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ORGANOCHLORINE PESTICIDE RESIDUES IN THE SEDIMENTS OF SOME RIVER NILE DISTRIBUTARIES AND DRAINS, EGYPT

M. Abdel-Razik, R. M. Abd El-Metwally*, M.A.H. Marzouk* and M.A. Abd El-Kader*
Central Agricultural Pesticides Laboratory, Agriculture Research Centre, Egypt

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A total of 18 sediment samples were collected monthly from the River Nile distributaries and drains at agricultural areas of Sharkia Governorate from February through April, 1986. Organochlorine pesticide residues were determined by gas liquid chromatography equipped with electron capture detector (ECD). The analytical data revealed that El-Ghar Canal sediments contained the highest level of endrin, chlordane, dieldrin and aldrin pesticides. However, high quantities of p,p'-DDT, lindane and α-BHC were detected in the sediments of El-Aslogy and El- Ebrahimia Drains. Bahr El-Dakar and Ekwa Drain sediments contained the lowest amounts of all the tested organochlorine pesticide residues. Sediments from Ekwa Drain contained comparatively smaller amounts of endrin, chlordane and lindane than those from Bahr El-Dakar. Moreover, low quantities of p,p'-DDT but no aldrin were obtained from El-Ebrahimia Drain sediments. Sediments may continue to be a source of water pollution.

Key words: Pesticides, Residues, River Nile, Sediments.

Introduction

Water is the main source of pesticides dissemination in the environment. Toxic chemicals may get into open basins with wastewater of industry producing pesticides. Aerial and surface applied pesticides on agricultural crops, forests and meadows may reach the basins by means of water from rain and melted snow. Direct treatment of open basins to destroy mollusks, algae, weeds and vectors of human and animal diseases by pesticides, may result in environmental pollution [1,2].

Soil, groundwater, lakes, rivers and oceans may become the depository for pesticides, consequently, affecting the whole drainage basin. Residues of organochlorine pesticides such as DDT, BHC and toxaphene have been detected in the water of open basins in different countries, however, only in rare cases their concentrations reached hazardous level [2,3].

The accumulation of persistent organochlorine pesticides in the ooze of bodies of water is of great concern. This may lead to secondary pollution of the water when it is stirred up. Studies on lakes and ponds have revealed that the concentration of the persistent chlorinated pesticide were high in bottom sediments, suspended particulate matter, and vegetation, but it was very low in surface water [4-6].

The objective of this study was to determine organochlorine pesticide concentrations in sediments taken from some distributaries of the River Nile and Drains in agricultural areas of Sharkia Governorate, Egypt. (Table 1).

Materials and Methods

A total of 18 subsamples of bottom sediments were collected from irrigation ditches of the El-Ghar Canal, Bahr El-Senety and Bahr El-Dakar and El-Aslogy, Ekwa and El-Ebrahimia Drains at agricultural areas of Sharkia Governorate, 85 km north-east of Cairo, Egypt (Fig. 1). The samples were taken monthly from February through April, 1986 using the technique of Miles [7] as follows:

A home made sampler consisted of a steel can (8.5 cm in diameter and 11 cm deep) attached to the end of 4 m long aluminium pole was used. The can was pushed into the bottom of the stream or drain. When it was rotated by 180°, the can picked up a 6 cm deep portion of bottom sediment. Five samples were taken from the bank to the middle of the stream or drain. These five samples from each location were combined and mixed thoroughly into one composite sample. A representative sample from each composite was then taken for residue analysis.

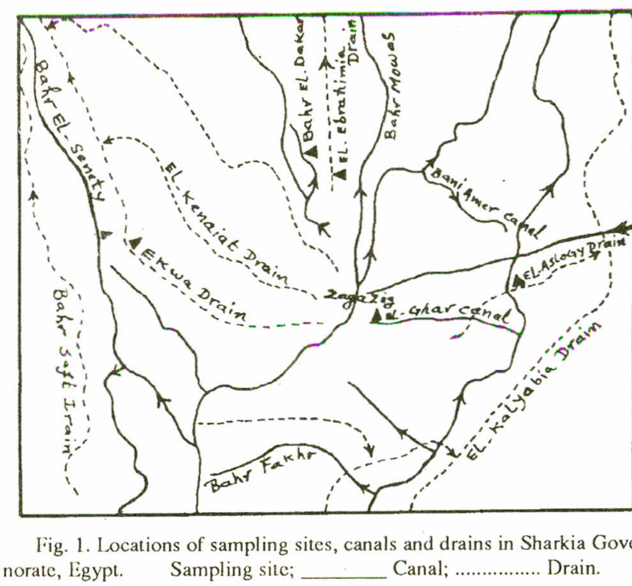

Fig. 1. Locations of sampling sites, canals and drains in Sharkia Governorate, Egypt. Sampling site; ________ Canal; .... Drain.

* Department of Hygiene and Preventive Medicine. Faculty of Vet. Med., Zagazig University, Egpt.

Extraction. The samples were extracted by weighing 100 gm of sediment in a one-litre narrow-neck glass bottle. 35 ml. of acetone was added to the sample and swirled to mix. Then 135 ml. of hexane was added to the bottle, stoppered, and tumbled over for one hour. The supernatent liquid was carefully transferred into a one-liter separatory funnel. The aqueous acetone was removed by washing the extract three times with redistilled water. The remaining hexane was received through granular anhydrous sodium sulphate and collected in 250 ml. round bottom flask and then evaporated to dryness at 40° using rotary evaporator [7].

Clean up. The sample extract was cleaned up by using the technique of Lichtenberg [8]. The extracted residues were dissolved in 5 ml. of hexane and transferred to a florisil column containing 6 gm activated florisil. The flask was rinsed thoroughly with hexane and transferred to the saturated column. The column was eluted with 200 ml of 15% methylene chloride in hexane at the rate of 3-4 drops per sec. The eluate was evaporated till dryness and the residue dissolved in a known volume of hexane for gas chromatographic analysis.

Gas chromatography. Pye-Unicam 104 gas chromatograph equipped with electron capture detector (ECD, Ni^{63}) was used for analysis. A glass column (2.21 m x 4 mm O.d.) packed with 1.5% OV-17 + 1.95% OV-210 on gas chrom. Q (80-100 mesh) was used for analyzing organochlorine residues. The GC was operated at column and injector temperature 220° and 230° respectively, with nitrogen as carrier gas at a flow rate of 120 ml/min.

Results were corrected according to the percentage rates of recovery (Table 2), determined by adding one microgram of each standard organochlorine pesticide to 100 gms. of sediment and subjected to the same technique. The results were calculated in ppb on a dry weight basis and each presented as an average of three samples.

Results and Discussion

The data in Table 1 show that α-BHC residues ranged from 0.08 to 0.77 with a mean of 0.27 ± 0.11 ppb in all tested sediments. These results are in agreement with those reported by other researchers [9,10] who reported that the maximum concentration of α-BHC in water was 0.042 ppb/solids suspended in one liter of water.

Lindane residues ranged from 0.06 to 3.99 with a mean of 0.84 ± 0.64 ppb. Herzeal [10] reported that lindane contributed to the maximum residue of 0.159 ppb/solid suspended in 1 liter of water taken from the Regnitze River, Germany.

The residues of aldrin in sediments varied from 0.25 to 0.52 with a mean of 0.30 ± 0.07 ppb. Aldrin could not be detected in sediment samples of the El-Ebrahimia Drain. Lichtenstein *et al.* [11] recorded that aldrin was more stable in water if it contained mud. On the other hand, Miles and Harris [5] could not detect aldrin in bottom mud samples taken from Big Creek (draining agricultural area), Thames River (urban-agricultural) and Muskoka River (resort areas) in Ontario, Canada.

The mean value of chlordane residues in sediment samples was 1.16 ± 0.48 ppb with a maximum of 2.68 and a minimum of 0.05 ppb. Similar results for chlordane have been observed by Miles and Bevenue [5,12].

The quantity of dieldrin in bottom sediments, ranged from 0.07 to 1.76 with a mean of 0.53 ± 0.29 ppb. Frank *et al.* and Bevenue found similar levels of dieldrin in bottom mud [6,12,13].

Endrin in bottom sediments varied from 0.04 to 4.17 with an average of 1.46 ± 0.58 ppb. Bridges [14] reported that most of the endrin in surface water was concentrated in the mud, vegetation where it persisted for a longer period.

P,P'-DDT in bottom sediments ranged from 0.26 to 8.37 with a mean of 3.10 ± 1.48 ppb. These results are in full

TABLE 1. ORGANOCHLORINE PESTICIDE RESIDUES IN THE SEDIMENTS OF THE RIVER NILE DISTRIBUTARIES AND DRAINS, SHARKIA GOVERNORATE, EGYPT.

	Pesticide residues (ppb/dry weight)						
Source	α-BHC	Lindane	Aldrin	Chlordane	Dieldrin	Endrin	p,p'-DDT
El-Ghar canal	0.30	0.67	0.52	2.68	1.76	4.17	6.97
El-Aslogy drain	0.27	3.99	0.31	0.32	1.04	1.47	8.37
Bahr El-Senety	0.11	0.09	0.36	0.68	0.13	0.97	2.13
Ekwa drain	0.11	0.06	0.35	0.05	0.09	0.04	0.33
Bahr El-Dakar	0.08	0.12	0.25	0.73	0.07	0.88	0.53
El-Ebrahimia drain	0.77	0.13	ND	2.63	0.08	1.24	0.26
Mean	0.27	0.84	0.30	1.16	0.53	1.46	3.10
S.E. (±)	0.11	0.64	0.07	0.48	0.29	0.58	1.48

ND: Non detectable.

TABLE 2. THE PERCENTAGE RATES OF RECOVERY OF CHLORINATED PESTICIDES FROM SEDIMENTS OF THE RIVER NILE DISTRIBUTARIES AND DRAINS.

Pesticide	Fortification level (ppb)	Percentage of recovery
α-BHC	10	62.50
Lindane	10	56.25
Aldrin	10	80.00
Chordane	10	70.83
Dieldrin	10	74.00
Endrin	10	76.67
P,P'-DDT	10	87.50

agreement with those of other researchers [5,7,12,13,15,16]. Moreover, Bridges, *et al.* [17] have found that DDT in water quickly concentrated into bottom mud and vegetation.

These results show that endrin, chlordane, dieldrin and aldrin concentrations were highest in the El-Ghar Canal sediments. However, high quantities of p,p'-DDT, lindane and -BHC were detected in the sediments of El-Aslogy and El-Ebrahimia drains. Bahr El-Dakar and Ekwa drain sediments contained the lowest amounts of all the tested organochlorine pesticide residues. Sediments from Ekwa drains contained comparatively lower levels of endrin, chlordane and lindane than that from Bahr-Dakar. Moreover, aldrin was not detected and low quantity of p,p'-DDT (0.26 ppb) were obtained from El-Ebrahimia drain sediments.

These results showed that the organochlorine pesticide residues were higher in bottom sediments than in the water above it [1,13,18]. Thus, the concentration of organochlorine pesticides are unlikely to occur in large quantities in water because they are relatively insoluble. However, turbulant water can keep the particulate matter in suspension. During a flood, some of the pesticides attached to the bottom sediments may be re-introduced into the main body of water. It seems that sediments of many surface waters are heavily contaminated with organochlorine pesticides and may continue to be a reservoir for periodic future contamination of the water [2,19].

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