ON THE VARIATIONS IN THE DEGRADATION OF CARBOFURAN BY THREE SOIL FUNGI

GRANULAR insecticides are applied to soil in larger quantities to control insect pests. Unless degraded subsequently these insecticides may pose health hazards. Microorganisms have been known to play a major role in the degradation of pesticides. Although considerable amount of work has been done on the effect of insecticides on microbial population[1–4], not much information is available on the extent of degradation of insecticides, particularly carbamates by different soil microorganisms. The present note communicates the degradation of carbofuran (N-Methyl-2, 3-dihydro-2, 2-dimethyl-7-benzo furanyl carbamate) and formation of its intermediary compounds by three different soil fungi.

Fungal cultures, *viz.*, *Aspergillus niger*, *Trichoderma viride* and *Helminthosporium* sp. isolated from garden land soil of Tamil Nadu Agricultural University Experimental Farm, by enrichment culture method were multiplied on potato dextrose agar. Discs of uniform size of fungal cultures were added to Czapek's broth containing 20 ppm of carbofuran. Residues of carbofuran and hydroxy carbofuran, an intermediary compound, present in the culture filtrate were estimated at weekly intervals after harvesting the fungal mat following the TLC procedure described by Metcalf *et al.*[5].

The rate of degradation of carbofuran by different fungi increased with incubation time (Table I). Among the fungi tested, *Helminthosporium* sp. showed greater ability to degrade carbofuran than *T. viride* and *A. niger*. *Helminthosporium* degraded 70 and 77·5 per cent of carbofuran during the first and second week, respectively, and there was no carbofuran residue at all during the third week indicating the complete degradation. Such a complete degradation of insecticides by microorganisms have been reported earlier with other groups of insecticides, *viz.*, chlorinated hydrocarbons and organophosphates[6–8], although informations are limited with carbamates.

The results also revealed that all the organisms were capable of forming an intermediary compound, hydroxy carbofuran. The formation of intermediary compounds bears certain amount of significance, since, sometimes, it is more toxic than the parent insecticide[10]. An analysis on the percentage of formation of hydroxy carbofuran from the degraded carbofuran by different organisms revealed that *Helminthosporium* sp., an efficient carbofuran degrading organism converted only 2·1 per cent as compared to 12·0 per cent by *Aspergillus niger* in the initial stage. The rest of the degraded products could not be identified as they formed part of unknown spots. Further, the compounds conjugated with glucose or other large molecules would not have been extracted with solvents and presumably, all these would have contributed to the unaccounted metabolites other than hydroxy carbofuran[5]. The present study thus reveals that soil microflora vary in their ability to degrade insecticides and further suggest that greater the rate of degradation lesser the amount of intermediary compounds formed.

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TABLE I

Degradation of carbofuran by some soil fungi

(Initial level of insecticide 20 ppm)

Organism	Quantity of carbofuran detected (ppm)			Quantity of hydroxy carbofuran detected (ppm)		
	7th day I	14th day II	21st day III	I	II	III
Aspergillus niger	15·0	6·0	4·5	0·6 (12·0)	0·75 (5·3)	0·3 (2·0)
Helminthosporium sp.	6·0	4·5	0·0	0·3 (2·1)	0·3 (2·0)	..
Trichoderma viride	9·0	6·0	6·0	0·3 (2·7)	0·3 (2·1)	0·3 (2·1)

Figures in the parenthesis denote the percentage formation of hydroxy carbofuran from degraded carbofuran.

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INCREASE IN AMMONIA IN THE ROOT EXUDATE OF ZINC DEFICIENT TOMATO SEEDLINGS

ZINC has been established to be one of the essential nutrients for plants[1,2]. It is involved in the action of pyridine nucleotide dependent dehydrogenase[3], metabolism of tryptophan[4] and IAA[5], peptidases[6,7,8] and protein biosynthesis[9,10]. Under the zinc deficient conditions, free amino acids and amides—in particular the glutamine, asparagine, glutamic acid and aspartic acid—have been found to accumulate in tissue[11]. As these metabolites are the first products of ammonia fixation, their accumulation may lead to a check on the further assimilation of ammonia. This may, therefore, result in the possibility of ammonia accumulating in the tissue, which may at higher concentration become toxic to the tissue itself. Alternatively the accumulated ammonia could be released through roots of the plant in the medium. In the nitrogen fixing organism[12] ammonia has been reported to be released in the medium. Thus the present preliminary study was carried out to see the fate of ammonia formed in a zinc deficient tomato seedling.

Fifteen days old seedlings of tomato having similar physical appearances were taken for this study. The control seedlings were transferred to a modified nutrient medium of Hewitt[13] in which ammonium molybdate was replaced by sodium molybdate. Another batch of seedlings was transferred to modified nutrient medium, in which zinc sulfate was committed to induce zinc deficiency in the plants. The medium was devoid of ammonium salts for facilitating the estimation of ammonia in the exudate. The nutrient medium was further treated by the procedure described by Nichols[14] to minimise the zinc present as contaminants. The nutrient medium was replaced and aerated each day. In each replicate three seedlings in 50 ml of the medium were grown for ten days. The volume was maintained by the addition of fresh medium throughout the period of experiment. When the plants growing in zincless medium started showing signs of zinc deficiency, ammonia was measured in the medium by Nessler's reagent[15] at intervals of eight hours.

The results as summarised in Fig. 1 show that the ammonia concentration increases in nutrient

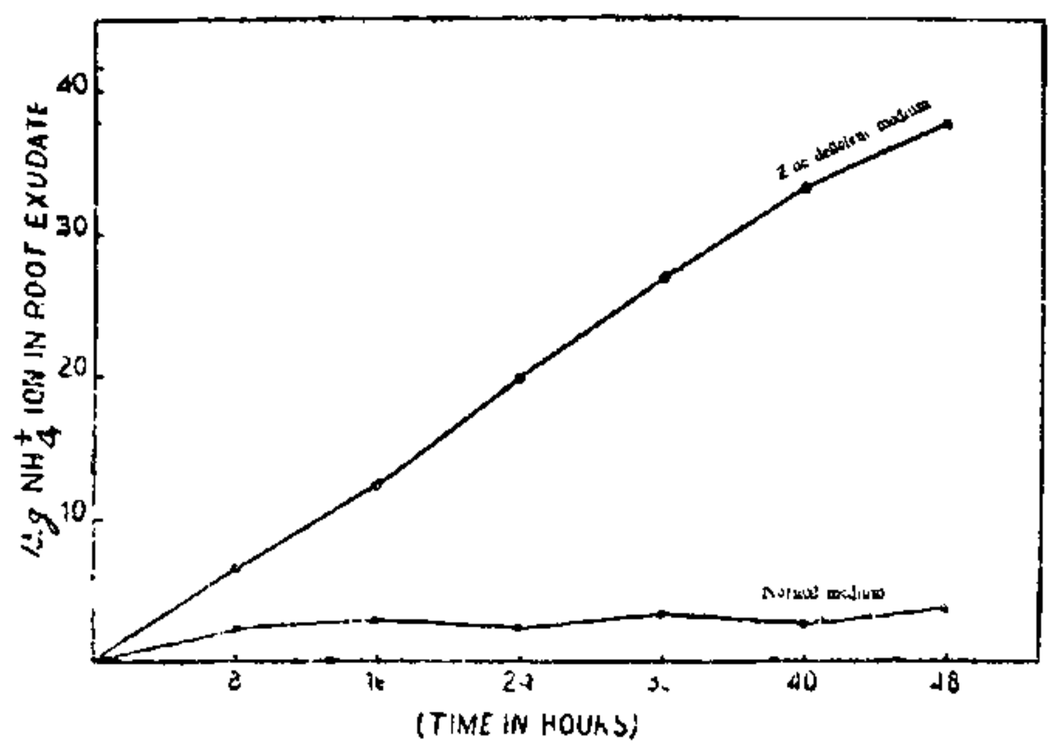

FIG. 1

medium deficient in zinc at a faster rate as compared to the normal medium (it is nil or in traces). As the nutrient medium did not contain ammonium salts, the data indicate that the zinc-deficient plants have released ammonia into the medium through the roots. Furthermore, as the nitrogen source in the medium was nitrate and in zinc deficiency products of ammonia assimilation, *i.e.*, glutamic acid, glutamine, etc., are accumulated[11] it appears that the nitrate reduction to ammonia has taken place, but further conversions have been blocked.

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