First exploration of currently used pesticides in garden dormouse in the Netherlands

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Abstract: The garden dormouse (*Eliomys quercinus*) is classified as *Critically Endangered* in the Netherlands. This study investigated the exposure of garden dormice to currently used pesticides in the Netherlands by analyzing pesticide residues in brain, fur, liver and stomach tissues of five individuals. In this first exploratory assessment for garden dormouse in the Netherlands, thirteen compounds were detected, including insecticides and herbicides. The study was limited by its small sample size (n=5) and variable sample quality. Consequently, it provides a first indication of the exposure of the Dutch garden dormouse population to currently used pesticides, but no conclusions can yet be drawn regarding the extent, severity, or ecological significance of this exposure.

Keywords: garden dormouse (*Eliomys quercinus*), pesticide exposure, currently used pesticides, wildlife toxicology, small mammals, herbicides, insecticides, critically endangered, hibernation, the Netherlands.

Introduction

The garden dormouse (*Eliomys quercinus*) is classified as *Critically Endangered* on the current Dutch Red List (van Norren et al. 2020) and has undergone a sharp population decline across its European range, resulting in a *Vulnerable* status on the Global Red List (Bertolino et al. 2024).

The Dutch garden dormouse population occurs only in the southern part of the province of Limburg. The two remaining populations live in the Savelsbos and Bemelerberg nature reserves and inhabit a fragmented landscape close to agricultural and urban areas (Norren et al. 2024). In the Netherlands, a garden dormouse conservation project has been ongoing since 2018 (Feys & Nijs 2018), focusing mainly on habitat restoration, communication and research. Recent research comprised food web and habitat use (Nijssen & Hiddes 2020, van Norren & Schepers 2023), genetic diversity (La Haye 2019) and population monitoring (van Norren et al. 2023, 2024).

Research on pesticides in garden dormice has not yet been conducted in the Netherlands, but such studies may be relevant because large-scale research has demonstrated negative sublethal effects of pesticides on non-target organisms (Wan et al. 2025). A German study suggested that pesticide exposure also applies to garden dormouse populations (Famira-Parcsetich et al. 2022, Büchner et al. 2024). The proximity of garden dormice to both agricultural and urban areas makes

Figure 1. The six garden dormice (*Eliomys quercinus*) that were analyzed. *Photo: Aafke Saarloos.*

the species potentially susceptible to pesticide exposure from various sources, such as households and agriculture. The garden dormouse mainly forages on arthropods such as insects, millipedes and spiders living in the litter layer and vegetation, and also consumes plant-based food sources, such as flowers, berries and other plant parts (Storch 1978). As a considerable part of their diet includes animal prey, garden dormice may be susceptible to the bioaccumulation of environmental contaminants. During torpor or hibernation, the lipid-metabolism system may result in release of chemicals stored in the lipids, which may make the garden dormouse vulnerable to lipophilic compounds.

The present study provides the first report on exposure to currently used pesticides in the Dutch garden dormouse population. Pesticide residues were analyzed in liver, fur, brain, and stomach tissues of five individuals of garden dormouse to assess the extent of exposure.

Material and methods

Sample collection and study area

Between 2015 and 2023, five carcasses of garden dormouse (*Eliomys quercinus*) were found in the Savelsbos and Bemelerberg nature reserves, located in the south of the province of Limburg, the Netherlands (Figure 1). All carcasses were collected opportunistically after natural death, therefore no permits or ethical approvals under Dutch animal welfare legislation were needed. The transport of the carcasses was carried out under permit. The carcasses were stored at -18 ˚C.

Dissection and tissue sampling

Each animal was weighed and measured (length, from head to tail tip) upon dissection. Observations were recorded on the state of decay, the presence or absence of target

Table 1. Individual characteristics of the garden dormouse carcasses included in the pesticide analysis. Length is head to end of tail.

#	Weight (g)	Length (cm)	Maggots	Area and date of collection	State of tissue
1	29.0	X*	Yes (a lot)	Bemelerberg 06-09-2022	Excluded from analysis Very bad, almost no tissue left, either eaten by maggots or other necrophagous animals; very advanced state of decay.
2	X	25.0	No	Bemelerberg 13-07-2022	Good
3	X*	16.5	Yes	Savelsbos 05-06-2015	Rather bad, advanced state of decay, organs were small and dry
4	65.2	24.5	No	Bemelerberg (Mettenberg) 01-09-2022	Good (Figure 2a)
5	66.5	23.5	No	Savelsbos or Bemelerberg, no date	Bad, Internal organs not present, potentially eaten by necrophagous animals (Figure 2b)
6	51.8	24.0	Yes	Bemelerberg (Koelebosch) 08-09-2023	Rather bad, Integrity of internal organs affected by maggots (Figure 2c)

X*: Not possible to measure, because of the advanced state of decay.

organs and the occurrence of necrophagous insects such as maggots.

Extraction procedure

Tissue extraction followed a slightly modified QuEChERs method (Anastassiades et al. 2003). Briefly, tissue samples were weighed and homogenized in acetonitrile (ACN). Ultrapure Milli-Q water was added, and samples were agitated using a head-over-head shaker for three hours. A salt mixture containing magnesium sulfate ($MgSO_4$), sodium chloride (NaCl), tri-sodium citrate 5,5-hydrate ($C_6H_5Na_3O_7 \cdot 5.5H_2O$) and di-sodium hydrogen citrate 1,5-hydrate ($C_6H_6Na_2O_7 \cdot 1.5H_2O$) was added to the solution. Per 5 g of tissue, the salt mixture contained 4 g MgSO4, 1g NaCl2, 1 g $Na_3C_6H_5O_7 \cdot 2H_2O$, 0.5 g $Na_2HC_6H_5O_7 \cdot 5H_2O$. After an additional three hours of shaking, samples were sonicated with Bandelin Sonorex RK100 and centrifuged in a Sigma 2-16KL centrifuge at 5000 rpm for five minutes. Both ACN and water layers were recovered and stored at -80 °C until further analysis.

Pesticide identification and quantification

Extracts were analyzed using a Shimadzu LC-MS/MS 8045 system with a Shim-pack Velox Biphenyl column (2.1 mm x 100 mm, 2.7 µm). The column oven temperature was maintained at 35 °C, injection volume 1 µL and a flowrate of 0.4 mL/min. The mobile phases consisted of 2 mmol/L ammonium formate + 0.002% formic acid in ultrapure Milli-Q water (mobile phase A) and 2 mmol/L ammonium formate + 0.002% formic acid in methanol (mobile phase B).

The samples were first screened qualitatively for the presence of 648 pesticides (Appendix). The presence of compounds with preliminary detection signals were confirmed using certified analytical standards (PESTANAL®). Pesticide concentrations were determined by comparing sample

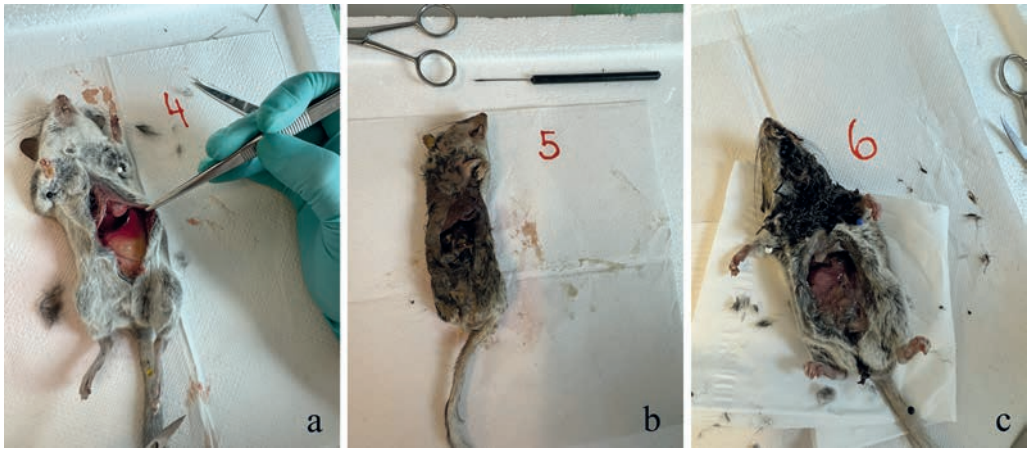

Figure 2. Photos illustrating variation in tissue condition across individuals: a. Individual #4, showing a relative big and yellowish colour of the stomach. b. Individual #5, showing the absence of internal organs. c. Individual #6, showing a dark colour of the liver. *Photos: Aafke Saarloos*.

Table 2. Linearity (r^2), accuracy range and limit of quantification (LOQ) for each of the 13 pesticides detected in at least one sample.

Pesticide	Linearity (r^2)	Accuracy (%)	LOQ (µM)
3-Indolyl-acetic acid	0.999	90.1-103.3	0.05
Mesotrione	0.999	91.6-106.9	0.01
Chloridazon	0.999	85.6-114.5	0.005
Deet	0.999	90.9-106.8	0.01
Fluopyram	0.999	97.9-104.5	0.005
Spirotetramat	0.999	95.6-107.4	0.01
Quinalphos	0.999	76.1-103.9	0.01
Isoxadifen-ethyl	0.999	86.4-115.4	0.005
Terbufos	0.999	90.6-105.8	0.05
Fenoxaprop-ethyl	0.999	93.3-105	0.05
Etoxazole	0.999	95.1-107.9	0.01
Resmethrin	0.998	95.9-109.3	0.005
Permethrin	0.999	94-112.8	0.05

signals with standard curves generated from these reference compounds.

All calibration curves showed excellent linearity, with r^2 values above 0.99 (Table 2). The limit of quantification (LOQ) for each compound was determined based on the lowest concentration showing recovery between 75% and 125%. Accuracy values for the 13 detected pesticides ranged from 76% to 115%.

Results

Decomposition and sample integrity

Considerable variation in the state of decomposition was observed among the five garden dormouse carcasses (Table 1). The five individuals were in different states at the moment of collection; two individuals (#3 and #6) showed advanced decay with partial loss of internal organs, one individual (#5) had no

Table 3. List of pesticides detected in at least one tissue sample (individual #1 was not analyzed).

Pesticide	Type	# individuals detected
3-Indolyl-acetic acid	Plant hormone, (also) occurring naturally	5 out of 5
Chloridazon	Herbicide	1 out of 5
DEET	Insect repellent	2 out of 5
Etoxazole	Insecticide	4 out of 5
Fenoxaprop-ethyl	Herbicide	1 out of 5
Fluopyram	Fungicide / nematicide	2 out of 5
Isoxadifen-ethyl	Herbicide antidote	5 out of 5
Mesotrione	Herbicide	2 out of 5
Permethrin	Insecticide	1 out of 5
Quinalphos	Insecticide / acaricide	3 out of 5
Resmethrin	Insecticide	5 out of 5
Spirotetramat	Insecticide	2 out of 5
Terbufos	Insecticide / nematicide	5 out of 5

Table 4. Pesticide concentrations (ng/g) in liver, fur, brain and stomach of garden dormouse #2 - #6. ND (green) means compound not determined in tissue. NA (grey) means tissue was not available. LOQ = Limit of Quantification (the pesticide has been found in the tissue, but the amount is too small to quantify).

Individual #	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6
Tissue from	Liver	Fur	Brain	Stom.	Liver	Fur	Brain	Stom	Liver	Fur	Brain	Stom	Liver	Fur	Brain	Stom	Liver	Fur	Brain	Stom.
3-Indolyl-acetic acid	70	1747	37	68	134	10,507	ND	127	89	17,697	10	83	NA	350	73	NA	114	1647	NA	142
Chloridazon	ND	ND	ND	ND	ND	ND	ND	ND	ND	<LOQ	ND	ND	NA	ND	ND	NA	ND	ND	NA	ND
DEET	ND	<LOQ	ND	ND	ND	505	ND	<LOQ	ND	ND	ND	ND	NA	ND	ND	NA	ND	ND	NA	ND
Etoxazole	<LOQ	ND	ND	ND	ND	ND	ND	ND	<LOQ	ND	ND	ND	NA	<LOQ	ND	NA	ND	<LOQ	NA	ND
Fenoxaprop-ethyl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	NA	ND	ND	NA	1187
Fluopyram	ND	<LOQ	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	NA	ND	<LOQ	NA	ND
Isoxadifen-ethyl	ND	24	ND	ND	106	30	ND	5	ND	<LOQ	ND	4	NA	257	ND	NA	4	18	NA	ND
Mesotrione	8	ND	ND	ND	ND	ND	ND	ND	<LOQ	ND	ND	ND	NA	ND	ND	NA	ND	ND	NA	ND
Permethrin	ND	ND	ND	ND	ND	ND	ND	ND	ND	<LOQ	ND	ND	NA	ND	ND	NA	ND	ND	NA	ND
Quinalphos	ND	ND	ND	ND	<LOQ	<LOQ	ND	<LOQ	ND	ND	ND	<LOQ	NA	ND	ND	NA	<LOQ	<LOQ	NA	13
Resmethrin	<LOQ	<LOQ	<LOQ	7	ND	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	5	NA	<LOQ	<LOQ	NA	ND	17	NA	ND
Spirotetramat	ND	ND	ND	ND	66	ND	ND	38	ND	ND	ND	ND	NA	ND	ND	NA	69	ND	NA	63
Terbufos	ND	149	<LOQ	99	ND	149	<LOQ	36	ND	<LOQ	ND	ND	NA	<LOQ	<LOQ	NA	43	173	NA	187
# pesticides	4	6	3	3	4	6	2	7	4	6	2	4		5	3		5	7		5

usable liver or stomach tissue due to scavenger activity, and one individual (#6) lacked usable brain tissue (Figures 2a-c).

Pesticide analysis

A total of 13 currently used pesticides were detected in different tissues (Table 3 and 4). The identified compounds included:

- Herbicides: chloridazon, fenoxaprop-ethyl, mesotrione
- Insecticides: etoxazole, permethrin, quinalphos, resmethrin, spirotetramat, terbufos
- Fungicide: fluopyram
- Insect repellent: DEET
- Herbicide antidote: isoxadifen-ethyl
- Plant hormone: 3-indolyl-acetic acid

The prevalence and concentrations of compounds varied among individuals, as did the tissue types available for analysis. Results per individual, including compound concentrations per tissue (liver, fur, brain and stomach), are presented in Table 4. The plant hormone 3-indolyl acetic acid was detected in nearly all samples, whereas the other compounds were present only in part of the tissues. The detection of this naturally occurring compound should be interpreted with caution as 3-indolyl acetic acid is a natural chemical, commonly found in nearly all environmental samples analyzed.

A substantial proportion of detected compounds were present at concentrations below the limit of quantification (LOQ), indicating low levels that cannot be reliably quantified. While the presence of these substances was confirmed, their exact concentrations remain undetermined (Table 4).

Discussion

This study provides the first exploratory investigation of currently used pesticide residues in the critically endangered garden dormouse population in the Netherlands. The detection of 13 pesticide residues in tissues from five individuals from two different locations confirms that garden dormice are exposed to such compounds in South Limburg, the area where the remaining Dutch populations occur.

Although pesticide compounds were detected in multiple tissues, these findings should be interpreted with caution, due to limitations in sample size and sample quality. The small number of carcasses analyzed (n=5), combined with a variable and often advanced state of decomposition, severely constrained the availability and integrity of organs suitable for chemical analysis. The decomposed state of the tissues may have resulted in degradation of chemicals, potentially underestimating exposures. Consequently, no firm conclusions can be drawn regarding the extent or ecological significance of the exposure to currently used pesticide in this population.

Multiple compounds were detected at low concentrations; however, their potential combined effects on garden dormice remain unknown. Furthermore, we don't know the exposure pathways (Buijs & Mantingh 2022) of pesticides for the garden dormice, because these have not been determined in a way Buijs & Mantingh (2022) have done for other species. It is unclear whether exposure occurs via contact with contaminated substrates, ingestion during grooming, or dietary intake of contaminated food items such as berries, nuts, or insects.

The plant hormone 3-indolylacetic acid, detected in nearly all samples, is found in most environmental samples, be it soil, vegetation or biota. Its presence in our samples is difficult to interpret, as it occurs both as a result of pesticide use and also as a naturally occurring plant hormone in the environment. Therefore, it is not clear what the background of this signal is.

Other currently used compounds such as glyphosate-based herbicides were not included, as these substances are difficult to be reliably measured in tissues. PFAS is another group that may be of interest, however, the methods applied in the current study did not allow their detection. Older pesticides that are no longer in use, for instance DDT and Dieldrin, may still be found in the garden dormice; however, they were not included in this study because they provide limited practical management perspective.

Given the limited availability of garden dormouse carcasses in the Netherlands, opportunities for further research are restricted. Nevertheless, future studies could aim to:

1. Increase sample size (i.e. increase the number of collected carcasses), or, if this is not feasible, collect blood samples from living individuals. Blood reflects the compounds circulating in the organism at the time of sampling and can therefore provide informa-

tion on recent pesticide exposure. 2. Collect and analyze droppings, which can indicate metabolic processes and the excretion of various compounds. 3. Include a broader range of contaminants, such as PFAS, glyphosate-based herbicides and legacy pollutants (PCBs, DDT, Dieldrin). 4. Investigate potential exposure pathways by analyzing pesticides in soil, food items (berries, fruits), and prey (insects). 5. Explore sublethal effects including immune suppression, reproductive impairments and disruptions to hibernation; and 6. Compare pesticide exposure with other mammal species (e.g. bats, hedgehogs) to better understand food web contamination.

Collaborations with transboundary research initiatives (e.g. German or Belgian studies) may be essential for obtaining more robust insights, given the limited and fragmented Dutch population.

Although this exploratory study provides a first indication that garden dormice in the Netherlands are exposed to multiple pesticide compounds, further research is required before any conclusions can be drawn regarding the role of pesticides in the species' decline in the Netherlands.

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Samenvatting

Een eerste verkenning van de blootstelling van eikelmuizen (*Eliomys quercinus*) aan momenteel gebruikte pesticiden in Nederland

De eikelmuis (*Eliomys quercinus*) is in Nederland geclassificeerd als Ernstig Bedreigd. In deze studie is voor het eerst de blootstelling van eikelmuizen in Nederland aan momenteel gebruikte pesticiden onderzocht. De hersenen, de vacht, de lever en maagweefsel van vijf individuen werden geanalyseerd. Dertien pesticiden werden gedetecteerd, waaronder insecticiden en herbiciden. De studie werd beperkt door het kleine aantal onderzochte dieren (*n*=5), en de variabele kwaliteit van de monsters. Hierdoor vormt het onderzoek een eerste indicatie over de blootstelling van de Nederlandse eikelmuispopulatie aan momenteel gebruikte pesticiden, maar kunnen er nog geen conclusies worden getrokken over de omvang, ernst of ecologische betekenis van deze blootstelling.

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Appendix

List of compounds the garden dormouse tissue samples were screened for.

#	Compound	#	Compound	#	Compound
1	Methamidophos	217	Pyroquilon	433	Cycloate
2	Cyromazine	218	Fenthion-sulfoxide	434	Phorate
3	Acephate	219	Simeconazole	435	Propiconazole (stereo isomer)
4	Nicotine	220	Methoprotryne	436	Fenothiocarb
5	Hymexazol	221	Azobenzene	437	Mefenacet
6	Picloram	222	Iodosulfuron-methyl	438	Pyraflufen-ethyl
7	Propamocarb	223	Mexacarbate	439	Triflumizole
8	Omethoate	224	Difenoxuron	440	Phenthoate
9	Butocarboxim-sulfoxide	225	Quizalofop (free acid)	441	Cyflufenamid
10	Dinotefuran	226	Quizalofop-P	442	Thiobencarb
11	Aldicarb-sulfoxide	227	Triasulfuron	443	Oxadiargyl
12	Asulam	228	Dodine	444	Thenylchlor
13	Dicyclanil	229	Disulfoton-sulfone	445	Azoxystrobin
14	Butocarboxim-sulfone	230	Metazachlor	446	Diflufenican
15	Aldicarb-sulfone (Aldoxycarb)	231	Methiocarb	447	Cafenstrole
16	Flonicamid	232	Flurtamone	448	Bromfenvinfos
17	Simazine-2-hydroxy	233	Monalide	449	Edifenphos
18	Atrazine-desisopropyl	234	Halosulfuron-methyl	450	Orbencarb
19	Monocrotophos	235	Ethametsulfuron-methyl	451	Pirimiphos-methyl
20	Oxamyl	236	Pyrimethanil	452	Di-allate
21	Fluroxypyr	237	Aziprotryne	453	Benzyldimethyltetradecylammonium Chloride
22	Oxydemeton-methyl	238	Benoxacor	454	Benzoylprop-ethyl
23	Methomyl	239	Foramsulfuron	455	Fenthion
24	Nitenpyram	240	Metalaxyl	456	Haloxyfop-P-methyl
25	2,6-Dichlorobenzamide	241	Metalaxyl-M (Mefenoxam)	457	Haloxyfop-methyl
26	Clothianidin	242	Dodemorph	458	Indanofan
27	Demeton-S-methyl-sulfone	243	Demeton-O	459	Didecyldimethylammonium
28	Atrazine-2-hydroxy	244	Demeton-S	460	Kresoxim-methyl
29	Quinclorac	245	Nuarimol	461	Disulfoton
30	Thiofanox-sulfoxide	246	Fluxapyroxad	462	Bromuconazole
31	Dicrotophos	247	Iprovalicarb	463	Clodinafop-propargyl
32	3-Indolyl-acetic acid	248	Fluopyram	464	Dinocap
33	Atrazine-desethyl	249	Flutolanil	465	2,4,6-Tribromophenol
34	Fenuron	250	Trifloxysulfuron	466	Pencycuron
35	Quinmerac	251	Trinexapac-ethyl	467	Dithiopyr
36	Mesotrione	252	Diphenylamine	468	Tolclofos-methyl
37	Pymetrozine	253	Azaconazole	469	Butamifos
38	Thiamethoxam	254	Prometryn	470	Triphenyl phosphate
39	Ethiofencarb-sulfoxide	255	Terbutryn	471	Prallethrin
40	Carbofuran-3-hydroxy (3-Hydroxycarbofuran)	256	Metominostrobin (E, Z)	472	Benalaxyl
41	Ethiofencarb-sulfone	257	Thifluzamide	473	Tebupirimfos

42 Thiofanox-sulfone
43 Carbendazim
44 Dimethoate
45 Isocarbamid
46 Ethidimuron
47 Chloridazon
48 Vamidothion
49 Dioxacarb
50 Cymoxanil
51 Methiocarb-sulfoxide
52 Mefluidide
53 Terbuthylazine-2-hydroxy
54 6-chloro-3-phenylpyridazin-4-ol
55 Sebuthylazine-desethyl
56 Thiazafluron
57 3-(3-Indolyl)-propionic acid
58 Mevinphos
59 Carbetamide
60 Imidacloprid
61 Fuberidazole
62 Aminocarb
63 Aldicarb
64 Oxycarboxin
65 Monuron
66 Methiocarb-sulfone
67 Fenthion-oxon-sulfoxide
68 Metolcarb (MTMC)
69 N-(2,4-Dimethyl-phenyl)formamide
70 Thiabendazole
71 1-(3,4-Dichlorophenyl)urea
72 Thidiazuron
73 Metoxuron
74 Imazaquin
75 Terbuthylazine-desethyl
76 Dimetilan
77 Fenthion-oxon-sulfone
78 Propoxycarbazone-sodium
79 Dichlorvos
80 Carbofuran-3-keto
81 Terbumeton-desethyl
82 Simazine
83 Cyanazine
84 Fluometuron
85 Sulfaquinoxaline
258 Bromobutide
259 Azimsulfuron
260 Barban
261 Cyproconazole
262 Clomazone
263 Fensulfothion
264 Saflufenacil
265 Oxasulfuron
266 Fenthion-oxon
267 Nitrothal-isopropyl
268 Rimsulfuron
269 Chlorantraniliprole
270 Valifenalate
271 Neburon
272 Thiophanate-ethyl
273 Fenhexamid
274 Warfarin
275 Dimethachlor
276 Triapenthenol
277 Benthiavalicarb-isopropyl
278 Bispyribac-sodium
279 Pyroxsulam
280 Isofenphos-oxon
281 Isoxaflutole
282 Propetamphos
283 Ofurace
284 Diphenamid
285 Triadimefon
286 Trietazine
287 Sulfosulfuron
288 Climbazole
289 Diclosulam
290 Famphur
291 Anilazine
292 Fensulfothion-sulfone
293 Myclobutanil
294 Tetraconazole
295 Primisulfuron-methyl
296 Mepronil
297 Chloroxuron
298 Diclobutrazol (stereo isomer)
299 Ethofumesate
300 Terbufos-sulfoxide
301 Fenamidone
474 Metaflumizone
475 Mefenpyr-diethyl
476 Tebufenpyrad
477 Pyraclofos
478 Anilofos
479 Phoxim
480 Isoxadifen-ethyl
481 Prosulfocarb
482 MCPA-butoxyethyl ester
483 Clethodim (isomer)
484 Isoxathion
485 Terbufos
486 Famoxadone
487 Profenofos
488 Cyanofenphos
489 Azinphos-ethyl
490 Chlorpyrifos-methyl
491 Sethoxydim (isomer)
492 Clomeprop
493 Dichlofenthion
494 Fluazifop-P-butyl
495 Fluazifop-butyl
496 Fluacrypyrim
497 Prochloraz
498 Oxadiazon
499 Allethrin
500 Fenchlorazol-ethyl
501 Fenthion-sulfone
502 Clofentezine
503 Dimepiperate
504 Haloxyfop-2-ethoxyethyl
505 Trifloxystrobin
506 Pretilachlor
507 Fluroxypyr-1-methylheptyl-ester
508 Fluoxastrobin
509 Tri-allate
510 Buprofezin
511 Esprocarb
512 Picolinafen
513 Tralkoxydim
514 Benzyldimethylhexadecyl-ammonium Chloride
515 Aramite
516 Pirimiphos-ethyl
517 Metrafenone

86 Bromacil
87 1-naphthaleneacetamide
88 Metamitron
89 Allidochlor
90 Acetamiprid
91 1-(4-Isopropylphenyl)urea
92 Tetraethylpyrophosphate
93 Pirimicarb-desmethyl
94 Benzthiazuron
95 4-(3-Indolyl)-butyric acid
96 Fensulfothion-oxon
97 Ethirimol
98 1-(3,4-Dichlorophenyl)-3-methylurea
99 Cycloheximide
100 Karbutilate
101 Tritosulfuron
102 Tebuthiuron
103 Propoxur
104 Phosphamidon
105 Naptalam
106 Fensulfothion-oxon-sulfone
107 Fluazifop
108 Fluazifop-P (free acid)
109 1-(4-Isopropylphenyl)-3-methylurea
110 Dimethirimol
111 Monolinuron
112 Metribuzin
113 Tolylfluanid Metabolite (DMST)
114 Paraoxon-methyl
115 Imazamethabenz-methyl (isomer)
116 Atraton
117 Chlorotoluron
118 Propham
119 Cymiazole
120 Phosfolan
121 Benzanilide
122 Dichlormid
123 Forchlorfenuron
124 Atrazine-d5
125 1,3-Diphenyl urea
126 Atrazine
127 Diuron-d6
128 Difenzoquat (Difenzoquat-methyl-sulfate)
302 Silthiofam
303 Flazasulfuron
304 Triticonazole
305 Fluopicolide
306 EPTC
307 Cloransulam-methyl
308 Boscalid
309 Fenpropimorph
310 Crotoxyphos
311 Beflubutamid
312 Molinate
313 Crufomate
314 Terbufos-sulfone
315 Imazosulfuron
316 Irgarol 1051
317 Methoxyfenozide
318 (Z)-Ferimzone
319 Dimethenamid
320 Dimethametryn
321 Dipropetryn
322 Flupyrsulfuron-methyl
323 Carpropamid
324 Penoxsulam
325 Imazalil
326 Fenarimol
327 Tebuconazole
328 Hexaconazole
329 Methidathion
330 Flurochloridone
331 Metosulam
332 Prothioconazole-desthio
333 Coumachlor
334 Flubendiamide
335 Fluridone
336 Furalaxyl
337 Diflubenzuron
338 Fenamiphos
339 Thiodicarb
340 Mepanipyrim
341 Benthiazole
342 Tebutam
343 Mesosulfuron-methyl
344 Diniconazole
518 Butachlor
519 Difenacoum
520 Pyrazoxyfen
521 Alanycarb
522 Difenoconazole (isomer)
523 Cycloxydim
524 Flocoumafen
525 Emamectin B1b
526 Phosalone
527 Cyclosulfamuron
528 Bifenox
529 Piperophos
530 Quizalofop-methyl
531 Indoxacarb
532 Flufenoxuron
533 Spinosyn A
534 Pyraclostrobin
535 Triazoxide
536 Amisulbrom
537 Piperonyl-butoxide
538 Nitralin
539 Fenoxaprop-ethyl
540 Fenoxaprop-P-ethyl
541 Fluoroglycofen-ethyl
542 Diclofop-methyl
543 Fluazuron
544 Benzoximate
545 Captafol
546 Emamectin B1a
547 Pyrimidifen
548 Cyflumetofen
549 Dialifos
550 Quinoxyfen
551 Chlorpyrifos
552 Methoprene
553 Lactofen
554 Quizalofop-P-ethyl
555 Quizalofop-ethyl
556 Imibenconazole
557 Spiromesifen
558 Furathiocarb
559 Butralin
560 Cloquintocet-mexyl

129 Pyracarbolid
130 Diuron (DCMU)
131 Fenamiphos-sulfoxide
132 Carbofuran
133 Isoprocarb
134 Carbaryl (NAC)
135 Metobromuron
136 Chlorsulfuron
137 Quinoclamine
138 Buturon
139 Fenamiphos-sulfone
140 Thiacloprid
141 Ancymidol
142 Isoproturon
143 Amidosulfuron
144 Propanil
145 Demeton-S-methyl
146 Thiofanox
147 Desmetryn
148 Clodinafop (free acid)
149 Ethiofencarb
150 Simetryn
151 Malaoxon
152 Fomesafen
153 Thiophanate-methyl
154 Metsulfuron-methyl
155 Rabenzazole
156 Triforine (isomer)
157 Secbumeton
158 Prometon
159 Cycluron
160 Thifensulfuron-methyl
161 Carboxin
162 Florasulam
163 Mephosfolan
164 Lenacil
165 3,4,5-Trimethacarb
166 Propazine
167 Flutriafol (isomer)
168 Sebuthylazine
169 Hexazinone
170 Linuron
171 Fenobucarb
172 Furametpyr
173 Haloxyfop
345 Flufenacet
346 Zoxamide
347 Malathion
348 Flamprop-methyl
349 Oryzalin
350 Tebufenozide
351 Penconazole
352 Bixafen
353 Bifenazate
354 Terbucarb
355 Ametoctradin
356 Orthosulfamuron
357 Fenoxanil
358 Isoxaben
359 Triazamate
360 Metconazole
361 Isoprothiolane
362 Isazofos
363 Triflumuron
364 Tepraloxydim (isomer)
365 Mandipropamid
366 Pyrazosulfuron-ethyl
367 Iprobenfos
368 Benzyldimethyldodecyl-ammonium Chloride
369 Vernolate
370 Pebulate
371 Hydramethylnon
372 Acibenzolar-S-methyl
373 Benazolin-ethyl
374 Flusilazole
375 Cyprodinil
376 Alachlor
377 Etaconazole
378 Isofenphos-methyl
379 Bupirimate
380 Epoxiconazole
381 Metolachlor
382 Furmecyclox
383 Pethoxamid
384 Butylate
385 Tris(2-chloro-1- (chloro-methyl)ethyl)phosphate
386 Fenazox
387 Fenoxycarb
388 Pyrifenox (E, Z)
389 Triazophos
561 Etoxazole
562 Chlorfluazuron
563 Spinosyn D
564 Pyriproxyfen
565 Brodifacoum
566 Ethion
567 Flumetralin
568 Pyrazophos
569 Propargite
570 Fluthiacet-methyl
571 Coumaphos
572 Pyributicarb
573 Acequinocyl
574 Carbophenothion
575 Spinetoram J
576 Hexythiazox
577 Prothiophos
578 Isopropalin
579 Pendimethalin
580 Spirodiclofen
581 Bromophos-methyl
582 Fenpropathrin
583 Acrinathrin
584 Spinetoram L
585 Cyhalothrin (isomer)
586 Propaquizafop
587 Flucycloxuron
588 Flucythrinate
589 Bioresmethrin
590 Resmethrin
591 Rotenone
592 Fenazaquin
593 Tetramethrin
594 Avermectin B1a
595 Cyphenothrin
596 Cypermethrin (isomer)
597 (E)-Fenpyroximate
598 Fluvalinate
599 Phenothrin (isomer)
600 Temephos
601 Pyridaben
602 Bifenthrin
603 Pyridate
604 Permethrin
605 Deltamethrin

174 Siduron
175 Ethiprole
176 Oxadixyl
177 Terbumeton
178 Benodanil
179 Desmedipham
180 Terbuthylazine
181 Naled (Dibrom)
182 Heptenophos
183 Methabenzthiazuron
184 Fosthiazate (isomer)
185 Spiroxamine
186 Pirimicarb
187 Phorate-sulfoxide
188 Propyzamide
189 Chlorbromuron
190 Ametryn
191 Phenmedipham
192 Deet
193 Methfuroxam
194 Halofenozide
195 Pirimicarb-desmethyl-formamido
196 Probenazole
197 Paraoxon-ethyl
198 Paclobutrazol
199 Isonoruron
200 Cinosulfuron
201 Disulfoton-sulfoxide
202 Dimefuron
203 Nicosulfuron
204 Azamethiphos
205 Thionazin
206 Promecarb
207 Norflurazon
208 Propachlor
209 Triadimenol (isomer)
210 Diethofencarb
211 Tricyclazole
212 Methacrifos
213 Fenpropidin
214 Prosulfuron
215 Fenoxaprop
216 Phorate-sulfone

390 Sulfallate
391 Thiazopyr
392 Spirotetramat
393 Diazinon
394 Etrimfos
395 Napropamide
396 Phosmet
397 Chromafenozide
398 Azinphos-methyl
399 Ethoxysulfuron
400 Novaluron
401 Fenbuconazole
402 Pyridaphenthion
403 Ipconazole
404 Dimoxystrobin
405 Bensulfuron-methyl
406 Chlorpyrifos-oxon
407 Propisochlor
408 Fluquinconazole
409 Bitertanol (diastereo isomers)
410 Pyriminobac-methyl (E)
411 Cadusafos
412 Sulfotep
413 Chlorimuron-ethyl
414 Fonofos
415 Dimethomorph (E, Z)
416 Triflusulfuron-methyl
417 Tolylfluanid
418 Cyazofamid
419 Mecarbam
420 Carfentrazone-ethyl
421 Propaphos
422 Butafenacil
423 Isomethiozin
424 Bensulide
425 Flamprop-M-isopropyl
426 Flamprop-isopropyl
427 Quinalphos
428 Tetrachlorvinphos (CVMP)
429 Chlorfenvinphos (E, Z)
430 Isofenphos
431 Pinoxaden
432 Picoxystrobin

606 Pyridalyl
607 Profoxydim
608 Ivermectin
609 Doramectin
610 Cinidon-ethyl
611 Moxidectin
612 Etofenprox
613 Bentazone
614 Gibberellic acid (Gibberellin)
615 4-Chlorophenoxyacetic acid
616 2,4-D (2,4-PA)
617 MCPA (MCP)
618 2-Naphthoxy acetic acid
619 Dichlorprop
620 Bromoxynil
621 2,4,5-T
622 Mecoprop-P
623 Triclopyr
624 Terbacil
625 Cyclanilide
626 Fenoprop
627 DNOC
628 Ioxynil
629 Acifluorfen
630 Fludioxonil
631 Fipronil
632 Fipronil-sulfide
633 Diclofop
634 Nicarbazin
635 Fipronil-sulfone
636 Dinoseb
637 Dinoterb
638 Endosulfan-sulfate
639 Hexaflumuron
640 Fluazinam
641 Lufenuron
642 Meptyldinocap
643 Bromadiolone
644 Noviflumuron
645 Teflubenzuron
646 Dithianon
647 Tembotrione
648 Cyantraniliprole