EFFECTS OF AN ORGANOTIN ON MICROBIAL ACTIVITIES IN SOIL

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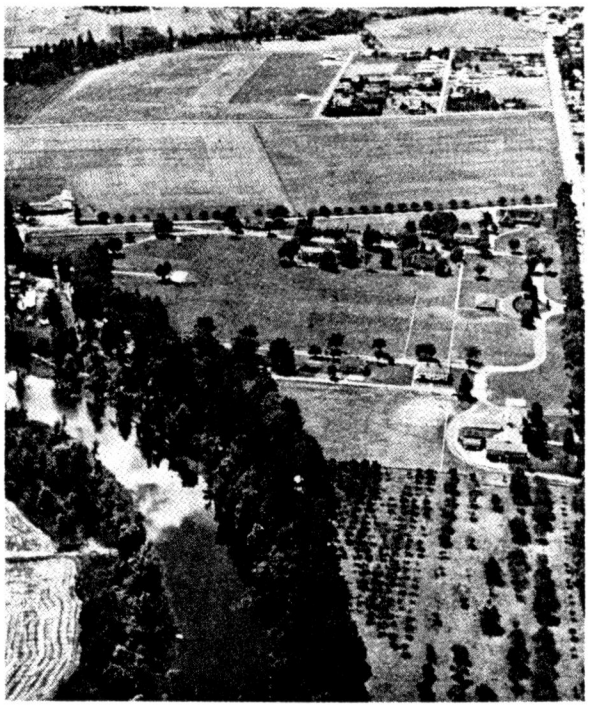

View of Willamette Valley where soils for study were collected.

Biologically active organotin chemicals, including bis (tri-n-butyltin) oxide, have fungicidal, bactericidal, and rodent repellent properties[4], as well as potential use in insect control[2]. This compound (of which TBTO† is a commercially available form) is a water-insoluble liquid having a high affinity for cellulose. Its biological activity, relatively low mammalian toxicity, and resistance to leaching suggest its possible use in forest management applications.

The influence of TBTO on soil microbial activities important to soil fertility must be determined before it can be recommended for any wide-scale use. We determined the influence of TBTO on soil microbial populations, ammonification, nitrification, sulphur oxidation, and soil respiration as determined by CO_2 evolution in three different soils from the Willamette Valley in Oregon. Chemical, physical, and microbial analyses of these soils and methods of study have been presented elsewhere[3].

TBTO was applied at 10 and 100 ppm active ingredient to air-dried, sieved soil (10-mesh). These concentrations were chosen to represent a range of amounts possible in the soil resulting from contact with treated seed, wood, paper, or other materials. The chemical was applied as an emulsion in water sufficient to bring the soil to 50% of water-holding capacity.

Resulting data were analysed statistically. The Zero level of TBTO was tested against the average response of both 10- and 100-ppm applications. The response at the 10-ppm level was then tested against that at the 100-ppm level (Tables 1–3).

Total mould counts and percent *Penicillium* spp. are significantly reduced by TBTO (Table 1), thus confirming its fungistatic properties[1]. However, these ephemeral decreases in moulds are not sufficient to have any important influence on soil fertility.

Total bacteria, percent *Streptomyces*, and soil respiration were not significantly affected by addition of TBTO to soil. Soil respiration is a good index of the activity of microflora in organic matter decomposition.

Of the three characteristics of native soil nitrogen studied, only nitrite nitrogen was significantly affected by TBTO (Table 2). However, these small changes in nitrite nitrogen concentrations are of little importance to soil fertility. Other microbial functions studied—ammonification,

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†Trademark of M and T Chemicals, Inc., Subsidiary of American Can Company, Rahway, New Jersey, bis (tri-n-butyltin) oxide $(C_4H_9)_3SnOSn(C_4H_9)_3$.

Table 1. Effect of TBTO on populations of soil microbes and decomposition of soil organic matter after 30 days' incubation

Variable	Contrasts of levels of TBTO *ppm*			
	0 vs. 10+100		10 vs. 100	
Total bacteria—(millions/g of soil)	126	197	187	206
Streptomyces—(percent of total bacteria)	58	53	56	50
Total moulds—(thousands/g of soil)	152	89[a]	101	76
Penicillia—(percent of total moulds)	65	41[a]	49	32
Decomposition of soil organic matter (total carbon as CO_2 (mg)/80 g soil)	16	15	17	12

[a] Significant at the 95% probability level.

Table 2. Effect of TBTO on the transformation of native soil nitrogen

Variable[a]	Contrasts of levels of TBTO *ppm*			
	0 vs. 10+100		10 vs. 100	
NH_4^+—nitrogen	66	129	146	113
NO_2^-—nitrogen	2	>1[b]	1	>1
NO_3^-—nitrogen	17	19	18	19

[a] NH_4^+—nitrogen after 5 days' incubation; NO_2^- and NO_3^-—nitrogen after 30 days.

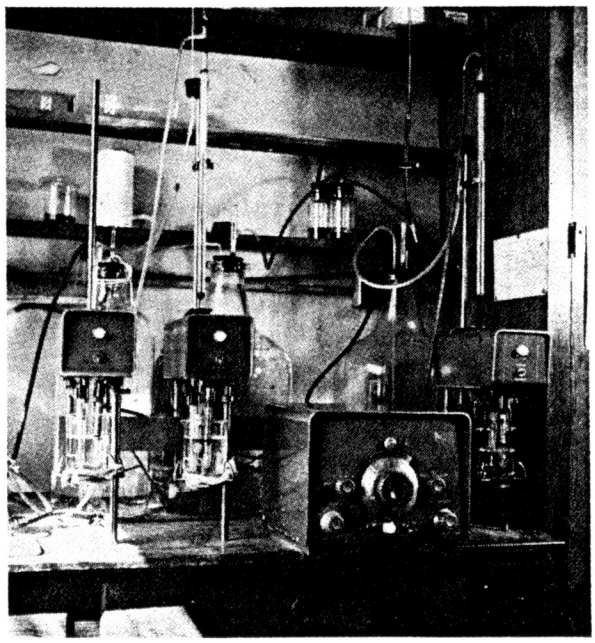
[b] Significant at the 95% probability level.

Table 3. Effect of TBTO on the transformation of peptone, ammonium sulphate, and flour sulphur[a]

Treatment[b]	Contrasts of levels of TBTO *ppm*			
	0 vs. 10+100		10 vs. 100	
Soil+peptone at 1,000 ppm N (data as ppm NH_4^+—N)	705	663	678	646
Soil+ammonium sulphate at 200 ppm N (data as ppm NO_3^-—N)	61	47	48	46
Soil+flour sulphur at 1,000 ppm S (data as ppm SO_4^-2—S)	206	166	168	164

[a] No differences between levels of TBTO were significant at the 95% probability level.

[b] Soil+peptone after 5 days' incubation; soil+ammonium sulphate and flour sulphur after 30 days.



Automatic titrator for determining CO_2 evolved from soils.

nitrification, and sulphur oxidation—were not significantly affected by TBTO (Table 3).

Significant soil-treatment interactions were found for total bacteria, total moulds, native soil NH_4^+–nitrogen, and transformation of ammonium sulphate. These interactions indicate that the three soils responded differently to treatments. Thus, inferences are directed to the average response over all soils.

From results of our study, we conclude that levels of TBTO up to 100 ppm in soil will have no biologically significant impact on soil microorganisms and their functions in maintaining soil fertility.

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References

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