



National Water Quality Assessment (NAWQA)
Pesticide National Synthesis Project

**PLANNING
COMMISSION
EXHIBIT # 73**

*near
Carpenter*

PESTICIDES USED ON AND DETECTED IN GROUND WATER BENEATH GOLF COURSES

[Compiled (4/3/97) and updated (11/24/98) by Jack Barbash [jbarbash@usgs.gov]. Where Used on Golf Courses: Years in parentheses, if given, represent those for which use data were compiled; note that the locations given are those for which data are available, but are not necessarily the only areas where the pesticides in question have been applied to golf courses. As, arsenic, presumed to have been derived from MSMA; BS&T, detected in stream bed sediments and tissues of aquatic biota, rather than ground water; CA, California; Disc., year in which use was discontinued, if applicable; NY, New York; Mass., Massachusetts; MCPP, potassium salt of mecoprop; unspec., particular use areas in country not specified.]

USE CLASS	COMPOUND (degradates indented)	WHERE USED ON GOLF COURSES (known sites only)	WH IN (golf)
Herbicides	2,4,5-TP (silvex; disc. 1983)	U.S. (unspec.)	
	2,4-D	Florida Massachusetts Massachusetts	Ma
		U.S. (unspec. [1982])	
		North Carolina	
		New Jersey (1993)	
		U.S. (unspec.)	
	amitrol	New Jersey (1993)	
	asulam	Japan	
		Japan	
	atrazine	Japan	
		North Carolina	
	benfluralin (benefin)	Japan	
		New Jersey (1993)	
	bensulide	Japan	
		U.S. (unspec. [1982])	
		New Jersey (1993)	
	bentazon	Florida	
		New Jersey (1993)	
	chlorsulfuron	New Jersey (1993)	
	clopyralid	New Jersey (1993)	
dacthal (DCPA)	Massachusetts Massachusetts		
	U.S. (unspec. [1982])		
	New Jersey (1993)		
dacthal diacid (TPA)		Ma	
dicamba	Florida Massachusetts Massachusetts	Ma	
	U.S. (unspec. [1982])		
	New Jersey (1993)		
dichlobenil	New Jersey (1993)		
diquat	New Jersey (1993)		

	dithiopyr	Japan	
		New Jersey (1993)	
	DSMA	New Jersey (1993)	
	ethofumesate	New Jersey (1993)	
	menoxaprop-ethyl	New Jersey (1993)	
	glyphosate	Florida	
		Massachusetts	
		New Jersey (1993)	
	isoxaben	New Jersey (1993)	
	MCPA	Japan	
	MCPP/mecoprop	Florida	
		Japan	
		Massachusetts	
		U.S. (unspec. [1982])	
		New Jersey (1993)	
		Massachusetts	
	metolachlor	New Jersey (1993)	
	metribuzin	Florida	
		Hawaii	
		Japan	
	molinate	Florida	Flo
	MSMA	U.S. (unspec. [1982])	
		New Jersey (1993)	
		Florida	
	oryzalin	New Jersey (1993)	
		Florida	
	oxadiazon	New Jersey (1993)	
		Florida	
		New Jersey (1993)	
		Southern California	(Sout
		Unspec. (Japan?)	
		Japan	
	pendimethalin	New Jersey (1993)	
		New Jersey (1993)	
	picloram	New Jersey (1993)	
	prodiamine	New Jersey (1993)	
		U.S. (unspec.); MD	
	pronamide	Florida	
		Japan	
	pyributicarb	Japan	
	siduron	Massachusetts	
		New Jersey (1993)	
	simazine	Florida	
		Japan	
		Japan	
		Unspec. (Japan?)	
	thiobencarb (benthiocarb)	Japan	
	triclopyr	Japan	
		New Jersey (1993)	
	trifluralin	New Jersey (1993)	
Insecticides	acephate	Florida	
	methamidophos		
	bendiocarb	Florida	
		New Jersey (1993)	
	Bt	New Jersey (1993)	
	carbaryl	Florida	
		New Jersey (1993)	
	chlordane (disc. in 1987)	Mass. (1950's-1970's)	Ma
			Ma
	heptachlor epoxide		
	chlorpyrifos	Florida	
		Hawaii	

		Massachusetts	Ma
		Massachusetts	
		North Carolina	
		New Jersey (1993)	
		U.S. (unspec.)	
	trichloropyridinol		Ma
	cyfluthrin	New Jersey (1993)	
	diazinon	Japan	
		Japan	
		Massachusetts	
		U.S. (unspec. [1982])	
		NY; other U.S. (unspec.)	
	dichlorvos	Japan	
	dicrotophos	New Jersey (1993)	
	disulfoton	New Jersey (1993)	
	ethoprop	Florida	
		New Jersey (1993)	
		U.S. (unspec.)	
	fenitrothion (MEP)	Japan	
		Japan	
		Unspec. (Japan?)	
		Japan	
		Japan	
	fenobucarb (BPMC)	Japan	
	fluvalinate	New Jersey (1993)	
	fonofos	Florida	
		New Jersey (1993)	
	isazofos	New Jersey (1993)	
	isofenphos	Japan	
		Massachusetts	Ma
		Massachusetts	
		U.S. (unspec. [1982])	
		New Jersey (1993)	
	isoxathion	Japan	
		Japan	
	malathion	Florida	
	oil	New Jersey (1993)	
	oxydemeton	New Jersey (1993)	
	prothiophos	Japan	
	pyridaphenthion	Japan	
	paraffinic oil (also an adjuvant)	U.S. (unspec. [1982])	
	tetrachlorvinphos	Japan	
	trichlorfon	Japan	
		U.S. (unspec. [1982])	
		New Jersey (1993)	
Fungicides	anilazine	Massachusetts	
		New Jersey (1993)	
	benomyl	Massachusetts	
		U.S. (unspec. [1982])	
		New Jersey (1993)	
	chloroneb	New Jersey (1993)	
	chlorothalonil	Florida	
		Japan	
		Massachusetts	Ma
		Massachusetts	
		U.S. (unspec. [1982])	
		North Carolina	
		New Jersey (1993)	
		U.S. (unspec.)	

	cycloheximide	New Jersey (1993)
	cyproconazole	New Jersey (1993)
	etridiazole	New Jersey (1993)
	fenarimol	Florida Japan Massachusetts New Jersey (1993)
	flutolanil	Japan Japan New Jersey (1993)
	fosetyl-al	New Jersey (1993)
	iprobenfos (IBP)	New Jersey (1993)
	iprodione	Japan Florida Japan Japan Massachusetts U.S. (unspec. [1982]) New Jersey (1993)
	isoprothiolane	Japan Japan Japan
	mancozeb	U.S. (unspec. [1982]) New Jersey (1993)
	maneb	Massachusetts U.S. (unspec. [1982])
	mepronil	Japan
	mercurous chloride	New Jersey (1993)
	metalaxyl	Florida Japan New Jersey (1993) New Jersey (1993)
	myclobutanil	New Jersey (1993)
	oxine-copper	Japan
	PMA	New Jersey (1993)
	propamocarb HCl	New Jersey (1993)
	propiconazole	New Jersey (1993)
	quintozene (PCNB)	New Jersey (1993)
	sulfur	New Jersey (1993)
	thiophanate	New Jersey (1993)
	thiophanate-methyl	New Jersey (1993)
	thiram	U.S. (unspec. [1982]) New Jersey (1993)
	toclofos-methyl	Japan
	triadimefon	Florida Japan Massachusetts New Jersey (1993)
	triflumizole	Japan
	vinclozolin	New Jersey (1993)
Nematicides	ethylene dibromide (EDB)	U.S. (unspec. [1982])
	fenamiphos	Florida New Jersey (1993) U.S. (unspec.)
	fenamiphos sulfoxide	
	fenamiphos sulfone	
Adjuvants (see note below**)	aromatic hydrocarbon solvents	U.S. (unspec. [1982])
	pentachlorophenol	Massachusetts
	(also a wood preservative)	U.S. (unspec. [1982])
	xylenes (mixture of isomers)	U.S. (unspec. [1982])

Growth	amidochlor	New Jersey (1993)
hormones	ammonium chloride	New Jersey (1993)
	azadirachtin	New Jersey (1993)
	flurprimidol	New Jersey (1993)
	mefluidide	New Jersey (1993)
	paclobutrazol	New Jersey (1993)
	trinexapac-ethyl	New Jersey (1993)

*REFERENCES CITED

- Cohen, S. Z., Nickerson, S., Maxey, R., Dupuy, A., Jr. and Senita, J. A. (1990). A ground water monitoring study for pesticides and nitrates associated with golf courses on Cape Cod. *Ground Water Monitoring Review*, 10(1): 160-173.
- Cox, C. (1991). Pesticides on golf courses--Mixing toxins with play? *Journal of Pesticide Reform*, 11 (3): 2-4.
- Crane, D.B. and Younghans-Haug, C. (1992). Oxadiazon residue concentrations in sediment, fish, and shellfish from a combined residential/agricultural area in southern California. *Bulletin of Environmental Contamination and Toxicology*, 48(4): 608-615.
- Dernoeden, P.H. (1998). Use of prodiamine as a preemergence herbicide to control annual bluegrass in Kentucky bluegrass. *Hortscience*, 33(5): 845-846.
- Hallberg, G. R., Riley, D. G., Kantamneni, J. R., Weyer, P. J. and Kelley, R. D. (1996). Assessment of Iowa Safe Drinking Water Act monitoring data: 1988-1995. The University of Iowa Hygienic Laboratory, 97-1. Iowa City, Iowa. 132 p.
- Horsley, S. W. and Moser, J. A. (1990). Monitoring ground water for pesticides at a golf course--A case study on Cape Cod, Massachusetts. *Ground Water (Winter, 1990)*: 101-108.
- Marquardt, S. (1997). Golf's green handicap. *The Green Guide*, No. 37, (March 21, 1997): 1-3.
- Miles, C.J., Leong, G., and Dollar, S. (1992). *Bull. Environ. Contam. Toxicol.*, 49: 179.
- Murata, T., and Takahashi, S. (1991). *Environ. Monit. Assess.*, 19: 55.
- Niitsuma, K., and Onishi, S. (1992). *Water Supply*, 10: 197.
- NJDEP (New Jersey Department of Environmental Protection, 1993). New Jersey 1993 Golf Course Pesticide Use Survey (data on file at NJDEP, Pesticide Control Program, Trenton, N.J.)
- Odanaka, Y., Taniguchi, T., Shimamura, Y., Iijima, K., Koma, Y., Takechi, T. and Matano, O. (1994). Runoff and leaching of pesticides in golf course [sic]. *Journal of Pesticide Science*, 19(1): 1-10.
- Ojima, M., Matsuura, F. and Hori, K. (1993). Experimental analysis on the moving characteristics of pesticides scattered in putting-greens of golf courses [sic]. XXV Congress of International Association for Hydraulic Research, Tokyo, Japan, IAHR Congress, pp. 328-335.

Ryals, S.C., Genter, M.B., and Leidy, R.B. (1998). Assessment of surface water quality on three eastern North Carolina golf courses. *Environ.Toxicol.Chem.*, 17(10): 1934-1942.

Sudo, M., and Kunimatsu, T. (1992). *Water Sci.Technol.*, 25: 85.

Suzuki, T., Kondo, H., Yaguchi, K., Maki, T., and Suga, T. (1998). Estimation of leachability and persistence of pesticides at golf courses from point-source monitoring and model [sic] to predict pesticide leaching to groundwater. *Env.Sci.Tech.*, 32(7): 920-929.

Swancar, A. (1996). Water quality, pesticide occurrence, and effects of irrigation with reclaimed water at golf courses in Florida. U.S. Geological Survey, Water-Resources Investigations Report 95-4250. Tallahassee, Florida. 85 p.

Yamamoto, A., Ohto, M., Hosorogi, S., Matsunaga, A., and Mizukami, E. (1992). *Jpn.J.Toxicol.Enviroin.Health*, 38: 374.

**Adjuvants are chemicals that are added to pesticide formulations to make them easier to handle or apply, or to improve the efficiency with which the pesticide active ingredient reaches its target organism (s). Adjuvant compounds include wetting agents, spreaders, emulsifiers, dispersing agents, foaming enhancers, foam suppressants, penetrants, correctives, surfactants, solvents, solubilizers and buffering agents (Farm Chemicals Handbook, 1995, Meister Publishing Co., Willoughby, Ohio).

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