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EFFECT OF ORGANIC MATTER AND PHOSPHORUS ON THE PERFORMANCE OF OAT IRRIGATED WITH INDUSTRIAL EFFLUENT

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ABSTRACT

A field experiment (2002 to 2003, 2003-2004) was conducted to study the effect of organic matter and phosphorus on the performance of oat irrigated with industrial effluent. Green foliage and dry matter yield of oat reduced significantly by 93.4% and 35.6 percent with irrigation by 100% effluent than those irrigated with canal water. The maximum yields of oat were noted under irrigation with canal water in both crop seasons. The results suggested that the addition of phosphorus and organic matter proved to be more effective in enhancing the yields of oat crop. Green foliage and dry matter yields of oat were improved by 168.2 and 166.9% with interactive effect of organic matter and effluent over unfertilized and no effluent as such, respectively.
Additional Keywords: Organic matter, phosphorus, oat, industrial effluent

INTRODUCTION

Water is most important constituent of life supported system for irrigation; industrial and domestic needs in particular and disposal of waste in general (Singh & Singh, 2005). Most of the water bodies pollute ponds, lakes, rivers, sea, ocean due to industrial growth, urbanisation and other anthropogenic activities. Many rivers of the world receive heavy flux of sewage, domestic waste, industrial effluents, agricultural waste etc. which contain substantial amount of plant nutrients to highly toxic chemicals like lead, mercury, zinc, copper, cadmium, chromium, sodium etc. (Bansal et al. 1992) to lesson the deleterious effects of industrial waste water application a suitable treatment is generally recommended. However, in India industrial waste is used as such or after dilution with well water (Kannan and Oblisami, 1990, Datta and Boissya 1997) has been examined for irrigating various agricultural crops. The practice is likely to result in an accumulation of even the essential micro nutrients in soils to such levels which may effect plants growth and bioavailability of each other. In India most of the primary effluents are discharged directly to sewerage system without much of monitoring and may create all the problems in the soils and plants. Addition of phosphorus (Sung et al. 1977) and organic matter (Miller et al. 1983) proved more effective in reducing the concentration of heavy metals in plant and soil. Keeping in view of the above importance, the objective of present study was to asses the response of organic matter and phosphorus on the performance of oat irrigated with industrial effluent.

MATERIAL AND METHOD

A field experiment was conducted in micro plots (1x 1m) at the research farm of R.B.S. College, Bichpuri Agra during rabi seasons of 2002-03 and 2003-04. The soil of experimental site was sandy loam in texture. The physico-chemical properties of the soil are given in Table 1. The experiment was laid out in a split plot design having irrigation in main plots and organic matter and phosphorus in sub plots with three replications. The treatments consisted of four levels of each of organic matter (0, 10, 20 and 30 t ha^{-1}) and phosphorus (0, 50, 100 and 200 kg P_2O_5 ha^{-1}) and three levels of effluents (best available water, effluent as such and 50% dilution). The effluent had pH 7.82, electrical conductivity 2.68 dSm^{-1}, total solids 3232.0 mg /L, total hardness/ 472.05 mg/L, carbonate 98.5 mg/L, bicarbonate 150.6 mg/, chloride 13.20 mg/L, phosphate 0.03 mg/L, sulphate 3.0mg/L, COD 172.0 ppm, BOD 410.5 ppm, SAR 7.82, NH_4–N 13.80 mg/L and NO_3-N 0.029 mg/L. Each micro plot was separated by polyethylene sheet up to 60 cm depth. Between one and other micro plot a bund of half meter was left. The doses of phosphorus and organic matter were

added as per treatments. The oat variety kent-1 was sown on Nov. 2002 and 2003. Irrigating with effluents collected from W.S. factory raised the crop. At harvest, green foliage and dry matter yield was recorded.

Table 1: Physico-chemical properties of experimental soil

Particulars	Value
Mechanical composition	
Sand (%)	60.85
Silt (%)	21.28
Clay (%)	17.87
Textural class	Sandy loam
PH	8.10
Organic carbon (%)	0.36
$CaCO_3$ (%)	0.50
Total nitrogen (%)	0.05
Available N (ppm)	10.00
Total P (%)	0.07
Available P (ppm)	9.20
Total Cd (ppm)	1.20
Available Cd (ppm)	0.01
Total Cr (ppm)	46.00
Available Cr (ppm)	0.11
Total Pb (ppm)	26.00
Available Pb (ppm)	0.67

Quality of effluent: The pH of effluent was alkaline owing to the use of caustic soda and carbonate in industry. It had considerably high EC indicative of soluble salts, but the SAR was low. The effluent also contained substantial amounts of NH_4-N, NO_3-N, phosphate and sulphate.

Green foliage yield: Data on green foliage yield are presented in Table 2. Decrease in green foliage yield of oat was almost regular with increasing level of effluent and green foliage yield under undiluted and 50% diluted effluent was 93.4 and 35.6 percent of the untreated (canal water) soil. The reduction in green foliage yield at higher concentration of effluent could be due to addition of higher amounts of soluble salts, carbonate and bicarbonate causing injurious effect on roots of sensitive oat plants. Reductions in green foliage yield of wheat and maize due to use of effluent from industries has reported by Bansal et al. (1992) and Singh and Singh (2005), respectively. Levels of organic matter had significant effect on the green foliage yield. Among the various levels of organic matter, 30 t ha^{-1} produced the highest yield of oat which was closely followed by 20 t ha^{-1}. The minimum green foliage yield of oat was recorded at control. The mean increases in green foliage yield due to 10, 20 and 30 t ha^{-1} organic matter over control were 16.3, 32.3 and 37.7 percent respectively. Narwal and Sidhu (2001) also reported similar results. The levels of P significantly influenced the green foliage yield of oat. The application of phosphorus increased the green foliage yield of oat by 2.2, 6.0 and 8.8% with 50, 100 and 200 kg P_2O_5 ha^{-1}, respectively over control during 2002-2003. The corresponding increases in yield during 2003-2004 were 1.2, 2.9 and 4.8 percent. Application of P in deficient soil increases the concentration of phosphorus in soil solution and ultimately helps in vigorous root development and over all better development of plants. This ultimately resulted in an increase in green foliage yield. These findings are in agreement with those of Gupta et al. (1997).

Table 2: Effect of industrial effluent, organic matter and phosphorus on green foliage & dry matter yield (q ha^{-1}) of oat

Treatments	Green foliage yield			Dry matter yield		
	2002-03	2003-04	Mean	2002-03	2003-04	Mean
Effluent levels						
BAW (canal water)	280.3	281.4	280.9	30.6	30.8	30.7
Effluent as such	141.1	149.3	145.2	15.3	15.4	15.3
Effluent after 50% dilution	208.3	206.3	207.2	23.1	23.3	23.2
SEm±	1.9	2.0	2.1	0.08	0.30	0.20
CD at 5%	6.0	6.1	6.4	0.30	1.01	0.60
Organic matter (t ha^{-1})						
0	174.4	174.9	174.7	19.7	19.9	19.8
10	199.1	207.4	203.2	22.0	22.2	22.1
20	231.0	231.0	231.2	24.7	24.8	24.8
30	235.1	236.2	205.6	25.6	25.7	25.7
SEm±	2.3	2.3	2.4	0.3	0.3	0.2
CD at 5%	6.9	7.0	7.4	0.9	0.9	0.7
Phosphorus levels (kg ha^{-1})						
0	200.9	207.7	204.3	21.8	22.0	21.8
50	207.3	210.3	208.8	22.3	22.4	22.4
100	213.0	213.8	213.4	23.4	23.5	23.4
200	218.5	217.6	218.0	24.6	24.7	24.6
SEm±	2.4	2.4	2.6	0.3	0.3	0.2
CD at 5%	6.8	6.4	7.4	0.8	0.9	0.7

Dry matter: A gradual reduction in dry matter production due to effluent application, significant at 50% and higher concentration, was observed (Table 2). The dry matter yield reducing by 100.0 and 99.8% with 100% effluent over no effluent (canal water) application in first and second year of study, respectively. Such adverse effect of effluent on dry matter yield may be attributed to salinity and toxicity effects. Singh and Singh (2005 reported similar results in maize irrigated with paper mill effluent. Application of organic

matter significantly increased the dry matter yield of oat over control during both the years. Dry matter yield increased by a mean of 29.9 and 29.1% owing to 30 t FYM ha^{-1} over the control in first and second year, respectively. Such a conducive effect of organic matter could be attributed to the supply of nutrients through mineralization and improvement of physico-chemical properties of soil. Results clearly indicated that dry matter yield of oat increased significantly with increasing levels of phosphorus. The mean dry matter yields were recorded to be 2.7, 7.3 and 12.8% with the phosphorus levels of 50, 100 and 200 kg P_2O_5 ha^{-1} respectively. The observed improvement in yield under P application might be attributed to improved root environment. Phosphorus plays an important role in formation of roots their proliferation and improvement in their functional activity.

Table 3: Interaction effect of industrial effluent and organic matter levels on green foliage and dry matter yield (q/ha) of oat

Effluent levels	2002-03				2003-04			
	Organic matter (t ha^{-1})							
	0	10	20	30	0	10	20	30
Green foliage yield (q ha^{-1})								
BAW (canal water)	231	265	309	316	231.1	256.9	311.6	317.0
Effluent as such	115	135	156	158	121.0	158.0	158.0	160.0
Effluent after 50% dilution	178	197	127	231	173.0	198.0	223.0	232.0
SEm±		6.0				6.5		
CD at 5%		16.0				18.5		
Dry matter yield (q ha^{-1})								
BAW (canal water)	25.7	28.8	33.3	34.5	25.9	29.1	33.4	34.9
Effluent as such	12.9	14.6	16.6	17.2	13.1	14.7	16.8	17.3
Effluent after 50% dilution	26.6	22.6	29.3	24.9	20.9	22.9	24.4	25.2
SEm±		0.75				0.50		
CD at 5%		2.25				1.75		

Interaction: The interaction effect of the levels of effluent and organic matter was found to be significant with respect to green foliage and dry matter production during both the years (Table 3). The combined application of 30 t FYM ha^{-1} and no effluent recorded significantly higher green foliage and dry matter yield of oat as compared to other treatments. It might be primarily due to improvement in physico-chemical properties of soil with FYM and secondly, due to higher availability of nutrients by plants through their well developed root system. In interaction effect, maximum dry matter yields (34.5 and 34.9 q ha^{-1}) were recorded in treatment combination of 30 t FYM per hectare and canal water. Application of FYM, which attributed to the increased better root development and growth of the plants thus resulting in increased dry matter yield. Thus, neither the use of organic matter alone nor the sole use of effluent may be adequate in maintaining sustained higher productivity under irrigation with industrial effluent. Sharma and Kansal (1984) reported similar results in maize and spinach.

Thus, it could be concluded from the study that irrigation with industrial effluent even after 50 % dilution is likely to reduce the yield of oat. Addition of organic matter and phosphorus had beneficial effect on the performance of oat crop.

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