IMPACT OF INSECTICIDES ON WILD FAUNA: A PROPOSED TOXICITY INDEX

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INTRODUCTION

The risks to fauna associated with the use of pesticides are generally known for individual pesticides. There exists, however, a lack of published material providing comparative coverage of all pesticides, although some partial compilations have been published[1,2]. In an attempt to redress this situation, we propose here a Toxicity Index covering fish, birds and bees for 169 currently available insecticides.

METHODOLOGY

The Index has been generated from data on the toxic effects of pesticides on fish,birds and bees published in various reference works[1-6]. The majority of data concern studies on standard laboratory test animals, completed whenever possible by validated field data.

Inspired by the World Health Organisation (WHO) Classification of Pesticides by Hazard, classification on a scale from 1 (Very highly toxic) to 5 (Practically non-toxic) centres on acute oral toxicity values (LD50, LC50) and is confirmed (or modified) whenever possible by additional toxicity data.

Values in parentheses in the tables indicate that either the toxicity value falls at or near the limit of two classes or that the principal classification is modified towards the classification in parentheses by other relevant parameters such as limiting or exacerbating physico-chemical properties, wide variability between species or between formulations, chemical forms, etc.

Classification for birds and fish is based on data for two principal indicator species. These species are standard choices in toxicity testing and considerably more data were available for them.

It should be stressed that all available data were considered and that the classification could be modified if data on other species deviated significantly from the indicator data. In the case where the indicator species fell into different classes, the more toxic was retained as the principal class and the less toxic shown in parentheses.

Birds

Principal indicator species were Mallard duck (*Anas platyrhynchos*) and Bobwhite quail (*Colinus virginianus*). Modifications involved consideration of repellent effects, quality of application, etc in addition to the principal parameters listed above. Dietary toxicological data were used to complement acute data or used alone if acute data were unavailable.

Fish

Principal indicator species were Rainbow trout (*Salmo gairdneri*) and Bluegill sunfish (*Lepomis macrochirus*). Modifications involved consideration of active ingredient solubility, adsorption, persistence, degradation or effect on other aquatic wildlife, etc in addition to the principal parameters listed above.

Bees

Most bee studies reported were carried out on unspecified strains of *Apis mellifera* L. Classification is less straightforward. In general, much variation between laboratory and field values was found and very few LD50 data were available. Indeed, LD50 values (oral and contact) were used only as a complementary criterion due to paucity of data. Modifications were made according to the standard parameters and to effects of timing and quality of product application, persistence, repellency, etc.

Table 1 - Key to Classification.

		Fish	*Birds*		*Bees*	
Class	Description	LC50 (mg/l)	Acute oral LD50 (mg/kg)	Dietary LC50 (mg/kg diet)	Use Category	LD50 (µg/bee)
1	Very highly toxic	<0.1	<10		Cannot safely be applied to flowering crops at any time	<0.1
2	Highly toxic	0.1 - 1	10 - 75		Cannot safely be applied to flowering crops at any time	<2
3	Moderately toxic	1 - 10	75 - 750	1 500 - 5 000	Hazardous if applied directly over bees	2 - 10
4	Slightly toxic	10 - 100	750 - 2 000	5 000 - 10 000		10 - 100
5	Practically non-toxic	>100	>2 000	>10 000	Can be applied at any time with minimum injury to bees.	>100

CONCLUSION

The WHO classification is included in the table for reference. In spite of the obvious limitations of a system whereby laboratory toxicity data on one species are extrapolated to other species and real situations, the WHO classification has proved to be a useful guide to toxicity and has attained worldwide acceptance. The Index proposed here is subject to the same limitations, and, hopefully, the same interest.

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Table 2 - Toxicity Index for insecticides.

Active ingredient (Common name)	Fish	Birds	Bees	WHO
abamectin	1	3 (5)	2	NC
acephate	5	3	2	III
aldicarb	1	1	2	IA
aldoxycarb	3	2	4 (3)	IB
aldrin	1	1	1	IB
allethrin	4	5 (4)	3	III
alpha-cypermethrin	1	5 (4)	2	II
amitraz	3	4 (3)	4	III
azamethiphos	2 (3)	5	1 (2)	III
azinphos-ethyl	1 (2)	3 (2)	1	IB
azinphos-methyl	1	3 (2)	1	IB
Bacillus thuringiensis	5	5	4 (3)	NC
bendiocarb	3 (2)	2	1 (2)	II
benfuracarb	2	3	4	IB
beta-cyfluthrin	nd	nd	nd	II
bialaphos	5	5	nd	NC
bifenthrin	1	4 (5)	2	II
bioallethrin	1	5 (4)	nd	II
bioresmethrin	1	nd	1	5
bromophos	1 (2)	4	2	III
bromophos-ethyl	2	3	2	IB
buprofezin	3	5 (4)	4	5
butoxycarboxim	5	3	4 (5)	IB
carbaryl	3 (2)	5 (4)	1	II
carbofuran	2	1	1	IB
carbophenothion	1 (2)	2	2	IB
carbosulfan	1	1 (2)	2	II
cartap hydrochloride	3 (2)	nd	3	II
chinomethionat	2	3	4 (5)	5
chlordane	1 (2)	2 (3)	2 (1)	II
chlorfenvinphos	2	2 (3)	2 (1)	IA
chlorfluazuron	5	5	5	5
chloropicrin	2	2	4	7
chlorpyrifos	1	2	1 (2)	II
chlorpyrifos-methyl	2	3	2 (1)	5
cloethocarb	3	nd	2	IB
coumaphos	nd	nd	nd	IA
creosote	2	nd	nd	NC
cyanophos	3	nd	2	II
cycloprothrin	3 (4)	5	2	5
cyfluthrin	1	5	2	II

Active ingredient (Common name)	Fish	Birds	Bees	WHO
cyhalothrin	1	5	nd	II
cypermethrin	1	5	2 (1)	II
cyphenothrin	nd	nd	nd	II
cyromazine	4 (5)	4 (5)	4 (5)	5
D-D	3	4 (3)	4	NC
dazomet	2	3	4 (5)	III
DDT	1 (2)	3 (2)	3	II
deltamethrin	1 (2)	5	2	II
demeton-S-methyl	3 (4)	2	2 (3)	IB
demeton-S-methylsulphon	3 (4)	nd	2 (3)	IB
dialifos	2 (3)	4	4 (5)	II
diazinon	3 (4)	1	1 (2)	II
dichlofenthion	2	nd	3	II
dichlorvos	2	1	1	IB
dicrotophos	4	1	1 (2)	IB
dieldrin	1	1	1	IB
diflubenzuron	5	4	4 (5)	5
dimethoate	3	2	1 (2)	II
dioxacarb	4	3	2 (1)	II
dioxathion	2	3	3	IB
disulfoton	2 (1)	1	3	IA
DNOC	3	2	1 (2)	IB
ebufos	2	2 (3)	nd	IB
endosulfan	1	2 (3)	3 (4)	II
EPN	2	1	2 (1)	IA
esfenvalerate	1	nd	nd	II
ethion	2	3	3 (2)	II
ethoprophos	3 (2)	2 (1)	3	IA
etofenprox	3	5	3	5
etrimfos	3	2 (3)	2	II
fenitrothion	2 (3)	2 (3)	1 (2)	II
fenobucarb	4 (3)	3	nd	II
fenoxycarb	3	5	4 (5)	5
fenpropathrin	1	4	2	II
fensulfothion	2 (3)	1	2	IA
fenthion	2	2 (1)	2 (1)	IB
fenvalerate	1	5	2 (1)	II
fipronil	2	5 (2)*	nd	II
flucycloxuron	5	5 (4)	4 (3)	5
flucythrinate	1	5	2 (1)	IB
flufenoxuron	5	5	4 (3)	5
fluvalinate	1	5	3	II
fonofos	1	2	2 (1)	IA

Active ingredient (Common name)	Fish	Birds	Bees	WHO
formetanate hydrochloride	3	2	3 (4)	IB
formothion	4	3	2 (1)	II
fosmethilan	3	2	4	IB
furathiocarb	1 (2)	2	2	IB
heptachlor	1	4 (3)	2	II
heptenophos	3	2	2	IB
hexaflumuron	2 (3)	5 (4)	5	5
hydrogen cyanide	1	2 (1)	1 (2)	7
imidacloprid	5	2 (3)	2	II
isazofos	1	2 (1)	2 (1)	IB
isofenphos	3	1	nd	IB
isoprocarb	3	nd	2	II
isoprothiolane	3	nd	nd	III
isoxathion	3	nd	nd	IB
lambda-cyhalothrin	1	5 (4)	2	II
lindane	2	2 (3)	2 (1)	II
malathion	2	3 (4)	2	III
mecarbam	nd	nd	2	IB
mephosfolan	3	2 (1)	2 (3)	IA
mercaptodimethur	2	2	2	II
mercurous chloride	2	nd	nd	II
metam	1	3 (4)	4 (5)	II
Metarhizium anisopliae	5	5	4 (5)	NC
methacrifos	3	3	2 (3)	II
methamidophos	4 (3)	1 (2)	1 (2)	IB
methidathion	1	2	2	IB
methomyl	2	2	2 (1)	IB
methoprene	3	4	4 (5)	5
methoxychlor	1 (2)	5 (4)	3	5
metolcarb	2 (3)	nd	nd	II
mevinphos	1	1	1	IA
MIT	2 (1)	3	4 (5)	II
monocrotophos	3	1	1	IB
naled	2 (3)	2	1 (2)	II
omethoate	3	2 (3)	1	IB
oxamyl	3	1	2	IB
oxydemeton-methyl	4 (3)	2	2	IB
parathion	2	1	1 (2)	IA
parathion-methyl	2 (3)	1	1 (2)	IA
pentachlorophenol	2	nd	nd	IB
permethrin	1	5	2 (1)	II
petroleum oil	4 (5)	nd	4	NC
phenothrin	1	5	2 (1)	5

Active ingredient (Common name)	Fish	Birds	Bees	WHO
phenthoate	2 (3)	3	1 (2)	II
phorate	1	1	3 (4)	IA
phosalone	2	3	4 (3)	II
phosfolan	nd	nd	1 (2)	IA
phosmet	2 (1)	3	1 (2).	II
phosphamidon	3 (2)	1	1 (2)	IA
phoxim	2	2 (3)	2	II
pirimicarb	4	2 (1)	4 (3)	II
pirimiphos-ethyl	1(2)	1 (2)	2	IB
pirimiphos-methyl	2	2 (3)	2 (1)	III
profenofos	1 (2)	2	2	II
promecarb	2	1 (2)	2	II
propetamphos	3	3	nd	IB
propoxur	3	2 (1)	1 (2)	II
prothiofos	2 (3)	nd	3	II
prothoate	4 (3)	2	2	IA
pyraclofos	1	2 (1)	2	II
pyrethrins	2 (1)	5 (4)	3	II
pyridaben	2	5	nd	III
pyridaphenthion	4 (3)	nd	nd	III
quinalphos	3	2	2	II
rotenone	1	4	3 (4)	II
sulfotep	nd	nd	4 (5)	IA
sulphur	5	5 (4)	4 (5)	5
sulprofos	4	2	3	II
tar oils	3 (2)	nd	nd	NC
teflubenzuron	5	5	4 (5)	5
tefluthrin	1	3 (4)	2	IB
temephos	4	2	2 (3)	5
terbufos	1	2	3	IA
tetrachlorvinphos	2 (3)	4	2	5
tetramethrin	1	4	2 (1)	5
thiocyclam hydrogen oxalate	1 (2)	1	3	II
thiodicarb	3	5 (4)	3	II
thiofanox	2	2	4 (5)	IB
thiometon	3 (4)	2 (3)	2	IB
tralomethrin	1	5	2	II
triazophos	3	2	2	IB
trichlorfon	2 (3)	2	2 (3)	III
triflumuron	5	5	nd	5
vamidothion	4	2	2	IB
xylylcarb	3	nd	nd	II

WHO Classification :

IA = Extremely Hazardous
IB = Highly Hazardous
II = Moderately Hazardous
III = Slightly Hazardous
5 = Table 5, Unlikely to present acute hazard in normal use
7 = Table 7, Fumigants
NC = Non-classified.
* = Large variation depending on species