research article | International Journal of Plant Sciences, (January to June, 2010) Vol. 5 Issue 1 : 170-173

Soil irrigation effect of sugarcane industrial effluent on changes of level of chlorophyll, growth and yield of *Triticum aestivum* cv.PBW-226

PARMILA RANI AND SANJEEV KUMAR

Accepted : October, 2009

SUMMARY

Effect of periodic watering with different concentration of sugarcane industrial effluent on different parameters such as length (root, shoot and spike), No. of leaves, no. of grain/ spike, leaf area and chlorophyll level of *Triticum aestivum* cv.PBW-226 had been assessed. The effluent reflected promotory effect of different concentration of sugarcane industrial effluent on chlorophyll level, growth and yield of plant.The experiment suggested that effluent can be used as fertilizer after dilution.

Key words : Sugarcane industrial effluent, Irriation, Chlorophyll level, Growth and yield, *Triticum aestivum*

Needless to say that the nature of soil is dependent on the quality of water entering into it.The physiochemical and biological studies of soil polluted with different industrial effluents revealed great change in the characteristics of soil and wild vegetation (Arora *et al*., 1973 and1974; Davis and Jaksnow, 1975; Tripathi, 1978; Bhattacharya and Das, 1980; Olademeaje *et al*., 1984). Sugar mill effluent have altered the physical and chemical composition of soil due to seepage absorption (Kumar, 1999).

Several workers suggested that industrial effluent might be used as a liquid fertilizer only for certain crops after proper dilution with water. The utilization of industrial effluents for irrigation of crop plants is one of the highly beneficial propositions of waste disposal (Day, 1973, Pound and Crites, 1973, Bauwer and Chaney, 1974).The sugar mill based distillery effluent has become a challenge for environment protection. It is necessary to deal with this effluent eco-friendly and cost-effectively. The sugar mill based distillery effluent was used to mix with other fertilizers to form liquid fertilizer, which was applied to sugarcane by Qi-zhan Tang *et al.* (2006).Kumar (1999) studied the effect of carbonaceous sugar mill effluent on root/shoot ratio of *Hordeum vulgare* IB-65.Patil *et.al*.(2001) noted the effect of sugar industry effluents on germination and growth of rabi monocotyledon crop *Triticum aestivum* as well as *Kharif* dicotyledon crop *Phaseolus vulgaris*.

Workers have studied the effects of industrial effluents on different plant parameters (Shantamurty, and Rangaswamy 1979, Shinde and Trivedy 1982, Sahai *et.al.* 1983, Banerjee and Ray *et.al*., 1983, Somasekhar 1985, Bhatnagar *et.al*. 1986).The present experiment has been planned to know the sensitivity level of the crop(*Triticum aestivum* cv.PBW-226) against different concentration of sugarcane industrial effluent on different parameters and and to know the nature of effluent wheather beneficial or harmful for the crop.

Correspondence to:
PARMILA RANI, Department of Botany, D.A.V. (P.G.) College, MUZAFFARNAGAR (U.P.) INDIA
Authors' affiliations:
SANJEEV KUMAR, Department of Botany, D.A.V. (P.G.) College, MUZAFFARNAGAR (U.P.) INDIA

MATERIALS AND METHODS

For the study of plant growth and yield development plant cv. (*Triticum aestivum* cvs.PBW-226) was grown in pots and irrigated with selected doses of sugarcane industrial effluent with control (*i.e.* from 10% to 100%) upto the development of yield. 20 seeds of selected plants were sown with proper space in polythene bags which bear appropriate weight of soil and irrigation of plants were carried out by 100 ml solution at regular intervals. Plants were subjected for detailed study of measurement of different plant parameters which are length, number, yield and leaf area of different plant parts.

Chlorophyll a,chlorophyll b and total chlorophyll:

For this fresh green leaves were plucked from the plants fornightly in morning hrs. Chlorophyll content was measured according to Arnon (1949). For this 50 mg of fresh leaves was homogenized with 80% acetone(80 ml acetone+20 ml distilled water) and a pinch of sodium bicarbonate.The homogenate was centrifused at 5000 rpm for 5 minute and make appropriate final volume with 80% acetone.The absorbance was recorded at 663nm and 645nm by spectrophotometer.The amount of chlorophyll a, b and total chlorophyll was calculated according to following formula-

Chlorophyll a = (12.7xA663)-(2.69xA645)

Chlorophyll b = (22.9XA645)-(4.68xA663)
Total chlorophyll = (20.2xA645)+(8.02xA663)

RESULTS AND DISCUSSION

Plant was sown in field and treated with different doses of sugarcane industrial effluent (from 10% to 100%).The treatment was given in the form of watering regularly until the crop was matured and different data of plant growth was collected, analysed and represented in tables.These observations are mentioned below-

Triticum aestivum cv.PBW-226, show promontory results when treated with sugarcane industrial effluent as studied in Table 1 and Fig. 1a, 1b and 1c. All doses show promotory effects in length of root, shoot and fruit. Out of all promotary doses, dose 20 % show maximum promotion in comparision to other doses. In this dose, length of root, shoot and fruit is 170%, 130% and 129% of control, No. of leaves, seed/fruit is 117% and 168%, leaf area is 168% of control, respectively, whereas doses 40% to 60% show inhibitory effects on no. of seed/spike *i.e.* 75% of control.

After the study of physiological impact on plant growth in terms of root, shoot and leaf growth, biochemical component *i.e.* chlorophyll a, b and total chlorophyll, was analysed in leaf after treatment of selected doses *i.e.*

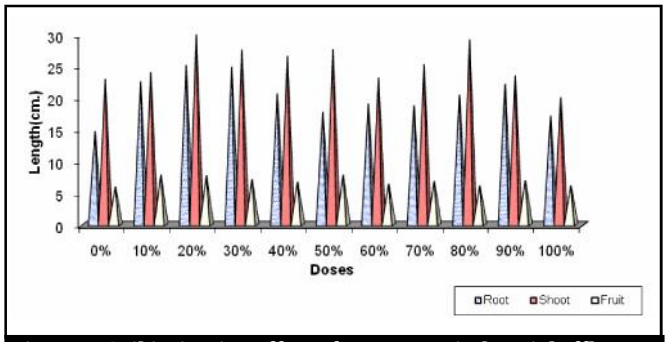

Fig.1 a: Soil irrigation effect of sugarcane industrial effluent on length ofroot, shoot and fruit of *Triticum aestivum* CV. PBW-226

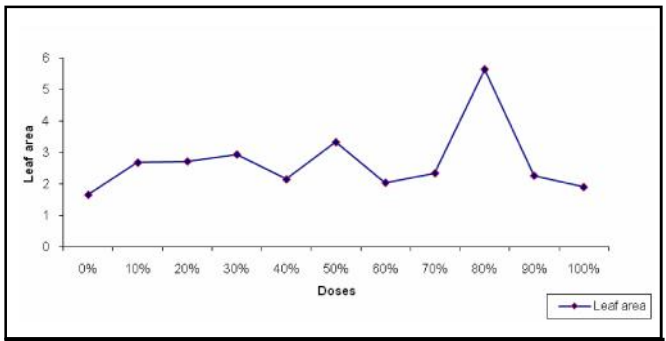

Fig.1 b: Soil irrigation effect of sugarcane industrial effluent on leaf area of *Triticum aestivum* CV. PBW-226

Table 1 : Soil irrigation effect of different concentrations of sugarcane industrial effluent on growth of *Triticum aestivum* cv.PBW-226

Dose→	CONT	10	20	30	40	50	60	70	80	90	100
Plant parts↓	Lergth (cm) ±SD										
Root	14.80	***	***	24.90	*	*	19.10	18.30	20.50	**	17.20
	±1.32	22.60	25.20	±5.14	20.70	17.80	±5.24	±5.44	±5.36	22.20	±1.44
		±1.74	±5.92		±9.09	±6.04				±6.72	
Shoot	23.00	24.10	****	**	26.60	27.70	23.20	25.30	***	23.50	20.10
	±6.11	±3.97	30.00	27.60	±3.30	±5.61	±3.94	±2.51	29.20	±5.14	±2.24
			±3.51	±4.60					±5.36		
Spike	6.04	**	*	7.20	6.82	**	6.50	*	6.20	*	6.20
	±1.13	7.90	7.80	±1.190	±1.38	7.90	±0.00	6.90	±0.75	7.04	±0.27
		±1.47	±0.97			±1.26		±0.79		±1.20	
No. of plant parts ±SD											
No. of leaves/plant	5±1.51	5±0.83	5±0.54	5±1.00	6±0.54	5±1.09	5±0.83	5±1.30	6±1.64	5±1.14	5±1.09
Leaf area	1.65	2.67	**	2.93	2.14	***	2.03	2.33	*****	2.25	1.89
	±0.55	±0.61	2.71	±0.81	±0.82	3.32	±0.58	±0.37	5.63	±0.90	±1.29
			±1.05			±1.15			±2.65		
No. seed/spike	4±0.54	4±1.81	* 5±0.83	*5±0.83	3±1.00	3±0.54	3±0.50	*5±0.89	***8±2.30	4±1.29	4±0.83

N.B. *= Significance at 0.10 % level **= Significance at 0.05% level *** = Significance at 0.025 % level **** = Significance at 0.01 % level ***** = Significance at 0.005 % level

Table 2 : Soil treatment effect of selected doses of sugarcane industrial effluent on changes of level of chlorophyll in *Triticum aestivum* cvs. PBW-226

		Triticum aestivum cv.PBW-226		
Plant parts	Biochemical components	Control	10 %	100 %
Leaf	Chlorophyll (a) (mg /gm fresh wt. ± S.D)	7.03 ± 0.11	7.40 ±0.11	7.50 ± 0 .20
	Chlorophyll (b) (mg /gm fresh wt. ± S.D)	3.10 ±0 .37	2.60 ±0.25	4.90 ±0.15
	Total chlorophyll(mg /gm fresh wt. ± S.D)	10.20 ± 0.41	9.80 ± 0.28	12.5 ±0 .15

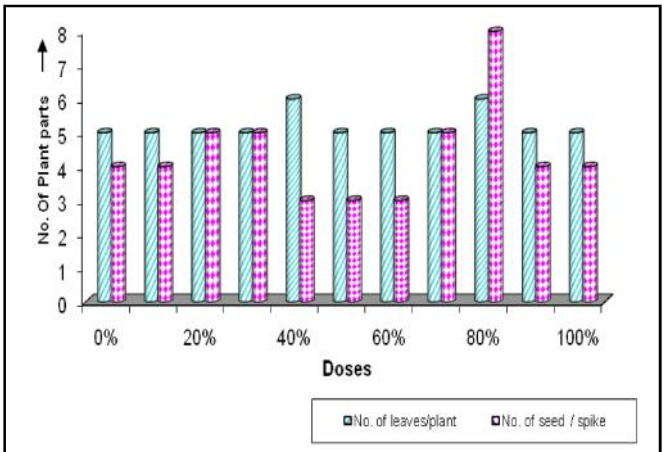

Fig.1 c: Soil irrigation effect of sugarcane industrial effluent on No. of leaves/plant and seed/spike of *Triticum aestivum* cv. PBW-226

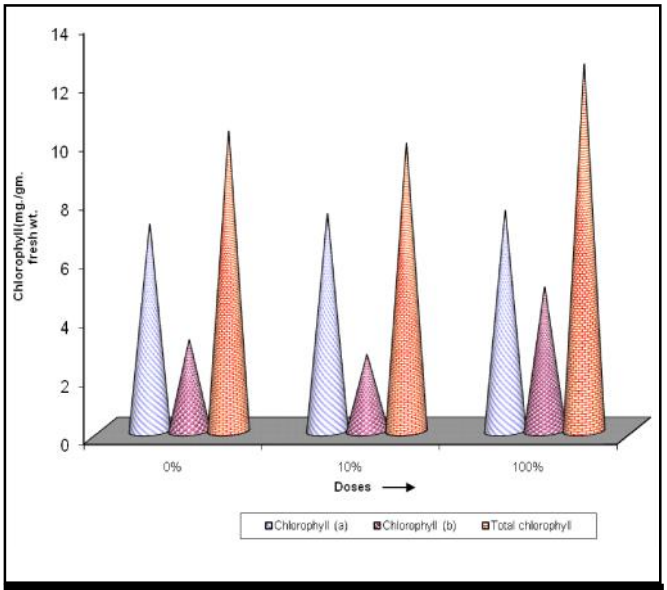

Fig.1 d: Soil irrigation effect of sugarcane industrial effluent on level of chlorophylls in *Triticum aestivum* cv. PBW-226

lower (10%) and higher (100%) dose of sugarcane industrial effluent. Results are mentioned below :

Table 2 Fig. 1d effect of sugarcane industrial effluent on chlorophyll level of *Triticum aestivum* cv.PBW-226 is given. In this chlorophyll a is 105% and 106%, chlorophyll b is 83% and 158% and total chlorophyll is 96% and 122% of control, respectively, at lower (10%) and higher (100%) dose of effluent.

Results shows promotory effect of different concentration of sugarcane industrial effluent on chlorophyll level, growth and yield of plant. Similar observations were also studied by many workers. Shetty *et al.*(1998) conducted experiments on *Triticum aestivum* and *Phseolus aureus* cvs. and reported that when these crops were treated with different concentrations of industrial effluent, there was slight increase in the shoot length, root length and dry matter accumulation and chlorophyll content at lower concentration (10% and 25%). Kingston (1999) argued that mill by-products contribute towards better yield, productivity, and profitability by affecting the physical condition of the soil, such as reducing bulk density in the surface soil and by raising pH of the surface soil. Taghavi *et al.*(1994) reported that elongation of growth was diretly proportional to the concentration of effluent. Ajmal *et al.* (1984) and Gautam *et al.* (1992) reported that cvs. of wheat, barley, kidney bean and pearl millet show promotory effects in response to industrial effluent. Similar observations were also studied during my research work. An increase in chlorophyll content takes place under treatment of sugarcane industrial effluent.Why?Increase in chlorophyll content is due to activation of chlorophyllase enzyme. Nag *et al.*(1981) had suggested increase in chlorophyllase activity by chemical agents.Another reason is due to the presence of Mg^{++} ions in the effluents , which are required for the synthesis of different chlorophyll molecules.

Promotion in growth and yield is due to increase in chlorophyll level , leaf area, increase in no. of leaves. Promotion in these parameters will lead to ultimate promotion in photosynthetic activity and hence promotion in growth and yield occurs. Maximum response was recorded in the plant suggests that the diluted effluent can be used for better growth of the test crop.

REFERENCES

Ajmal, M., Khan A.U. and Nomani, A.A.(1984). Effect of brewery effluent on agriculture soil and crop plants. *Environ.Pollu.* (series A)., **33** : 341-451.

Arnon,D,I.(1949).Copper enzymes in isolated chloroplasts. *Plant Physiol.*, **24**(1):1-15.

Arora, H.C., Chattopadhyay, S.N., Sharma, V.P. and Routh, T. (1973). Survey of Sugar mill waste disposal Part–I, *Environ. Health*, **15** : 28-38.

Arora, H.C., Routh, T., Chattopadhya, S.N. and Sharma, V.P. (1974). Survey of sugar mill disposal part –II. A comparative study of sugar mill effluent characteristics. *Indian J. Environ. Health*, **16**(2) : 233-246.

Banerjee,A., Sarkar,P.K. and Mukherjee,S.(1983).Reduction in soluble protein and chlorophyll contents in a few plants as indicators of automobile exhaust pollution. *Internat. J.Environ.Studies*,**20**:239-243.

Bauwer, H., and Chaney, R.L.,(1974). Land treatment of waste water. *Adv.Agron.*, **26**: 133-136.

Bhatnagar,A.R., Pathak,K.C. and Dodia,P.(1986). Effects of sugar factory effluents on germination and growth of Rice Oryza sativa. *Environ. Ecol*., **4** (2) : 218-220.

Bhattacharya, A.K. and Das, R.R. (1980). Effects of industrial effluents on soil. *J.Indian Bot. Soc.*, **59**: 174.

Day, A.D. (1973). Recyling urban effluents on land using annual crops. *In: Proc. Nat. Workshop on Land Application of Municipal sludge effluent.*pp.155-160.

Devis, J.A. and Jaksnow, J. (1975). Heavy metals in waste water in these urban areas. *J. water pollut. Cont. Fed*., **47**: 2292-2297.

Gautam, D.D.and Bishnoi, S. (1992). Effect of dairy effluents on wheat Triticum aestivum. *J.Ecobiol*., **4** (2) : 111-115.

Kingston, G. (1999). A role for silicon, nitrogen and reduced bulk density in yield responces to sugar mill ash and filter mud/ash mixtures, *Proceedings of the Australian Sociaty of Sugarcane Technologists Conference, Townsville,* pp. 114-121.

Kumar, Arindam(1999).Effect of carbonaceous sugar mill effluent on root/shoot ratio of Hordeum vulgare IB65. *Adv. Plant Sci.*, **12**(1) : 49-52.

Kumar, Arindam(1999).Alternation in physico-chemical characteristics of soil under stress of carbonaceous sugar mill effluent. *Adv. Plant Sci.*, **12**(1) : 103-109 [4 Ref].

Nag, P., Paul, A.K. and Mukherjee, A.(1980).Effects of mrcury, copper and zinc on growth, cell elongation, cell division, 6-A induced amylase synthesis and membrane permeability of plant tissue. *Indian J. Exp. Bist.*, **18** : 822-827.

Olademeaje, A., Adebaya and Wada, J.M. (1984). Effects of effluent from a sewage treatment plant on the aquatic organisms. *Water, Air & Soil Pollu*., **23**:120-126.

Pound C.E., and Crites, R.W. (1973). Waste water treatement and reuse by land application. Vol. (1&2): *Environ. Protection Agency. Ada. Oklahoma. E.P.A.*

Qi-Zhan Tang1, Zhong-Xiao Tian2, Shu-Biao Zhu2 and Ya-De Deng3(2006). Effect of liquid fertilizer made from sugar mill based distillery effluent on sugarcane. *Sugar Tech*., **8** (4) : 303-305.

Sahai. R., Jasbeen, S. and Saxena, P.K.(1983).Effects of distillary effluent on seed germination, seedling growth and pigment content of rice. *Indian J. Ecol.*, **10**: 7-10.

Shantamurty, K.B. and Rangaswamy, V.(1979). cytological effects of paper mill effluent on somatic cells of Allium cepa. *Cytolgia*, **44** : 921-926.

Shetty, A.G.M., Somshekar, R.K., Aditya , A.K. and Haldar, P. (1998). Effect of industrial effluent on germination and growth on *Phaseolus aureus* L. National seminar on Environ. Bio. Visva Bharti Uni. Santiniketan, India. 54-59.

Shinde, D.B. and Trivedy, R.K.(1983).Effects of distillery waste water irrigation on agronomical characteristics of Abelmoschus esculentus and Zea mays at germination stage. *Environ. Ecol*.,**1**: 109-111.

Smasekhar, R.K., Gurudev,M.R. and Ramiah, S. (1985). Somatic cell abnormalities induced by industry waste water. *Cytolgia*, **50** : 129-134.

Taghavi, S. Manuchehr, Vora AB.(1994). Effect of industrial effluent on germination and growth development of guar seed(var.PNB). *J Environ. Bio.*, **15**(3) : 209-212[8 Ref].

Tripathi B.D. (1978). Soil pollution studies around factory at Varanasi. *Indian J.Ecol.Environ.Sci*.,**4** : 15-18.

****
*****