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EFFECT OF PAPER FACTORY EFFLUENT ON SOIL AVAILABLE MACRO NUTRIENTS AND YIELD OF RICE

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ABSTRACT

A study on the environmental pollution due to paper industry was undertaken. The undiluted effluent of the paper mill was dark brown in colour with appreciable quantities of suspended and dissolved solids with high values of BOD and COD. The effluent had slightly alkaline pH and high EC with appreciable quantities of Cl^-, SO_4^{2-}, HCO_3^-, Na^+, Ca^{2+}, Mg^{2+} and variable amounts of micronutrients. Effluent irrigation, in general, increased the available N, K status, whereas P status in soil decreased. Rice husk ash application favoured higher P and K availability in soil. Effluent irrigation did not affect the grain yield. These results indicate the possibilities of the use of effluent for irrigating rice crop without any adverse effect on the growth and yield.

KEY WORDS: Paper factory effluent, Rice husk, Pollution

Pollution of water resources by domestic and industrial liquid waste impairs quality of water. Polluted water is used for irrigation as the effluent water contains plant nutrients which are essential for plant growth. The present paper deals with some effects of paper factory effluent on the agricultural ecosystem.

MATERIALS AND METHODS

The effluent samples from M/s. Sun Paper Mills Ltd., Cheranmahadevi were collected at effluent discharge points during both Kar and Pishanam seasons and analysed for physical, chemical and biological characteristics by adopting standard techniques. Field experiments were conducted during Kar (Jun-Aug) and Pishanam (Nov-Feb) crop seasons of 1995-96 at M/s Sun Paper Mills Ltd., Cheranmahadevi adopting three irrigation sources viz., irrigation with good quality water (M_1), 1:1 diluted effluent (M_2) and undiluted effluent (M_3) two soil amendments viz., rice husk ash (S_2) and gypsum (S_3), normal NPK application (S_1). Totally nine treatment combinations were tried in split plot design with three replications. The soil samples were collected and analysed for chemical constituents and the data subjected to statistical scrutiny.

RESULTS AND DISCUSSION

The physical, chemical and biological characteristics of effluent samples are presented in Table 1.

Colour of the effluent, collected at different periods, was dark brown. The colouring body present in the waste water was organic in nature and contained wood extractives, lignin and its degradation products. This corroborates the earlier findings of Subramaniyam *et al.*, (1984). The unpleasant phenolic odour of the effluent might be attributed to the presence of hydrogen sulphide and other organic sulphides in the effluent which was evident from the higher sulphate content in the effluent sample.

The effluent collected at different periods contained appreciable quantities of total solids and suspended solids, which are in line with the reports of Pushpavalli (1990) and Arumugam (1994). The pH of the effluent was alkaline in reaction. This might be due to the addition of sodium compounds during pulping process. This corroborates the earlier findings of Subrahmanyam *et al.*, (1984), Pushpavalli (1990) and Arumugam (1994). The EC of the effluent used in the present study was above 2.0 dSm^{-1} at different periods. This also falls in line with the works of Pushpavalli (1990) and Arumugam (1994).

Larger amounts of suspended solids could have resulted in high BOD and COD of the effluent samples. Due to the presence of varying quantities of suspended and dissolved organics in the effluent, the organic carbon content ranged from 0.82 to 0.87 per cent. This was in agreement with the findings of Pushpavalli (1990).

Table 1. Physical, chemical and biological characteristics of the paper factory effluents sampled during two seasons

Property	Kar	Pishanam
Physical properties		
Colour	Dark brown	Dark brown
Odour	Phenolic	Phenolic
Total solids mg l^{-1}	1935.00	1899.00
Suspended solids mg l^{-1}	100.00	105.00
Dissolved solids mg l^{-1}	1835.00	1899.00
Chemical properties		
pH	7.48	7.62
EC dSm^{-1}	2.98	3.06
BOD mg l^{-1}	386.00	412.00
COD mg l^{-1}	1096.00	1146.00
Phosphorus mg l^{-1}	13.52	12.15
Ammonical N mg l^{-1}	11.74	11.98
Nitrate N mg l^{-1}	Trace	Trace
Potassium mg l^{-1}	14.66	13.34
Calcium mg l^{-1}	95.40	87.20
Magnesium mg l^{-1}l	1.57	10.32
Sodium mg l^{-1}	362.50	356.50
Carbonates mg l^{-1}	Trace	Trace
Bicarbonates mg l^{-1}	663.70	605.12
Sulphate mg l^{-1}	634.10	651.70
Chloride mg l^{-1}	19.52	17.98
Organic carbon %	0.87	0.82
Micronutrients		
Iron (ppm)	0.58	0.64
Copper (ppm)	0.16	0.17
Zinc (ppm)	0.20	0.22
Manganese (ppm)	0.25	0.28
Biological properties		
Bacteria (10 ml^{-1})	72.20	67.60
Actinomycetes ($x10^4$ ml^{-1})	8.60	8.40
Fungi ($x10^3$ ml^{-1})	11.60	11.40

The present study showed that the effluent contained relatively lower concentrations of NPK. At the same time effluent contained relatively higher concentration of Ca^{2+}, Mg^{2+}, Na^{+}, SO_4^{2-} and HCO_3^{-}. These are in line with the results of Pushpavalli (1990) and Arumugam (1994). The effluent samples contained various amounts of micronutrients like Zn, Cu, Fe, and Mn.

In both the seasons. a low population of actinomycetes and an appreciable number of bacteria were observed.

The results of the effect of various irrigation sources and soil amendments on chemical characters of soil are presented in Table 2. An increase in the available N and K contents of the soils was noticed in the treatments receiving various effluent irrigations. This could be attributed to the addition of nutrients through the effluent which contained an average of 11.86 and 14.00 mg/litre of N and K respectively. Similar trend was reported by Pushpavalli (1990) and Arumugam (1994). The superiority of rice husk ash in increasing the soil available K was also noticed. The enhanced K availability with the addition of rice husk ash compared to other soil amendments used in the present investigation.

Undiluted effluent irrigation registered lower available P over the control. The unfavourable physical environment in the effluent irrigated soil could have reduced microbial activity and thereby reduced mineralization of soil P. The variations in the available P for the irrigation treatments need further investigation. The superiority of rice husk in increasing the soil available P status has been clearly seen. The enhanced P availability for the addition of rice husk ash could be attributed to the higher content of P in the rice husk ash when compared to gypsum and the effective mineralization of organic matter.

The grain yield of rice was not affected by the effluent irrigation. The effluent used for irrigation had an EC around 3.0 dSm^{-1} and a SAR around 9.0 which the rice crop could have tolerated due to its ability to withstand high saline conditions. Moreover as the effluent contained appreciable amounts of N,P,K,Ca, Mg and micronutrients which would have enhanced the crop growth.

The soil amendments used in the presnt investigation produced appreciable variation in grain yield of rice. The use of gypsum recorded lower yield of grain and straw in both the seasons. The reduction in yield at higher dosage levels of gypsum might be due to its hindrance to the availability of nutrients to crop.

Table 2: Effect of paper factory effluent on available NPK and yield in rice

Treatments		Available N kg ha^{-1}		Available P kg ha^{-1}		Available K kg ha^{-1}		Grain yield kg ha^{-1}		Straw yield kg ha^{-1}	
		Kar	Pishanam	Kar	Pishanam	Kar	Pishanam	Kar	Pishanam	Kar	Pishanam
Mean	M_1	378.0	382.0	43.3	74.7	95.0	163.0	6861.0	5306.0	8575.0	6627.0
	M_2	372.0	375.0	46.0	71.7	98.0	192.0	6750.0	5178.0	8426.0	6471 0
	M_3	381.0	387.0	40.0	73.7	116.0	256.0	7000.0	5283.0	8747.0	6596.0
	S_1	369.0	375.0	39.0	65.9	91.0	165.0	7117.0	5361.0	8893.0	6693.0
	S_2	377.0	383.0	47.0	81.2	133.0	273.0	6989.0	5417.0	8726.0	6769.0
	S_3	385.0	387.0	43.0	72.7	85.0	173.0	6506.0	4989.0	8128.0	6233.0
CD (P=0.05)											
	M	NS	NS	3.3*	NS	NS	NS	NS	NS	NS	NS
	S	NS	NS	NS	7.8**	22*	32**	489*	393*	607*	383*
	M at S	NS	NS	NS	NS	NS	78**	NS	NS	NS	NS
	S at M	NS	NS	NS	NS	NS		NS	NS	NS	NS

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METHOD OF SOWING AND WEED MANAGEMENT IN IRRIGATED SESAME IN RICE BASED SEQUENCE

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ABSTRACT

An experiment was conducted in a farmer's field with clay loam soil in Cauvery delta zone of Tiruchirapalli district during summer '93 and summer '95 to identify the effect of method of sowing and weed management practices on weed characters, growth and productivity of irrigated sesame grown in rice based cropping sequence. Sowing sesame early in summer (February) immediately after rice, in lines with a spacing of 30 cm x 30 cm with pre-emergence application of pendimethalin at 0.75 kg ha^{-1} followed by one hand weeding on 30 DAS reduced the population of broad leaved weeds and grasses,reduced the weed dry matter and enhanced the crop growth, yield attributes and yield of sesame crop. This treatment also recorded the highest gross income of Rs. 19775, net profit of Rs 13750 and benefit cost ratio of 3.28.

KEY WORDS: Method of sowing, Weed management, Sesame

In Tamil Nadu sesame is cultivated in an area of 0.15 million ha with a production of 0.05 million tonnes. Out of the total area, Cauvery delta zone accounts for 35.3 per cent. In this zone 61.0 per cent of the farmers are cultivating sesame in rice fallow in different rice based cropping sequences depending upon the resources and also to meet the home need and cash flow. The major production constraints in sesame are weed menace, labour scarcity, lack of adequate plant population due to improper method of sowing and poor economic resource of the farmers. Method of sowing is