Impact of paper mill effluent, farm yard manure and biofertilizer amendment on soil, growth and bio chemical constituents of *Vigna radiata* (L.)Wilczek

S.SHARMILA, C. INDRANI MANORAMA, P. PREMA MALINI AND P. ABIRAMI

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See end of the article for authors' affiliations

Correspondence to :
S. SHARMILA
Department of Botany, Vellalar College for Women, ERODE (T.N.) INDIA

SUMMARY

Studies on the effect of paper mill effluent in combination with farm yard manure and biofertilizers on soil, growth, biochemical constituents and nodulation of green gram were carried out under potted condition. The growth parameters such as shoot length, root length and biomass were increased upto 50% concentrations of the effluent in combination with FYM and BF. The chlorophyll content was exhibited a slight increase in 25 and 50% concentrations in combination with FYM and BF. The bacterial and fungal populations were also studied. Higher populations were seen at 50% concentration. Root nodulation also showed a significant increase at 50% effluent treatment. All these parameters decreased progressively with further increase in the effluent concentration *viz.*, 75 and 100%.

Key words : Green gram, *Vigna radiata*, Paper mill effluent, Phytotoxicity, F.Y.M., Biofertilizer

Water is the most precious thing in the world. Nowadays, most of our water resources are gradually becoming polluted by addition of huge amounts of sewage, industrial and agricultural effluents. These effluents contain materials with varying properties from simple nutrients to highly toxic substances. The discharge of industrial effluents with varying amounts of pollutants has altered the water quality.

Water requirements to meet agricultural, domestic, industrial and other demands indicate the need for regeneration of waste waters. Discharge of effluents with high load of pollutants into the rivers has been studied extensively. Waste water from paper and pulp industry could successfully be used for irrigation, it would be possible to prevent river water pollution (Oblisami and Palaniswami, 1991). Several studies have been done on the impact of various industrial effluents on various crops (Lakshmi and Sundaramoorthy, 2001; Kaushik *et al*., 2004). The combined use of FYM and BF might provide the soil with need based nutrients and with better physical and microbiological environment, thus improving the soil fertility and productivity. This is in agreement with (Baronia, 2000; Dubey, 2000; Kalaichelvi, 2001; Rajeswari, 2003).

MATERIALS AND METHODS

The treated effluent discharged from Seshassayee Paper and Boards Limited, Pallipalayam, Namakkal District, Tamil Nadu was used as irrigation water in the present study.

Uniform seeds of green gram [*Vigna radiata* (L.)] Wilczek obtained from Department of Pulses, Tamil Nadu Agricultural University, Coimbatore were surface sterilized with 0.1% $HgCl_2$ and washed thoroughly. Earthern pots (30 cm x 20 cm) were filled with field soil and farm yard manure in the ratio of 5 : 1 (FYM : Soil). In biofertilizers, the pot was filled with 5 : 1 ratio (Soil : Biofertilizer). The carrier based inoculum packets of Rhizobium and Phosphobacteria were obtained from Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore. The pots were drenched with different concentrations (25, 50, 75 and 100%) of the effluent and left as such for 1 week. Five replicates were maintained for each treatment. The pots were sown with KM2 variety of green gram at the rate of 10 seeds per pot and watered with the respective effluent concentration.

The plants were uprooted on 20th day after sowing. The measurement for length (shoot and root) and biomass were made. The number of root nodules in the root system was counted and expressed as individuals plant^{-1}. Chlorophyll was estimated as per Yoshida *et al*. (1976). Protein estimation was done following Lowry *et al.* (1951) method. Dilution plate method was employed for the enumeration of microbial population in the soil

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samples. Well water was used for intermittent watering whenever necessary and also used for control set. No pesticide was applied to the plants during the course of the study.

RESULTS AND DISCUSSION

Table 1 reveals the physico-chemical characteristics of soil analysis. The chemical characteristics of the potted soil in combination with FYM and BF amendment were studied one week after the first effluent treatment. The initial pH of 8.00 increased with the increasing concentrations of the effluent and biofertilizer treatment upto 8.55. The EC also increased from 0.14 to 0.36 dsm^{-1}. The other chemical parameters like nitrate, total phosphorus and total potassium of the treated soil registered increased over their controls irrigated with plain water and the increases were linearly related to the concentrations of the effluent. The same trend was observed by other workers (Mishra *et al.*, 1992; Kannapiran, 1995; Sharma and Namdeo, 1999).

Table 2 reveals the rhizosphere (bacterial and fungal) populations of green gram. Lower concentrations (25 and 50%) and BF treatment recorded higher bacterial and fungal populations. The 100% effluent irrigated soil showed decreased bacterial population and overall decrease in fungal population. The FYM and BF amendment generally increased the bacterial and fungal population in all the treatments. This is in agreement with the reports of Hashem Farh (1980), Gupta *et al.* (1998) and Kalaichelvi (2001).

Table 1: Impact of different concentrations of treated paper mill effluent in combination with Farmyard manure and Biofertilizers on the physico – chemical characteristics* of soil samples

Effluent concentration (%)	Parameter				
	pH	Electrical conductivity (dsm^{-1})	Nitrates (mg/kg)	Total phosphorus (mg/kg)	Total potassium (mg/kg)
Control	8.00 c	0.14 f	18.0 f	0.077 d	0.14 d
25% + FYM	8.27 f	0.21 e	48.00 d	0.070 abc	0.18 cd
25%+BF	8.28 f	0.21 e	48.20 d	0.069 cde	0.18 c
50% + FYM	8.42 de	0.22 d	56.60 c	0.070 abc	0.17 e
50% + BF	8.45 d	0.23 d	57.00 c	0.069 bcd	0.17 e
75% + FYM	8.52 bc	0.32 b	61.00 b	0.071 a	0.18 cd
75% + BF	8.54 ab	0.30 c	61.40 b	0.071 ab	0.8 cd
100% + FYM	8.56 ab	0.35 a	64.00 a	0.069 cde	0.19 a
100% + BF	8.55 ab	0.35 a	64.40 a	0.069 abcd	0.19 b

* Based on five determinations for each treatment.
FYM indicates farmyard manure and BF indicates biofertilizers.
Values with same alphabet in each sample do not differ significantly from each other ($P<0.05$).

Table 2 : Impact of different concentrations of treated paper mill effluent in combination with Farmyard manure and Biofertilizers on the rhizosphere bacterial and fungal population of green gram

Effluent concentration (%)	Bacterial population (x 10^6 cfu g^{-1})*		Fungal population (x 10^3 ppg g^{-1}) *	
	Plant Age (Days)			
	0	20	0	20
Control	12.20 c	13.20 d	2.80 d	3.0 defg
25% + FYM	17.20 b	23.40 bc	4.60 c	5.20 bc
25%+BF	18.00 b	23.80 abc	4.80 bc	5.60 abc
50% + FYM	20.80 a	27.40 ab	5.80 ab	6.60 ab
50% + BF	21.40 a	28.00 a	6.20 a	7.20 a
75% + FYM	17.00 b	23.80 abc	2.40 de	4.20 cdef
75% + BF	17.60 b	24.20 abc	2.60 de	4.40 cde
100% + FYM	11.80 c	13.40 d	1.60 ef	2.40 fg
100% + BF	12.00 c	13.60 d	1.80 def	2.50 efg

* Based on five determinations for each treatment.
FYM indicates farmyard manure and BF indicates biofertilizers.
Values with same alphabet in each sample do not differ significantly from each other ($P<0.05$).

Table 3 : Impact of various concentrations of treated paper mill effluent in combination with Farmyard manure and Biofertilizers on the growth, biochemical constituents and nodulation of green gram

Effluent concentration (%)	Shoot length (cm)*	Root length (cm)*	Biomass (g plant^{-1})*	Chlorophyll (µg g^{-1} leaf dry weight)*	Protein (mg g^{-1} leaf dry weight)*	Nodules (Plant^{-1})*
Control	11.38 c	4.10 fghi	0.150 fgh	2.35 d	57.8 cde	8.80 bcde
25% + FYM	12.12 c	4.52 cde	0.206 cd	2.52 bc	56.4 def	10.00 abcd
25%+BF	12.32 bc	4.60 cd	0.222 bc	2.54 abc	56.6 cdef	10.60 abc
50% + FYM	14.22 a	4.90 ab	0.246 ab	2.60 a	62.8 b	12.60 a
50% + BF	14.42 a	5.02 a	0.268 a	2.62 a	66.6 a	13.00 a
75% + FYM	11.66 c	4.34 defg	0.156 fg	2.21 e	58.2 cd	8.00 bcdef
75% + BF	11.78 c	4.40 def	0.174 ef	2.22 e	56.2 ef	8.60 bcde
100% + FYM	9.92 d	3.92 hi	0.120 i	1.91 f	49.4 g	6.00 ef
100% + BF	10.12 d	4.04 ghi	0.143 ghi	1.93 f	47.2 h	6.80 def

* Based on five determinations for each treatment
FYM indicates farmyard manure and BF indicates biofertilizers
Values with same alphabet in each sample do not differ significantly from each other (P<0.05)

The impact of various concentrations of effluent in combination with FYM and BF amendment on the growth, biochemical constituents and nodulation of (green gram) *Vigna radiata* is shown in Table 3. Among the different treatments, 50% concentration and BF treatment supported higher growth. Normally the farm yard manure and biofertilizer treatments enhanced the growth of *Vigna radiata* in all the cases. All the above said parameters decreased with further increase in the effluent concentration *viz.*, 75 and 100%. This is in agreement with Joshi *et al*. (2000).

In the present investigation, pronounced increase in the total chlorophyll and protein content were observed in 25 and 50% effluent concentrations and biofertilizer treatment. Pronounced decreases in the total chlorophyll contents indicate various host tissue injury in the leaves of *Vigna radiata*. The contents of chlorophyll and protein was not adversely affected by the effluent treatment upto 75% concentration in both FYMand BF. The results are in conformity with the findings of Sharma and Namdeo (1999), Baronia (2000) and Kalaichelvi (2001).

The rhizobial nodulation in *Vigna radiata* was not inhibited by different concentrations of paper mill effluent in combination with FYM and BF. The number of nodules were significantly higher in 50% effluent treated plants and biofertilizer treatment. (Rajeswari, 2003 and Gupta, 2005).

Authors' affiliations
C. INDRANI MANORAMA, P. PREMA MALINI AND P. ABIRAMI, Department of Botany, Vellalar College for Women, ERODE (T.N.) INDIA

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