

Snails as Temporal Biomonitors of the Occurrence and Distribution of Pesticides in an Apple Orchard

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Section S1. List of assessed pesticides

List of non-volatile pesticides: pymetrozine, carbendazim, chloridazon, acetamiprid, nicosulfuron, thiacloprid, chlortoluron, carbetamide, terbutryn, spinosad A, isoproturon, diuron, metalaxyl-M, spinosad D, dimethenamid-p, penconazole, isoxadifen, tebuconazole, diflubenzuron, epoxiconazole, prothioconazole, propiconazole, chlorfenvinphos, triflusulfuron methyl, pendimethalin, cyazofamid, pyraclostrobine, diflufenican, flufenoxuron, and lufenuron.

List of semi-volatile pesticides: clofentezine, dichlobenil, etridiazole, diphenylamine, trifluralin, chlorpropham, tebutam, clomazone, propyzamide, lindane, pyrimethanil, dimethenamid-P, dimethachlor, acetochlor, alachlor, fenpropidin, carbaryl, ethofumesate, malathion, fenpropimorph, metolachlor-S, chlorpyrifos, flurochloridone, cyprodinil, pendimethalin, tolyfluanid, metazachlor, penconazole, procymidone, captan, folpet, oxadiazon, buprofezine, kresoxim-methyl, bupirimate, flusilazole, myclobutanil, aclonifen, trifloxystrobin, bromoxynil octanoate, propiconazole, quinoxifen, lenacile, diclofop-methyl, chloridazon, diflufenicanil, fluazinam, tebuconazole, bifenthrin, dimoxystrobin, epoxiconazole, fenoxycarb, isoxaflutole, tebufenpyrad, bifenox, lambda cyhalothrin, fenarimol, pyraclostrobin, prochloraz, cypermethrin, boscalid, indoxacarb, difenoconazole, deltamethrin, azoxystrobin, dimethomorph, spiromamine, and metamitron.

Table S1. Method validation parameters.

Compounds	Regression line equation	Regression coefficient	Limit of detection (ng/g)	Limit of quantification (ng/g)	Repeatability (intra-day RSD%)	Reproducibility (Inter-day RSD %)	Recovery (%)
pymetrozine	$Y = 0.0008 * X$	0.995	2.63	8.8	4.59	8.74	67.80
carbendazim	$Y = 0.0040 * X$	0.996	1.13	3.78	4.22	5.19	72.09
chloridazon	$Y = 0.0021 * X$	0.997	1.01	3.39	0.55	4.15	85.53
acetamiprid	$Y = 0.0011 * X$	0.998	5.13	17.1	0.93	5.73	74.73
thiacloprid	$Y = 0.010 * X$	0.995	1.96	6.53	1.45	4.83	79.26
nicosulfuron	$Y = 0.0009 * X$	0.997	5.22	17.41	Nd	Nd	Nd
foramsulfuron	$Y = 0.0014 * X$	0.998	2.71	9.03	4.06	4.42	97.40
chlortoluron	$Y = 0.010 * X$	0.998	1.98	6.61	1.81	5.58	74.03
carbetamide	$Y = 0.0073 * X$	0.997	2.56	8.58	3.21	5.46	67.37
terbutryn	$Y = 0.0242 * X$	0.993	1.99	6.64	0.10	3.96	84.03
spinosad A	$Y = 0.0294 * X$	0.996	4.19	14	0.48	5.81	72.43
isoproturon	$Y = 0.0244 * X$	0.998	1.19	3.95	0.09	5.90	79.04
diuron	$Y = 0.0050 * X$	0.999	0.52	1.73	1.43	4.79	77.79
metalaxyl-M	$Y = 0.0043 * X$	0.996	4.42	14.7	1.93	6.34	69.12
DPMU	$Y = 0.0060 * X$	0.997	1.73	5.77	Nd	Nd	Nd
spinosad D	$Y = 0.0067 * X$	0.996	0.16	0.55	0.61	4.97	82.21
dimethenamid-P	$Y = 0.1194 * X$	0.997	0.46	1.55	1.01	4.38	92.87
penconazole	$Y = 0.0145 * X$	0.998	1.42	4.73	1.84	6.85	97.68
isoxadifen	$Y = 0.0076 * X$	0.998	1.76	5.85	1.60	4.93	77.05
tebuconazole	$Y = 0.0188 * X$	0.994	0.94	3.13	0.49	5.71	92.61
epoxiconazole	$Y = 0.0715 * X$	0.998	1.06	3.53	0.06	6.74	87.00

propiconazole	$Y = 0.0302 * X$	0.997	3.73	12.43	1.33	5.60	94.10
clofenvinphos	$Y = 0.0045 * X$	0.998	3.32	11.08	2.50	6.27	73.50
triflu-Methyl	$Y = 0.0185 * X$	0.999	1.51	5.04	0.13	4.87	101.65
pendimethalin	$Y = 0.0160 * X$	0.998	1.68	5.6	0.79	5.25	95.63
cyazofamid	$Y = 8.8e-005 * X$	0.995	2.48	8.26	0.75	7.81	98.25
pyraclostrobin	$Y = 0.0154 * X$	0.992	0.79	2.63	0.00	5.77	77.28
diflufenican	$Y = 0.0465 * X$	0.997	1.03	3.44	0.83	6.03	98.50
flufenoxuron	$Y = 0.0087 * X$	0.995	1.11	3.71	2.60	5.72	95.49
lufenuron	$Y = 0.0007 * X$	0.997	5.87	19.57	0.63	6.87	97.53
clofentezine	$Y = 0.030 * X - 1.82e-006 * X^2$	0.994	3.75	12.5	4.51	12.31	91.47
dichlobenil	$Y = 0.080 * X + 4.68e-005 * X^2$	0.996	0.27	0.89	3.35	9.88	86.52
etridiazole	$Y = 0.076 * X + 3.66e-006 * X^2$	0.998	5.64	18.8	7.61	9.86	79.62
diphenylamine	$Y = 0.321 * X + 0.0001 * X^2$	0.998	2.31	7.69	7.59	10.03	80.58
trifluralin	$Y = 0.008 * X + 2.74e-005 * X^2$	0.999	0.83	2.78	1.13	11.91	76.93
chlorpropham	$Y = 0.056 * X + 1.18e-005 * X^2$	0.998	5.12	17.07	9.48	8.90	78.74
tebutam	$Y = 0.0817 * X - 4.09e-006 * X^2$	0.996	5.27	17.57	2.31	10.51	82.07
clomazone	$Y = 0.008 * X + 5.21e-006 * X^2$	0.993	5	16.7	6.48	7.74	81.77
Propyzamide	$Y = 0.076 * X + 7.17e-005 * X^2$	0.996	7.33	24.43	1.85	8.18	77.86
lindane	$Y = 0.03 + 0.0032 * X$	0.996	0.65	2.17	7.39	9.73	81.82
pyrimethanil	$Y = 0.085 * X + 7.43e-005 * X^2$	0.997	2.5	8.33	2.79	8.05	84.72
dimethenamid-P	$Y = 0.0007 * X + 1.17e-007 * X^2$	0.996	10.53	35.11	1.14	10.12	79.30
dimethachlor	$Y = 0.0039 * X + 9.18e-006 * X^2$	0.999	4.17	13.89	5.91	10.61	81.94
acetochlor	$Y = 0.010 * X + 3.00e-005 * X^2$	0.996	13.53	45.11	5.94	10.49	78.61
alachlor	$Y = 0.0009 * X + 1.39e-006 * X^2$	0.991	5	16.7	1.79	11.94	86.35
fenpropidin	$Y = 0.0019 * X + 3.27e-006 * X^2$	0.992	20	66.67	8.24	10.79	77.83
carbaryl	$Y = 0.28 + 0.0049 * X - 2.7e-007 * X^2$	0.991	5.63	18.8	4.32	11.20	82.26
ethofumesate	$Y = 0.13 + 0.001 * X + 2.25e-006 * X^2$	0.997	9.38	31.3	0.26	12.29	82.12
malathion	$Y = 0.002 * X - 6.17e-008 * X^2$	0.996	9.46	31.5	3.32	9.71	89.06

fenpropimorph	$Y = 0.002 \cdot X + 3.78e-007 \cdot X^2$	0.996	7.5	25	7.29	8.01	80.89
metolachlor-S	$Y = 0.053 \cdot X + 2.27e-005 \cdot X^2$	0.991	6.43	21.43	2.93	12.26	84.94
chlorpyrifos	$Y = 0.003 \cdot X + 7.64e-008 \cdot X^2$	0.999	4.09	13.6	6.22	9.87	89.60
flurochloridone	$Y = 0.022 \cdot X - 4.32e-006 \cdot X^2$	0.993	12.27	40.9	6.80	9.23	82.26
cyprodinil	$Y = 0.0212 \cdot X + 1.13e-005 \cdot X^2$	0.994	5	16.7	1.13	11.41	84.00
pendimethalin	$Y = 0.0012 \cdot X + 3.38e-006 \cdot X^2$	0.996	7.06	23.53	1.90	9.55	85.31
tolyfluanid	$Y = 0.0003 \cdot X + 2.76e-007 \cdot X^2$	0.995	5	16.7	2.79	11.62	84.14
metazachlor	$Y = 0.0028 \cdot X - 3.23e-007 \cdot X^2$	0.997	19.3	64.8	8.91	11.36	85.04
penconazole	$Y = 0.048 \cdot X + 4.63e-005 \cdot X^2$	0.972	0.22	0.72	4.73	8.11	84.94
procymidone	$Y = 0.0011 \cdot X + 1.80e-007 \cdot X^2$	0.997	18.6	62.1	4.16	10.80	90.77
captan	$Y = 0.0049 \cdot X - 3.35e-007 \cdot X^2$	0.998	13.91	46.38	3.74	8.68	92.04
folpet	$Y = 4.76e-005 \cdot X + 2.89e-008 \cdot X^2$	0.981	11.7	38.9	6.12	9.27	80.27
oxadiazon	$Y = 0.0018 \cdot X - 3.6e-007 \cdot X^2$	0.991	5	16.7	6.83	10.34	84.74
buprofezin	$Y = 0.002 \cdot X + 1.39e-005 \cdot X^2$	0.994	7.5	25	3.92	12.58	76.55
kresoxim-methyl	$Y = 0.0001 \cdot X - 1.41e-008 \cdot X^2$	0.998	11.25	37.5	7.94	9.49	80.23
bupirimate	$Y = 0.099 + 0.005 \cdot X$	0.996	11.63	38.75	8.14	11.33	82.64
flusilazole	$Y = 0.014 \cdot X - 8.51e-007 \cdot X^2$	0.991	2.47	8.22	12.17	10.20	76.45
myclobutanil	$Y = 0.0027 \cdot X + 3.41e-006 \cdot X^2$	0.998	11.78	39.29	3.15	10.56	89.47
aclonifen	$Y = 1.53 + 0.023 \cdot X$	0.961	9.43	31.43	3.73	10.08	71.03
trifloxystrobin	$Y = 0.016 \cdot X + 3.34e-005 \cdot X^2$	0.991	9.5	31.7	6.24	11.41	84.21
bromoxynil octanoate	$Y = 0.007 \cdot X + 2.3e-006 \cdot X^2$	0.997	13.93	46.43	Nd	Nd	Nd
propiconazole	$Y = 0.008 \cdot X + 2.7e-005 \cdot X^2$	0.995	1.82	6.06	3.21	11.85	79.90
quinoxifen	$Y = 0.017 \cdot X + 1.52e-005 \cdot X^2$	0.991	0.44	1.47	5.91	7.66	89.66
lenacil	$Y = 0.0016 \cdot X + 5.41e-007 \cdot X^2$	0.998	14.4	48.1	5.64	9.31	74.17

diclophop-methyl	$Y = 0.068X + 6.27e-005X^2$	0.988	1.22	4.07	3.17	11.35	84.52
chloridazon	$Y = 0.0001X + 2.49e-007X^2$	0.997	5	16.7	0.05	11.48	81.32
diflufenicanil	$Y = 0.062X + 0.0003X^2$	0.98	0.88	2.94	8.27	11.91	72.19
fluazinam	$Y = 9.20e-005X + 1.84e-007X^2$	0.995	12	40	2.44	9.88	79.21
tebuconazole	$Y = 0.013 + 0.0004X$	0.998	13.12	43.75	7.51	11.46	82.67
bifenthrin	$Y = 0.127X + 0.0001X^2$	0.988	9.95	33.2	4.63	8.83	79.23
dimoxystrobin	$Y = 0.150X + 4.36e-005X^2$	0.997	1.86	6.19	3.95	9.72	92.64
epoxiconazole	$Y = 0.0027X + 2.14e-007X^2$	0.99	10.73	35.77	5.86	9.91	90.87
fenoxycarb	$Y = 0.0003X + 6.07e-008X^2$	0.991	6	20	4.53	12.62	90.46
isoxaflutole	$Y = 0.0002X + 9.52e-008X^2$	0.993	5	16.7	2.57	8.01	91.42
tebufenpyrad	$Y = 0.0013X - 2.02e-007X^2$	0.999	0.61	2.04	1.44	11.57	82.15
bifenox	$Y = 0.0005X + 1.5e-006X^2$	0.999	12.39	41.3	9.56	8.84	75.20
lambda cyhalothrin	$Y = 0.0013X + 1.06e-005X^2$	0.989	8.18	27.3	2.91	10.65	92.19
fenarimol	$Y = 0.152 + 0.001X$	0.998	8.33	27.77	14.71	8.49	70.45
pyraclostrobin	$Y = 0.359 + 0.010X$	0.996	9.16	30.55	6.58	11.07	81.05
prochloraz	$Y = 0.0023X + 2.43e-006X^2$	0.997	14.4	48	6.63	9.65	79.56
cypermethrin	$Y = 0.185 + 0.005X$	0.997	12	40	6.62	7.44	79.83
boscalid	$Y = 0.006X + 1.18e-005X^2$	0.998	2.34	7.81	6.74	10.12	81.90
indoxacarb	$Y = 0.0009X + 3.29e-006X^2$	0.998	8.72	29.61	Nd	Nd	Nd
difenoconazole	$Y = 0.0053X + 7.872e-006X^2$	0.998	15.1	50.3	6.59	9.89	76.08
deltamethrin	$Y = 0.0001X + 6.25e-007X^2$	0.998	7.5	25	5.05	7.21	82.60
azoxystrobin	$Y = 0.084 + 0.0017X$	0.996	2.73	9.09	5.24	10.68	84.47
dimethomorph	$Y = 0.0006X - 4.97e-009X^2$	0.993	6.25	20.8	5.29	7.56	83.36
spiroxamine	$Y = 0.0007X + 3.04e-007X^2$	0.983	6.36	21.2	8.58	7.77	79.44

metamitron	$Y = 0.0006 \cdot X + 5.45e-008 \cdot X^2$	0.995	7.5	25	Nd	Nd	Nd
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Nd: not determined

Table S2. Partitioning coefficient log K_{ow} of assessed pesticides.

Pesticide	Log KOW
Foramsulfuron	-0.78
Pymetrozine	-0.19
Carbendazim	1.48
Dimethenamid-P	1.89
Dimethachlore	2.17
Ethofumesate	2.7
Malathion	2.75
Myclobutanil	2.89
Spiroxamine	2.89
Tebutam	3
Alachlor	3.09
Epoxiconazole	3.3
Kresoxim-Methyl	3.4
Lindane	3.5
Dimoxystrobin	3.59
Bupirimate	3.68
Tebufenpyrad	3.7
Chlorpropham	3.76
Fenoxycarb	4.07
Clofentezine	4.09
Trifloxystrobin	4.5
Buprofezin	4.93
Lambda cyhalothrin	5.5
Cypermethrine	5.55
Bromoxynil octanoate	6.2
Fenpropidine	6.4
Bifenthrin	6.6

Section S2. Non-volatile pesticides classification

Insecticides: Bifenthrin, Buprofezin, Clofentezine, Cypermethrin, Fenoxycarb, Lambda cyhalothrin, Lindane, Malathion, Tebufenpyrad,

Fungicides: Bupirimate, Cyprodinil, Diphenylamine, Dimoxystrobin, Fenpropidin, Kresoxim-Methyl, Myclobutanil, Pyrimethanil, Spiroxamine, Tolyfluand, Trifloxystrobin

Herbicides: Acetochlor, Alachlor, Benoxacor, Bromoxynil octanoate, Chlorpropham, Dimethachlor, Dimethenamid-P, Ethofumesate, Flurochloridone, Metolachlor, Pendimethalin, Propyzamide, Tebutam