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Influence of composted bagassepith and treated paper mill effluent irrigation on groundnut

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Abstract : A field experiment was conducted at Tamil Nadu Newsprints and Papers Limited Model Farm, Moolimangalam to assess the impact of treated paper mill effluent irrigation and composted bagassepith (BP) on yield and quality of groundnut crop and biochemical properties of soil. Composted bagassepith is identified as an effective ameliorant, which overcomes the ill effects of paper mill effluent polluted soil environments. Bagassepith compost obtained by mixing bagassepith and activated sludge @ 1:1 ratio along with 100% of recommended NPK increased the growth characters, yield attributes, pod yield and quality parameters of groundnut TMV-7 under polluted soil environment due to continuous land application of treated paper mill effluent in light textured soils. The soil bacteria, fungi and actinomycetes populations and the N, P and K uptake were also increased due to combined application of composted bagassepith and effluent irrigation.

Key words: Paper mill effluent, Bagassepith compost, Yield and quality of groundnut and soil properties.

Introduction

Huge quantity of solid wastes and effluents generated from different industries are being dumped into the environment, causing hazards in the long run. The paper and pulp industry is one of the major industries in India that contributes to water and soil pollution. The solid wastes and wastewaters generated from paper mills are rich in essential nutrients that enhance the crop growth. Due to high content of organic matter in paper sludges, composting and land application are attractive alternative for disposal. Organic constituents in these sludges are potential soil conditioners, which improve biochemical properties. In the present study, an attempt has been made to utilize the composted bagassepith (BP) as an amendment for the production of groundnut in paper mill effluent polluted soil environments.

Materials and methods

Field experiment was conducted in FRBD during 1999 at Tamil Nadu Newsprint and Papers Limited (TNPL) Model Farm, Moolimangalam, Pugalur of Karur district. Composting was done by mixing BP, activated sludge (AS) and effluent treatment plant slud (ETPS) at different proportions and the selected treatments were evaluated under paper mill polluted soil using groundnut TMV-7 as a test crop. The details of treatments are given in Table 2. The treatment includes four amendments (composts of BP + AS @ 1:1 ratio, BP + AS + ETPS @ 2:1:1 ratio and BP + AS + ETPS @ 6:1:1 ratio along with FYM as control) and two fertilizer levels (50 and 100% of recommended NPK). The recommended NPK for groudnut was 17:34:54 kg ha^{-1}. The treated paper mill effluent and well water were used as irrigation sources.

Results and Discussion

Application of composted BP and effluent irrigation had a favourable effect on growth parameters *viz.* germination percentage, plant height, Crop Growth Rate (CGR) and Relative Growth Rate (RGR). Effluent irrigation produced taller plants than well water irrigation. Among the amendments, BP + AS @ 1:1 ratio with 100 per cent NPK increased the growth parameters of groundnut and it performed better than FYM with 100 per cent NPK (Table 1). Combined

Treat ments	Germi- nation (%)	Plant height (cm)	Vigour index	CGR (g m^{-2} day^{-1})	RGR (g g^{-1} day^{-1})	No.of pods $plant^{-1}$	Shelling per cent	Seed test wt.(g)	Pod yield (q ha^{-1})	Oil yield (kg ha^{-1})	Crude protein (%)
T_1	89.7	31.6	1163	8.07	0.049	23.2	73.2	45.0	17.5	610	25.8
T_2	90.6	32.2	1192	8.46	0.048	25.7	74.0	45.6	18.9	674	26.7
T_3	90.0	33.4	1249	8.32	0.048	27.2	73.9	45.3	18.4	663	26.5
T_4	90.7.	33.8	1295	8.50	0.047	30.5	75.2	45.9	20.5	757	27.2
T_5	89.4	31.7	1128	8.07	0.049	22.7	72.7	44.5	17.4	602	25.4
T_6	90.0	32.3	1186	8.31	0.048	25.2	73.8	45.5	18.8	667	26.4
T_7	85.1	29.7	928	7.97	0.049	18.5	69.8	42.3	16.4	543	24.7
T_8	87.0	30.5	988	8.14	0.049	22.0	70.9	43.5	17.2	582	25.3
CD (P=0.05)	0.31	0.21	5.6	0.21	0.0001	1.5	0.3	0.28	0.08	3.0	0.16
I_1	88.8	31.2	1070	8.01	0.048	21.0	71.6	42.8	17.0	571	25.0
I_2	89.3	31.9	1212	8.47	0.049	27.8	74.3	44.1	19.3	703	26.5
CD (P=0.05)	0.15	0.11	2.8	0.10	NS	0.8	0.2	0.14	0.04	1.5	0.23

Table 2. Influence of composted bagassepith and paper mill effluent irrigation on soil nutrient status

Treatments	pH	EC (dSm^{-1})	OC (%)	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T_1 - FYM+50% of NPK	7.74	0.79	0.58	147	11.6	216
T_2 - FYM + 100% of NPK	7.69	0.81	0.59	161	11.5	253
T_3 - BP + AS @ 1:1 ratio + 50% of NPK	7.89	0.86	0.41	173	12.5	232
T_4 - BP + AS @ 1:1 ratio + 100% of NPK	7.83	0.87	0.42	194	12.7	273
T_5 - BP + AS + ETPS @ 2:1:1 ratio + 50% of NPK	7.87	0.91	0.58	147	10.8	211
T_6 - BP + AS + ETPS @ 2:1:1 ratio + 100% of NPK	7.80	0.94	0.59	165	11.5	255
T_7 - BP + AS + ETPS @ 6:1:1 ratio + 50% of NPK	7.94	0.81	0.69	139	10.6	202
T_8 - BP + AS + ETPS @ 6:1:1 ratio + 100% of NPK	7.87	0.85	0.69	1.56	11.0	227
CD (P=0.05)	0.02	0.02	0.01	1.10	0.27	0.2
I_1 - Well water	7.57	0.75	0.52	155	10.6	231
I_2 - Effluent	8.11	0.96	0.62	165	12.4	236
CD (P=0.05)	0.01	0.01	0.01	0.50	0.13	0.41

(BP - Composted bagassepith; AS - Activated sludge; ETPS - Effluent treatment plant sludge).

use of treated paper mill effluent along with composted BP might have been provided enough nutrients and better physical and microbial environment, thus improving the soil fertility, which ultimately resulted in better performance of groundnut crop than FYM. Positive effect on growth parameters of sorghum, maize and sunflower due to combined use of paper mill effluent and pressmud was reported by Dhevagi (1996).

Yield attributes and yield

Production of pegs and pods were significantly influenced due to combined use of composted BP and effluent irrigation. The number of pegs and pods per plant were maximum in BP + AS @ 1:1 ratio with 100 per cent NPK under effluent irrigation than rest of the treatment combinations. The number of pegs per plant under BP + AS @ 1:1 along with 50 per cent NPK was comparable with that of FYM with 100 per cent NPK indicated the superiority of composted BP. Production of more pods under composted BP under effluent irrigation might be due to adequate supply of assimilates at the pod formation stage leading to increased number of pods.

Higher pod yield was obtained due to application of BP + AS @ 1:1 ratio with 100 per cent NPK under effluent irrigation (Table 1). Slow and steady release of nutrients during mineralisation of BP compost directly influenced the yield attributes *viz.* number of pods per plant, seed test weight and shelling percentage which in turn increased the pod yield of groundnut in this treatment. Increased pod yield of groundnut due to organic manure application was reported by Loganathan and Krishnamoorthy (1980). Similar results of increased yield in oil seed crops under paper mill effluent irrigation were reported by Dhevagi (1996).

The quality characters *viz.* oil content, oil yield and crude protein were increased

Table 3. Influence of composted bagassepith and paper mill effluent irrigation on soil microflora and nutrient uptake

Treatments	Bacterial population (x 10^5 CFU g^{-1} dry soil)	Fungal population (x 10^4 CFU g^{-1} dry soil)	Actinomycetes population (x 10^3 CFU g^{-1} dry soil)	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
T_1 - FYM+50% of NPK	53.0	23.8	26.5	142.3	14.8	74.7
T_2 - FYM + 100% of NPK	50.2	25.5	27.8	142.7	14.9	74.4
T_3 - BP + AS @ 1:1 ratio + 50% of NPK	57.2	28.4	30.7	144.3	14.9	74.9
T_4 - BP + AS @ 1:1 ratio + 100% of NPK	59.7	29.6	32.0	144.8	15.0	74.9
T_5 - BP + AS + ETPS @ 2:1:1 ratio + 50% of NPK	54.7	25.2	29.1	141.8	14.8	73.5
T_6 - BP + AS + ETPS @ 2:1:1 ratio + 100% of NPK	53.2	26.4	29.1	142.8	14.8	74.3
T_7 - BP + AS + ETPS @ 6:1:1 ratio + 50% of NPK	48.7	25.0	27.4	141.0	14.7	74.0
T_8 - BP + AS + ETPS @ 6:1:1 ratio + 100% of NPK	50.7	25.9	25.3	142.2	14.8	74.5
CD (P=0.05)	0.02	0.14	0.16	0.04	0.02	1.22
I_1 - Well water	44.3	23.0	21.8	140.8	14.2	74.3
I_2 - Effluent	62.5	29.4	35.1	144.7	15.5	74.4
CD (P=0.05)	1.07	2.06	1.67	0.02	0.01	0.61

(BP - Composted bagassepith; AS - Activated sludge; ETPS - Effluent treatment plant sludge)

le to addition of BP + AS @ 1:1 ratio lm FYM either with 50 or 100 per cent ı NPK application. Increased availability of sential nutrients and greater utilization of N ı groundnut crop reflected higher crude protein ntent under effluent irrigation. The increased d yield recorded in BP was ultimately responsible r higher oil yield.

il fertility status

Progressive increase in soil pH and EC as noticed under effluent irrigation (Table 2). he increase in soil pH under paper mill effluent igation was reported by Vanconcelos and Cabral 993).. The EC was increased due to presence soluble salts in the effluent. The effluent o contained higher quantity of organic poly ctrolyte, which bind divalent cations resulting ligher EC under effluent irrigation. Combined plication of BP and effluent irrigation increased il organic carbon and available NPK. Groundnut a leguminous crop, which is capable of king atmospheric N in the root nodules. The fluent irrigation was not deleterious to nodulation either native or inoculated rhizobia. The proved fertility status observed under BP mpost over FYM revealed that BP could ssibly be recycled as an effective amendment paper mill effluent polluted soils.

bil microflora

The bacteria, fungi and actinomycetes pulations were comparatively higher in effluent rigated soils than in well water irrigation able 3). This might be due to the heterotrophic ature of these microbial groups, which would ssimilate various constituents of wastewater nd proliferate in the soil. Humic substances compost also would have contributed for creased level of soil microflora. It is well nown that soil organic matter serves as a ore house of food for soil microbes. Addition f organic matter in the form of compost and rganic matter content of effluent might have nhanced the survival of the soil microorganisms. lameed and Udayasoorian (1999) and Udaya-oorian *et al.* (1999) reported higher microbial opulation in soils irrigated with paper mill ffluent irrigated soils and Hameed *et al.* (1999) bserved increased microbial load due to compost pplication.

Nutrient uptake

Application of composted bagassepith (BP + AS @ 1: 1 ratio) to soil along with continuous effluent irrigation recorded higher N, P and K uptake by plants. Higher nutrient uptake in plants might be due to the greater availability of nutrients in biomanure and effluent added plots in turn reflected in an increased plant uptake of these nutrients. In general, the nutrient uptake was much higher due to increased accumulation. Hameed and Udayasoorian (1999) reported increased uptake of nutrients due to addition of organic amendments especially ETP sludge with treated paper mill effluent irrigation.

The above results suggested that the BP compost obtained by mixing BP + AS @ 1:1 ratio could possibly be used as an ameliorant in paper mill effluent polluted soil habitats.

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