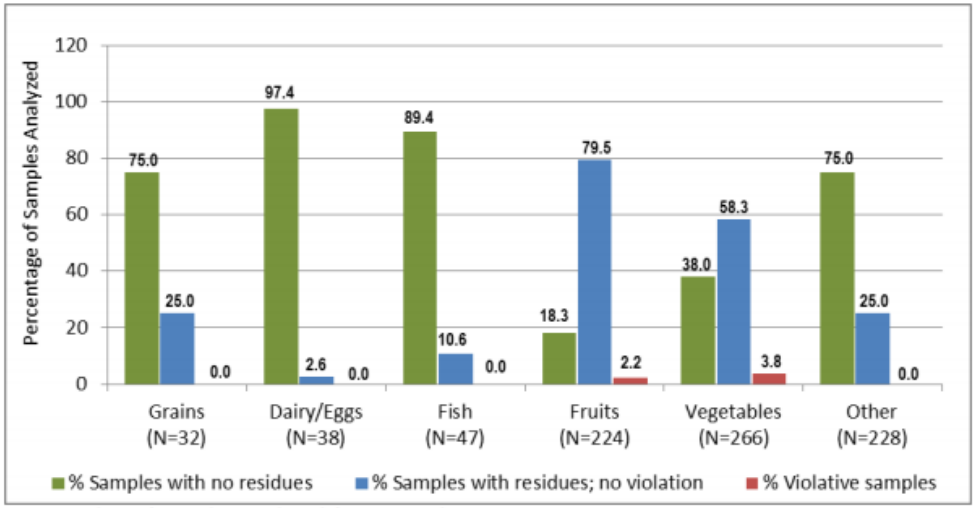


Figure 3.3. Total Amount of Organophosphate and All Other Insecticide Active Ingredients Usage in the United States in All Market Sectors, 2000–2012

Pesticide Residue Monitoring Program Fiscal Year 2015 Pesticide Report

U.S. Food and Drug Administration

Figure 1 - Results of Domestic Samples by Commodity Group



N = Number of samples analyzed for commodity group

FDA Market Basket Report 2014
Frequency of Pesticide Residues
in Total Diet Study

Chlorpyrifos - 7.4% 0.0001-0.177 ppm

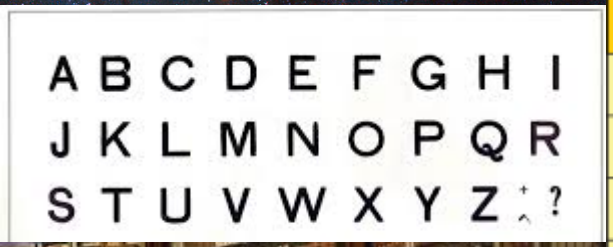
N-Sample Size 1061 Items

FDA Tolerance for acceptable level varies for specific commodity from 0.01 to 13.0 ppm

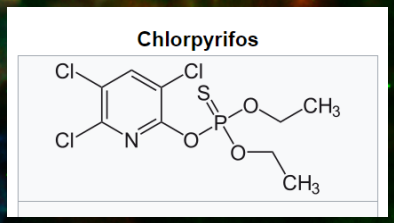
Referenced EPA 40 FR 29715 180.342

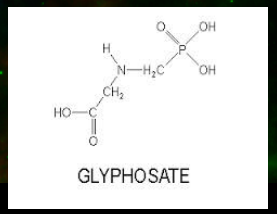
The Second Edition of the 20-volume Oxford English Dictionary contains full entries for 171,476 words in current use

The Library of Congress is the largest library in the world, with more than 158 million items on approximately 838 miles of bookshelves.



CAS REGISTRY is the most authoritative collection of disclosed chemical substance information, containing more than 89 million organic and inorganic substances and 65 million sequences.





1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 -71	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89 -103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	117 Uus	118 Uuo

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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Panel Discussion

Chlorpyrifos and the Legal Landscape of Pesticide Regulation

Questions?

Ronald David Myers
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