

EFFECT OF FUNGICIDE DEXON (*p*-DIMETHYLAMINO BENZENEDIAZO SODIUM SULFONATE) ON SOIL AGGREGATION

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ABSTRACT

Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate), a soil fungicide, was found to lower the water stable aggregates when added to soil and incubated for a long time. With its disappearance, the soil structure seems to restore itself. The restoration is mainly brought by an increase in the 0.25 mm aggregates. The immediate effect of addition of the fungicides was an enhancement in the water-stable aggregates of the soil. Within eight weeks as much as 80-90% of the fungicide gets degraded in soil.

CONTROL of soil-borne plant pathogens particularly those affecting seedlings is essential for successful agriculture. This is achieved either by seed treatment with fungicides or applying them directly to soil. At the same time, it is increasingly being realised that large scale application of fungicides to the land brings along with it problems affecting the environment. Apart from this, the immediate effects of these additions on soil as an ecosystem have not been fully investigated. The fungicides may affect directly or indirectly both the microbial balance and the physical properties of the soil.

The Governments of various countries are directing now their serious attention towards testing thoroughly the effect of fungicides on other microbes, ascertaining at the same time, their stability, persistence, and movement in soil before recommending them for general agricultural use.

Among the seedling diseases, the more serious and deadly are the "damping-off" diseases caused by the phythiaceous fungi. No effective remedy was available against them until a few years ago. The fungicide Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate), introduced recently, was observed to be rather specific against these organisms, most other fungi remaining unaffected by it.¹⁻⁴ We have been studying for the past few years the activity of Dexon and its degradation by micro-organisms in soil. In this communication we present our observations on the effect Dexon has on the soil structure.

MATERIALS AND METHODS

400 g of air-dried red-loam soil passed through 2 mm sieve were transferred to 400 ml polythene beakers. Dexon was incorporated at three levels, viz., 0, 1,000 and 2,000 ppm and 0.1% nitrogen in the form of either ammo-

nium chloride or sodium nitrite, these being the forms usually used in experiments to study nitrification. The contents were thoroughly mixed and incubated at room temperature (25-30° C). Three replicates were kept in each treatment. The moisture level was maintained at 60% of water holding capacity (WHC) of the soil by adding tap water periodically. The rate of nitrification of these two were followed but the results will be published elsewhere. For aggregate analysis, soil samples were drawn at monthly intervals. 10 g of wet samples from each treatment, in duplicate, were kept under 1:3 water for overnight and were then sieved through a nest of sieves manually. The aggregates retained on each sieve were then transferred into a weighed petri-dish, dried in the oven and their dry weights were recorded. The actual amount of aggregated material was obtained after subtracting the weights of primary particles. After drawing undisturbed samples for aggregate analysis, the contents were thoroughly mixed and samples were taken for the estimation of residual Dexon. The analytical techniques used for Dexon estimation was that of Anderson and Adams⁵ with some slight modifications to suit the present experimental set up.

RESULTS AND DISCUSSION

Dexon recovered from soil at different time intervals is given in Table I. Only about 70-80% could be recovered immediately after application. The fungicide which is anionic can be sorbed by the organic matter in soil⁶ and this may explain its low recovery. A part of it might also get adsorbed by the clay particles, mostly in the edges by iron and aluminium hydroxides. Dexon was observed to disappear rather rapidly in soil. Only about 7-20% could be recovered after 8 weeks. The rate of disappearance appears to be much faster

than that reported by Alconero and Hagedorn¹ which might be due to the differences in the type of soil, temperature of incubation (25-30° C) and optimum conditions maintained throughout the experiments.

TABLE I
Residual Dexon in soil

Treatment	% recovery after		
	2 hours	5 weeks	8 weeks
1,000 ppm Dexon:			
No nitrogenous chemical	.. 80.0	39.9	10.8
Ammonium chloride	.. 79.0	62.6	16.1
Sodium nitrite	.. 81.0	51.5	15.1
2,000 ppm Dexon:			
No nitrogenous chemical	.. 71.0	30.8	7.6
Ammonium chloride	.. 70.8	40.9	9.5
Sodium nitrite	.. 81.4	49.9	20.8

Of interest was the finding that amending the soil with nitrogenous chemicals resulted in a slight increase in the residue levels. The availability of an easily utilisable source of nitrogen might spare the use of the fungicide as a nitrogen source. Further, those organisms that are capable of degrading the fungicide might slightly be suppressed by the faster proliferation of other saprophytes in the presence of a rich available nitrogen.

The effect of the fungicide on soil structure was even more profound. Within a few weeks of its application, a conspicuous fall in the total water stable aggregates occurred which was followed within a month by the tendency to increase and to reach the original levels. No doubt, the microbial activity so essential for aggregate formation might get inhibited by high concentrations of Dexon but it is more than likely that with the steady degradation of the fungicide the activity is regained, thereby enhancing the aggregate formation (Table II

TABLE II
Effect of Dexon on aggregate status of soil

Treatment		Dexon ppm		
		0	1,000	2,000
Nil	..	38.2; 36.9*	20.4; 33.3	28.7; 36.6
Ammonium chloride		25.5; 25.8	20.8; 28.1	20.0; 31.9
Sodium nitrite		4.9; 3.4	3.1; 6.6	8.3; 5.5

* Per cent water stable-aggregates >0.125 mm after 5 and 8 weeks respectively.

and Fig. 1). The recovery in the soil structure is mainly brought about by an increase in the 0.25 mm sized aggregates, which is the fraction that is considered to be of significance in

evaluating soil structure in relation to agriculture.⁷

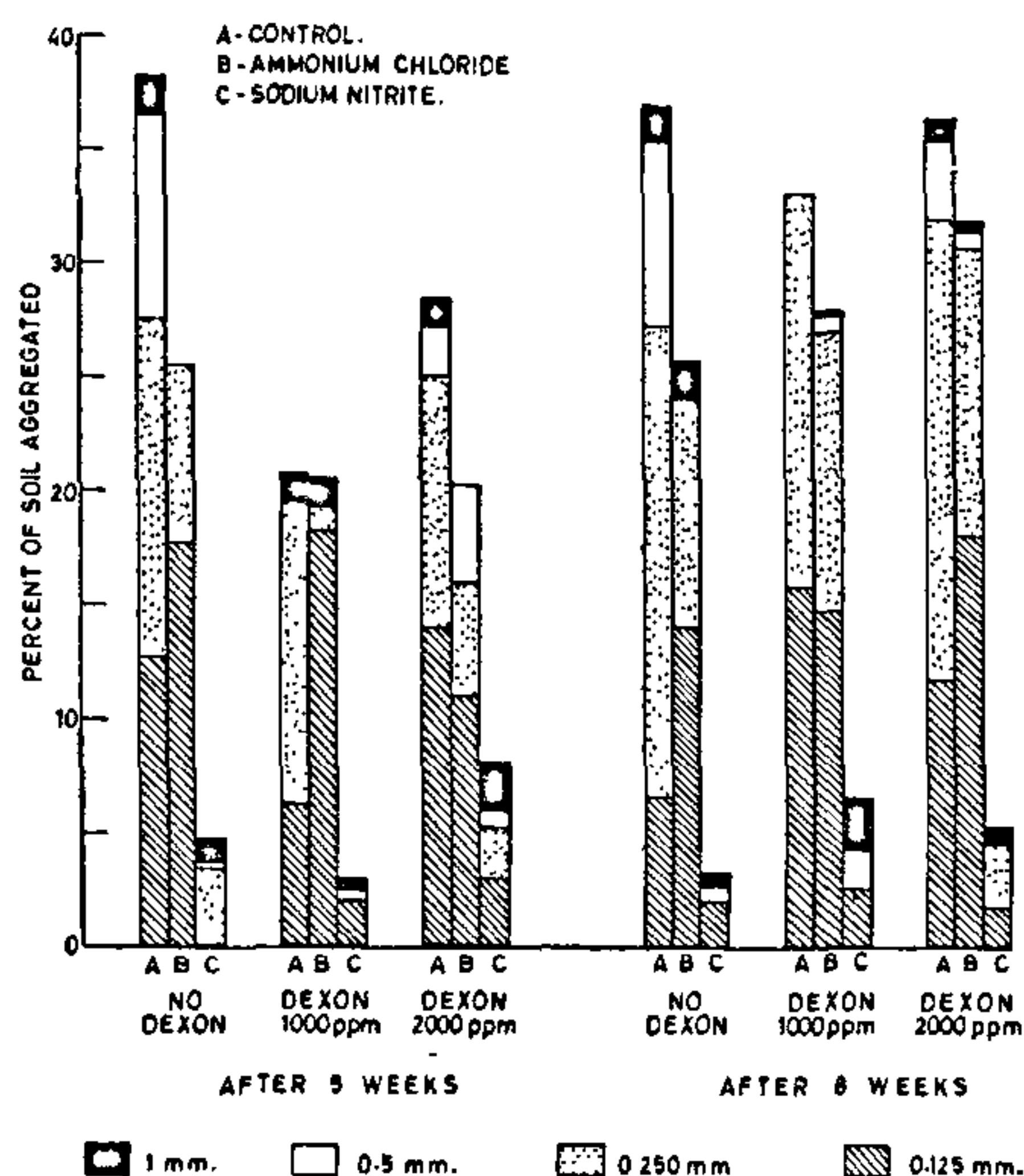


FIG 1. Distribution of water stable aggregates in soil treated with different levels of dexon and nitrogenous chemicals

The addition of the nitrogenous chemicals into the soil in the absence of a corresponding amount of carbonaceous material upsets the carbon nitrogen ratio, causing thereby a disturbance in the microbial balance. This could be one of the reasons for the fall in the amount of the aggregated material in all the samples treated with nitrogenous compounds. While this damage is not appreciable in the case of ammonium chloride, sodium nitrite has a devastating effect on the soil structure which may be due to its action on soil humic substances. The deleterious effect of high concentrations of sodium ions on soil structure is also well known.^{8,9} When both fungicide and the chemicals are present we find a cumulative effect.

Since Dexon is frequently used as a seed dressing or as a soil drench prior to sowing, we considered it worthwhile to see whether or not it has any short time effect on soil structure. To verify this, 10 g of soil (<2.00 mm) were transferred to paper cups; Dexon, ammonium chloride or sodium nitrite were added to the soil in the paper cups. The addition of the fungicide and the nitrogenous compounds were done in different sequences. After mixing them with the soil thoroughly,

moisture level was brought upto 60% WHC. The control samples received only water. Half the number of samples were sieved through immediately, whereas the other half was allowed to dry at room temperature before sieving. The results are presented in Table III.

TABLE III
Immediate effect of Dexon on soil aggregation

Treatment	% water-stable aggregate >0.125 mm	
	Sieved immediately	Sieved after drying
Control	8.5	14.3
Ammonium chloride without Dexon	10.3	12.2
Dexon and ammonium chloride added simultaneously	13.3	15.5
Dexon before ammonium chloride	15.5	8.9
Dexon after ammonium chloride	19.6	10.9
Sodium nitrite without Dexon	9.1	9.9
Dexon and sodium nitrite added simultaneously	19.3	11.9
Dexon before sodium nitrite	17.9	9.2
Dexon after sodium nitrite	21.0	9.2
Dexon only	14.9	17.8

On immediate sieving, all Dexon-treated soils showed greater aggregation than the untreated ones. Considerable portion of the increase came in fractions larger than 2.0 mm, a fraction which was altogether absent in soils wherein no Dexon was present. On immediate wet sieving, highest level of aggregation was witnessed in samples wherein Dexon was add-

ed at the end, whereas simultaneous addition of Dexon and the nitrogenous compounds resulted in maximum aggregate formation when the samples were air-dried before sieving. The increased aggregation might be mostly due to cohesive properties of the clay though the role of Dexon as a weak anion bridge between clay particles cannot be ruled out in this context. Curiously, we found (except in a few cases) air-drying had the effect of lowering water-stable aggregate in the samples. This, however, could be due to loss of clay cohesion and partial breakdown of the fungicide.

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SPECTRAL AND MAGNETIC STUDIES ON URANYL (VI) COMPLEX OF 7-HYDROXY-4-METHYLCOUMARIN-6-CARBOXYLIC ACID

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COUMARIN derivatives have been successfully used as chelating reagents and their gravimetric and spectrophotometric studies in solution have been reported by several workers.^{1,2} Rastogi et al.³⁻⁵ have also studied the spectral and magnetic behaviour of several metal complexes of 8-amino-7-hydroxy-4-methylcoumarin (AHMC) and 7-hydroxy-4-methylcoumarin-6-carboxylic acid (HMCC). In this communication, HMCC has been found to form a light greyish-buff-coloured complex

with $\text{UO}_2(\text{VI})$ ion, which has been isolated and characterised by analyses, magnetic, conductometric and spectral studies. Magnetic measurements reveal an anomalous magnetic behaviour (μ_{eff} 0.67 B.M.) which is due to temperature independent paramagnetism (TIP). Infrared spectral studies indicate the essentially ionic character of metal-oxygen bond.

Reagents.—7-Hydroxy-4-methylcoumarin-6-carboxylic acid (HMCC) was prepared by the method of Kumar.⁶ All reagents used were