Development and Conservation

International Conference on Managing Natural Resources for Sustainable Agricultural Production in the 21st Century

Extended Summaries

Vol. 2 : Voluntary Papers

Natural Resources

NEW DELHI, INDIA

February 14-18, 2000

by compost application and 11 kg ha^{-1} in NPK plot. For wheat the values were 10 kg ha^{-1} by compost and 11.9 kg ha^{-1} in NPK plot.

The soil fertility parameters in terms of available nutrients were recorded in three years trial. It was found that there was significant improvement in organic C, available N, P content in the second and third consecutive years by manuring, compared to city garbage or NPK application.

The soil microbial biomass carbon which denotes the active C-pool improved by compost application @ 25 q ha^{-1} than NPK under recommended dosed or city garbage @ 25 q ha^{-1}. Similar was the phenomenon with soil respiration values which is the indicator of microbial activity. In compost incorporated plots, dehydrogenase enzyme - activity and phosphatase showed higher values than in comparison to city garbage and NPK plots. This indicated the improvement of biological health, this improvement was sustainable because in second and third year the values were at par. Thus, the crop residues, which are not fed to the animals (soybean, mustard straw) or incorporated into the farm, if utilized by converting into compost (enriched) may improve the soil health and crop quality.

References

1. Bhardwaj, K.K.R. and Gaur, A.C. 1985. In : *Recycling of Organic Wastes.* ICAR, New Delhi : p. 104.
2. Hajra, J.N. 1992. *Indian Journal of Agricultural Sciences* **62** (8) : 540.
3. Manna, M. C., Hazra, J.N. Sinha, N.B. and Ganguly, T.K. 1998. *Indian Journal of Agricultural Sciences* **68** (11) : 732

Bioremediation of DDT-Contaminated Soil by the Bacterial Isolate *Pseuomonas aeruginosa* DT-Ctl

H.K. MANONMANI AND A.A. KUNHI

Department of Food Microbiology, Central Food Technological Research Institute Mysore 570 013, India.

DDT, an organochlorine pesticide, used extensively in public health programmes and also in agriculture, is found in significant concentrations in certain soils, natural water sources and in the atmosphere. It is highly persistent compound and finds its way into the food chain. It is not possible to remote this compound directly from food articles. Hence, it is advisable to remove them from contaminated sites viz. soil and water. Bioremediation by microorganism is beneficial as these have the potential to degrade many of the toxic compounds. Optimization of conditions for microbial remediation of contaminated soils is of practical importance, to reduce the remediation time and to save treatment costs.

Here data presented are on the degradation of DDT residues in soil under laboratory conditions by *Pseudomonas aeruginosa* DT-Ctl. This bacterial strain was isolated from a DDT-contaminated soil. The degrading ability of the strain was improved by acclimation with increasing concentrations of DDT through sequential transfers.

Degradation of DDT in shake flasks was studied by growing the culture in a mineral salts medium (pH 7.5) containing the required amount of DDT. Soil bioremediation studies were done by taking 80 gm of sterile soil spiked with required concentration of DDT in plastic cups. After inoculation with required amount of strain DDT-Ctl, cups were incubated at room temperate (25 to 30°C) in a moist chamber. Samples were drawn at regular intervals. Quantitative determination of residual substrate was done by gas chromatography (GC) with ^{63}Ni electron capture detector (ECD) or by thin layer chromatography on silica gel G. For residue analysis, and growth of the strain. All the experiments were done in replicates of nine.

Degradation of 15µg DDT/g sterile soil water indicated that the rates of degradation of DDT increased with increase in the inoculum size (Table 1). A period of 120 h required for the complete degradation of the added DDT with the inocula of 0.5 and 1.0 mg cells/g soil with increased rate of inocule, the period for complete dyxdation of DDT reduced a bit. The inoculum size is a major factor determining the success of biodegradation of a polluting compound. Ramandan et. al. (3) have observed that sufficient inoculum of the p-nitrophenot degrading culture must be added to

Table 1. Effect of inoculum size on the degradation of 15 µg DDT per g soil by *Pseudomonas aeruginosa* DT-Ct-l

Inoculum size (mg dry weight/g soil)	Incubation period (h)	Residual DDT (µg/g soil)
0.5	0	15.00
	24	13.80
	48	9.58
	72	8.33
	96	7.43
	120	0.00
1.0	0	15.00
	24	12.05
	48	11.25
	72	8.34
	96	7.09
	120	0.00
2.0	0	15.00
	24	11.51
	48	8.16
	72	5.67
	96	0.00
5.0	0	15.00
	24	7.96
	48	2.82
	72	0.00
10.0	0	15.00
	24	2.82
	48	0.00
Control (uninoculated)	0	15.00
	24	15.00
	48	14.49
	72	12.05

Table 2. Degradation of different concentrations of DDT in sterile soil by *P. aeruginosa* DT-Ct-l

DDT added (µg/g soil)	Incubation period (h)	Residual DDT (µg/g soil)
5	0	5.03
	24	0.00
10	0	11.22
	24	5.50
	48	2.92
	96	0
15	0	15.35
	24	5.58
	48	3.40
	72	1.21
	96	0
25	0	23.12
	24	15.51
	48	7.25
	72	5.48
	120	3.82
	144	3.46
50	0	48.46
	24	28.18
	48	23.43
	72	21.28
	120	17.57
	144	16.39

natural water, as small populations added failed to survive, because of many other factors.

The soil containing 5, 10, 15, 25 and 50 µg DDT/gm soil were inoculated with induced cells of the strain DT-Ctl at 1.67, 3.33, 5.00, 8.33 and 16.67 mg (dry wt)/g soil, respectively. Complete degradation of 5, 10 and 15 µg DDT/g oil was observed in 24, 72 and 96 h respectively (Table 2). However, 25 and 50 µg DDT/gm soil was only partially degraded (Table 2).

The effect of rice straw and peanut meal (partially defatted, both in powder from @ at 10 mg/g soil) on the degradation water tested. Inoculum used was 5 mg (dry wt) cells/g soil. Retardation of DDT degradation was observed in the presence of co-substrates (Table 3). After 120 h, 68 and 71% of 15µg DDT/gm soil was degraded in the cups containing rice straw and peanut meal, respectively whereas, degradation was complete in the control cups within this time (Table 3).

The degradation of 15 µg DDT/g soil by the strain DT-Ctl (inoculated at 5 mg (dry wt) cells/g soil in non-sterile soil was studied in the presence or absence of co-substrates like rice straw powder or peanut meal powder. (both at 10 mg/g soil). In the absence of co-substrates only 58% of the added DDT was degraded, where as, in the cups with rice straw and peanut meal it was 65 and 68% respectively (Table 4). This lower degradation could be due to the interaction of native microflora with inoculant strain. However, no intermediary metabolites like DDE, DDD etc. were detected in the soil extracts. Singleton *et al.*, (4) has speculated the concomitant formation and breakdown of DDE during the bioremediation of DDT by composting. Aislabie et al. (1) have observed the degradation of DDE to DDD during composting. Nadeau et al (2) have reported the degradation of DDD. However, in our studies DDE present as a contaminant in the DDT sample disappeared completely

Table 3. Effect of co-substrates on the degradation of DDT (15 µg/g) in soil

Co-substrates	Incubation period (hr)	Residual DDT (ug/g soil)
A	0	15.13
	24	12.02
	48	6.31
	72	4.79
	120	4.79
B	0	13.80
	24	11.48
	48	8.91
	72	6.92
	120	4.37
C	0	14.50
	24	5.58
	48	3.40
	72	1.21
	120	0

A : Rice straw powder; B : Peanut meal powder; C : Control (without any co-substrate)

concomitantly with DDT degradation. The degradation of DDT occurred at mesophilic temperatures, while Singleton (4) have indicated increased degradations at higher temperatures. The present study has demonstrated a possibility of bioremedation of DDT-contamination soil. However, a number of parameters have to be studied before optimizing and advocating a viable technology.

Table 4. Degradation of DDT in native and native and in the presence/absence of co-substrate

Co-substrate	Incubation period (h)	Residual DDT (µg/g soil)
Rice straw	0	15.00
	24	11.48
	48	8.91
	72	5.62
	120	5.24
Peanut meat	0	15.00
(inoculated)	24	12.58
	48	10.00
	72	4.79
	120	4.79
Rice straw	0	15.00
powder	24	12.99
(inoculated)	48	11.95
	72	11.62
	120	11.16
Peanut meal +	0	15.00
DDT	24	12.99
	48	11.95
	72	11.62
	120	11.16
Control	0	15.00
(without co-	24	12.60
substrate	48	11.01

References

1. Aislabie, J.M., Richards, N.K. and Bour, H.L. 1997 *New Zealand Journal of Agricultural Research.* **40** : 269-282.
2. Nadeau, L.O; Menn, F, Breen, A and Sayler, G.S. 1994 *Applied and Environmental Microbiology* 60 : 51-55.
3. Ramdan, M.A; El-Tayed, O.M. and Alexander, M. 1990. *Applied and Environmental Microbilogy* 56 : 1392-1396.
4. Singleton, I, Mc Clure, NC, Bentham, R, Xie, P, Kantachote, D; Megharaj, M; Dandie, C; Franco, C.M.M. ades, J.M. and Naidu, R, 1998. *In seeking Agriculture Produce Free of Pesticide Residues, Australian Center for International Agricultural Research Proceedings* No. 85, Canberra, Austraila pp. 334-337.