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CONTENTS

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Residual Impact of Pesticides in Agricultural Soil Profile of Kadegaon Tahsil (M.S) India.

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Abstract: Soil is a complex mixture of chemical constituents having adequate nutritional value useful for agricultural crop. The farmer finds it extremely difficult to know the proper type of fertilizer required to the soil for economic increase in the agricultural production. The main objective of this study was focused on chemical investigation of the likely presence of residual pesticides in agricultural soil samples in Kadegaon Tahsil of Sangli district. Twelve agricultural soil samples were taken for chemical analysis from different agricultural cluster fields of neighboring five villages and analyzed using Gas Chromatography consisting of electron capture detector for organochlorine pesticides. Eleven samples were eventually found to be positively polluted by pesticides including α-HCH, β- HCH, Endosulphan-1, o,p-DDT and p,p'-DDT, Dielderin. Although Endosulphan-1 occurred with more abundance among the residual pesticides in the soil samples and the highest concentration compared to the other residues, all the detected pesticides residues were found in low concentration.

Keywords: Residual pesticides, Soil profile, Environmental impact, Dielderin, Endosulphan, DDT, Gas Chromatography. Persistent organic pollutants.

INTRODUCTION:

Soil is the most important Natural Resource from the agriculture point of view as it is the only media for the growth of vegetation. According to Joffe[8] the soil is a natural body of mineral and organic material differentiated into horizons, which differ among themselves as well as from underlying materials in their morphology, physical make-up, chemical composition and biological characteristics[22]. Soil can develop from weathered rocks, volcanic ash deposits or accumulated plant residues. Soil thus form a substrate for plant growth which performs many functions essential to life and in general, most plants grow by absorbing nutrients from the soil whose ability to do this depends on the nature of the soil. Soil formation is a constructive as well as destructive process[16]. The predominant destructive process are physical and chemical breaking down of materials, plants and animal structures which result in the partial loss of more soluble and volatile products. Soil types are a major factor in determining what types of plants will grow in a certain area as plants use inorganic elements from the soil such as nitrogen, potassium and phosphorus. However microorganisms like fungi, bacteria and other microscopic life forms available within the soil are also vital and hence soil is a dynamic medium made up of minerals, organic matter, water, air and microorganisms. The nature of soil primarily depend upon its continued change under the effect of physical factors like the parent material, time, the climate, the organic activity means excessive use of fertilizers and organo pesticides in it etc[21]. Since soil is made up of such diverse materials like weathered rock particles and organic material (humus), it can be classified into various types based on the size of the particles it contain[22, 6]. The modern concept of soil quality is the ability to sustain plant and animal productivity, to increase water and air quality and to contribute plant and animal health[3,4]. Although all physico-chemical properties are involved in soil functioning, bio chemical properties tend to react most rapidly to get change in the external environment[14, 24].

The continuously rising agricultural trends over the past forty five years showing global production of Pesticides, use of fertilizers and cereal production[23]reveals that there is growing environmental[1] issue attracting both scientific and public concern because of their nature of toxicity, persistence, health problems and endocrine disrupting effects. This materials may remain for a long time in the environmental media especially in soil, the final behavior depends upon physical, chemical and biological factors, which governs the fate of pesticides include sorption-desorption, volatilization, chemical and biological degradation, plant up-take, surface runoff and leaching[20].Pesticides may reach the soil through direct application to the soil surface, incorporation in the first few inches of soil, or during application to crops[11].The probable impacts of pesticide residues on the soil profile includes risk of injury to crops and non target species, development of resistance to weeds, effect on soil biota and associated processes e.g.nitrogen fixation, incidence and severity of root diseases and

interference in nutrient uptake and utilization by plants[5,12].

The literature survey reveals that an endosulphan was found to be one of the most dominant pollutant in soil samples of Cotton farm land collected from Burkina Faso[15]. According to Jinky Leilanie[7] there is a restriction and ban on the Endosulphan in Philippines. A study on agricultural soil samples from Australia showed the contamination of soil samples by triazine herbicides[26].In southern Iran, atrazine residue were found in different soils in shiraz[2]. In Ethiopia, low concentration or non-detectable level of persistent organic pollutants such as aldrin, dieldrin, endrin, heptachlor and HCHs were found in few soils[25]. Some farmers who uses 2, 4-D suffer from neurotic illness, moreover digestive diseases and prostate cancer[17, 19]. According to Liu et. Al[10]. 2,4-D causes slight decrease in testosterone release and significant increase in estrogen release from testicular cells.

Hence need of this investigation to monitor the soil management by analyzing the agricultural soil samples from various fields of kadegaon district at regular interval to evaluate the effects of anthropogenic activity ie excessive use of chemical fertilizers and organo pesticides by the farmers on the characteristic of agricultural profile of soils and the information obtained could serve as a base line data for future investigations and interpretations of Soil and chemical fertilizers and pesticides contamination problems also, which will be helpful to extend the co-operation to the farmers in and around the kadegaon who approaches for knowing the condition of soil.

MATERIALS AND METHODS:

Description of study area:

Kadegaon is a taluka place and is located in rural and hilly area of Sangli district in Maharashtra. It is rapidly growing city on account of trade and agricultural practices located at $17^0 18'$ N. latitude and $74^0 21'$ E longitudes. The majority of population lives in rural area and most of the peoples in these villages are economicaly dependent on agricultural practices. The majority of the farmer cultivates various crops according to the econonmical point of view by using excess various chemical fertilizers and organo pesticides in their field which affects agricultural profile, which is very harmful to the proper vegetation of the crops under cultivation. Most of the farmers are illiterate with soil science. Farmers from in and around kadegaon tahsil are no exception to this.

Soil Sample location:

The twelve soil samples from different fields of kadegaon tahsil of sangli district were collected. Each of which was representative of five sub samples collected from neighboring four village corners of the site and one from the approximate centre.Soil samples were collected from the 5.30 cm layer from the soil surface, air dried and sieved through a No. 20 brass soil sieve and refrigerated at 4°c until the analysis. Pesticides standards (organochlorine pesticides) were screened for a total of eighteen pesticides like Aldrin, α-HCH, β- HCH, γ-HCH, Dielderin. 2,4-DDD, 2,4-DDT, 4,4-DDE, 4,4-DDT, Endosulphan-1 and Endosulphan-2. The sample coding for cluster of five neighboring villages under study area in kadegaon tahsil of sangli district are given in Table.1. The map of kadegaon tahsil is presented by Fig.1.

Sample Extraction:

The additions of ammonium chloride solution followed by fifty ml distilled acetone were done to the fifty gram soil of each sample under study kept in a different glass jar. After shaking this mixture for twenty minutes, fifty ml of distilled petroleum ether was added to it and kept in shaker for overnight. Each sample mixture was filtered through Whatman No.1 filter paper and followed by adding fifty ml of acetone to each soil sample and filtered again. The eluate was collected and concentrated to one ml using a rotatory flash evaporator. The soil extract was then subjected to additional clean steps. Activated florisil was placed in the chromatographic column above the glass wool and then added with about two to four cm sodium sulphate to absorb any residual moisture from the extract. The column was pre-wetted with fifty ml petroleum ether and was not allowed to dry up. K-D with volumetric or graduated receiving flasks was placed under the column to receive eluate. The extract was diluted to twenty five ml petroleum ether (22.5 ml) and acetone (2.5). The solution was transferred to florisil column, letting it to pass through at about five ml per minute. Column was eluted at about five ml per minute with 160 ml petroleum ether mixed with diethyl ether. Florisil eluate was evaporated to near dryness. The final volume was reached to five ml with GC grade solvent.

Gas Chromatograph:

The analysis of Organochlorine and organophosphorous pesticide residues are carried out by using Shimazu 14B GC unit, OV 17 column(Japan) consisting of electron capture detector (ECD) and flame photometric detector(FPD) respectively. During experimentation manually all extracts and standards were injected. The GC analysis was carried out by using highly pure pesticides of analytical grade as a reference standard. The injector temperature was 230°c and the detector temperature was 240°c during GC analysis. The temperature program on the capillary column was 220°c. As carrier gas ultra pure nitrogen (flow rate 40 ml/min) with zero error and as a flame source ultra pure hydrogen gas for FPD detector (flow rate 60 ml/min) were used. To record the

chromatograms and peak areas CR-6 chromatographic data processor was used. The calculation of residual pesticides in samples are done and compared with the technical standard pesticides.

The recovery experimentation was carried out to confirm the exact quantity of residual pesticide in soil samples. The soil samples free from residual pesticides were collected and sprayed with the known concentration of pesticides standards in triplicate. The calculation for difference between the sprayed concentration and the concentration obtained after standard procedure of extraction and clean up were carried out in the percent recovery to obtain correction factor which was included while calculating and expressing the result of residual pesticides in soil samples. The recovery obtained varied from 80 to 85 %.

Results:

The results of the soil sample analysis for pesticide residue are predicted in Table.2. The frequency of residual pesticides detected in soil sample analysis of kadegaon tahsil of Sangli district are shown in fig.2. The Gas Chromatographic analysis of soil sample shows the presence of Organochlorine pesticide residues in all the samples except L which is hilly area where average rain fall is more. Out of eighteen injected pesticide standards, six pesticides and their metabolites were detected including Endosulphan-1, Dielderin., α-HCH, β- HCH , p,p'-DDT and its breakdown product , o,p-DDT. Multiresidual contamination occurred in a C and G soil samples.

The most common pesticide residue detected in the area under study was Endosulphan-1 isomer constituting of 45% of the samples(A,B,C,F and I) followed by o,p-DDT(E and G), α-HCH (Sample D and G) and β- HCH (Sample C and H) 20%. Eventhough, Endosulphan-1 exhibited generally the highest frequency of residues in the soil samplesA,B,C,F and I, the maximum amount of a single residue detected was found for o, p-DDT (0.0016) in the soil sample code. E.

It means that, all the samples collected from this area have been contaminated by residual pesticides except L which is hilly area where average rain fall is more .

Among the all soil samples collected, two samples (J and K) showed very minute (10%) presence of Dielderin and , p,p'-DDT residual pesticides. The residues of aldrin, 2,4-DDD, $_{\gamma}$-HCH, 4,4-D DE and Endosulphan-2 pesticides were not detected in any of the sample under study.

Discussion:

The occurrence of organochlorine pesticides (like Endosulphan-1, α-HCH, β- HCH and o,p'-DDT) and moderately persistent pesticide residues such as Dielderin and , p,p'-DDT at low concentration in the soil samples collected from growing areas of kadegaon tahsil. High occurance of pesticide residues in eastern part of the tahsil might have happened because of the intensive use of chemical fertilizers and organo pesticides in this area. Recent non agricultural applications of p,p'-DDT along with historical usage of this persistent pesticide may be considered as the other likely reasons for the present analysis.

The literature survey regarding the concentration of organochlorine pesticides residue in other countries reveals that the concentration of organochlorine pesticides residue was found to be quite low.(2,10,14,11,15,16).

Conclusion:

According to the results obtained after complete analysis of all twelve samples from various cluster region of kadegaon tahsil, eleven samples were eventually found to be positively polluted by pesticides including α-HCH, β- HCH, Endosulphan-1, o,p-DDT and p,p'-DDT, Dielderin. Although Endosulphan-1 occurred with more abundance among the residual pesticides in the soil samples and the highest concentration compared to the other residues, all the detected pesticides residues were found in low concentration.

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TABLE: 1 The sample coding for cluster of five neighboring villages under study area in Kadegaon tahsil of Sangli district

Sr.	Sampling Place Cluster of Villages	Sample Code	Sr.	Sampling Place Cluster of Villages	Sample Code	Sr.	Sampling Place Cluster of Villages	Sample Code
1	Raygaon		21	Kotij		41	Shirgaon	
2	Bombalewadi		22	Kherade (vita)		42	Shirasgaon	
3	Hingangaon (BK.)	A	23	Tupewadi(Kh)	E	43	Sonsal	I
4	Shalgaon		24	Bhikawadi(kh)		44	Sonkire	
5	Yede		25	Hanmant vadiye		45	padali	
6	Karandewadi		26	Shivaji nagar		46	Vajegaon	
7	Belawade		27	Kadegaon		47	Chinchani	
8	Vihapur	B	28	Kadepur	F	48	Ambak	J
9	Renushewadi		29	Chikhali		49	Asad	
10	Nimsod		30	Amarapur		50	Vadgaon (Mohite)	

Sr.	Sampling Place Cluster of Villages	Sample Code	Sr.	Sampling Place Cluster of Villages	Sample Code	Sr.	Sampling Place Cluster of Villages	Sample Code
11	Upale (wangi)		31	Nevari		51	Ramapur	
12	Upale(mayani)		32	Ambegaon		52	Deorashtre(E)	
13	Saspase	C	33	Yevlewadi	G	53	Deorashtre(W)	K
14	Tondoli		34	Shivani		54	Kumbhargaon	
15	Soholi		35	Vadiye raibaag				
16	Dhanewadi		36	Hingangaon(kh)		55	Apshinge	
17	Kherade(wangi)		37	Shelakbao		56	Khambale(A)	
18	Kanherwadi	D	38	Tadsar	H	57	Kotaweade	L
19	Yetgaon		39	Wangi-East		58	Nerli	
20	Tupewadi(y)		40	Wangi-West				

TABLE: 2 Amount of residual pesticides (ppm) detected in agricultural soil samples A to K

Sr.	Sample code	Residual pesticides detected in soil samples(ppm)					
		Endosulphan-1	α-HCH	β- HCH	Dielderin	o,p-DDT	p,p'-DDT
1	A	0.0009	---	---	---	---	---
2	B	0.0011	---	---	---	---	---
3	C	0.0010	---	0.0003	---	---	---
4	D	---	0.0003	---	---	---	---
5	E	---	---	---	---	0.0016	---
6	F	0.0004	---	---	---	---	---
7	G	---	0.0002	---	---	0.0004	---
8	H	---	---	0.0002	---	---	---
9	I	0.0007	---	---	---	---	---
10	J	---	---	---	0.0001	---	---
11	K	---	---	---	---	---	0.0003
Average %		45%	20%	20%	10%	20%	10%

Figure. 1. Map of Kadegaon Tahsil of Sangli District in Maharashtra(India)

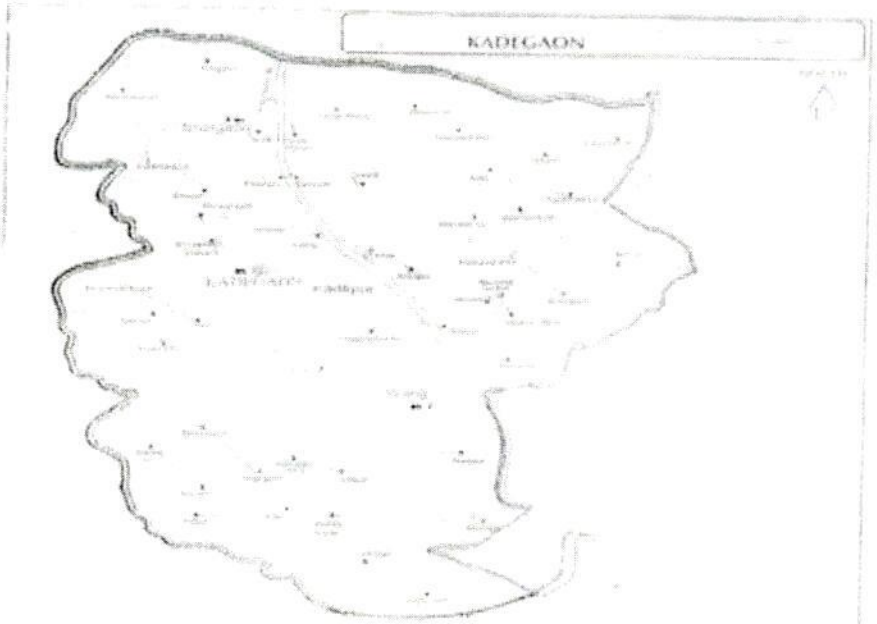

Figure.2. The frequency of residual pesticides detected in soil sample analysis of kadegaon tahsil of Sangli district .