

The Role of Indirect Photochemical Degradation in the Environmental Fate of Pesticides: A Review

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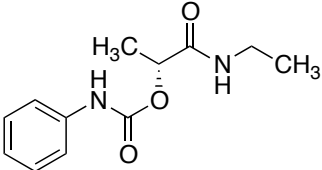
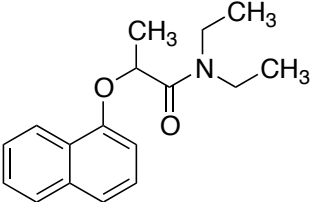
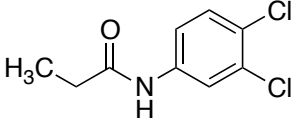
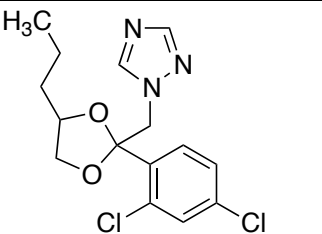
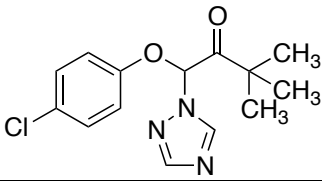
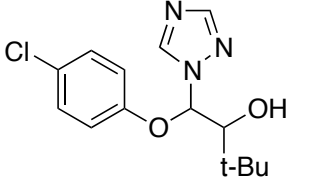
Madison, Wisconsin

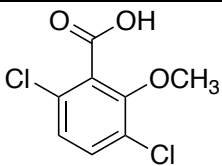
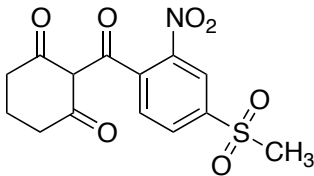
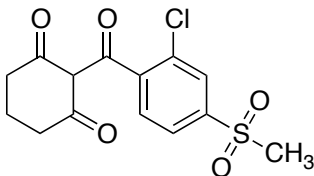
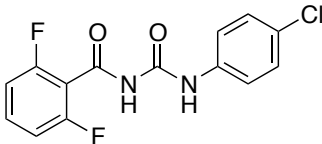
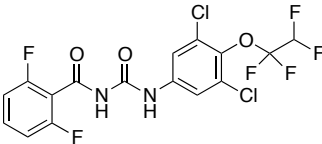
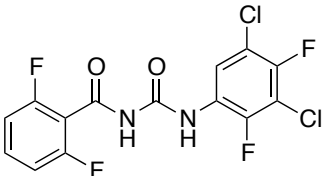
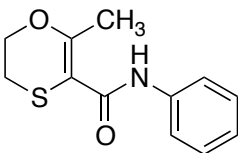
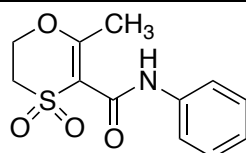
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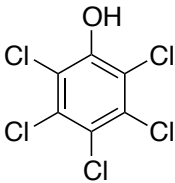
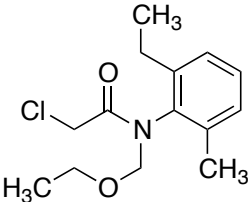
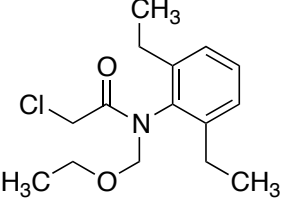
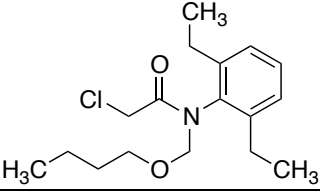
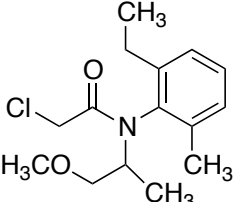
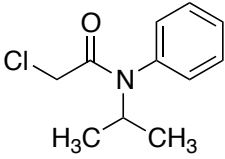
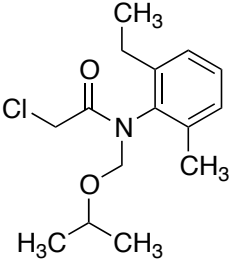
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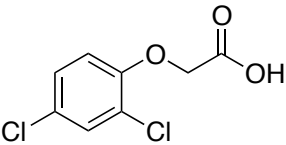
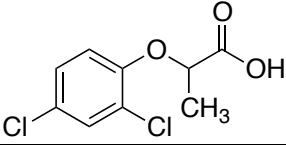
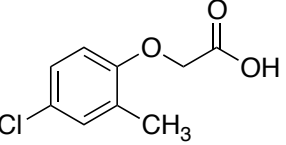
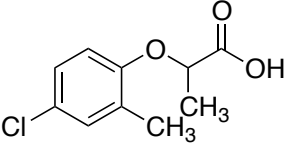
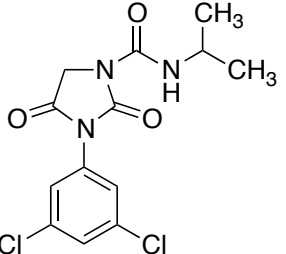
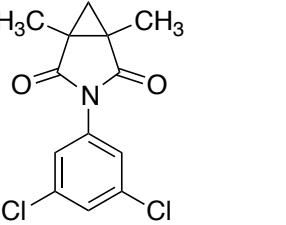
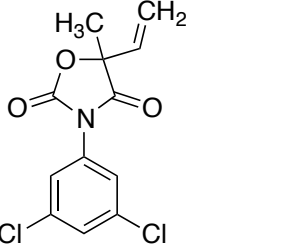
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Table S1: Summary of aqueous pesticide photochemistry studies conducted in the presence and absence of dissolved organic matter. Reference types are 1: Environmental photochemistry studies (direct + indirect photolysis; $\lambda > 290$ nm); 2: Environmentally-relevant studies (direct photolysis only; $\lambda > 290$ nm); 3: Studies in the presence of DOM ($\lambda < 290$ nm); and 4: Studies using other sensitizers ($\lambda > 290$ nm).

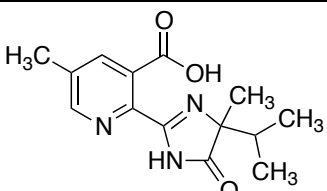
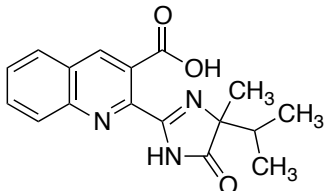
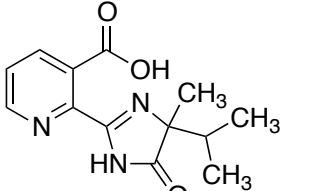
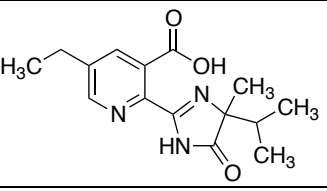
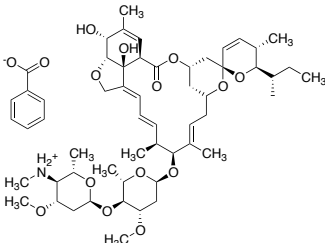
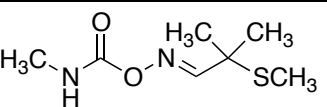
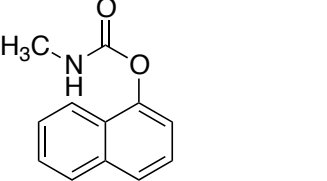
Name	CAS #	Structure	Reference Type			
			1	2	3	4
<i>Amide Herbicides</i>						
Carbetamide	16118-49-3		1			
Napropamide	15299-99-7		2	3-5		
<i>Anilide Herbicide</i>						
Propanil	709-98-8		6	5, 7, 8		9, ^d 10, ^j 11 ⁱ
<i>Azole Fungicides</i>						
Propiconazole	60207-90-1		12-15			
Triadimefon	43121-43-3		16	17, 18		
Triadimenol	55219-65-3			17, 18		

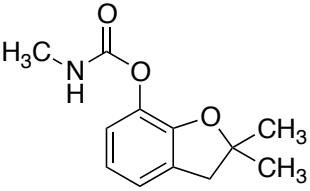
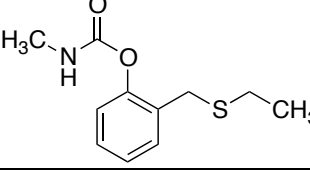
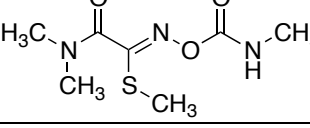
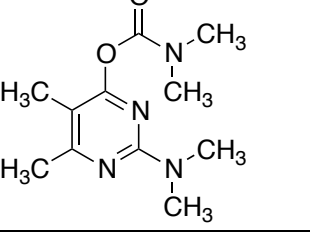
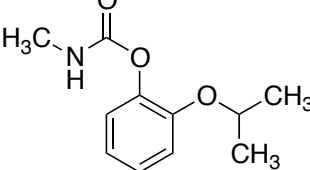
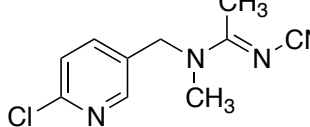
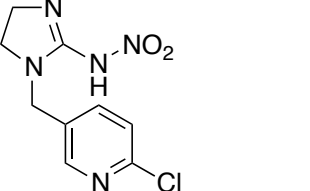
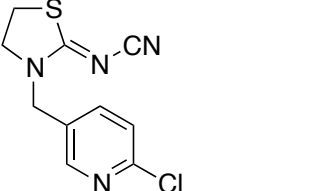
<i>Benzoic Acid Herbicide</i>						
Dicamba	1918-00-9					19 ^l
<i>Benzoylcyclohexanedione Herbicides</i>						
Mesotrione	104206-82-8		15, 20-23			24, ⁿ 25 ^s
Sulcotrione	99105-77-8		21	26		
<i>Benzoylurea Insecticides</i>						
Diflubenzuron	35367-38-5		27, 28			
Hexaflumuron	104206-82-8		28			
Teflubenzuron	83121-18-0		28			
<i>Carboxamide Fungicides</i>						
Carboxin	5234-68-4		29, 30			31 ^m
Oxycarboxin	5259-88-1		29			

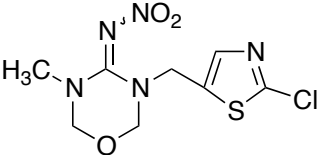
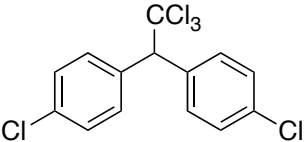
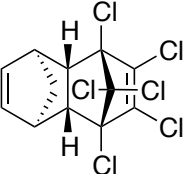
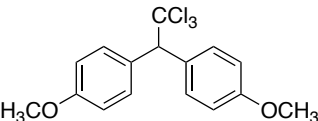
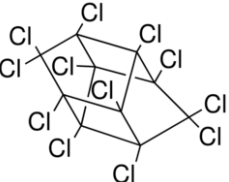
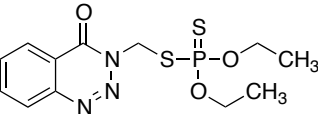
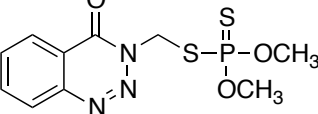
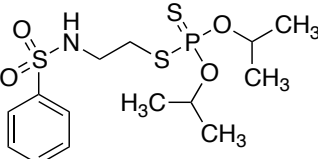
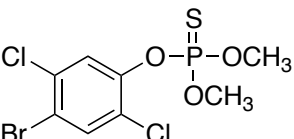
<i>Chlorinated Phenol Pesticide</i>						
Pentachloro-phenol	87-86-5		32-35	36, 37	38	
<i>Chloroacetanilide Herbicides</i>						
Acetochlor	34256-82-1		15, 39, 40		41, 42	43, ⁿ 44 ^v
Alachlor	15972-60-8		15, 45-48		49, 49	
Butachlor	23184-66-9		46, 50	51	41, 42, 52, 53	
Metolachlor	51218-45-2		15, 46, 54-57	58	53, 59, 60	
Propachlor	1918-16-7				53	61 ^{m,t}
Propisochlor	86763-47-5				42	

<i>Chlorophenoxyacid or Ester Herbicides</i>						
2,4-D	94-75-7			62		11, ^j 19 ^j
Dichlorprop	120-36-5		63	5, 64, 65		25 ^s
MCPA	94-74-6		11, 63, 66, 67	5		68, ^{j,o} 69 ^{p,r}
Mecoprop	93-65-2		70	5		19, ^j 71 ^{i,o}
<i>Dicarboximide Fungicides</i>						
Iprodione	36734-19-7		72			
Procymidone	32809-16-8		73, 74			
Vinclozolin	50471-44-8		74, 75			

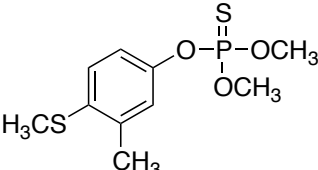
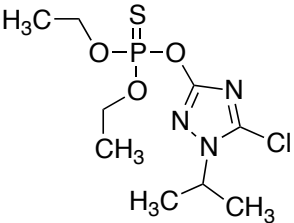
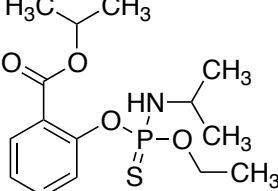
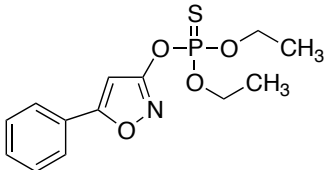
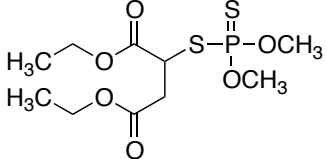
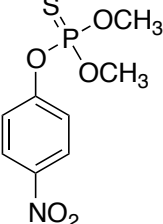
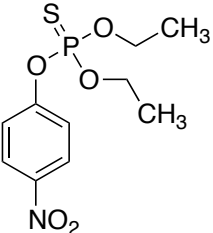
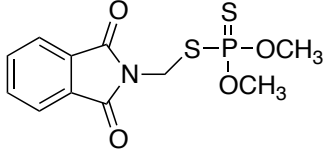
<i>2,6-Dinitroaniline Herbicides</i>						
Ethalfuralin	55283-68-6		15			
Pendimethalin	40487-42-1		15, 76, 77			
Trifluralin	1582-09-8		15, 78, 79	80, ^v 81, 82		
<i>Diphenyl Ether Herbicide</i>						
Acifluorfen	50594-66-6		13, 83	84, 85		
<i>Dithiocarbamate Fungicide</i>						
Thiram	137-26-8		86, 87			
<i>Hydroxybenzonitrile Herbicides</i>						
Bromobonil	25671-46-9			88		
Chloroxynil	1891-95-8		89	90		
Ioxynil	1689-83-4			89, 90		

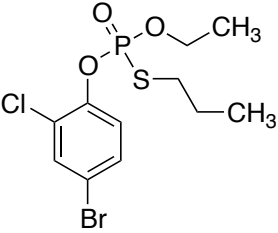
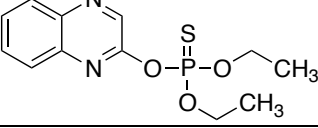
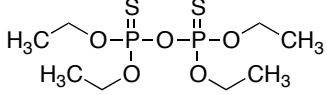
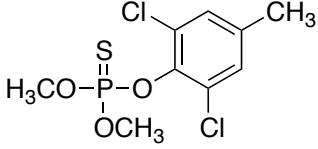
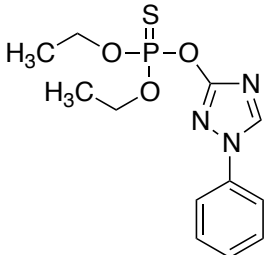
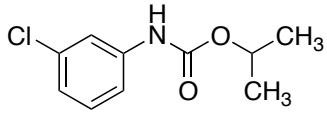
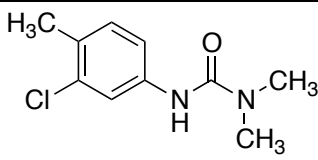
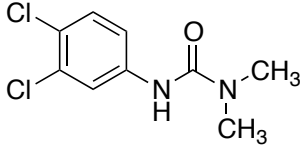
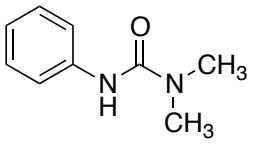
<i>Imidazolinone Herbicides</i>						
Imazapic	104098-48-8			91		
Imazaquin	81335-37-7		72, 92	93, 94		95 ^{a,p,t}
Imazapyr	81334-34-1		92, 96	93		
Imazethapyr	81335-77-5		92, 97-100	93		
<i>Macrocyclic Lactone Insecticide</i>						
Emamectin benzoate	137512-74-4		14, 101			
<i>N-Methyl Carbamate Insecticides</i>						
Aldicarb	116-06-3		102	103		
Carbaryl	63-25-2		11, 86, 102, 104-106	107, 108		80, ^v 103 ^a

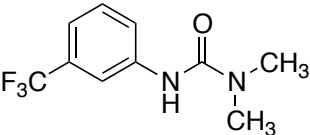
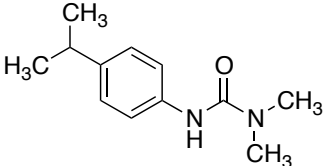
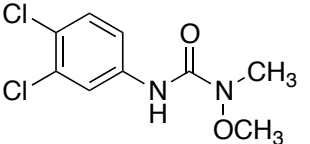
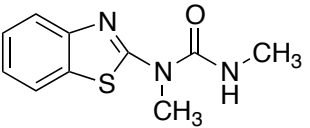
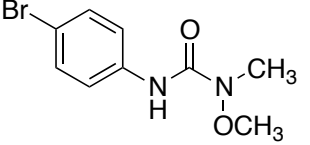
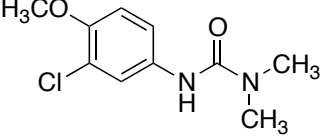
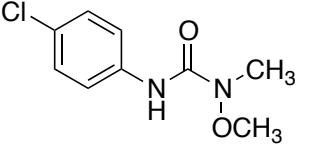
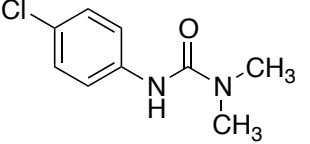
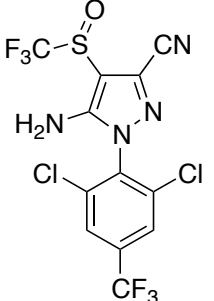
Carbofuran	116-06-3		11, 86, 102, 109, 110	111, 112	113	10, ^j 76, ^j 77 ⁱ
Ethiofencarb	29973-13-5		13, 114	115, 116		
Oxamyl	23135-22-0			117		
Pirimicarb	23103-98-2		118	119		
Propoxur	114-26-1		114			
<i>Neonicotinoid Insecticides</i>						
Acetamiprid	135410-20-7		120, 121			122, ^d 123, ^j 124 ^u
Imidacloprid	105827-78-9		125, 126	127- 130		122, ^d 123, ^j 124 ^u
Thiacloprid	111988-49-9		131			122, ^d 123, ^j 124 ^u

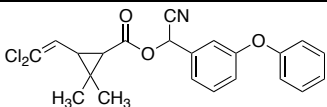
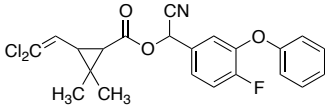
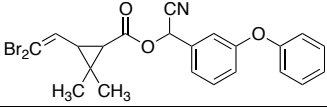
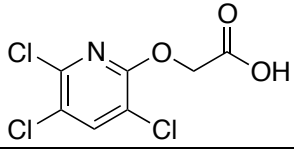
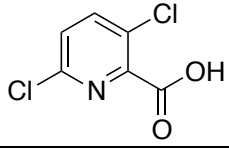
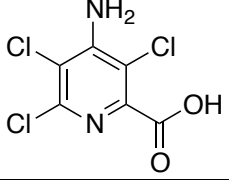
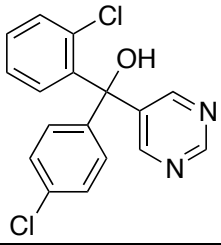
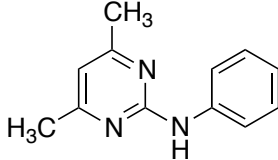
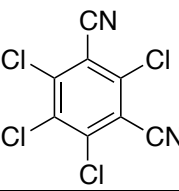
Thiamethoxam	153719-23-4		131	132		
<i>Organochlorine Insecticides</i>						
4,4'-DDT	50-29-3		133			
Aldrin	309-00-2		134			10 ^j
Methoxychlor	72-43-5		135			
Mirex	2385-85-5		136-139			
<i>Organophosphate Insecticides</i>						
Azinphos-ethyl	2642-71-9		104			
Azinphos-methyl	86-50-0		104, 140, 141	58, 142-144		
Bensulide	741-58-2		145, 146			146 ^t
Bromophos	2104-96-3		104			

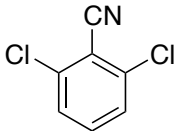
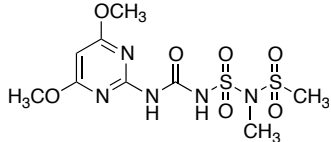
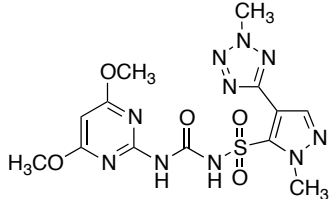
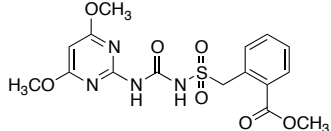
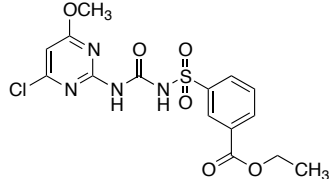
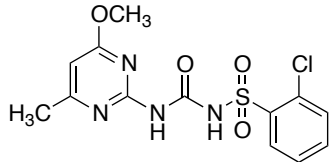
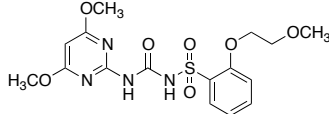
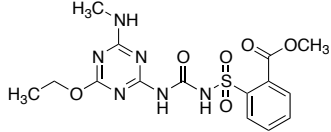
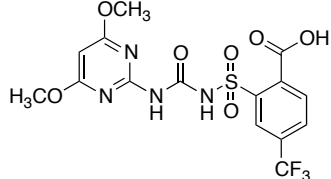
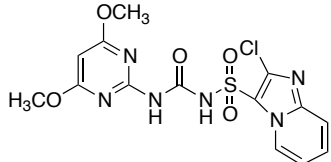
Butamifos	36335-67-8		147			147 ^a
Coumaphos	56-72-4		104	148		
Chlorpyrifos	2921-88-2		15, 141, 145, 146	142, 148- 150	151 ^d	152, ^v 19, ^v 146 ^f
Diazinon	333-41-5		1, 76, 77, 104, 141, 145, 146, 153	148		146 ^f
Dichlorvos	62-73-7		104, 141			
Dimethoate	60-51-5		104, 141			
Disulfoton	298-04-4		154, 155	10, 156		
EPN	2104-64-5		145	148		
Fenitrothion	122-14-5		104, 141, 145, 146, 153, 157- 160	148, 161- 164		146 ^f

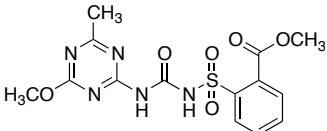
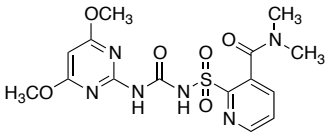
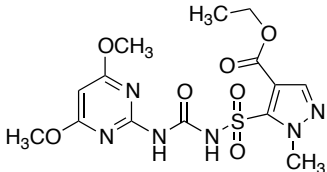
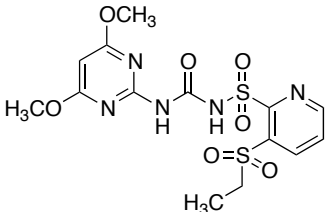
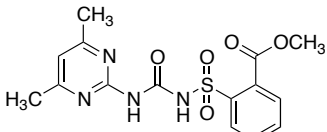
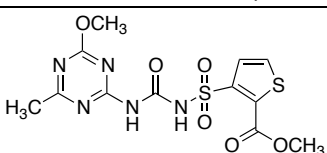
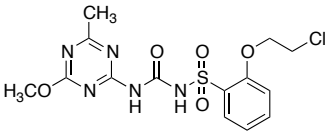
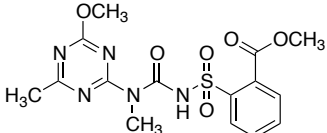
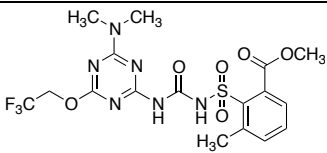
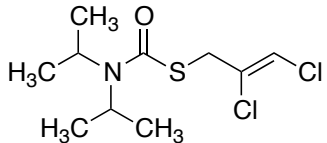
Fenthion	55-38-9		141, 145, 146, 159, 165	148, 156, 166- 168		146, [†] 166 ^u
Isazofos	42509-80-8		155			
Isofenphos	25311-71-1		145, 146, 155	58, 148		146 [†]
Isoxathion	18854-01-8		145, 146			146 [†]
Malathion	121-75-5		104, 141, 145, 169	142		170, ^w 171, ^w 172 ^w
Methyl parathion	298-00-0		104, 141, 159, 173, 174	10, 103, 148, 163, 164		175 ^w
Parathion	56-38-2		1, 104, 114, 141, 145, 159, 169	10, 58, 148	151 ^d	176 ^y
Phosmet	732-11-6		104			

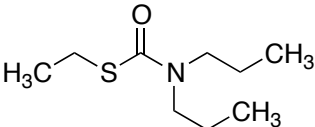
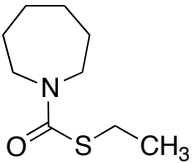
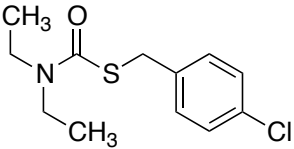
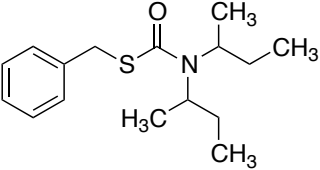
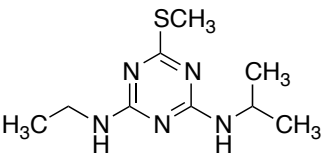
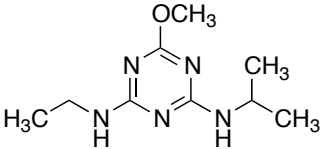
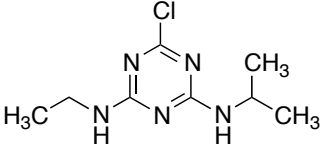
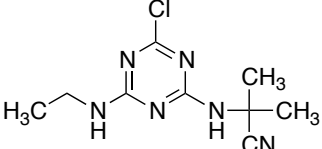
Profenofos	41198-08-7		155			
Quinalphos	13593-03-8		177			
Sulfotep	3689-24-5		114			
Tolchlofos methyl	57018-04-9		145			
Triazophos	24017-47-8		104			
<i>Other Carbamate Herbicide</i>						
Chlorpropham	101-21-3			5, 8, 178, 107		
<i>Phenylurea Herbicides</i>						
Chlortoluron	15545-48-9		14, 179- 182	5, 183	184, 185	9, ^d 186 ^b
Diuron	330-54-1		15, 67, 179, 180, 187- 189	5, 8, 190, 191	38, 184	9, ^d 44, ^v 186, ^b 192, ^b 193, ^l 194 ^v
Fenuron	101-42-8		179, 188, 189, 195- 200	5		9, ^d 25, ^s 44, ^v 186, ^b 192, ^b 201 ^{d,k}

Fluometuron	2164-17-2		179, 202, 203	204		9, ^d 186, ^b 25 ^s
Isoproturon	34123-59-6		15, 77, 179, 205	5, 183, 206	38, 184	9, ^d 192, ^b 186, ^b
Linuron	330-55-2		180, 207	5, 8, 103, 208- 210	184	
Methabenzthiazuron	18691-97-9		1, 114, 211			22, ⁿ 212 ⁿ
Metobromuron	3060-89-7			5, 8, 213, 214		
Metoxuron	19937-59-8		15, 179	5, 215		9, ^d 192, ^b 186 ^b
Monolinuron	1746-81-2		207	58		216 ⁿ
Monuron	150-68-5		188, 197, 217	8, 208, 218- 221		9, ^d 222, ⁿ 223 ^t
<i>Pyrazole Insecticide</i>						
Fipronil	120068-37-3		126, 224, 225	226		

Pyrethroid Insecticides						
Cypermethrin	52315-07-8		227, 228			
Cyfluthrin	68359-37-5		114			
Deltamethrin	52918-63-5		229, 230			
Pyridine Herbicide						
Triclopyr	55335-06-3		231	232		19 ^j
Pyridinecarboxylic Acid Herbicides						
Clopyralid	1702-17-6		15, 233	234		
Picloram	1918-02-1		235, 236	237, 238		239 ^c
Pyrimidine Fungicides						
Fenarimol	60168-88-9		240	241		
Pyrimethanil	53112-28-0					242 ⁱ
Substituted Benzene Pesticides						
Chlorothalonil	1897-45-6		14, 243, 244	90		19 ^j

Dichlobenil	1194-65-6			90		
Sulfonylurea Herbicides						
Amidosulfuron	120923-37-7			245		
Azimsulfuron	120162-55-2		246, 247			
Bensulfuron methyl	83055-99-6		202, 246, 248	249		19 ^l
Chlorimuron ethyl	90982-32-4		250			
Chlorsulfuron	64902-72-3		251, 252	253		19 ^l
Cinosulfuron	94593-91-6			254, 255		
Ethametsulfuron-methyl	97780-06-8		256, 257			
Flupyrsulfuron-methyl	144740-53-4			258		
Imazosulfuron	122548-33-8		248			

Metsulfuron-methyl	74223-64-6		256, 257	259, 260		
Nicosulfuron	111991-09-4			261		
Pyrazosulfuron-ethyl	93697-74-6			262		
Rimsulfuron	122931-48-0			263		
Sulfometuron methyl	74222-97-2		264			19 ^l
Thifensulfuron-methyl	79277-27-3		256, 257	265	266	
Triasulfuron	82097-50-5			254, 255, 267		
Tribenuron methyl	101200-48-0		268			
Triflusulfuron-methyl	126535-15-7			269		
<i>Thiocarbamate Herbicides</i>						
Diallate	2303-16-4			270		

EPTC	759-94-4			271		
Molinate	2212-67-1		6, 272, 273			10, ^j 19, ^j 44, ^v 274 ^{a,j,m,x}
Thiobencarb	28249-77-6		13, 134	270		10, ^j 19 ^j
Tiocarbazil	36756-79-3					275 ^j
<i>Triazine Herbicides</i>						
Ametryne	34-12-8		276			9, ^d 192, ^b 277, ^a 278, ^{i,m,t,u} 279, ^l 280 ^q
Atraton	1610-17-9					9, ^d 277, ^a 278 ^{i,m,t,u}
Atrazine	1912-24-9		6, 15, 55, 72, 104, 187, 202, 276, 281- 289	290- 292	38, 293- 298	9, ^d 11, ^j 44, ^v 192, ^b 194, ^v 277, ^a 278, ^{i,m,t,u} 279, ^l 280, ^q 299, ^{e,j} 300, ^h 301 ^t
Cyanazine	21725-46-2		15	103, 291, 292		

Cybutryne	28159-98-0		302			
Cyprazine	22936-86-3		104			
Prometon	1610-18-0					279 ^l
Prometryn	7287-19-6		6, 14, 285, 286		303	9, ^d 25, ^s 279 ^l
Propazine	139-40-2		6, 304	290		
Simazine	122-34-9		284-286	290-292		
Terbutylazine	5915-41-3		1, 77, 286, 305			
Terbutryne	886-50-0					9 ^d
<i>Triazinone Herbicides</i>						
Hexazinone	51235-04-2		202			11 ^l

Metamitron	41394-05-2		306	77, 128, 307- 309		
Metribuzin	21087-64-9					310 ^l
<i>Triazolopyrimidine Herbicide</i>						
Florasulam	145701-23-1		311			
<i>Unclassified Pesticides</i>						
Amitrole	61-82-5		114	312		
Bentazon	25057-89-0		15, 45, 63, 313, 314	58, 315		
Epoxiconazole	106325-08-0		23			
Ethofumesate	26225-79-6		23			
Fluridone	59756-60-4		316, 317	318, 319		

Niclosamide	50-65-7			320		
Oxadiazon	19666-30-9		50, 313	321		19, ^v 50 ^g
Pinoxaden	243973-20-8		14			
3-Trifluoromethyl-4-nitrophenol	88-30-2		322	323		
<i>Uracil Herbicides</i>						
Bromacil	314-40-9					310, ^j 324, ^m 325 ^m
Terbacil	5902-51-2		326			326 ^{m,t}
<i>Xylylalanine Fungicide</i>						
Metalaxyl	57837-19-1		327			

a = acetone; b = aromatic ketones; c = benzophenone; d = carbonate radical (CO₃^{•-}); e = 4-carboxybenzophenone; f = cyclodextrin; g = diethylamine; h = DOC mimics; i = flavin mononucleotide; j = hydrogen peroxide (H₂O₂); k = hydroxyl radical (•OH); l = iron; m = methylene blue; n = nitrate; o = nitrite; p = phenolic acids; q = porphyrins; r = 2-propanol; s = protein hydrolyzed fertilizers; t = riboflavin; u = Rose Bengal; v = theoretical calculations; w = TiO₂; x = tryptophan; y = zeolites.

References

1. M. Mansour and E. A. Feicht, *Chemosphere*, 1994, **28**, 323-332.
2. S. Chen, W. P. Inskeep, S. A. Williams and P. R. Callis, *Environ. Sci. Technol.*, 1994, **28**, 1582-1588.
3. L. L. Chang, B. Y. Giang, K. S. Lee and C. K. Tseng, *J. Agric. Food Chem*, 1991, **39**, 617-621.
4. J.-P. Aguer, P. Boule, F. Bonnemoy and J. M. Chezal, *Pestic. Sci.*, 1998, **54**, 253-257.
5. P. Boule, L. Meunier, F. Bonnemoy, A. Boulkamh, A. Zertal and B. Lavedrine, *Int. J. Photoeng.*, 2002, **4**, 69-78.
6. I. K. Konstantinou, A. K. Zarkadis and T. A. Albanis, *J. Environ. Qual.*, 2001, **30**, 121-130.
7. K. W. Moilanen and D. G. Crosby, *J. Agric. Food Chem*, 1972, **20**, 950-953.
8. F. S. Tanaka, B. L. Hoffer and R. G. Wien, *J. Pestic. Sci.*, 1985, **16**, 265-270.
9. S. Canonica, T. Kohn, M. Mac, F. J. Real, J. Wirz and U. von Gunten, *Environ. Sci. Technol.*, 2005, **39**, 9182-9188.
10. W. M. Draper and D. G. Crosby, *J. Agric. Food Chem.*, 1984, **32**, 231-237.
11. S. A. Mabury and D. G. Crosby, *J. Agr. Food Chem.*, 1996, **44**, 1920-1924.
12. D. Vialaton, J.-F. Pilichowski, D. Baglio, A. Paya-Perez, B. Larsen and C. Richard, *J. Agric. Food Chem*, 2001, **49**, 5377-5382.
13. D. Vialaton and C. Richard, *Aquat. Sci.*, 2002, **64**, 207-215.
14. D. F. Wallace, L. H. Hand and R. G. Oliver, *Environ. Toxicol. Chem.*, 2010, **29**, 575-581.
15. T. Zeng and W. A. Arnold, *Environ. Sci. Technol.*, 2012, **47**, 6735-6745.
16. P. N. Moza, K. Hustert, E. Feicht and A. Kettrup, *Chemosphere*, 1995, **30**, 605-610.
17. J. P. Da Silva, A. M. Da Silva, I. V. Khmelinskii, J. Martinho and L. F. Vieira Ferreira, *J. Photochem. Photobiol. A: Chem.*, 2001, **142**, 31-37.
18. J. P. Da Silva, L. F. Vieira Ferreira and A. I. M. da Silva, *J. Photochem. Photobiol. A: Chem.*, 2002, **154**, 293-298.
19. K. L. Armbrust, *Environ. Toxicol. Chem.*, 2000, **19**, 2175-2180.
20. A. ter Halle and C. Richard, *Environ. Sci. Technol.*, 2006, **40**, 3842-3847.
21. H. Chaabane, E. Vulliet, F. Joux, F. Lantoine, P. Conan, J. F. Cooper and C.-M. Coste, *Water Res.*, 2007, **41**, 1781-1789.
22. C. Richard, A. ter Halle, O. Brahmia, M. Malouki and S. Halladja, *Catal. Today*, 2007, **124**, 82-87.
23. C. Coelho, L. Cavani, A. ter Halle, G. Guyot, C. Ciavatta and C. Richard, *Chemosphere*, 2011, **85**, 630-636.
24. T. Charbouillot, M. Brigante, L. Deguillaume and G. Mailhot, *Photochem. Photobiol.*, 2012, **88**, 32-37.
25. M. A. Malouki, L. Cavani, A. ter Halle, C. Ciavatta and C. Richard, *J. Photochem. Photobiol. A: Chem.*, 2009, **203**, 186-191.
26. A. ter Halle, J. Wiszniowski, A. Hitmi, G. Ledoigt, F. Bonnemoy, J.-L. Bonnet, J. Bohatier and C. Richard, *Pest Manag. Sci.*, 2009, **65**, 14-18.
27. S. A. Mabury and D. G. Crosby, *Environ. Toxicol. Chem.*, 1996, **15**, 1908-1913.
28. A. M. Marsella, M. Jaskolka and S. A. Mabury, *Pest Manag. Sci.*, 2000, **56**, 789-794.

29. K. Hustert, P. N. Moza and A. Kettrup, *Chemosphere*, 1999, **38**, 3423-3429.
30. M. DellaGreca, M. R. Iesce, F. Cermola, M. Rubino and M. Isidori, *J. Agric. Food Chem.*, 2004, **52**, 6228-6232.
31. M. R. Iesce, F. Cermola, F. De Lorenzo, M. L. Graziano and B. Caliendo, *Environ. Sci. Poll. Res.*, 2002, **9**, 107-109.
32. M. J. Mille and D. G. Crosby, *Mar. Chem.*, 1983, **14**, 111-120.
33. J. J. Pignatello, M. M. Martinson, J. G. Steiert, R. E. Carlson and R. L. Crawford, *Appl. Environ. Microb.*, 1983, **46**, 1024-1031.
34. E. L. Pupilampu and D. K. Dodoo, *J. Photochem. Photobiol. A: Chem.*, 2000, **135**, 81-84.
35. M. Fukushima and K. Tatsumi, *Environ. Sci. Technol.*, 2001, **35**, 1771-1778.
36. A. S. Wong and D. G. Crosby, *J. Agric. Food Chem.*, 1981, **29**, 125-130.
37. Y. I. Skurlatov, L. S. Ernestova, E. V. Vichutinskaya, D. P. Samsonov, I. V. Semenova, I. Y. Rod'ko, V. O. Shvidky, R. I. Pervunina and T. J. Kemp, *J. Photochem. Photobiol. A: Chem.*, 1997, **107**, 207-213.
38. S. Sanches, M. T. B. Crespo and V. J. Pereira, *Water Res.*, 2010, **44**, 1809-1818.
39. P. Brezonik and J. Fulkerson-Brekken, *Environ. Sci. Technol.*, 1998, **32**, 3004-3010.
40. H. Zheng and C. Ye, *J. Environ. Sci.*, 2003, **15**, 783-790.
41. H. Zheng and C. Ye, *Bull. Environ. Contam. Toxicol.*, 2001, **67**, 601-608.
42. G. Xu, F. Li and Q. Wang, *J. Environ. Sci. Heal. B*, 2007, **42**, 165-171.
43. J. Fulkerson-Brekken and P. L. Brezonik, *Chemosphere*, 1998, **36**, 2699-2704.
44. D. Vione, R. Das, F. Rubertelli, V. Maurino, C. Minero, S. Barbati and S. Chiron, *Int. J. Environ. Anal. Chem.*, 2010, **90**, 260-275.
45. S. Chiron, D. Barceló, J. Abian, M. Ferrer, F. Sanchez Baeza and A. Messegue, *Environ. Toxicol. Chem.*, 1995, **14**, 1287-1298.
46. R. I. Wilson and S. A. Mabury, *J. Agr. Food Chem.*, 2000, **48**, 944-950.
47. P. L. Miller and Y.-P. Chin, *Environ. Sci. Technol.*, 2005, **39**, 4454-4462.
48. J. J. Guerard, P. L. Miller, T. D. Trouts and Y.-P. Chin, *Aquat. Sci.*, 2009, **71**, 160-169.
49. A. C. Hogenboom, W. Niessen and U. A. Brinkman, *Rapid Commun. Mass Sp.*, 2000, **14**, 1914-1924.
50. Y. J. Lin, C. Lin, K. J. Yeh and A. Lee, *B. Environ. Contam. Tox.*, 2000, **64**, 780-785.
51. Y.-L. Chen, C.-C. Lo and Y.-S. Wang, *J. Pestic. Sci.*, 1982, **7**, 41-45.
52. H. Zheng and C. Ye, *Environ. Sci. Technol.*, 2001, **35**, 2889-2895.
53. F. J. Benitez, J. L. Acero, F. J. Real and C. Maya, *J. Chem. Technol. Biotechnol.*, 2004, **79**, 987-997.
54. J. Kochany and R. J. Maguire, *J. Agr. Food Chem.*, 1994, **42**, 406-412.
55. Y.-J. Lin, M. Karupiah, A. Shaw and G. Gupta, *Ecotox. Environ. Safe.*, 1999, **43**, 35-37.
56. A. D. Dimou, V. A. Sakkas and T. A. Albanis, *J. Agr. Food Chem.*, 2005, **53**, 694-701.
57. S. Huntscha, H. Singer, S. Canonica, R. P. Schwarzenbach and K. Fenner, *Environ. Sci. Technol.*, 2008, **42**, 5507-5513.
58. D. Vialaton, D. Bagli, C. Richard, H. Skejoe-Andresen, A. Payae-Perez and B. Larsen, *Fres. Environ. Bull.*, 2001, **10**, 554-560.
59. R. Mathew and S. U. Khan, *J. Agric. Food Chem.*, 1996, **44**, 3996-4000.

60. S. Coffinet, A. Rifai, C. Genty, Y. Souissi, S. Bourcier, M. Sablier and S. Bouchonnet, *J. Mass Spectrom.*, 2012, **47**, 1582-1593.
61. M. Rejto, S. Saltzman and A. J. Acher, *J. Agric. Food Chem.*, 1984, **32**, 226-230.
62. S. S. Q. Hee, S. H. Paine and R. G. Sutherland, *J. Agric. Food Chem.*, 1979, **27**, 79-82.
63. F. Al Housari, P. Höhener and S. Chiron, *Sci. Total Environ.*, 2011, **409**, 582-587.
64. M. J. Climent and M. A. Miranda, *J. Agric. Food Chem.*, 1997, **45**, 1916-1919.
65. L. Meunier, E. Gauvin and P. Boule, *Pest Manag. Sci.*, 2002, **58**, 845-852.
66. S. J. Stangroom, C. L. Macleod and J. N. Lester, *Water Res.*, 1998, **32**, 623-632.
67. S. Chiron, C. Minero and D. Vione, *Annali di chimica*, 2007, **97**, 135-139.
68. A. Zertal, T. Sehili and P. Boule, *J. Photochem. Photobiol. A: Chem.*, 2001, **146**, 37-48.
69. D. Vione, S. Khanra, R. Das, C. Minero, V. Maurino, M. Brigante and G. Mailhot, *Water Res.*, 2010, **44**, 6053-6062.
70. S. Halladja, A. ter Halle, J.-F. Pilichowski, A. Boulkamh and C. Richard, *Photochem. Photobiol. Sci.*, 2009, **8**, 1066.
71. L. Meunier and P. Boule, *Pest Manag. Sci.*, 2000, **56**, 1077-1085.
72. J. R. Garbin, D. M. B. P. Milori, M. L. Simões, W. T. L. da Silva and L. M. Neto, *Chemosphere*, 2007, **66**, 1692-1698.
73. N. Mikami, K. Imanishi and H. Yamada, *J. Pestic. Sci.*, 1984.
74. K. Hustert and P. N. Moza, *Chemosphere*, 1997, **35**, 33-37.
75. B. Schick, P. N. Moza, K. Hustert and A. Kettrup, *Pestic. Sci.*, 1999, **55**, 1116-1122.
76. I. Scheunert, M. Mansour, U. Doerfler and R. Schroll, *Sci. Total Environ.*, 1993, **132**, 361-369.
77. M. Mansour, E. A. Feicht, A. Behechti and I. Scheunert, *Chemosphere*, 1997, **35**, 39-50.
78. A. D. Dimou, V. A. Sakkas and T. A. Albanis, *J. Photochem. Photobiol. A: Chem.*, 2004, **163**, 473-480.
79. A. D. Dimou, V. A. Sakkas and T. A. Albanis, *Int. J. Environ. Anal. Chem.*, 2004, **84**, 173-182.
80. R. G. Zepp and D. M. Cline, *Environ. Sci. Technol.*, 1977, **11**, 359-366.
81. P. Dureja and S. Walia, *Pestic. Sci.*, 1989, **25**, 105-114.
82. M. G. S. Tagle, M. Laura Salum, E. I. Buján and G. A. Argüello, *Photochem. Photobiol. Sci.*, 2005, **4**, 869.
83. D. Vialaton, D. Baglio, A. Paya-Perez and C. Richard, *Pest Manag. Sci.*, 2001, **57**, 372-379.
84. A. Pusino and C. Gessa, *Pestic. Sci.*, 1991, **32**, 1-5.
85. L. Scrano, S. A. Bufo, M. D'Auria, P. Meallier, A. Behechti and K. W. Shramm, *J. Environ. Qual.*, 2002, **31**, 268-274.
86. V. Samanidou, K. Fytianos, G. Pfister and M. Bahadir, *Sci. Total Environ.*, 1988, **76**, 85-92.
87. O. M. S. Filipe, S. A. O. Santos, M. R. M. Domingues, M. M. Vidal, A. J. D. Silvestre, C. P. Neto and E. B. H. Santos, *Chemosphere*, 2013, **91**, 993-1001.
88. J. Kochany, *Chemosphere*, 1992, **24**, 1119-1126.
89. M. A. Malouki, A. Zertal, B. Lavédrine, T. Sehili and P. Boule, *J. Photochem. Photobiol. A: Chem.*, 2004, **168**, 15-22.
90. M. Millet, W.-U. Palm and C. Zetzsch, *Ecotox. Environ. Safe.*, 1998, **41**, 44-50.

91. M. Harir, A. Gaspar, M. Frommberger, M. Lucio, M. E. Azzouzi, D. Martens, A. Kettrup and P. Schmitt-Kopplin, *J. Agric. Food Chem.*, 2007, **55**, 9936-9943.
92. M. Ramezani, D. Oliver, R. Kookana, G. Gill and C. Preston, *J. Environ. Sci. Heal. B*, 2008, **43**, 105-112.
93. W. S. Curran, M. M. Loux, R. A. Liebl and F. W. Simmons, *Weed Sci.*, 1992, 143-148.
94. H. Barkani, C. Catastini, C. Emmelin, M. Sarakha, M. El Azzouzi and J. M. Chovelon, *J. Photochem. Photobiol. A: Chem.*, 2005, **170**, 27-35.
95. R. Venkatesh, S. K. Harrison and M. M. Loux, *Weed Sci.*, 1993, 454-459.
96. M. Elazzouzi, A. Bensaoud, A. Bouhaouss, S. Guittonneau and A. Dahchour, *Fres. Environ. Bull.*, 1999, **8**, 478-485.
97. M. Elazzouzi, M. Mekkaoui, S. Zaza, M. E. Madani, A. Zrineh and J. M. Chovelon, *J. Environ. Sci. Heal. B*, 2002, **37**, 445-451.
98. H. Barkani, M. Harir, M. El-Azzouzi, A. El-Hourch, H. Mountacer, A. Zrineh, A. Assabbanne, Y. A. Ichou and J. Chovelon, *Asian J. Chem.*, 2006, **18**, 1589.
99. L. A. Avila, J. H. Massey, S. A. Senseman, K. L. ARMBRUST, S. R. Lancaster, G. N. Mccauley and J. M. Chandler, *J. Agric. Food Chem.*, 2006, **54**, 2635-2639.
100. R. Espy, E. Pelton, A. Opseth, J. Kasprisin and A. M. Nienow, *J. Agric. Food Chem.*, 2011, **59**, 7277-7285.
101. M. Mushtaq, A. C. Chukwudebe, C. Wrzesinski, L. R. Allen, D. Luffer-Atlas and B. H. Arison, *J. Agr. Food Chem.*, 1998, **46**, 1181-1191.
102. N. de Bertrand and D. Barceló, *Anal. Chim. Acta*, 1991, 235-244.
103. G. Durand, N. de Bertrand and D. Barceló, *J. Chromatog.*, 1991, **554**, 233-250.
104. S. B. Lartiges and P. P. Garrigues, *Environ. Sci. Technol.*, 1995, **29**, 1246-1254.
105. P. L. Miller and Y.-P. Chin, *J. Agr. Food Chem.*, 2002, **50**, 6758-6765.
106. G. Z. Tsogas, D. L. Giokas, P. G. Nikolakopoulos, A. G. Vlessidis and N. P. Evmiridis, *Anal. Chim. Acta*, 2006, **573-574**, 354-359.
107. N. L. Wolfe, R. G. Zepp and D. F. Paris, *Water Res.*, 1978, **12**, 565-571.
108. O. Brahmia and C. Richard, *J. Photochem. Photobiol. A: Chem.*, 2003, **156**, 9-14.
109. S. Campbell, M. D. David, L. A. Woodward and Q. X. Li, *Chemosphere*, 2004, **54**, 1155-1161.
110. M. R. Iesce, M. d. Greca, F. Cermola, M. Rubino, M. Isidori and L. Pascarella, *Environ. Sci. Poll. Res.*, 2005, **13**, 105-109.
111. P. Raha and A. K. Das, *Chemosphere*, 1990, **21**, 99-106.
112. A. Atifi, M. Talipov, H. Mountacer, M. D. Ryan and M. Sarakha, *J. Photochem. Photobiol. A: Chem.*, 2012, **235**, 1-6.
113. J. Bachman and H. H. Patterson, *Environ. Sci. Technol.*, 1999, **33**, 874-881.
114. U. Jensen-Korte, C. Anderson and M. Spiteller, *Sci. Total Environ.*, 1987, **62**, 335-340.
115. J. Sanz-Asensio, M. Plaza-Medina, M. T. Martínez-Soria and M. Perez-Clavijo, *J. Chromatog.*, 1999, **840**, 235-247.
116. D. Vialaton and C. Richard, *J. Photochem. Photobiol. A: Chem.*, 2000, **136**, 169-174.
117. P. Mazellier, C. Zamy and M. Sarakha, *Environ. Chem. Lett.*, 2010, **8**, 19-24.
118. E. R. Taboada, P. Schmitt and M. Mansour, *Fres. Environ. Bull.*, 1995, **4**, 649-654.
119. E. Romero, P. Schmitt and M. Mansour, *Pestic. Sci.*, 1994, **41**, 21-26.

120. X. Guohong, L. Guoguang, S. Dezhi and Z. Liqing, *Bull. Environ. Contam. Toxicol.*, 2008, **82**, 129-132.
121. C. Luciano, M. A. Antonio, D. O. Mártire, M. C. Gonzalez, J. Gomis, A. Bernabeu, A. M. Amat and A. Arques, *Water Res.*, 2012, **46**, 4732-4740.
122. M. L. Dell'Arciprete, J. M. Soler, L. Santos-Juanes, A. Arques, D. O. Mártire, J. P. Furlong and M. C. Gonzalez, *Water Res.*, 2012, **46**, 3479-3489.
123. M. L. Dell'Arciprete, L. Santos-Juanes, A. A. Sanz, R. Vicente, A. M. Amat, J. P. Furlong, D. O. Mártire and M. C. Gonzalez, *Photochem. Photobiol. Sci.*, 2009, **8**, 1016.
124. M. L. Dell'Arciprete, L. Santos-Juanes, A. Arques, R. F. Vercher, A. M. Amat, J. P. Furlong, D. O. Martire and M. C. Gonzales, *Catal. Today*, 2010, **151**, 108-113.
125. D. Redlich, N. Shahin, P. Ekici, A. Friess and H. Parlar, *CLEAN – Soil, Air, Water*, 2007, **35**, 452-458.
126. D. Q. Thuyet, H. Watanabe, K. Yamazaki and K. Takagi, *Bull. Environ. Contam. Toxicol.*, 2011, **86**, 548-553.
127. P. N. Moza, K. Hustert, E. Feicht and A. Kettrup, *Chemosphere*, 1998, **36**, 497-502.
128. J. Cacho, I. Fierro, L. Deban, M. Vega and R. Pardo, *Pestic. Sci.*, 1999, **55**, 949-954.
129. H. Wamhoff and V. Schneider, *J. Agr. Food Chem.*, 1999, **47**, 1730-1734.
130. T. Ding, D. Jacobs and B. K. Lavine, *Microchem. J.*, 2011, **99**, 535-541.
131. A. Pena, J. A. Rodríguez-Liébaña and M. D. Mingorance, *Chemosphere*, 2011, **84**, 464-470.
132. B. J. Schwartz, F. K. Sparrow, N. E. Heard and B. M. Thede, *J. Agric. Food Chem.*, 2000, **48**, 4671-4675.
133. M. Kulovaara, P. Backlund and N. Corin, *Sci. Total Environ.*, 1995, **170**, 185-191.
134. R. D. Ross and D. G. Crosby, *Environ. Toxicol. Chem.*, 1985, **4**, 773-778.
135. R. G. Zepp, N. L. Wolfe, J. A. Gordon and R. C. Fincher, *J. Agr. Food Chem.*, 1976, **24**, 727-733.
136. A. R. Mudambi and J. P. Hassett, *Chemosphere*, 1988, **17**, 1133-1146.
137. S. E. Burns, J. P. Hassett and M. V. Rossi, *Environ. Sci. Technol.*, 1996, **30**, 2934-2941.
138. S. E. Burns, J. P. Hassett and M. V. Rossi, *Environ. Sci. Technol.*, 1997, **31**, 1365-1371.
139. K. L. Lambrych and J. P. Hassett, *Environ. Sci. Technol.*, 2006, **40**, 858-863.
140. R. Schulz, C. Hahn, E. R. Bennett, J. M. Dabrowski, G. Thiere and S. K. C. Peall, *Environ. Sci. Technol.*, 2003, **37**, 2139-2144.
141. B. Druzina and M. Stegu, *Int. J. Environ. Anal. Chem.*, 2007, **87**, 1079-1093.
142. M. Bavcon Kralj, M. Franko and P. Trebše, *Chemosphere*, 2007, **67**, 99-107.
143. M. Ménager, X. Pan, P. Wong-Wah-Chung and M. Sarakha, *J. Photochem. Photobiol. A: Chem.*, 2007, **192**, 41-48.
144. L. Yeasmin, S. A. MacDougall and B. D. Wagner, *J. Photochem. Photobiol. A: Chem.*, 2009, **204**, 217-223.
145. M. Kamiya and K. Kameyama, *Chemosphere*, 1998, **36**, 2337-2344.
146. M. Kamiya, K. Kameyama and S. Ishiwata, *Chemosphere*, 2001, **42**, 251-255.
147. T. Katagi, *J. Agric. Food Chem.*, 1993, **41**, 496-501.
148. H. B. Wan, M. K. Wong and C. Y. Mok, *J. Agr. Food Chem.*, 1994, **42**, 2625-2630.
149. W. L. Dilling, L. C. Lickly, T. D. Lickly, P. G. Murphy and R. L. McKellar, *Environ. Sci. Technol.*, 1984, **18**, 540-543.

150. D. Barceló, G. Durand and N. de Bertrand, *Toxicol. Environ. Chem.*, 1993, **38**, 183-199.
151. C. Wu and K. G. Linden, *Water Res.*, 2010, **44**, 3585-3594.
152. T. Mill, *Chemosphere*, 1999, **38**, 1379-1390.
153. J. E. Ukpebor and C. J. Halsall, *Wat. Air Soil Poll.*, 2011, **223**, 655-666.
154. R. G. Zepp, G. L. Baughman and P. F. Schlotzhauer, *Chemosphere*, 1981, **10**, 109-117.
155. C. Zamy, P. Mazellier and B. Legube, *Water Res.*, 2004, **38**, 2305-2314.
156. Y. Hirahara, H. Ueno and K. Nakamuro, *J. Health Sci.*, 2001, **47**, 129-135.
157. N. Mikami, K. Imanishi, H. Yamada and J. Miyamoto, *J. Pestic. Sci.*, 1985, **10**.
158. S. Lacorte and D. Barceló, *Environ. Sci. Technol.*, 1994, **28**, 1159-1163.
159. T. M. Sakellarides, M. G. Siskos and T. A. Albanis, *Int. J. Environ. Anal. Chem.*, 2003, **83**, 33-50.
160. A. Derbalah, H. Wakatsuki, T. Yamazaki and H. Sakugawa, *Geochem. J.*, 2004, **38**, 201-214.
161. T. Matsushita, Y. Matsui and Y. Matsui, *Chemosphere*, 2006, **64**, 144-151.
162. S. M. A. D. Zayed and F. Mahdy, *Chemosphere*, 2008, **70**, 1653-1659.
163. J. Weber, C. J. Halsall, J. J. Wargent and N. D. Paul, *J. Environ. Monitor.*, 2009, **11**, 654.
164. J. Weber, R. Kurkova, J. Klanova, P. Klan and C. J. Halsall, *Environ. Poll.*, 2009, **157**, 3308-3313.
165. J. Huang and S. A. Mabury, *Chemosphere*, 2000, **41**, 1775-1782.
166. Y. Hirahara, H. Ueno and K. Nakamuro, *Water Res.*, 2003, **37**, 468-476.
167. Y. Hirahara, T. Okuno, H. Ueno and K. Nakamuro, *J. Health Sci.*, 2003, **49**, 34-39.
168. S. Torrisi and S. Sortino, *J. Agric. Food Chem.*, 2004, **52**, 5943-5949.
169. X. Zhao and H.-M. Hwang, *Arch. Environ. Contam. Toxicol.*, 2008, **56**, 646-653.
170. L. Muszkat, L. Bir and L. Feigelson, *J. Photochem. Photobiol. A: Chem.*, 1995, **87**, 85-88.
171. R.-a. Doong and W.-h. Chang, *J. Photochem. Photobiol. A: Chem.*, 1997, **107**, 239-244.
172. M. Bavcon Kralj, U. Černigoj, M. Franko and P. Trebše, *Water Res.*, 2007, **41**, 4504-4514.
173. J. Manzanilla-Cano, M. Barcelo-Quintal and T. Coral-Martinez, *J. Environ. Sci. Heal. B*, 2008, **43**, 546-552.
174. J. Manzanilla-Cano, M. Barcelo-Quintal, L. D. Alcocer-Can and T. Coral-Martinez, *J. Environ. Sci. Heal. B*, 2010, **45**, 274-278.
175. I. K. Konstantinou, T. M. Sakellarides, V. A. Sakkas and T. A. Albanis, *Environ. Sci. Technol.*, 2001, **35**, 398-405.
176. A. Sanjuán, G. Aguirre, M. Álvaro and H. García, *Water Res.*, 2000, **34**, 320-326.
177. C. Gonçalves, A. Dimou, V. Sakkas, M. F. Alpendurada and T. A. Albanis, *Chemosphere*, 2006, **64**, 1375-1382.
178. F. F. Guzik, *J. Agric. Food Chem.*, 1978, **26**, 53-55.
179. A. C. Gerecke, S. Canonica, S. R. Müller, M. Schärer and R. P. Schwarzenbach, *Environ. Sci. Technol.*, 2001, **35**, 3915-3923.
180. M. V. Shankar, S. Nélieu, L. Kerhoas and J. Einhorn, *Chemosphere*, 2008, **71**, 1461-1468.

181. S. Nelieu, F. o. Perreau, F. Bonnemoy, M. Ollitrault, D. Azam, L. Lagadic, J. Bohatier and J. Einhorn, *Environ. Sci. Technol.*, 2009, **43**, 3148-3154.
182. R. G. Oliver, D. F. Wallace and M. Earll, *Pest Manag. Sci.*, 2012, **69**, 120-125.
183. M. Millet, W.-U. Palm and C. Zetzsch, *Environ. Toxicol. Chem.*, 1998, **17**, 258-264.
184. F. J. Benitez, F. J. Real, J. L. Acero and C. Garcia, *J. Haz. Mat.*, 2006, **138**, 278-287.
185. K. Sarka and Z. Martina, *Res. J. Chem. Environ.*, 2008, **12**, 4.
186. S. Canonica, B. Hellrung, P. Müller and J. Wirz, *Environ. Sci. Technol.*, 2006, **40**, 6636-6641.
187. G. Durand, D. Barceló, J. Albaigés and M. Mansour, *Toxicol. Environ. Chem.*, 1991, **31**, 55-62.
188. J.-P. Aguer and C. Richard, *Chemosphere*, 1999, **38**, 2293-2301.
189. F. Al Housari, D. Vione, S. Chiron and S. Barbati, *Photochem. Photobiol. Sci.*, 2010, **9**, 78.
190. F. S. Tanaka, B. L. Hoffer and R. G. Wien, *Toxicol. Environ. Chem.*, 1986, **11**, 261-269.
191. J. Jirkovský, V. Faure and P. Boule, *Pestic. Sci.*, 1997, **50**, 42-52.
192. S. Canonica and H.-U. Laubscher, *Photochem. Photobiol. Sci.*, 2008, **7**, 547-551.
193. P. Mazellier, J. Jirkovský and M. Bolte, *Pestic. Sci.*, 1997, **49**, 259-267.
194. D. Vione, V. Maurino, C. Minero, M. E. Carlotti, S. Chiron and S. Barbati, *Comptes rendus-Chimie*, 2009, **12**, 865-871.
195. J.-P. Aguer and C. Richard, *Pestic. Sci.*, 1996, **46**, 151-155.
196. J.-P. Aguer, C. Richard and F. Andreux, *J. Photochem. Photobiol. A: Chem.*, 1997, **103**, 163-168.
197. C. Richard, D. Vialaton, J.-P. Aguer and F. Andreux, *J. Photochem. Photobiol. A: Chem.*, 1997, **111**, 265-271.
198. J.-P. Aguer, O. Trubetskaya, O. Trubetskoj and C. Richard, *Chemosphere*, 2001, **44**, 205-209.
199. J.-P. Aguer, C. Richard, O. Trubetskaya, O. Trubetskoj, J. Lévêque and F. Andreux, *Chemosphere*, 2002, **49**, 259-262.
200. C. Richard, O. Trubetskaya, O. Trubetskoj, O. Reznikova, G. Afanas'eva, J.-P. Aguer and G. Guyot, *Environ. Sci. Technol.*, 2004, **38**, 2052-2057.
201. P. Mazellier, C. Busset, A. Delmont and J. De Laat, *Water Res.*, 2007, **41**, 4585-4594.
202. M. W. Lam, K. Tantuco and S. A. Mabury, *Environ. Sci. Technol.*, 2003, **37**, 899-907.
203. S. Halladja, A. Amine-Khodja, A. ter Halle, A. Boulkamh and C. Richard, *Chemosphere*, 2007, **69**, 1647-1654.
204. M. W. Lam, C. J. Young and S. A. Mabury, *Environ. Sci. Technol.*, 2005, **39**, 513-522.
205. G. Kulshrestha and S. K. Mukerjee, *Pestic. Sci.*, 1986, **17**, 489-494.
206. P. Dureja, S. Walla and K. K. Sharma, *Toxicol. Environ. Chem.*, 1991, **34**, 65-71.
207. G. Gatidou and E. Iatrou, *Environ. Sci. Poll. Res.*, 2011, **18**, 949-957.
208. J. D. Rosen, R. F. Strusz and C. C. Still, *J. Agr. Food Chem.*, 1969, **17**, 206-207.
209. F. S. Tanaka, B. L. Hoffer and R. G. Wien, *Toxicol. Environ. Chem.*, 1986, **11**, 271-280.
210. V. Faure and P. Boule, *Pestic. Sci.*, 1997, **51**, 413-418.
211. M. A. Malouki, G. Giry, P. Besse, B. Combourieu, M. Sancelme, F. Bonnemoy, C. Richard and A. M. Delort, *Environ. Toxicol. Chem.*, 2003, **22**, 2013-2019.

212. M. A. Malouki, B. Lavédrine and C. Richard, *Chemosphere*, 2005, **60**, 1523-1529.
213. J. D. Rosen and R. F. Strusz, *J. Agr. Food Chem.*, 1968, **16**, 568-570.
214. A. Boulkamh, T. Sehili and P. Boule, *J. Photochem. Photobiol. A: Chem.*, 2001, **143**, 191-199.
215. A. Boulkamh, D. Harakat, T. Sehili and P. Boule, *Pest Manag. Sci.*, 2001, **57**, 1119-1126.
216. S. Nelieu, L. Kerhoas, M. Sarakha and J. Einhorn, *Environ. Chem. Lett.*, 2004, **2**, 83-87.
217. H. Boucheloukh, T. Sehili, N. Kouachi and K. Djebbar, *Photochem. Photobiol. Sci.*, 2012, **11**, 1339.
218. D. G. Crosby and C. S. Tang, *J. Agric. Food Chem.*, 1969, **17**, 1041-1044.
219. F. S. Tanaka, R. G. Wien and R. G. Zaylskie, *J. Agric. Food Chem*, 1977, **25**, 1068-1072.
220. F. S. Tanaka, R. G. Wien and B. L. Hoffer, *J. Agric. Food Chem*, 1981, **29**, 1153-1158.
221. F. S. Tanaka, R. G. Wien and E. R. Mansager, *Pestic. Sci.*, 1982, **13**, 287-294.
222. S. Nélieu, M. V. Shankar, L. Kerhoas and J. Einhorn, *J. Photochem. Photobiol. A: Chem.*, 2008, **193**, 1-9.
223. W. Chu, K. Chan, C. Jafvert and Y. Chan, *Chemosphere*, 2007, **69**, 177-183.
224. S. S. Walse, P. L. Pennington, G. I. Scott and J. L. Ferry, *J. Environ. Monitor.*, 2004, **6**, 58.
225. S. S. Walse, S. L. Morgan, L. Kong and J. L. Ferry, *Environ. Sci. Technol.*, 2004, **38**, 3908-3915.
226. K. K. Ngim, S. A. Mabury and D. G. Crosby, *J. Agric. Food Chem*, 2000, **48**, 4661-4665.
227. N. Takahashi, N. Mikami, T. Matsuda and J. Miyamoto, *J. Pestic. Sci.*, 1985, **10**.
228. J. Xie, P. Wang, J. Liu, X. Lv, D. Jiang and C. Sun, *Environ. Toxicol. Chem.*, 2011, **30**, 2440-2448.
229. R. J. Maguire, *J. Agric. Food Chem.*, 1990, **38**, 1613-1617.
230. R. J. Maguire, *Wat. Sci. Technol.*, 1992, **25**, 99-102.
231. K. B. Woodburn, F. R. Batzer, F. H. White and M. R. Schultz, *Environ. Toxicol. Chem.*, 1993, **12**, 43-55.
232. P. J. McCall and P. D. Gavit, *Environ. Toxicol. Chem.*, 1986, **5**, 879-885.
233. G. Xu, N. Liu, M. Wu, T. Bu and M. Zheng, *Ind. Eng. Chem. Res*, 2013, **52**, 9770-9774.
234. B. Eyheraguibel, A. ter Halle and C. Richard, *J. Agric. Food Chem*, 2009, **57**, 1960-1966.
235. Y. I. Skurlatov, R. G. Zepp and G. L. Baughman, *J. Agric. Food Chem*, 1983, **31**, 1065-1071.
236. K. B. Woodburn, D. D. Fontaine, E. L. Bjerke and G. J. Kallos, *Environ. Toxicol. Chem.*, 1989, **8**, 769-775.
237. R. C. Hall, C. S. Giam and M. G. Merkle, *Weed Res.*, 1968, **8**, 292-297.
238. A. R. Mosier and W. D. Guenzi, *J. Agric. Food Chem.*, 1973, **21**, 835-837.
239. B. L. Glass, *J. Agric. Food Chem.*, 1975, **23**, 1109-1112.
240. M. Mateus, A. M. Da Silva and H. D. Burrows, *Water Res.*, 2000, **34**, 1119-1126.
241. M. Mateus, A. I. M. da Silva and H. D. Burrows, *Chemosphere*, 2002, **48**, 363-373.
242. A. Vanni and F. Fontana, *J. Environ. Monitor.*, 2003, **5**, 635-639.
243. G. A. Peñuela and D. Barceló, *J. Chromatog.*, 1998, **823**, 81-90.

244. V. A. Sakkas, D. A. Lambropoulou and T. A. Albanis, *Chemosphere*, 2002, **48**, 939-945.
245. M. Harir, A. Chnirheb, B. Kanawati, M. El-Azzouzi and P. Schmitt-Kopplin, *J. Agric. Food Chem.*, 2013, **61**, 5271-5278.
246. K. L. Armbrust, Y. Okamoto, J. Grochulska and A. C. Barefoot, *J. Pestic. Sci.*, 1999, **24**, 357-363.
247. M. V. Pinna, M. Zema, C. Gessa and A. Pusino, *J. Agric. Food Chem.*, 2007, **55**, 6659-6663.
248. K. Takagi, F. F. Fajardo, M. Ishizaka, T. K. Phong, H. Watanabe and J. Boulange, *Paddy Water Environ.*, 2012, **10**, 139-151.
249. P. Fidente, C. Carpentiero, P. Morrica and S. Seccia, *Int. J. Environ. Anal. Chem.*, 2006, **86**, 277-287.
250. P. P. Choudhury and P. Dureja, *J. Agric. Food Chem.*, 1996, **44**, 3379-3382.
251. M. Herrmann, D. Kotzias and F. Korte, *Chemosphere*, 1985, **14**, 3-8.
252. H. J. Streck, *Pestic. Sci.*, 1998, **53**, 52-70.
253. H. J. Streck, *Pestic. Sci.*, 1998, **53**, 29-51.
254. E. Vulliet, C. Emmelin, M. F. Grenier-Loustallot, O. Païssé and J. M. Chovelon, *J. Agric. Food Chem.*, 2002, **50**, 1081-1088.
255. E. Vulliet, C. Emmelin and J.-M. Chovelon, *J. Photochem. Photobiol. A: Chem.*, 2004, **163**, 69-75.
256. J. V. Headley, J.-L. Du, K. M. Peru and D. W. McMartin, *Mass Spectrom. Rev.*, 2010, **29**, 593-605.
257. A. J. Cessna, D. B. Donald, J. Bailey, M. Waiser and J. V. Headley, *J. Environ. Qual.*, 2006, **35**, 2395-2401.
258. S. K. Singles, G. M. Dean, D. M. Kirkpatrick, B. C. Mayo, A. D. Langford Pollard, A. C. Barefoot and F. Q. Bramble, *Pestic. Sci.*, 1999, **55**, 288-300.
259. S. Samanta, R. K. Kole and A. Chowdhury, *Chemosphere*, 1999, **39**, 873-879.
260. M. Caselli, *Chemosphere*, 2005, **59**, 1137-1143.
261. M. Benzi, E. Robotti and V. Gianotti, *Anal. Bioanal. Chem.*, 2010, **399**, 1705-1714.
262. Y. Wang, L. Du and L. Bai, *J. Brazil. Chem. Soc.*, 2013, **24**, 26-31.
263. L. Scrano, S. A. Bufo, P. Perucci, P. Meallier and M. Mansour, *Pestic. Sci.*, 1999, **55**, 955-961.
264. J. Harvey, John, J. J. Dulka and J. J. Anderson, *J. Agric. Food Chem.*, 1985, **33**, 590-596.
265. S. Aziz, S. Dumas, M. El-Azzouzi, M. Sarakha and J.-M. Chovelon, *J. Photochem. Photobiol. A: Chem.*, 2010, **209**, 210-218.
266. J. Headley, J.-L. Du, X. Xu and K. Peru, *Commun. Soil Sci. Plant Anal.*, 2002, **33**, 3287-3302.
267. A. Pusino, I. Braschi, S. Petretto and C. Gessa, *Pestic. Sci.*, 1999, **55**, 479-481.
268. A. K. Bhattacharjee and P. Dureja, *Pestic. Sci.*, 1999, **55**, 183-188.
269. N. Chafik, M. Mansour, B. Elamrani, K.-W. Schramm, A. Kettrup and M. K. Elamrani, *Pest Manag. Sci.*, 2001, **57**, 527-530.
270. L. O. Ruzo and J. E. Casida, *J. Agric. Food Chem.*, 1985, **33**, 272-276.
271. A. W. Abu-Qare and H. J. Duncan, *Chemosphere*, 2002, **46**, 1183-1189.

272. C. J. Soderquist, J. B. Bowers and D. G. Crosby, *J. Agric. Food Chem*, 1977, **25**, 940-945.
273. J. M. Carrasco, C. Sabater, J. L. Alonso, J. Gonzalez, S. Botella, I. Amoros, M. J. Ibanez, H. Boira and J. Ferrer, *Sci. Total Environ.*, 1992, **123**, 219-232.
274. W. M. Draper and D. G. Crosby, *J. Agric. Food Chem*, 1981, **29**, 699-702.
275. W. M. Draper and D. G. Crosby, *J. Agric. Food Chem*, 1984.
276. D. McMartin, J. Headley, B. Wood and J. Gillies, *J. Environ. Sci. Heal. B*, 2003, **38**, 293-303.
277. N. Burkhard and J. A. Guth, *Pestic. Sci.*, 1976, **7**, 65-71.
278. M. Rejto, S. Saltzman, A. J. Acher and L. Muszkat, *J. Agric. Food Chem*, 1983, **31**, 138-142.
279. R. A. Larson, M. B. Schlauch and K. A. Marley, *J. Agric. Food Chem.*, 1991, **39**, 2057-2062.
280. S. L. H. Rebelo, A. Melo, R. Coimbra, M. E. Azenha, M. M. Pereira, H. D. Burrows and M. Sarakha, *Environ. Chem. Lett.*, 2006, **5**, 29-33.
281. C. Minero, E. Pramauro, E. Pelizzetti, M. Dolci and A. Marchesini, *Chemosphere*, 1992, **24**, 1597-1606.
282. P. Schmitt, D. Freitag, Y. Sanlaville, J. Lintelmann and A. Kettrup, *J. Chromatog.*, 1995, **709**, 215-225.
283. A. Torrents, B. G. Anderson, S. Bilboulia, W. E. Johnson and C. J. Hapeman, *Environ. Sci. Technol.*, 1997, **31**, 1476-1482.
284. S. D. W. Comber, *Pestic. Sci.*, 1999, **55**, 696-702.
285. E. Evgenidou and K. Fytianos, *J. Agric. Food Chem.*, 2002, **50**, 6423-6427.
286. S. Navarro, N. Vela, M. José Giménez and G. Navarro, *Sci. Total Environ.*, 2004, **329**, 87-97.
287. X. Ou, X. Quan, S. Chen, H. Zhao and Y. Zhang, *J. Agric. Food Chem.*, 2007, **55**, 8650-8656.
288. X. Ou, S. Chen, X. Quan and H. Zhao, *Chemosphere*, 2008, **72**, 925-931.
289. K. Y. Lin and W. Chu, *J. Haz. Mat.*, 2011, **192**, 1260-1266.
290. B. E. Pape and M. J. Zabik, *J. Agric. Food Chem*, 1972, **20**, 316-320.
291. G. Durand and D. Barceló, *J. Chromatog.*, 1990, **502**, 275-286.
292. J. Abian, G. Durand and D. Barceló, *J. Agric. Food Chem.*, 1993, **41**, 1264-1273.
293. F. H. Frimmel, *Environ. Int.*, 1994, **20**, 373-385.
294. N. Karpel Vel Leitner, P. Berger and P. Gehringer, *Rad. Phys. Chem.*, 1999, **55**, 317-322.
295. C. M. Sharpless, D. A. Seibold and K. G. Linden, *Aquat. Sci.*, 2003, **65**, 359-366.
296. H. Prosen and L. Zupancic-Kralj, *Environ. Poll.*, 2005, **133**, 517-529.
297. X. Ou, S. Chen, X. Quan and H. Zhao, *J. Geochem. Explor.*, 2009, **102**, 49-55.
298. X. Sun, H. Liu, Y. Zhang, Y. Zhao and X. Quan, *J. Environ. Sci.*, 2011, **23**, 773-777.
299. A. E. Hartenbach, T. B. Hofstetter, P. R. Tentscher, S. Canonica, M. Berg and R. P. Schwarzenbach, *Environ. Sci. Technol.*, 2008, **42**, 7751-7756.
300. C. J. Hapeman, S. Bilboulia, B. G. Anderson and A. Torrents, *Environ. Toxicol. Chem.*, 1998, **17**, 975-981.

301. H. Cui, H. Hwang, K. Zeng, H. Glover, H. Yu and Y. Liu, *Chemosphere*, 2002, **47**, 991-999.
302. V. A. Sakkas, D. A. Lambropoulou and T. A. Albanis, *J. Photochem. Photobiol. A: Chem.*, 2002, **147**, 135-141.
303. S. U. Khan and D. S. Gamble, *J. Agric. Food Chem*, 1983, **31**, 1099-1104.
304. D. Barceló, G. Durand, N. de Bertrand and J. Albaigés, *Sci. Total Environ.*, 1993, **132**, 283-296.
305. Y. Sanlaville, S. Guittonneau, M. Mansour, E. A. Feicht, P. Méallier and A. Kettrup, *Chemosphere*, 1996, **33**, 353-362.
306. L. Cox, M. C. Hermosin, J. Comejo and M. Mansour, *Chemosphere*, 1996, **33**, 2057-2064.
307. C. Olmedo, L. Deban, E. Barrado, Y. Castrillejo and L. Herrero, *Electrochim. Acta*, 1994, **39**, 2237-2241.
308. W.-U. Palm, M. Millet and C. Zetzsch, *Chemosphere*, 1997, **35**, 1117-1130.
309. S. Kouras-Hadef, P. de Sainte-Claire, A. ter Halle, A. Amine-Khodja and C. Richard, *J. Phys. Chem. A*, 2011, **115**, 14397-14406.
310. L. Muszkat, L. Feigelson, L. Bir and K. A. Muszka, *Chemosphere*, 1998, **36**, 1485-1492.
311. M. S. Krieger, R. N. Yoder and R. Gibson, *J. Agric. Food Chem*, 2000, **48**, 3710-3717.
312. C. Catastini, S. Rafqah, G. Mailhot and M. Sarakha, *J. Photochem. Photobiol. A: Chem.*, 2004, **162**, 97-103.
313. L. Comoretto, B. Arfib and S. Chiron, *Sci. Total Environ.*, 2007, **380**, 124-132.
314. M. Peschka, M. Petrovic, T. P. Knepper and D. Barceló, *Anal. Bioanal. Chem.*, 2007, **388**, 1227-1234.
315. G. P. Nilles and M. J. Zabik, *J. Agric. Food Chem.*, 1975, **23**, 410-415.
316. D. C. Muir and N. P. Grift, *J. Agric. Food Chem*, 1982, **30**, 238-244.
317. D. G. Saunders and J. W. Mosier, *J. Agric. Food Chem*, 1983, **31**, 237-241.
318. M. A. Mossler, D. G. Shilling and W. T. Haller, *J. Aquat. Plant Manage.*, 1989, **27**, 69-73.
319. G. E. MacDonald, W. T. Hailer and D. G. Shilling, *J. Aquat. Plant Manage.*, 1996, **34**, 78-80.
320. P. Graebing, J. Chib, T. Hubert and W. Gingerich, *J. Agr. Food Chem.*, 2004, **52**, 870-878.
321. G.-G. Ying and B. Williams, *J. Environ. Sci. Heal. B*, 1999, **34**, 549-567.
322. J. H. Carey and M. E. Fox, *J. Great Lakes Res.*, 1981, **7**, 234-241.
323. D. Ellis and S. Mabury, *Environ. Sci. Technol.*, 2000, **34**, 632-637.
324. A. J. Acher and E. Dunkelblum, *J. Agric. Food Chem*, 1979, **27**, 1164-1167.
325. A. J. Acher, C. J. Hapeman, D. R. Shelton, M. T. Muldoon, W. R. Lusby, A. Avni and R. Waters, *J. Agric. Food Chem.*, 1994, **42**, 2040-2047.
326. A. J. Acher, S. Saltzman, N. Brates and E. Dunkelblum, *J. Agric. Food Chem*, 1981, **29**, 707-711.
327. P. Sukul, P. N. Moza, K. Hustert and A. Kettrup, *J. Agric. Food Chem*, 1992, **40**, 2488-2492.