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BIODYNAMIC MANAGEMENT IN SODIC SOILS

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ABSTRACT

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Experiments were conducted during the year 1999, at Shivri farm of Uttar Pradesh Sudhar Nigam, Lucknow (India) to assess the utility and importance of cow horn in the preparation of cow horn manure (BD 500) in sodic soils. It was observed that the preparation (cow dung) harvested after a period of 6 months from the cow horn was significantly better in terms of physical, chemical and biological properties when compared with the preparation (cow dung) harvested from bull horn, buffalo horn and mud pot. The BD-500 harvested from the pits had a heavy texture with the characteristics of soil. Biodynamic management could be another promising technology that could be employed in bioremediation process of problematic soils.

Key words: Sustainable development, biodynamic methods, soil fertility, compost

INTRODUCTION

Large extents of land in India are affected by salinity and alkalinity due to major degradation processes like salinization, water logging, chemical impairment and desertification (Dagar and Singh, 1994; Dagar *et al.*, 1994). Sodic soil does not contain any significant amount of soluble salts. The detrimental effects these soils have on plants are not only due to the toxicity of Na^+, HCO_3^- and OH^- ions but also due to reduced water infiltration and aeration.
The concept of biodynamic agriculture that aims to produce well balanced plant growth and sustainable soil fertility, by improving the soil structure and nutrient availability, is based on the work of Steiner (1924). It basically involves preparations from ingredients like cow manure, quartz and herbs, which when used on the soil in the form of compost or liquid manure increases the biological activity in the soil.

Biodynamic system involves the addition of compost, green manure, crop rotation and bio-control of pests and diseases. In comparison with the conventional methods, biodynamically managed soils have better physical, chemical and biological properties like soil texture, porosity, water holding capacity and organic matter. Higher microbial activity and earthworm population are also characteristic features of biodynamically managed soils. Biodynamic technology is an eco-friendly technology that has proved to be very effective in farming practices in New Zealand and Europe, and is gradually being accepted in India.

MATERIAL AND METHOD

Experiments were carried out during the year 1999, at Shivri farm of Uttar Pradesh Sudhar Nigam, Lucknow, to explore the significance of biodyanmic preparation-500 (BD-500) as compost inoculum in sodic soils. Usually, biodynamic preparation is prepared in cow horn but the reasons for the required necessity are incomplete. Moreover cow horn being a scarcity in certain parts of India an attempt was made to study the process in cow horn, bull horn, buffalo horn and mud pot. The details are given below:

1. Cow Horn [CWH]
2. Bull Horn [BLH]
3. Buffalo Horn [BFH]
4. Mud pot [MDP]

Three pits of size 1m x 1m x 0.4m each were dug. All the above materials were filled with fresh cow dung obtained from healthy lactating cows and were placed in the pit in vertical position. These were covered with garden soil followed by FYM and hay. Finally, the pit was filled with soil and covered with jute bag kept moist by watering. These were buried for a period of six months and were lifted from the pit after 180 days.

The cattle dung filled in each of the material was subjected to microbial analysis (total heterotrophs, nitrogen fixing bacteria *Nitrosomonas* and *Nitrobacter*, and total fungi). These were also subjected to physical and chemical analysis (pH, Electrical Conductivity, organic carbon, nitrogen, phosphorus, potassium, magnesium, zinc, manganese, ferrous and copper).

Plots each $140m^2$ (7m x 20m) were marked for trial (in triplicate), for cultivation of paddy and wheat. The treatments were as follows:

Control	[C]
Farm yard manure	[FYM]
Chemical fertilizers	[CHE]
Biodynamic preparation-500	[BD]
Vermicompost	[VC]
Vermicompost + Biodynamic preparation-500	[VCBD]

Composite soil samples were taken from the trial plots at pre-sowing stage and post-harvesting stage and were subjected to chemical analysis (pH, electrical conductivity, organic carbon and sodicity).

On harvest of crop, after 100 days, grain yield (kg/ha) was recorded.

RESULTS AND DISCUSSION

Total heterotrophs was maximum in preparation [BFH] followed by [BLH] and [CWH]. *Nitrosomonas* was maximum in preparation [CWH] followed by [MDP] and [BLH]. *Nitrobacter* was maximum in preparation [BLH] followed by [CWH]. Total fungi was maximum in preparation [CWH] followed by [MDP] (Table 1). pH of the preparations [CWH], [BFH] and [MDP] were observed to be 6.04, 6.22 and 6.28 (in the acidic range), whereas that of [BLH] was 7.48 (in the alkaline range). The electrical conductivity was 1.44 dSm^{-1} in [BLH] followed by 3.72 dSm^{-1} in [BFH] and 3.82 dSm^{-1} in [MDP] (Table 1). The organic carbon was 15.19% in preparation [CWH] followed by 13.55% in [BFH] and 13.15% in [BLH]. Total phosphate was 630 ppm in preparation [MDP] followed by 627.2 ppm in [CWH] and 604.8 ppm in [BFH]. Total potassium was 5043 ppm in preparation [MDP] followed by 5033 ppm in [BFH] and 1808 ppm in [BLH] (Table 1).

The quantity of calcium was 3699 ppm in preparation [CWH] followed by 3607 ppm in [BFH] and 2903 ppm in [MDP]. Copper was observed to be 12.3 ppm in [BLH] followed by 6.1 ppm in [MDP] and 5.5 ppm in [BFH]. Ferrous was 51.3 ppm in preparation [CWH] followed by 49.0 ppm in [BFH] and 47.3 ppm in [BLH]. Magnesium was observed to be 4823 ppm in preparation [CWH] followed by 4421 ppm in [BFH] and 4355 ppm in [BLH]. Manganese was 81.5 ppm in preparations [BLH] followed by 77.8 ppm in [BFH] and 71.1 ppm in [CWH]. Zinc was 63.7 ppm in preparation [BLH] followed by 47.4 ppm in [CWH] and 46.8 ppm in [BFH] (Table 1).

Statistical analysis based on the composite index of various preparations indicates that [CWH] preparation is qualitatively better for soil application as a soil enhancer (Table 2).It is evident from table 3 that there is considerable decrease in pH , EC, sodicity suggesting bio-remediation and qualitative improvement of sodic soil, in plots amended with [BD], [VC] and [VCBD]. Maximum wheat yield of 1.8295 tonnes per hectare was recorded in plots amended with [VCBD] while the yield of paddy was maximum of 1.603 tonnes per hectare in plots amended with [VCBD] (Table 4).

Table 1. Nutrient analysis of biodynamic preparations (Chemical and microbial characteristics)

S.No	Name of the parameter	Preparations			
		CWH	BLH	BFH	MDP
1	pH	6.04	7.48	6.22	6.28
2	EC (dSm^{-1})	4.82	1.44	3.72	3.82
3	OC (%)	15.19	13.15	13.55	11.32
4	N (ppm)	370.7	198.9	382.2	401.4
5	P (ppm)	627.2	554.9	604.8	630.0
6	K (ppm)	995	1808	5033	5043
7	Ca^{+2} (ppm)	3699	1561	3607	2903
8	Cu^{+2} (ppm)	4.9	12.3	5.5	6.1
9	Fe^{+2} (ppm)	51.3	47.3	49.0	17.4
10	Mg^{+2} (ppm)	4823	4355	4421	3830
11	Mn^{+2} (ppm)	71.1	81.5	77.8	48.2
12	Zn^{+2} (ppm)	47.4	63.7	46.8	32.0
13	Heterotrophs (CFU)	$1.8x10^5$	$2.5x10^5$	$4.0x10^5$	$1.4x10^5$
14	*Nitrosomonas* (CFU)	$16x10^3$	$3.0x10^3$	$0.2x10^3$	$4.0x10^3$
15	*Nitrobacter* (CFU)	$1.9x10^3$	$4.2x10^3$	$0.5x10^3$	$0.5x10^3$
16	Fungi (CFU)	$8.7x10^4$	0	0	$9.0x10^3$

Table 2. Composite index of biodynamic preparations based on chemical and microbial characteristics

Preparations	CWH	BLH	BFH	MDP
pH	1	3	2	4
Electrical Conductivity	4	1	2	3
Organic Carbon	1	3	2	4
Nitrogen	3	4	2	1
Phosphate	2	4	3	1
Potassium	4	3	2	1
Calcium	1	4	2	3
Copper	4	1	3	2
Ferrous	1	3	2	6
Magnesium	1	3	2	4
Manganese	4	1	2	3
Zinc	2	1	3	4
Heterotrophs	3	2	1	4
Nitrosomonas	1	3	4	2
Nitrobacter	2	1	3	3
Fungi	1	3	3	2
Composite index	35	40	38	47
Rank	1	3	2	4

Table 3. Soil chemical analysis

Amendments	Decrease in pH	Decrease in EC	Increase in OC %	Decrease in Sodicity
[C]	-0.20	-0.28	-0.18	-10.15
[FYM]	0.25	-0.22	-0.01	10.84
[CHE]	0.10	-0.28	-0.11	7.96
[BD]	0.40	0.14	0.09	7.17
[VC]	0.40	0.02	0.30	29.72
[VCBD]	0.30	0.09	0.30	33.82

Table 4. Grain yield (tonnes /ha) (Mean $\pm$ SD)

Amendments	*T. aestivum* (Wheat)	*O. sativa* (Paddy)
[C]	1.113$\pm$0.001	0.913$\pm$0.002
[FYM]	1.314$\pm$0.049	1.038$\pm$0.052
[CHE]	1.558$\pm$0.265	1.310$\pm$0.479
[BD]	1.123$\pm$0.079	1.229$\pm$0.532
[VC]	1.677$\pm$0.028	1.510$\pm$0.052
[VCBD]	1.8295$\pm$0.001	1.603$\pm$0.248

Concern about the environment and the economic and social impacts of chemical or conventional agriculture has led to many thinking groups seeking alternative practices that will make agriculture more suitable. Biodynamic farming practices and systems have shown promise in mitigating some of the detrimental effects of chemical-dependent, conventional agriculture on the environment (Reganold *et al.* 1993).

Unlike the other organic farming methods, biodynamic farming practices require eight specific preparations, made from cow manure, silica and various herbs, to enhance soil quality and plant life (Carpenter *et al.,* 2000).

Experiments were conducted to assess the utility and importance of cow horn in the preparation of cow horn manure (BD-500). It was observed that the preparation (cow dung) harvested after a period of 6 months from the cow horn was significantly better in terms of physical, chemical and biological properties when compared with the preparation (cow dung) harvested from bull horn, buffalo horn and mud pot. This correlates with the earlier works of Pfeiffer (1983) that BD-500 in cow horn has increased levels of micronutrients like calcuim, copper, magnesium, manganese thus stimulate soil micro-life with increase in microflora and humus-forming bacteria.

BD-500 harvested from the pits had a heavy texture with the characteristics of soil. The fermentation process within the cow horn created a very fine humus-like material, which when sprayed on the land in small quantities caused a

definite improvement in soil structure, humus formation, populations of microbes, earthworm activity, supporting deeper root penetration and strong, upright growth in plants (Ismail, 1995; Procter, 1997).

Experiments have been carried out to prepare BD-500 in cow horns at Jawaharlal Nehru Krishi Viswa Vibyala Agricultural University, at Indore, India during 1996 by Shri TGK Menon, and his team (Procter, 1997). Subsequently, trials conducted to study the effect of BD-500 on soil and crops, showed considerable improvement in soil structure, better root development and plant growth with BD-500 application compared with the effects of conventional chemical fertiliser application (Procter, 1997). It correlates with the present investigations carried out.

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