Pesticide Residues Contamination in Water Samples Collected from four Lakes of Mysore City

Mohammad Nasser Modoodi and S.L. Belagali

Department of Studies in Environmental Science, University of Mysore, Mysore, Karnataka, India
e-mail : mnmadoodi@yahoo.com

ABSTRACT

Experiments were conducted to determine the residues of 18 pesticides in water samples collected from Four Lakes (Kamana, Karanji, Kukkarahally and Dalvoi lakes) located in Mysore city and comparison of their contamination level with other agricultural water sources around Mysore district, Karnataka, India. These Samples were analyzed by Gas Chromatograph (GC) consisting of Electron Capture Detector (ECD) for determination of organochlorine pesticides (OCPs) and Flame Photometric Detector (FPD) for the determination of organophosphorus pesticides (OPPs). All the lake water samples, as well as ground water samples, had no detectable pesticide residues. Instead, seven pesticides including Aldrin, β-HCH, γ-HCH, Heptachlor, 2, 4-DDD, 2, 4-DDT and 4, 4-DDE were detected in other agricultural water samples collected from inside the farmlands. For the pesticides detected, the presence of β-HCH and 2, 4-DDT was comparatively more. All detected pesticides in water samples were in low concentrations. No organophosphorus pesticide residues were detected in water samples.

INTRODUCTION

Water is one of the most important and essential natural resources of the planet earth for the survival of any form of life. The whole earth's water, not even 1% quantity of water is available for drinking, agriculture, domestic and industrial consumption. Indeed, because of industrialization and population explosion, the demand of water is increasing several folds, leading to more pollution in the limited quantity of water (Padmanabha and Belagali, 2007).

Agricultural production in India increased dramatically during the last four decades and over the next three decades, production of food grains in the country has to increase at least 2 million tones a year to meet the food demand of the growing population (Paroda and Kumar, 2000; Birthal and Sharma, 2004). Concurrently, insect pests, diseases and weeds cause considerable damage to potential agricultural production. Until recently, although pesticides consumption has increased (Birthal, 2003), they have been the major available tool to limit the production losses.

There are three principal ways in which a pesticide can reach the aquatic environment spillage on surface water, spray, direct runoff & negligence on the part of the user in the

disposal of empty containers or washings from used equipments. However, it is evident that, trace levels of pesticide residues present in water may result in harmful effects on human and environment. Although the quality of water depends upon its Physical, Chemical and Biological characteristics. Assessment of water resource quality from any region is an important aspect, because the rivers, lakes and man made reservoirs are used for water supply to domestic, industrial, agricultural and fish cultures (Jain and Seethapathi 1996).

Now-a-days, all major lakes are facing acute pollution problem. A review of the scientific literature on pesticide residues in freshwater, indicates the presence of persistent organochlorine insecticide residues in lake waters. In Turkey, some organochlorine (OC) pesticide residues such as â-BHC, DDT and its derivatives, caused by intensive agricultural activities, have been observed in water samples of the Sariyar Dam Lake (Ozmena et al. 2008). Rivers are found to be more polluted than lakes (Ioannis 2006). In a study carried out to analyze water and sediment samples at six locations in Volta Lake, Ghana, for residues of persistent organochlorine pesticides, lindane and endosulfan were identified in water samples. No significant contamination was noted in the lake (Ntow 2005). A survey was carried out in Africa which revealed the presence of selected organochlorine pesticides (e.g. p, p'-DDT and endrin but at low concentrations) and PCBs in fish species (Cichlids) from the north end of the Lake Tanganyika, Burundi (Manirakiza et al. 2002). The comparatively low residue levels of DDT when it is distributed in a large amount of organic matter, followed by a high biological degradation of the substance has been considered for the high productivity feature of the Songkhla Lake and the Gulf of Thailand (Kumblad et al. 2001).

Mysore has many small and large lakes. These lakes serve as a source of domestic water supply especially for agricultural purposes to nearby locality. The present survey was conducted to determine the likely pesticide residues levels in four selected lakes namely Kamana lake, Karanji lake, Kukkarahally lake and Dalvoi lake. Despite the frequent use of agricultural pesticides in Mysore, there is a basic lack of information about the presence of pesticide residues in the Mysore city's lake waters.

MATERIALS AND METHODS

Water samples were collected from various parts of Mysore district during January to March 2007 (Table 1). The samples were stored at a 4°C in a refrigerator and all were extracted within 7 days

Water samples were extracted using liquid-liquid partition (LLP). Each sample (1L) was poured through a folded filter paper and measured in a graduated cylinder (1L) before transfer to a separating funnel (1L). Sodium sulfate (10 g) was added to the separating funnel and dissolved by shaking. The water-sodium sulfate mixture was extracted with dichloromethane (3 x 100 ml) and after each separation, the upper organic

Table 1 : Locations and water Sample Codes in Mysore District

Sample Code	Taluk	Location	Water type	Sample Code	Taluk	Location	Water type
W1	Mysore	Mysore city	Kamana lake	W11	Hunsur	Gomatagiri	Agricultural
W2	Mysore	Mysore city	Karanji lake	W12	Hunsur	Hunsur	Agricultural
W3	Mysore	Mysore city	Kukkarahally lake	W13	Hunsur	Bilikere	Bore well
W4	Mysore	Mysore city	Dalvoi lake	W14	H.D. Kote	H.D. Kote	Agricultural
W5	Mysore	Elavais	Agricultural	W15	H.D. Kote	Sargur	Bore well
W6	Mysore	Srirangapatna	Agricultural	W16	H.D. Kote	Beerwalnagu	Agricultural
W7	Nanjangud	Santemar	Agricultural	W17	Periyapatna	Kushalnagar	Agricultural
W8	Nanjangud	Nanjangud	Bore well	W18	Periyapatna	Periyapatna	Bore well
W9	Narasipura	Bannur	Agricultural	W19	K.R. Nagar	K.R. Nagar	Agricultural
W10	Narasipura	Narasipura	Agricultural	W20	K.R. Nagar	Saligrama	Agricultural

Table 2 : Geographic position and physical features of lakes in the Mysore city

	Kamana lake	Karanji lake	Kukkarahally	Dalvoi lake
Location	Northern part	Eastern part	Western part	Southern part
Length (Km)	0.6	0.7	1.4	1.0
Breadth (Km)	0.5	0.8	1.0	1.2
Shape	Oval	Oval	Oval	Oval
Bund	North-West	East-North	East- West	South-West
Depth (mtrs)				
a. Maximum	9	10	12	8
b. Normal	4	5	7	6
Water source	1. Rain water 2. Seepage water 3.Agricultural run off	1. Rain water 2. Domestic sewage	1. Rain water 2. Domestic sewage	1. Rain water 2. Domestic sewage 3.Agricultural runoff
Color	Clear	Light green	Green	Green
Pollution	Low	Moderate	Heavy	Severe
Longitude	76°42'28"E	76°40'30"E	76°38'1" E	76°39'29"E
Latitude	12°21'40"N	12°18'10"N	12°18'29" N	12°15'0"N
Altitude (m)	700	747	710	714

Source: Padmanabha. B. 2006

layer was collected in a separate beaker and the lower aqueous layer was again extracted with 100 ml of dichloromethane. The combined dichloromethane layers were reduced in volume on a rotary evaporator to about 5 ml. The crude extracts were cleaned up by florisil Column chromatography. Glass columns (40 cm x 1.1cm i.d.) were packed from the bottom with a glass wool plug, 8 cm of deactivated florisil and 4 cm anhydrous Na_2SO_4 to remove excess oil, fat and moisture contents respectively. The packed column was prewashed with 50 ml of petroleum ether. The extracts were transferred to the column and eluted with 200 ml petroleum ether mixed with diethyl ether (85:15). The combined extracts were reduced almost to dryness and the final volume reached to 5 ml with GC grade solvent. No additional cleanup was needed and the water extracts were subjected to GC analysis.

A Shimadzu 14B GC unit, OV 17 column and electron capture detector (ECD) was used to analyze organochlorine pesticides and flame photometric detector (FPD) was used for the analysis of organophosphorus pesticides. Pure analytical grade pesticide standards were used for GC analysis as reference standards. The temperature programs of GC were as follows:

Injector 230°C, Column 220°C, Detector 260°C. Ultra pure nitrogen gas was used as carrier gas (flow rate 40 ml/min) and Zero air and ultra pure hydrogen were used as flame source for FPD detector (the flow rate was 60 ml/min). CR-6 chromatographic data processor was used to record the chromatograms and Peak areas were used to calculate the pesticide residues in the sample comparing with the technical standard pesticides.

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Table 3: Pesticides considered for monitoring study

NO.	Name of pesticide	NO.	Name of the pesticide	NO.	Name of pesticide
1	Aldrin	7	Heptachlor	13	4,4- DDT
2	α-HCH	8	Heptachlor ep.	14	Endosulfan-1
3	β-HCH	9	2,4-DDD	15	Endosulfan-2
4	Dieldrin	10	2,4-DDT	16	Atrazin
5	Endrin	11	4,4-DDD	17	Methoxychlor
6	γ-HCH	12	4,4-DDE	18	Dimethoate

RESULTS AND DISCUSSION

Occurrence and range of pesticide residues are summarized in Table 4. Analysis of samples by gas chromatography revealed no pesticide residues in all the four lake water samples while some of the agricultural water samples showed organochlorine pesticide residues but at low concentrations.

Seven pesticides were detected in the agricultural water samples including Aldrin, β-HCH, γ-HCH, Heptachlor, 2,4-DDD, 2,4-DDT and 4,4-DDE. For the pesticides detected, the frequency of β-HCH and 2, 4-DDT was identified more compared to others.

A comparative picture reveals that water samples collected from west part of Mysore district contain less pesticide residues compared to water tested from the east sites. Among the organochlorines, derivatives of DDT were more frequently detected. Although DDT was not detected in any of the samples, one of its metabolites, 2, 4-DDD, was identified. The highest concentration for β-HCH and 2, 4 DDT were 0.008 and 0.009 mg/l respectively for agricultural water samples. Maximum concentration of 0.001 mg/l was detected for 2,4-DDD in an agricultural water sample. No organophosphorus pesticides were detected in the samples. All the bore well water samples in the study were completely free from pesticide residues.

Table 4. Pesticide residues (mg/l) **in agricultural water samples, Mysore district**

Sample No.	Aldrin	α-HCH	β-HCH	Dieldrin	Endrin	γ-HCH	Heptachlor	Heptachlor ep.	2,4-DDD	2,4-DDT	4,4-DDD	4,4-DDE	4,4- DDT	Endosulfan-1	Endosulfan-2	Atrazin	Methoxychlor	Dimethoate
W1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W5	0.003	ND	ND	ND	ND	0.009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W6	ND	ND	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W7	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.009	ND	ND	ND	ND	ND	ND	ND	ND
W8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W9	ND	ND	0.007	ND	ND	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W10	ND	ND	0.008	ND	ND	ND	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W12	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.009	ND	ND	ND	ND	ND	ND	ND	ND
W13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W14	0.009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W17	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND
W18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
W19	ND	ND	0.008	ND	ND	0.003	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 5: Some Physico-Chemical characteristics of water samples collected from Mysore district

sample No.	PH	EC	DO mg/l	TDS mg/l	T.Alk. mg/l	T.H. mg/l	Ca^{++} mg/l	Mg^{++} mg/l	Na^{+} mg/l	K^{+} mg/l	Chloride mg/l	Sulfate	Phosphate
W1	6.8	3329	8.57	1594	86	660	248	249	477	51.8	624	240	0.025
W2	7.17	252	6.93	269.4	234	400	56	62	97.2	1.8	65.7	60	0.03
W3	7.28	105	4.48	106.4	118	611	105	83	281.6	35.1	206	170	0.3
W4	7.67	430	7.75	35.2	106	92	10	11	141.5	8.4	47.9	0	0.02
W5	8.18	420	7.34	29.2	98	132	21	19	99.2	6.1	58.6	100	0.02
W6	6.53	1038	2.85	206.8	48	70	14	8.4	9.0	16.1	40.8	0	0.025
W7	7.18	203	4.08	642.4	160	272	47	36	167.5	0.4	115	0	0.035
W8	7.52	108	6.93	90.4	226	387	79	45	291	125.7	315	200	0.4
W9	7.77	4412	5.3	15.7	16	22	3	5	10.8	2.6	55	0	0.22
W10	7.2	735	6.12	52.0	220	101	24	9	30.3	2.0	39.1	0	0.3
W11	8.09	150	6.8	67.4	102	46	176	137	245.5	11.1	224	5	0.025
W12	7.1	166	7	120.8	94	36	211	63	196.5	20.4	197	40	0.45
W13	8.14	175	8.1	54.4	98	44	140	147	188.5	1.2	165	30	0.025
W14	8.21	384	6.63	25.2	40	24	70	84	133.5	0.1	90.5	0	0.02
W15	8.13	132	4.6	95.2	90	68	246	211	168.5	1.7	291	180	0.01
W16	7.95	190	5.3	82.4	72	44	228	95	158.5	4.0	167	240	0.015
W17	7.96	304	7.2	92.8	58	18	140	10	131.5	10.7	69.2	0	0.45
W18	7.58	304	3.93	30.4	52	24	140	42	132.5	2.8	90.5	70	0.03
W19	8.24	477	6.3	19.2	42	14	105	10	126.2	2.2	60.4	0	0.015
W20	8.09	430	7.8	37.2	48	22	176	10	78.2	0.4	74.6	0	0.01

CONCLUSION

Pollution problem in India is worse than some of the industrialized countries as since many years as India uses the pesticide such as BHC (Li 1999). The pesticides present in urban lakes and ponds are highly degraded due to the direct entry of domestic sewage. Pollutants like insecticides, herbicides and domestic sewage get access to the fresh water bodies, which deplete the water quality severely. Fortunately the surveyed lakes in Mysore city exhibit no pesticide residues and for other types of agricultural water sources in the district, the OCP's residue levels observed below the detection limits reported by others (Wan et al. 2005). DDT and its derivatives found in the water samples might have resulted either from historical use as a general insecticide when large quantities of DDT were directly applied to agricultural soils (ATSDR, 2000) or from the pesticide application for other than agricultural uses specifically for vectors control (Vieira et al. 2001, Torres et al. 2002).

The results of this research work suggest that contamination by pesticides in the Mysore district is not as severe as might be anticipated. However, this study was limited

Table 6: Some heavy metals (mg/l) **present in water samples collected from Mysore district**

Heavy Metal	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W12	W15	W16	W17	W18	W19	W20
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.092	ND	ND
Zinc	0.006	ND	ND	ND	ND	0.018	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	0.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

to samples collected from a small number of agricultural water bodies in only one phase of the growing season. Further residues studies in other agricultural areas of Mysore district are needed in order to assess the levels of pesticide residues in Mysore district agricultural water resources. Continuous monitoring of pollutants in agricultural water sources is a crucial step for agriculture.

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