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EFFECT OF DIMECRON ON THE ORGANIC MATTER CONTENT IN SOILS COLLECTED FROM DIFFERENT AREAS OF BANGLADESH

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Five representative Bangladesh soils were treated with a pesticide dimecron at 0,10,100 and 1000μg/gm. They were kept at room temperature (30 ± 2°) for 40 days at field capacity moisture content in glass containers. The correct moisture level was checked once in a week. After mixing, 50gm soil from each sample was collected after 0,5,10,20,30 and 40 days of incubation to study the organic matter content in soils. The results showed that the dimecron decreased the organic matter content in all five soils upto 20 days of observation and then slightly increased it with future incubation time. Dimecron significantly reduced the organic matter content in soils with increasing the rates of application for the five soils. The reduction was linear with high dosages of dimecron in soils. For control treatments, the organic matter was almost constant over the period of observation. The t-test results confirmed that the yields did not vary when the incubation periods were compared but they differed significantly ($P<0.001$ to 0.01) when the dosages or levels were compared in a particular soil.

Key words: Dimecron, Organic matter content, Soils, Pesticide, Dosage.

Introduction

Organophosphorus pesticides are widely introduced to all types of environment against a large variety of pests. They show a wide range of stability towards environmental degradation but are generally regarded as non-persistent. The biological effect, movement and persistence of pesticides in soil depend in large part on interaction of the pesticide with the soil adsorption complex. Soil organic matter is an important constituent of mineral and organic soils. Organic matter in soil comes from plant and animal residues. Pesticide residues may influence soil properties, including the rate of change of organic matter status. Soil organic matter is an adsorbent for pesticides [1]. Activity or loss of a pesticide from soils depends on numerous soil properties such as texture, clay mineral types and pH, in addition to soil organic matter content. Weber [2] reported that pesticide adsorption by organic matter involved fractions of soil humus, primarily humic acid. Properties of soil organic matter apparently vary with source and degree of humification. Retention of the organophosphates by soil is related to both the soil clay and organic matter contents [3]. Grover [4] reported that adsorption of picloram was correlated only with organic matter content.

Although, reports are available on the effects of pesticides on soil organic matter content [5,6], none is available for Bangladesh soils. Therefore, the effects of dimecron on the organic matter content of five representative soils of Bangladesh has been studied.

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Materials and Methods

Soil sampling. Five soil samples representing noncalcareous alluvium [1], noncalcareous dark grey floodplain [2], red brown terrace [3], acid sulphate and grey floodplain [5] soils were collected from the different areas of the country at a depth of 0-15cm (Fig. 1). The sampling sites were free from the usage of any pesticides. Soils were dried at room temperature, ground to pass through a 10- mesh sieve and then used in the experiment. Some of the major soil characteristics are reported in Table 1.

Soil treatments. Each 500gms. soil sample was treated with dimecron 100 (CIBA-GEIGY) at the rate of 0,10,100 and

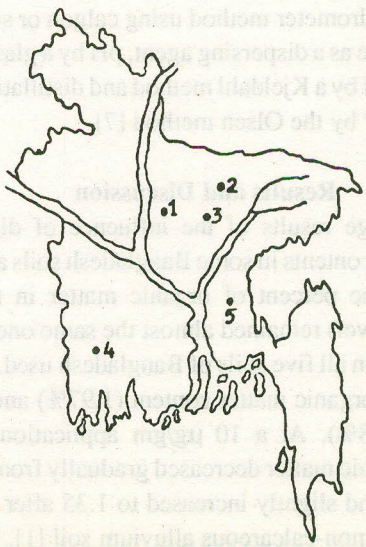

Fig. 1. Locations of five representative soil sampling areas in Bangladesh: Noncalcareous alluvium (1), Noncalcareous dark grey floodplain (2), Red brown terrace (3), Acid sulphate (4) and Grey floodplain (5), soils.

TABLE 1. PHYSICAL AND CHEMICAL CHARACTERISTICS OF FIVE SOILS OF BANGLADESH.

Characteristics	Soils				
	1	2	3	4	5
Sand %	14	56	38	15	13
Silt %	28	36	19	60	50
Clay %	58	8	43	25	37
Textural class	*Clay*	*sandy loam*	*Clay*	*Silt loam*	*Silty clay loam*
pH	5.0-7.0	4.5-5.5	5.0-5.5	3.0-4.0	5.0-6.0
% Organic matter	1.42	1.27	1.18	1.75	1.97
Total-N	0.073	0.11	0.11	0.126	0.09
Available-P	1.31	0.54	1.48	0.21	2.04

1000 µg/gm levels at field capacity moisture content. The exact quantity of dimecron applied were 5,50 and 500mg in each 500gm soil against 10,100 and 1000 µg/gm levels, respectively. The samples were then transferred to glass containers with appropriate lids by maintaining air-tight condition and kept at room temperature for 40 days. The moisture levels of the samples were checked after a week. Five soils were similarly treated with the same pesticide.

Incubation. 50 Grams sub-samples of treated soils were collected after uniform mixing after 0,5,10,20,30 and 40 days of incubation for determining organic matter content.

Method of analysis. Organic carbon in soil was determined by the Walkley and Black method as described by Sattar and Rahman [7]. In this method, 2gm soil was treated with 10 ml of potassium dichromate and 20 ml of conc. H_2SO_4, kept for 30 mins, used 10 ml of conc. phosphoric acid and 2 ml of diphenylamine indicator and finally titrated against ferrous sulphate solution. The percent of soil organic matter was estimated by multiplying the percentage of organic carbon by a standard conversion factor of 1.73. Particle size analysis was done by the hydrometer method using calgon or sodium hexametaphosphate as a dispersing agent, pH by a glass electrode method, total-N by a Kjeldahl method and distillation titration and available-P by the Olsen method [7].

Results and Discussion

The average results of the influence of dimecron on organic matter contents in some Bangladesh soils are reported in Table 2. The percent of organic matter in the control treatment (O level) remained almost the same one the period of observation in all five soils of Bangladesh used. Soil-5 had the maximum organic matter content (1.97%) and soil-3 the minimum (1.18%). At a 10 µg/gm application level, the percent of organic matter decreased gradually from 1.34-1.25 upto 20 days and slightly increased to 1.35 after 40 days of incubation in a non-calcareous alluvium soil [1]. In the non-calcareous dark grey floodplain soil [2], the percent of organic matter gradually decreased from 1.20-1.13 upto 20 days and then increased to 1.21 after 40 days of incubation. In the red brown terrace soil [3], the percent of organic matter decreased from 1.09 to 0.94 upto 20 days and then slightly increased to 1.11 after 40 days of incubation at 10 µg/gm application level. A similar gradual initial decrease and later increase of the percent organic matter content was also recorded in acid sulphate [4] and grey flood plain soils [5]. Similar patterns of changes were recorded at 100 and 1000 µg/gm levels where the yields also decreased gradually upto 20 days and then increased slightly with the progress of time upto 40 days of incubation. The over all average results indicated that the percent organic matter content decreased upto 20 days and then increased gradually with incubation time with different levels of dimecron applied. This was probably due to the active ingredient of dimecron acted on the mineralization of organic matter in soils at certain period (20 days) and during this process, the pesticides inhibit the activities of micro-organisms. The organic matter content decreased with increasing the rates of dimecron applied during the different incubation periods (Table 2). Some researchers [8,9] reported that high doses of pesticides initially suppressed the activity of micro-organisms

TABLE 2. EFFECT OF DIMECRON ON PERCENT ORGANIC MATTER CONTENT IN SOME SOILS OF BANGLADESH (AVERAGE OF THREE RESULTS).

Soils	Dimecron applied (µg/g)	Incubation time (days)					
		0	5	10	20	30	40
1	0	1.42	1.42	1.41	1.40	1.42	1.43
	10	1.34	1.31	1.29	1.25	1.28	1.35
	100	1.27	1.21	1.17	1.14	1.19	1.26
	1000	1.20	1.15	1.11	1.08	1.16	1.22
2	0	1.27	1.27	1.26	1.27	1.26	1.27
	10	1.20	1.17	1.14	1.13	1.15	1.21
	100	1.16	1.11	1.06	1.02	1.09	1.17
	1000	1.11	1.05	1.00	0.94	1.02	1.12
3	0	1.18	1.17	1.18	1.17	1.17	1.18
	10	1.09	1.05	1.00	0.94	1.10	1.11
	100	0.94	0.89	0.80	0.74	0.83	0.95
	1000	0.86	0.78	0.68	0.59	0.70	0.84
4	0	1.75	1.76	1.75	1.75	1.76	1.75
	10	1.68	1.63	1.59	1.54	1.59	1.63
	100	1.62	1.57	1.51	1.47	1.52	1.59
	1000	1.56	1.50	1.43	1.40	1.48	1.53
5	0	1.97	1.97	1.96	1.97	1.96	1.97
	10	1.87	1.84	1.80	1.77	1.81	1.85
	100	1.78	1.70	1.68	1.62	1.66	1.74
	1000	1.70	1.64	1.59	1.55	1.63	1.71

in soils and after certain period, the organisms regain their properties for normal activities in soil and probably, here a similar phenomena can be recorded with dimecron. The overall results concluded that the percent organic matter contents gradually decreased with increasing application rate of dimecron in all five soils. The maximum organic matter yields were recorded from soil-5 and minimum from soil-3 (Fig. 2). The jars were not completely sealed so it seems that the carbon increases towards the end of the experiment. Probably, this is an error arising from reduction of Fe(III) to Fe(II) during the long incubation of moist soil, Fe(II) would consume dicaromate causing an apparent increase in carbon control. Soil respiration can also play some role on this phenomena. Usually soil respiration is affected by some pesticides where they possess broad killing or inhibiting powers, causing maximum disruption of the soil microflora and this degree of killing or inhibition increases with increasing pesticide concentration and time of exposure [10]. Chandra and Bollen [11] reported that some pesticides depress respiration (CO_2 evolution) for 28 days but after 56 days, all treated soils had evolved more carbon dioxide than the controls. The greater the kill, the more dead microbial tissue available as a substrate for the surviving heterotrophic flora, and ultimately the greater the amount of carbon dioxide evolved. Other events contributing to the increased respiratory activity often observed in the secondary phase include pesticide or solvent-induced extraction of soil organic components and their utilization by the surviving organisms, and microbiological utilization of the pesticide as

TABLE 3. A PAIRED t-TEST COMPARISON OF THE PERCENT ORGANIC MATTER CONTENT IN SOME BANGLADESH SOILS WITH INCUBATION TIME (df=5).

Soils	Incubation time	Comparisons (days)				
		5	10	20	30	40
1	0	0.46	0.77	1.06	0.60	0.11
	5	–	0.30	0.57	0.12	0.16
	10	–	–	0.28	0.20	0.56
	20	–	–	–	0.49	1.20
	30	–	–	–	–	0.70
2	0	0.60	1.08	1.20	0.91	0.12
	5	–	0.47	0.71	0.29	0.75
	10	–	–	0.28	0.20	0.75
	20	–	–	–	0.46	1.31
	30	–	–	–	–	1.05
3	0	0.40	0.78	1.09	0.51	0.03
	5	–	0.41	0.74	0.16	0.41
	10	–	–	0.32	0.22	0.78
	20	–	–	–	0.53	1.09
	30	–	–	–	–	0.51
4	0	0.14	1.03	1.31	0.88	0.44
	5	–	0.52	0.81	0.14	0.05
	10	–	–	0.30	0.17	0.67
	20	–	–	–	0.48	0.96
	30	–	–	–	–	0.49
5	0	0.40	0.78	1.09	0.51	0.02
	5	–	0.41	0.74	0.16	0.41
	10	–	–	0.32	0.22	0.78
	20	–	–	–	0.53	1.09
	30	–	–	–	–	0.51

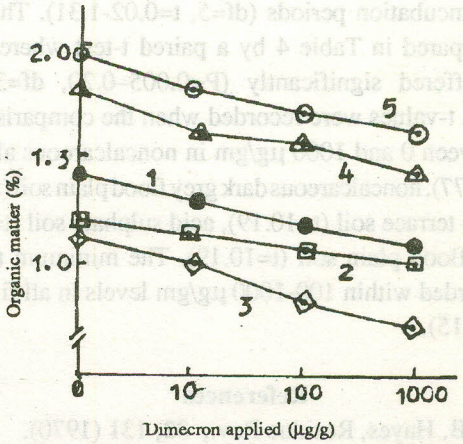

Fig. 2. Change of organic matter status in five Bangladesh soils with different dosages of dimecron applied.

TABLE 4. A PAIRED t-TEST COMPARISON OF THE PERCENT ORGANIC MATTER CONTENT IN SOME BANGLADESH SOILS WITH AMOUNTS OF DIMECRON APPLIED (df=3).

Soils	Levels applied (µg/g)	Comparisons		
		10	100	1000
1	0	5.4	8.19	10.77
	10	–	3.84	2.88
	100	–	–	1.89
2	0	7.35	6.99	8.07
	10	–	2.40	4.09
	100	–	–	1.69
3	0	4.59	9.48	10.19
	10	–	4.39	6.10
	100	–	–	2.15
4	0	7.28	9.00	10.97
	10	–	2.11	4.04
	100	–	–	1.90
5	0	4.59	9.48	10.19
	10	–	4.38	6.19
	100	–	–	2.15

a carbon of energy source [12]. With organophosphorus pesticides on oxygen uptake, Tu [13] observed that the rate of oxygen consumption increased with increasing pesticide concentration where the detected reasons were the microbial degradation and utilization of pesticides. Some pesticides and their degradation products may function as uncouples oxidative phosphorylation from the electron transfer system, thereby increasing microbiological oxygen consumption [12].

A paired t-test was applied to the results of Table 3 and 4. The t-test results showed that the organic matter content did not differ significantly when comparison was done within the different incubation periods (df=5, t=0.02-1.31). The doses were compared in Table 4 by a paired t-test where all the results differed significantly (P<0.005–0.20, df=3). The maximum t-values were recorded when the comparison was done between 0 and 1000 µg/gm in noncalcareous alluvium soil (t=10.77), noncalcareous dark grey flood plain soil (t=8.07), red brown terrace soil (t=10.19), acid sulphate soil (t=10.97) and grey flood plain soil (t=10.19). The minimum t-values were recorded within 100-1000 µg/gm levels in all five soils (t=1.69-2.15).

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