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Toxicities of Agricultural Pesticides to Selected Aquatic Organisms

Chuck Mischke[1] and Jimmy Avery[1]

A large portion of aquaculture in the southeastern United States is practiced in open, outdoor systems. These systems are most often in rural settings, surrounded by agricultural crops or livestock pastures. The production of these neighboring crops often requires the application of various pesticides. The purpose of this publication is to help farmers, chemical applicators, and fisheries biologists evaluate the risk of using a specific chemical on fields near fish ponds or natural waters.

Pesticide Regulation

Pesticide regulation began in 1910 with the passage of the Federal Insecticide Act which sought to insure the quality of chemicals purchased. The use of synthetic organic pesticides became widespread after World War II and prompted passage of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). This act required that pesticides be registered with the United States Department of Agriculture and established certain labeling standards. The publication of *Silent Spring* by Rachel Carson in 1962 prompted public awareness of pesticide use risks and led to the creation of the Environmental Protection Agency (EPA) in 1970. This move changed the emphasis of pesticide regulation from quality assurance and labeling to public health and environmental protection.

Today, pesticides are mainly regulated by FIFRA, which regulates the sale and use of pesticides, and the Federal Food, Drug and Cosmetic Act which controls the amount of pesticide residues allowed. All pesticides must be registered with the EPA and classified as general or restricted use – restricted use classification requires that applicator has received sufficient training to warrant certification. Other federal statutes also subject pesticides to regulation, including the Occupational Safety and Health Act, the Endangered Species Act, the Clean Water Act, the Safe Drinking Water Act, the Resource Conservation and Recovery Act, the Transportation Safety Act, and the Food, Agriculture, Conservation, and Trade Act.

Pesticide Toxicities

Determining the concentration of a specific chemical that is "toxic" is difficult. Toxicities listed in this publication are from laboratory studies under controlled conditions, and values reported should only be used as general guidelines. Many factors influence the toxicity of chemicals to fish and other aquatic organisms, including the age, size, species, and general health of the organism; the temperature, pH, turbidity, biological oxygen demand (BOD), and other physical and chemical water variables; the amount and kind of aquatic vegetation present; the chemical concentration and formulation used; and the exposure time. Any surfactants or adjuvants used can also influence toxicity.

The general categories of acute pesticide toxicities to aquatic organisms range from "Super Toxic" to "Practically Nontoxic" (Table 1). This is a quick way to compare the relative safety of different pesticides. To understand the amount of material required to reach toxic levels in the environment, some background information may be helpful. A concentration of one part per million (or 1

[1]Mississippi State University

Table 1. Categories of acute toxicity of pesticides

Toxicity Category	96-hour LC_{50} (ppm)
Super Toxic	<0.01
Extremely Toxic	>0.01 to 0.1
Highly Toxic	>0.1 to 1
Moderately Toxic	>1 to 10
Slightly Toxic	>10 to 100
Practically Nontoxic	>100

mg/L) is equal to 2.72 pounds of material in 1 acre-foot of water (1 acre-foot equals 1 surface acre with a depth of 1 foot, or 325,850 gallons or 2,719,328 pounds of water).

Values listed in this publication are short-term lethal (acute) toxicity values. The preferred lethality test for most aquatic organisms is a 96-hour LC_{50}. This represents the chemical amount required to kill 50 percent of the organisms in 96 hours. The various lethality tests cited in this publication are defined in Table 2. Although these values will give a general idea of relative chemical toxicities, they do not indicate anything about longer-term exposure or *sublethal* (chronic) effects of the chemicals. Toxicities are based on the active ingredient rather than the chemical formulation.

Although there are many types of pesticides, the most common categories used either in or in close proximity to aquaculture locations are herbicides (those used to kill plants), insecticides (those used to kill insects), and fungicides (those used to kill fungus). Table 3 gives the toxicity of agricultural chemicals used in the southeastern United States to six species of aquatic organisms: channel catfish, *Ictalurus punctatus;* rainbow trout, *Oncorhynchus mykiss;* red swamp crawfish, *Procambarus clarkii.;* bluegill, *Lepomis macrochirus;* water flea, *Daphnia magna;* and green algae *Pseudokirchneriella* sp. Channel catfish and rainbow trout were selected because they are commonly cultured species in the region. Red swamp crawfish are also cultured and serve as a comparative species for other shellfish. The bluegill is a commonly required test species for pesticide clearance studies. *Daphnia* and green algae were chosen to give some idea of the ecological effects of the chemical.

The toxicities listed in Table 3 were gathered from the ECOTOX database of the U.S. Environmental Protection Agency based on the active ingredient contained in common agricultural chemicals. If a particular chemical or toxicity for one of the selected aquatic species could not be found on ECOTOX, then toxicity information was recorded from a specific label formulation. The toxicities listed may or may not reflect specific formulations; trade names are given only as examples of representatives of specific chemical formulations. Unless otherwise noted, the toxicities are expressed as a 96-hour LC_{50} given in parts per million (the column headed "ppm").

There is a growing trend to combine pesticides into a single formulation. The formulations are commonly referred to as "premixes". The most common "premixes" are listed in Table 4. To evaluate the toxicity of these premixes, look up the toxicity of the individual pesticides in Table 3.

Minimizing Impacts from Pesticides

When using any agricultural pesticide near aquaculture facilities, special care must be taken to avoid contamination of those facilities. Pesticide contamination can kill organisms directly (lethal effects) or they can lead to several sublethal effects such as poor growth, increased disease susceptibility, reduced reproductive potential, or accumulation of residues making the product unsuitable for human consumption.

With careful management, it is possible to protect crops from insects, weeds, and diseases while at the same

Table 2. Definitions of tests used to evaluate pesticide toxicities.

Abbreviation	Superscript used in Table 3	Definition
96h LC_{50}	none	Concentration lethal to 50% of organisms after 96 hours of exposure
48h LC_{50}	3	Concentration lethal to 50% of organisms after 48 hours of exposure
21d LOEC	4	Concentration that induces the lowest observable effect after 21 days of exposure
2d LOEC	5	Concentration that induces the lowest observable effect after 2 days of exposure
72h EC_{50}	6	Concentration that induces a response halfway between baseline and maximum after 72 hours of exposure
120h EC_{50}	7	Concentration that induces a response halfway between baseline and maximum after 120 hours of exposure

time preventing pesticides from harming aquacultural operations. One option is to plant crops that require little or no pest control. Active scouting of agricultural fields for pests allows the producer to use chemicals only when warranted. When a pesticide must be used, select a product registered for the intended use and the least toxic and least persistent product available. Always follow label directions exactly.

The risk of pesticide drift by can be reduced by:

- Using low-volatility formulations
- Using low pressure
- Using high volume
- Using the largest spray nozzles and tips practical
- Releasing spray pattern as near the crop or soil surface as possible
- Not spraying during high temperatures
- Spraying when wind is low and blowing away from aquaculture facilities
- Using spray adjuvants when appropriate

The risk of pesticide runoff can be reduced by:

- Delaying application if rain is expected
- Irrigating in accordance with pesticide label instructions and monitoring to avoid runoff and excess surface water accumulation
- Using no-tillage or minimum-tillage cropping systems
- Using soil-incorporation methods
- Using adjuvants that promote pesticide retention on treated surfaces
- Grading the surface and constructing drainage ditches and dikes
- Planting border vegetation

Table 3. Toxicities of agricultural pesticides to selected aquatic organisms (96-hour LC_{50} unless otherwise noted).

Pesticide name	Trade Name[1]	Type[2]	Bluegill ppm	Channel Catfish ppm	Rainbow Trout ppm	Crawfish ppm	*Daphnia* ppm	Green algae ppm
azoxystrobin	Quadris	F	1.1		0.47		0.071-0.277 [3]	
cyproconazole	Alto	F	2.1		19		0.57 [4]	
fluoxastrobin	Aftershock, Evito	F	0.97		0.435		1.58 [5]	
flutriafol	Topguard	F	20-33		7.8-61.3		3.2-10 [4]	
metconazole	Caramba	F			10		9.28 [3]	6.91 [6]
picoxystrobin	Aproach	F			0.24		0.086 [3]	1.2 [6]
propiconazole	Tilt, Bumper	F	1.3-9.8	1-4.87	0.85-13.2	4.9	5-8.5 [3]	
prothioconazole	Proline	F	4.23-5.53		1.69-1.83		1.74 [4]	
pyraclostrobin	Headline	F	0.011		<0.01		<0.01 [4]	
tebuconazole	Folicur, Orius	F	5.7		4.4			
tetraconazole	Domark	F	3.85		3.91-5.2		1.6 [4]	
trifloxystrobin	Gem RC	F	0.054		0.014		0.012 [4]	
2,4-D	Weedtrine II	H	180-263		110-358		417.8	
2,4-DB	Navigate	H	0.61->50	0.78-1.35	0.452-3.689		1.7-7.2 [3]	
acetochlor	Surpass, Warrant	H	1.3-1.6		0.38-1.2		7.2-14 [3]	<0.01 [7]
acifluoren	UltraBlazer	H	31	80			28 [3]	
alachlor	Lasso	H	2.8-12.4	6.5-16.7	0.24-9.1	19.5	7.7-35	<0.01-0.036
ametryn	Evik	H	4.1-19		3.2-13.5		28-40 [3]	<0.01-0.12
amicarbazone	Xonerate	H	>128.5		>120.4		40.8 [3]	0.084
aminocyclopyrachlor	Imprelis, Perspective	H	>120		14->122		39.7 [3]	>120 [6]
aminopyralid	Milestone, Grazon Next	H	>100		>100		>98.6 [3]	30
asulam	Asulam	H	>180		>180			0.18 [7]

[1] Commercial products are registered (®) by the manufacturers. [2] H = herbicide, I = insecticide, F = Fungicide. [3] 48h LC_{50}. [4] 21d LOEC. [5] 2d LOEC. [6] 72h LC_{50}. [7] 120h LC_{50}.

Table 3 continued

Pesticide name	Trade Name[1]	Type[2]	Bluegill ppm	Channel Catfish ppm	Rainbow Trout ppm	Crawfish ppm	*Daphnia* ppm	Green algae ppm
atrazine	Atrazine	H	16-50	0.22-0.34	4.5-43		4.6->50	0.2-0.3
benefin	Balan	H	0.065-0.6		0.081->10		0.031-0.135 [4]	2.5 [7]
bensulfuron-methyl	Londax	H	>150	>150	>150	>71		
bensulide	Bensumac	H	0.81-1.4	0.379-0.38	0.72-3.2		0.58-1.75 [3]	1.8 [7]
bentazon	Basagran	H	610-1060		190-635		125->500 [3]	4.5 [6]
bispyribac-sodium	Velocity	H	>102		>102		>99.2 [3]	0.25-3.187
bromacil	Hyvar	H	12.7		36->180		121 [3]	<0.01 [7]
bromoxynil	Buctril	H			2.09-18		19.22-74 [3]	2.4-7.762
butoxone	Butyrac	H	7.4-16.8		1.97-14.3		25 [3]	
carfentrazone-ethyl	Aim	H	2		1.6->99.2		>9.8 [3]	0.013 [6]
chlorimuron-ethyl	Classic	H	>2		8.4		>10 [3]	5.535
chlorothalonil	Chlorostar	H	0.026-0.386	0.026-0.43	0.01-0.25		0.054-0.202 [3]	0.147
chlorsulfuron	Telar XP	H	>300	50	>250		370 [3]	0.135-0.81
clethodim	Clethodim, Select Max	H	>33		19-110		20.2 [3]	22.868
clomazone	Command	H	34		19		5.2 [3]	3.5 [7]
cloransulam-methyl	First Rate	H			>45.8			<0.01
cyhalofop-butyl	Clincher SF	H	0.76-0.93		>0.49		>100	
DCPA	Dacthal W-75	H	<3.7-14	0.43-7.94	2.3-12.8	7.9	1.2-6.7 [3]	0.012-0.031
dicamba	Clarity	H	135.3		135.4-153		110.7 [3]	>3.7 [7]
dichlobenil	Image	H	5.7-14.7		4.93-18		6.2-10 [3]	1.5 [7]
diclofop methyl	Hoelon	H	0.15-0.54		0.17-219			
diclosulam	Strongarm	H	>136		>110			
diglycolamine	Diglycolamine Agent	H	>400		>400		>400 [3]	
dimethenamid-P	Outlook	H	10		6.3		12 [3]	
diquat dibromide	Reward	H	13.9-508		14.83->100		0.77-3 [3]	<0.01-0.08
dithiopyr	Dimension Ultra	H	0.47		0.46		5.2-17 [3]	0.02 [7]
diuron	Direx, Karmex	H	28-84	1.8	1.95-2.38		0.4-8.6 [3]	<0.01
endothall	Aquathol, Hydrothol	H	1.2-180	2.1	0.31-1.8			
ethalfluralin	Sonalan	H	0.032-0.21		0.037-0.136		0.06 [3]	0.025 [7]
ethofumesate	Prograss	H	2.5->320		0.5->180		64-294 [3]	>2.76 [7]
fluazifop-P-butyl	Fusilade	H					412.4-553.9 [3]	>1.8
flucarbazone-sodium	Align, Everest	H	>99.3		>96.7		>109 [3]	5.57
flufenacet	Define	H	2.26-2.4		3.49-5.84			<0.01 [7]
flumetsulam	Python	H	>300		>300		254 [3]	<0.01 [7]
flumioxazin	Valor, Clipper	H	>21		2.3		0.0107 [4]	
fluometuron	Cotoran	H	13.5-96	0.64-22.5	14.5-47		9.9 [3]	0.03-0.306 [7]

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Table 3 continued

Pesticide name	Trade Name[1]	Type[2]	Bluegill ppm	Channel Catfish ppm	Rainbow Trout ppm	Crawfish ppm	*Daphnia* ppm	Green algae ppm
fluridone	Sonar, Restore	H	6.5-13	5-15	4.2-11.7		3-6.3 [3]	
fluroxypyr	Vista	H	14.3		>100		>100 [3]	8.48
fomesafen	Fomesafen, Reflex	H	6030		680		294-397 [3]	0.092 [6]
glufosinate	Liberty, Ignite	H	6.5		12.27->320		15-667.56 [3]	7.8 [6]
glyphosate	Roundup, Rodeo	H	1.8-220	3.3-130	1.3-4290.8		2.95-164.3 [3]	5.555-129
halosulfuron-methyl	Permit, Halomax	H	>118		>131		>107 [3]	<0.01 [7]
hexazinone	Velpar	H	238		146.7-1964		85-152 [3]	0.024-0.028
imazamox	Beyond, Clearcast	H	>119		>122		>122 [3]	>0.037 [7]
imazapic	Cadre	H	423	240	344		>110 [3]	>101
imazapyr	Arsenal, Habitat	H	>100	>100	>110		>100	7.1 7
imazaquin	Scepter	H	420	320	280		280 [3]	
imazethapyr	Newpath, Pursuit	H	423	240	344		>100 [3]	>101
imazosulfuron	League	H	>74		>69		32 [3]	>5.1
indaziflam	Specticle	H	0.32		0.572		>9.88 [3]	0.077
isoxaben	Gallery	H	>1		>1.1		>1.3 [3]	
lactofen	Cobra	H	>0.1		3.7		0.378-17.689 [3]	
linuron	Lorox, Linex	H	9.2-16.2	1.8-29	3.085-16.4		7	0.067 [6]
mesotrione	Callisto	H	>130		114		840 [3]	1.9 [7]
metribuzin	Metribuzin, Sencor	H	75.96-131.3	3.4->100			35.360 [3]	0.036
metsulfuron-methyl	Ally, Manor	H	>150		>150		>150 [3]	0.13-24.696
MSMA	Target	H	12->100	26.8-3050	78->167	101-1100		5.63 [6]
napropamide	Devrinol	H	12-13.3		9.4-13.4		14.3-24.7 [3]	3.4
nicosulfuron	Accent	H	>1000		>1000		>1000	1.431
norflurazon	Solicam	H	16.3		8.1		>15 [3]	<0.01 [7]
orthosulfamuron	Strada	H	>142		>122	>129	>97.3 [3]	2.9-6.2
oryzalin	Surflan	H	2.88		3.26-3.45		1.5 [3]	0.042 [7]
oxadiazon	Ronstar	H	0.88-8.2		1.05-26		0.53-2.18 [3]	<0.01 [7]
oxyfluorfen	Goal	H	0.2-0.21	0.4	0.25-0.41		0.08-1.5 [3]	<0.01
paraquat dichloride	Paraquat, Gramoxone	H	13-156	>100	15-76		2.8-11.3	0.32-0.67
pendimethalin	Prowl	H	0.199-90.4	0.418-1.9	0.138-86.6	>1	0.28-53 [3]	0.179
penoxsulam	Grasp	H	>103		>147		>98.3 [3]	0.094-92
picloram	Outpost, Tordon	H	13.5-86.1	1.4-74.8	5.5-310		34-76 [3]	21.7-36.79 [7]
pinoxaden	Axial	H			2.35		2.05 [3]	16 [6]
prodiamine	Stonewall, Evade	H	3.18-19.6	5.2->100	>0.829		>0.658 [3]	
prometryn	Caparol	H	10		2.9-7.2		9.7-18.59 [3]	0.012-0.021 [6]
propanil	Propanil	H	5.4-14	0.43-7.94	2.3-12.8	7.9	1.2-6.7 [3]	0.012-0.031
prosulfuron	Peak	H	>155		>160		>120 [3]	0.01 [7]

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Table 3 continued

Pesticide name	Trade Name[1]	Type[2]	Bluegill ppm	Channel Catfish ppm	Rainbow Trout ppm	Crawfish ppm	*Daphnia* ppm	Green algae ppm
pyrithiobac sodium	Staple	H	>930	W>970	>1000	>910	260 [4]	0.095 [7]
pyroxasulfone	Zidua	H			2.2		4.4 [3]	<0.01 [6]
pyroxsulam	PowerFlex	H			>100		>100 [3]	0.111
quinclorac	QuinStar, Facet	H	31.6		>83.5		29.8 [3]	9.134
quizalofop p-ethyl	Assure, Targa	H			0.21->91.7		2.05-82.4 [4]	0.262
rimsulfuron	Matrix, Resolve	H	>390		>390		1000 [3]	>0.029 [7]
saflufenacil	Sharpen	H	>108		>112		>98.2 [3]	0.042
sethoxydim	Poast Plus	H	1.6-265		1.2-170		2.6-78.1 [3]	
simazine	Simazine	H	100-118		40.5-330	>100 [3]	1->1000 [3]	0.1-1.24
s-metolachlor	Dual Magnum	H	10	4.9	9->100		1.1-26 [3]	0.051-5.508
tembotrione	Capreno, Laudis	H	>100				48.9 [3]	0.31
thifensulfuron methyl	Harmony	H	>100		>100		>1000 [3]	>0.016 [7]
thiobencarb	Bolero	H	0.56-2.48	1.8-2.29	0.76-1.5	0.2-9.24	0.101-2.33 [3]	0.017 [7]
triclopyr	Garlon, Grandstand	H	148		7.5-117		133	32.5 [7]
trifloxysulfuron sodium	Envoke	H			146		139 [3]	0.043 [6]
trifluralin	Treflan	H	<0.01-0.28	0.21-2.2	0.01-1.6	12-26	0.193-0.628 [3]	0.214-3.3
abamectin	Agri-Mek, Zorro	I	0.01-260	0.024	<0.01-23		<0.01-7.6 [3]	>100 [7]
acephate	Orthene	I	34-46		1.28-51		0.026-0.238 [3]	
acetamiprid	Intruder	I	>119.3		>100		50 [3]	
aldicarb	Temik	I	0.052-0.45	45	0.56-0.66		0.075-0.74 [3]	
beta-cyfluthrin	Baythroid	I	<0.01	0.002 [3]	<0.01	<0.01 [3]	<0.01 [3]	
bifenazate	Acramite	I	0.58		0.76		0.5 [3]	0.89
bifenthrin	Brigade, Discipline	I	<0.01		<0.01-0.015		<0.01	
carbaryl	Sevin, Carbaryl	I	1.8-290	0.14-17.3	0.86-5.4	1-1.9	3.28	1.27-3.2
chlorantraniliprole	Prevathon	I	>15.1	>13.4	>13.8		<0.01-0.017 [3]	>1.78 [6]
chlorpyrifos	Lorsban, Nufos	I	<0.01-0.108	0.280-2.077	<0.01-2		<0.01	
clothianidin	Belay, Poncho	I	>117		>1058	0.059	>119	64 [7]
cyfluthrin	Tombstone	I	<0.01	<0.01 [3]		<0.01 [3]	<0.01 [3]	
cypermethrin	Ammo	I	<0.01		<0.01-0.013		<0.01 [3]	
deltamethrin	Battalion, Delta Gold	I	<0.01		<0.01	<0.01 [3]	<0.01	
dicofol	Dicofol	I	0.51-3.1	0.3-0.36	0.124-0.95		0.2 [3]	
dicrotophos	Bidrin	I	2.8-24.2	7.66	6.3	4 [3]	0.0127-0.0192 [3]	
diflubenzuron	Dimilin	I	135-660	370	140-342		<0.01 [3]	
dimethoate	Dimethoate	I	6		6.2-8.6		0.58-6.4 [3]	36-38
emamectin benzoate	Denim	I	0.18		0.174		<0.01 [3]	<0.01 [7]

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Table 3 continued

Pesticide name	Trade Name[1]	Type[2]	Bluegill ppm	Channel Catfish ppm	Rainbow Trout ppm	Crawfish ppm	*Daphnia* ppm	Green algae ppm
endosulfan	Endosulfan, Thionex	I	<0.01	<0.01	<0.01	0.024-0.423	0.053-0.056	
esfenvalerate	Adjourn, Asana	I	<0.01		<0.01-0.0167		<0.01 [3]	
ethoprop	Mocap	I	0.3-8.9		1.1-13.8		0.016-0.023 [4]	
etoxazole	Zeal	I	>0.3				<0.01 [4]	
fenpyroximate	Fujimite, Portal	I	<0.01		<0.01			
flonicamid	Carbine	I	>98.8		>97.9		50 [4]	
flubendiamide	Belt	I	>80.2		>91.1		<0.01-0.0685 [4]	
gamma-cyhalothrin	Prolex, Declare	I	<0.01		<0.01		<0.01 [4]	
imidacloprid	Admire Pro, Gaucho	I	>105		229.1		10.44-64.873 [3]	
indoxacarb	Steward	I	0.9-1.2	0.29	0.394->1.3		>0.19 [4]	
lambda-cyhalothrin	Karate, Warrior	I	<0.01		<0.01-0.013	<0.01	<0.01 [3]	
malathion	Fyfanon, Malathion	I	0.02-1.2	7.62-52.2	<0.01-0.73	1.34-49.17	<0.01-0.08 [3]	
methomyl	Lannate	I	0.35-7.7	0.3-1.8	1.05-4.4		0.02417 [3]	
methoxyfenozide	Intrepid	I	>4.3		>4.2		0.390 [4]	
methyl parathion	Methyl, Penncap-M	I	1-6.9	5.24	2.2-161	0.04 [3]	0.012-0.0402 [3]	
novaluron	Diamond, Mayhem	I	>0.960		62.4		<0.01 [4]	
oxamyl	Vydate	I	5.6-10	13.5-17.5	4.2-12.4		0.502 [4]	
permethrin	Ambush, Pounce	I	<0.01		<0.01-0.092		<0.01 [3]	
phorate	Thimet, Phorate	I	<0.01-0.012	<0.01-0.280	0.013-0.045		0.0195 [3]	
phosmet	Imidan	I	<0.01-0.12	3.22-3.29	<0.01-0.028	<0.01 [3]	<0.01 [3]	
phosphorothioate	Aztec	I	1.38-3.4	0.65-1.68	0.55-0.93		>0.050 [3]	
profenophos	Curacron	I	0.135-0.3	0.0135-2.39	0.021-0.043			
propargite	Comite II	I	0.031-0.167		0.118-0.455			
pymetrozine	Fulfill	I	>134		>128		0.050 [4]	
pyriproxyfen	Knack	I	5.9		0.45		<0.01 [4]	
chlorantraniliprole	Prevathon	I	>15.1	>13.4	>13.8			
spinetoram	Radiant	I	5.4				4.79 [3]	0.0515
spinosad	Tracer, Spintor	I					14 [3]	
spiromesifen	Oberon	I	0.05675		0.0168->102		<0.01 [4]	
tefluthrin	Force	I	<0.01		<0.01		<0.01 [4]	
terbufos	Counter	I	<0.01-0.0133	<0.01-1.8	<0.01-0.068	<0.01-4.0	<0.01 [4]	
thiamethoxam	Centric, Cruser	I	>114		>100	0.967		
thiodicarb	Larvin	I	1.2-1.47		3.3-3.45		2.9 [3]	
zeta-cypermethrin	Mustang Max	I	<0.01		<0.01-0.092		<0.01 [3]	

[1] Commercial products are registered (®) by the manufacturers. [2] H = herbicide, I = insecticide, F = Fungicide. [3] 48h LC_{50}. [4] 21d LOEC. [5] 2d LOEC. [6] 72h LC_{50}. [7] 120h LC_{50}.

Table 4. Common Pesticide Premixes.

Product name[1]	Active ingredients	Type[2]
Absolute 500 SC	tebuconazole (22.6%) + trifloxystrobin (22.6%)	F
Athena	bifenthrin () + avermectin ()	I
Authority XL	sulfentrazone (62.2%) + chlorimuron ethyl (7.8%)	H
Avaris	azoxystrobin (7.0%) + propiconazole (11.7%)	F
Besiege	λ-cyhalothrin + chlorantraniliprole	I
Bicep II Magnum	atrazine (33%) + S-metolachlor (26.1%)	H
Bidrin XP II	dicrotophos, bifenthrin	I
Boundary	metribuzin (31.8%) + S-metolachlor (58.2%)	H
Brigadier	bifenthrin, imidacloprid	I
Canopy	metribuzin (64.3%) + chlorimuron ethyl (10.7%)	H
Canopy EX	chlorimuron ethyl (22.7%) + tribenuron methyl (6.8%)	H
Capreno	tembotrione (28.3%) + thiencarbazone-methyl (5.6%)	H
Endigo ZC	thiamethoxam, λ-cyhalothrin	I
Enlite	flumioxazin (36.2%) + thifensulfuron methyl (8.8%) + chlorimuron ethyl (2.9%)	H
Envive	flumioxazin (29.2%) + thifensulfuron methyl (2.9%) + chlorimuron ethyl (9.2%)	H
Evito T	fluoxastrobin (18%) + tebuconazole (25%)	F
Firstshot	thifensulfuron methyl (25%) + tribenuron methyl (25%)	H
Fultime	acetochlor (24.8%) + atrazine (16.8%) + dichlomid (4.2%)	H
Fultime NXT	acetochlor (29%) + atrazine (14.5%)	H
Guardsman Max	atrazine (37%) + s-dimethenamid (19%)	H
Halex GT	S-metolachlor (20.5%) + glyphosate (20.5%) + mesotrione (2.1%)	H
Harmony Extra	thifensulfuron methyl (33.9%) + tribenuron methyl (16.7%)	H
Hero 1.24	bifenthrin, Z-cypermethrin	I
Layby Pro	linuron (20%) + diuron (20%)	H
Leverage 360 EC	imidacloprid + β-cyfluthrin	I
Lexar	S-metolachlor (19%) + atrazine (18.6%) + mesotrione (2.4%)	H
Marksman	atrazine (22.2%) + dicamba (13.4%)	H
Prefix	S-metolachlor (46.4%) + fomesafen (10.2%)	H
Priaxor	pyraclosbtrobin (28.58%) + fluxapyroxad (14.33%)	F
Prosaro 421 SC	prothioconazole (19%) + tebuconazole (19%)	F
Quadris TOP	azoxystrobin (18.2%) + difenoconazole (11.4%)	F
Quadris Xtra	azoxystrobin (18.2%) + cyproconazole (7.3%)	F
Quilt	azoxystrobin (7.0%) + propiconazole (11.7%)	F
Quilt Xcel	azoxystrobin (13.5%) + propiconazole (11.7%)	F
Sequence	S-metolachlor (29%) + glyphosate (21.8%)	H
Spartan Charge	sulfentrazone (31.8%) + carfentrazone ethyl (3.5%)	H
Stallion	zeta-cypermethrin () + chlorpyrifos ()	I
Stratego	trifloxystrobin (11.4%) + propiconazole (11.4%)	F
Stratego YLD	trifloxystrobin (32.3%) + prothioconazole (10.8%)	F
Suprend	prometryn (79.3%) + trifloxysulfuron-sodium (0.7%)	H
TwinLine 1.75 EC	metconazole (7.4%) + pyraclostrobin (12%)	F
Verdict	S-dimethenamid (56%) + saflufenacil (6.5%)	H

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