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STUDY OF URMUL DAIRY EFFLUENT AND ITS EFFECT ON SEED GERMINATION AND SEEDLING GROWTH OF SOME RABI CROP PLANTS

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The present investigation deals with the effect of dairy effluent on seed germination and seedling growth of some rabi crop plants *viz.* wheat, oat and rizka. The dairy effluent is slightly alkaline and contains large amount of suspended and dissolved solids resulting in high BOD and COD. It is noticed that wheat plant is more tolerant to pure effluent than oat and rizka.

Key words : Dairy effluent; Germination; Seedling growth; Biomass.

Introduction

The large amount of industrial and dairy effluent discharged by rapid industrialization in the developing countries is creating a serious pollution problem and health hazard. Western Rajasthan is a major part of "Thar Desert". The soil of this area is sandy, alkaline and poor in nutrients. The availability of water is generally scarce due to low and erratic rainfall. The ground water is highly saline and deep, water problem becomes worse during the dry months of the year. In such a situation it becomes quite imperative to use available and alternative source of water to raise commercial and fodder crops for increasing pressure of cattle population. Urmul Dairy, Bikaner, is the biggest dairy in western Rajasthan, running since 1971. At present its effluent discharge is 4–5 lakh litres per day, which is wasted without any treatment.

Material and Methods

The test crops wheat (*Triticum aestivum* linn.) Var. H. D. 2329, Oat (*Avena sativa* linn.) Var. Kant. and rizka (*Medicago sativa* Linn.) Var. Barah Masi, were taken for experiments. Laboratory experiments were carried out in petri plates of 15 x 2 cm size. The crude effluent was collected from Urmul Dairy, Bikaner, Rajasthan. Two concentrators of the

effluent were used. The pure effluent was diluted (50% v/v) with ordinary tap water in the ratio of 1:1. Treatment with ordinary tap water was taken as control. In each treatment there were four replicates and 25 seeds were placed on sterilized filter papers in petri plates. The experiment was done under laboratory condition of diffused light and day temperature 23.5±2°C.

The germination and seedling growth were observed upto 3 days and 10 days, respectively. Weeding out of seedlings was done and only 10 seedlings were left in each replicate. After 10 days, ten seedlings selected at random from each replicate were studied for their growth and biomass (fresh and dry) of shoot and root. All the data were statistically analysed (Snedecor and Cochran, 1967). The tap water and the dry effluent were analysed for physicochemical characteristics by standard method of A. P. H. A. (1966).

Result and Discussions

Observations were made as follows :

(a) *Physico-chemical characteristics of the effluent*—Urmul Dairy effluent was slightly alkaline with pH 8.45(Table 1). It contains large amount of total solids (2589 mg/l) and dissolved solids (2005 mg/l) resulting in high BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand), being above maximum recommended tolerance I.S.I. limit. The basic nutrients, ammonical nitrogen (0.15 mg/l), chloride (145 mg/l), phosphate (0.20 mg/l) nitrate nitrogen (0.01 mg/l), sulphate (0.055 mg/l) and metalic components, iron (0.02 mg/l) in effluent were maximum as recommended by tolerance limit of I. S. I. (1974, 1977) values. The E. C. value was 1.68 m. mhos/cm showing low salinity. Gupta (1986) while classifying quality of irrigation water, reported water of low salinity (E. C. 1.5-3.0 m. mhos/cm) can be used for most of semi tolerant and tolerant crops.

(b) *Germination*—The 100% seed germination in wheat treated with diluted and undiluted effluent was at par with that of its control (Table 2). Similar observation was made by Bhumbla and Singh(1965) that barley is most tolerant to E.C. levels of 2, 4, 8, 12 and 16 m. mhos/cm and followed by wheat, sugarbeet, berseem, mustard and gram. Thus wheat was not affected by the effluent with E.C. 1.68 m. mhos/cm. In oat the germination was inhibited in undiluted effluent whereas diluted effluent did not effect the germination as compared to control. Mehrotra and Gangwar (1964) observed that pea, gram, masoor, berseem, oat, linseed and mustard are more sensitive to salinity and alkalinity condition. The response of rizka seeds was inhibitory in diluted and undiluted effluent and

Table 1 : Physico-Chemical Characteristics of effluent and water.

Characteristics	Effluent value	Water (Control) value	Maximum Recommended Concentration	Reference
Turbidity	0.045	0.010	—	—
Appearence	High Turbid	Clear	—	—
Colour	Milky	Colourless	Should be absent	I.S.I.: 2490
Odour	Unpleasant	Unpleasant	Odourless	I S.I.: 2490
pH	8.45	7.55	5.5–90	I.S.I.: 2296
E. C.*	1.68	1.35	—	—
Total Solids*	2589	1504	2700	—
(a) Total Suspended Solids*	586	139	600	I.S.I.: 3306
(b) Total Dissolved Solids*	2005	1365	2100	I S.I.: 3307
BOD* (5 days 20°)	1140.0	10.0	30	I.S.I.: 2490
COD*	3800.0	20.0	250	I.S.I.: 2490
Oil and Corease*	58	2	10	I.S.I.: 2490
Ammonical Nitrogen*	0.15	0.06	—	—
Nitrate Nitrogen*	0.14	0.04	—	—
Nitrate Nitrogen*	0.01	Traces	—	—
Phosphate* (as P)	0.20	0.02	—	—
Chloride* (as Cl)	145	55	600	I.S.I.: 2296
Total Alkalinity*	510	212	—	—
Calcium hardness*	76	67	600	I.S.I.: 1975
Magnecium hardness*	14	44	—	—
Sulphate* (as SO_4)	0.055	0.25	—	—
Iron*	0.02	0.01	1.0	SR Vol. 20 (March, 1983)
Metals*	Nil	Nil	—	—

*=All values in mg/l, — = Values could not be available.

Table 2. Effect of Effluent on Seed germination and Seedling growth

Parameters / Treatments	Percentage Germination	No. of lateral roots	Length in cm/plant			Biomass in g/plant			
			Leaf	Shoot	Root	Shoot		Root	
						Fresh	Dry	Fresh	Dry
(a) Wheat (*Triticum aestivum* Linn.) Var. H. D. 2329.									
Water (Control)	100	5 ±0.774	8.94 ±0.520	8.78 ±0.616	10.9 ±1.343	0.0810 ±0.0050	0.0108 ±0.0037	0.1212 ±0.0124	0.0210 ±0.0035
50% Diluted Effluent	100	6 ±1.155	10.46** ±0.540	10.26* ±0.606	14.06* ±2.240	0.0916 ±0.0171	0.0128 ±0.0028	0.1460 ±0 0045	0.0252 ±0.0071
Undiluted Effluent	100	6 ±1.0	10 86** ±0 672	10.42* ±1.149	7.92* ±2.330	0.1166 ±0.0143	0.0170 ±0 0026	0.0922 ±0.0185	0.0128 ±0.0060
(b) Oat (*Avena sativa* Linn.) Var. Kant.									
Water (Control)	97 ±4.330	4 ±1.0	8.49 ±0.991	8.38 ±1.248	8.80 ±1.603	0.0856 ±0.0221	0.0130 ±0.0036	0.0810 0.0110	0.0138 0.003
50% Diluted Effluent	97 ±2.5	5 ±1.414	8.62 ±1.143	8.46 ±1.848	6 62** ±1.832	0.0975 ±0.415	0.0140 ±0.0130	0.084 ±0.0094	0 0160 ±0.0017
Undiluted Effluent	84* ±7.828	6** ±1.581	7.54** ±1.047	7.22 ±2.090	6.52* ±3.326	0.0802 ±0.235	0.0124 ±0.0025	0.086 ±0.0186	0.0160 ±0.0195

Table 3. Effect of Effluent on Seed germination and Seedling growth of *Madicago sativa* Linn. (Var. Barah Masi)

Parameters / Treatments	Percentage Germination	No. of Plant Parts/Plant			Length in cm/plant		Biomass in g/plant			
		Cotyledon leaves	Folliage leaves	Lateral roots	Internode	Root	Shoot Fresh	Shoot Dry	Root Fresh	Root Dry
Water (Control)	98 ±3.464	2 ±0.939	3 ±1.095	2 ±1.183	1.30 ±0.535	5.18 ±2.949	0.0270 ±0.0050	0.0026 ±0.0050	0 0128 ±0.0048	0.0008 ±0.0006
50% Diluted Effluent	93* ±5.916	2 ±0.747	4 ±3.714	1** ±1.01	1.60 ±0.636	6.32 ±2.177	0.0352 ±0.0058	0.0040 ±0.0010	0.0150 ±0.0 45	0.0018 ±0.0316
Undiluted Effluent	89* ±7.681	2 ±1.01	3 ±0.774	1** ±1.121	1.44 ±0.569	5 5 ±2.032	0.0330 ±0.0077	0.0036 ±0.0190	0.0140 ±0.0061	0.0011 ±0.0007

± : Standard Deviation;
* : Significant difference from control at p=0.01;
** : Significant difference from control at p=0.05.

germination percentage decreased with increase in concentration of the effluent. Thus rizka was noticed to be more sensitive to the effluent concentration than wheat and oat. Similarly, Handas (1976) reported that high T. D. S. value would retard the seed germination by enriching the salinity and conductivity of the solutes being absorbed by seed prior to germination.

(c) *Growth*—In wheat, the shoot growth along with leaves were stimulated (10.42 cm and 10.86 cm, respectively) by undiluted effluent but the root length (7.92 cm) was retarted (Table 2). The lateral root branchings were increased. The stimulatry effect on the shoot and leaves may be due to sufficient amount of basic nutrient and low salinity in the effluent. Panda *et al.* (1979) and Kumar and Singh (1979) also reported higher grain yield under different levels of salinity in some varieties of wheat. In oat and rizka the diluted effluent favoured the growth of root and shoot and undiluted inhibited the same (Table 2 and 3). Mehrotra and Gangwar (1964) reported oat, to be sensitive to higher alkalinity and salinity. Rajaram et al. (1988) observed inhibitory effect on seedling growth in cowpea. Reddy (1982) reported green gram to be sensitive at lower (2 m.mhos/cm) levels of E.C. It might be due to high amount of T. D. S., alkalinity and low E. C. value responsible for the inhibition of subsequent seedling growth as the salt contents effluent would disturb the osmatic relation of seed with water and this reduce the amount of water absorbed.

The biomass (fresh and dry) of shoot and root in all test crops were in correlation with their growth and lateral root branching (Table 2 and 3).

From above investigation it could be concluded that wheat is more tolerant to pure effluent than oat and rizka. Therefore, in wheat the effluent can be used as such for irrigation whereas for oat and rizka, it is proposed in diluted form. Thus the effluent can be utilized without recycling and the pollution hazard caused by stagnation can be minimised.

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References

A. P. H. A. 1966, Standard methods for the examination of water and waste water (including bottom sediments and sludes). 12th ed. Rep., New York.

Bhumbla D R and Singh N T 1965, *Sci. Cult.* **31** 96

Gupta I C 1986, *Curr. Agri.* **10** (1-2) 1

Handas A 1976, *J. Exp. Bot* **27** 480

Indian Council of Medical Research 1975, Manual of standards of quality for drinkings water supplies. II Ed. Special Rep.

Indian Standard Institution 1974, Tolerance limits for inland surface waters subjects to pollution (first rivisions) No. 2296, New Delhi.

Indian Standard Institution, 1974, Tolerance limits for industrial effluent discharged into inland surface waters part-I (first revisions) No. 2590, New Delhi.

Indian Standard Institution 1974, Tolerance limits for industrial effluents discharge into public sewers (first revisions), No. 3306, New Delhi.

Indian Standard Institution 1974, Tolerance limits for discharge of industrial effluents on land for irrigation. No. 3307, New Delhi.

Kumar V and Singh V P 1979, *Curr, Agric.* 3 103

Mehrotra C L and Gangwar B R 1964, *Journal Indian Soc. Soil Sc.* **12** 75

Panda S C, Singh N and Mishra B 1979, *Curr. Agric.* 3 63

Rajaram N, Manoharan M and Janardhanan K 1988, *Curr. Sci* 57 559

Reddy G V 1982, *Curr. Agric.* 6 183

Snedecor G W and Cochran W G 1967, *Statistical Methods* 6th Ed. Oxford & I B H Publishing Co., New Delhi.