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Original Research Paper

Responses of *Vigna radiata* and *Vigna unguiculata* Seedlings to Distillery Effluent

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ABSTRACT

The present study was undertaken to find out the physico-chemical characteristics of both untreated and treated distillery effluent and effect of various concentrations (25, 50, 75, 100 % v/v) of treated distillery effluent on the seed germination and seedling growth of *Vigna radiata* (L.) R. Wilczek Var. Pusa baisaki and *Vigna unguiculata* (L.) Walp. Var. CS 1. The physico-chemical analysis of the effluent showed high alkalinity with high BOD and COD, total dissolved solids, and total suspended solids. The germination in 25% concentration was found to be maximum as compared to 75 and 100% concentrations. 25% concentration of distillery effluent was found to be beneficial for the growth of shoot and root in both the plants as compared to control, indicating the enhancing influence of plant nutrients present in the effluent. However, the reduction in seedling growth revealed that constituents of distillery effluent at higher concentrations exhibited deleterious effects on both the crops plants.

INTRODUCTION

Distilleries are one of the major agrobased revenue earning industries that produce ethyl alcohol. Presently there are 319 distilleries in India producing 3.25 billion litres of alcohol annually (Uppal 2004). These industries use sugarcane molasses as a raw material for the production of alcohol by fermentation. The amount of waste generated from distilleries is nearly 15 times the total production of alcohol.

There are 39 distilleries in the state of Karnataka with an installed capacity of 282.5 million litres of alcohol production generating 3672.5 million litres of spent wash (Sugar India 2005). The State earns more than 3000 crores by way of excise duty annually. Studies have shown that distillery effluent contains large quantities of plant nutrients in addition to high organic load and dissolved organic matter. The practice of applying PME (post methanation effluent) in agricultural fields either as pre or post sown has been found to be beneficial. Most field crops have shown positive response to PME effluent application with irrigation water (Chhonkar et al. 2000).

The research efforts are geared towards assessing the agricultural potential of treated distillery spent wash. Using industrial effluent for irrigation purpose is a beneficial proposition. Non-judicious use of spent wash has shown to adversely affect the growth of the crop and soil properties by increasing salinity of the soil (Jagdale & Savanth 1979). Considering this, a study was undertaken to know the effect of distillery effluent on *Vigna radiata* and *Vigna unguiculata.*

MATERIALS AND METHODS

The effluent samples were collected from the Chamundi Distilleries located at Maliyur, T. Narasipur Taluk in Mysore District. The physico-chemical characteristics of the effluent were analysed by the methods prescribed by the American Public Health Association (APHA 1985).

Germination studies: The germination studies were carried out in the laboratory according to the standard methods recommended by International Seed Testing Association (ISTA 1985). The seed samples of certified varieties of *V. radiata* Var. Pusa baisaki and *V. unguiculata* Var. CS1 were procured from the Regional Agricultural Institute University, V.C. Farm, Mandya, Karnataka. Ten healthy seeds of the test crops were kept in sterilized Petri dishes in replicates containing equal amount of sterilized soil. Ten mL of different concentrations 25, 50, 75, 100 % v/v, symbolically represented as T_2, T_3, T_4 and T_5 and tap water as control (T_1). Germination percentage was recorded on 15th day of the germination. The root and shoot length was measured. Vigour index of the seedlings was calculated as per the method of Abdul Baki & Anderson (1973).

RESULTS

The characteristics of untreated and treated spent wash were analysed and the results are given in Table 1.

Seedling growth: Fig. 1 shows the general growth of the two species in different concentrations of the distillery waste and the control. Fig. 2a, 2b and 2c represent the data on germination percentage and seedling growth parameters of *V. radiata* and *V. unguiculata*. The analysis of variance performed for these values revealed a significant difference between concentrations and plants. Germination percentage in T2 effluent concentration in both *V. radiata* and *V. unguiculata* was on par with that of control, while percent germination was significantly reduced in T5 effluent concentrations in both the plants (14 and 18 % respectively).

The root length and shoot length values followed the similar trend as in case of percent germination in both the plants. The maximum root length and shoot length were recorded in T_2 effluent concentrations (11.43 and 12.93 cm) in *V. radiata* and (7.86 and 16.40 cm) in *V. unguiculata* respectively. T_5 effluent concentration did not support seedling growth in both the plants.

With regard to vigour index, maximum values were recorded in T2 effluent concentrations in *V. radiata (*2481.00) and in V. *unguiculata* (2428.33). Vigour index reduced with increase in effluent concentrations and was absent at T_4 effluent concentrations in both the plants.

DISCUSSION

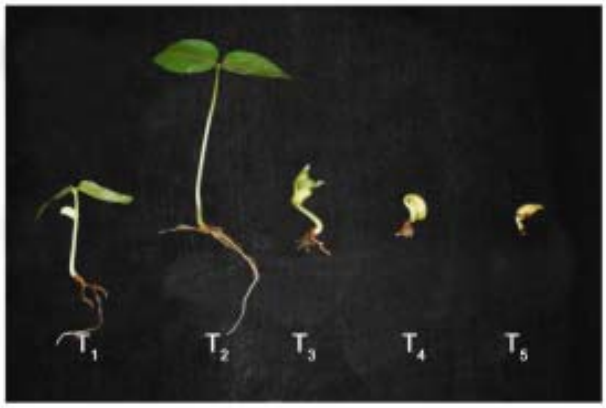
Physico-chemical characteristics: The pH of the untreated effluent was acidic, while the treated effluent was alkaline in nature. This is in conformation with the earlier reports of Sahai & Srivastava (1986). The total solid content of the untreated and treated effluent was 88532 and 21566 mg/L respectively. Suspended solids as well as total dissolved solids have exceeded the ISI limits of 200 mg/L and 2100 mg/L respectively. This is in accordance with the findings on distillery effluent by Vijayakumari & Kumudha (1990). The biochemical oxygen demand (BOD) of the untreated and secondarily treated spent wash was 37500 and 2100 mg/L respectively. The chemical oxygen demand (COD) of the raw and treated spent wash was 96556 and 9561 mg/L respectively. The high COD of the raw effluent is due to presence of large quantities of organics in the raw effluent. This is in conformation with earlier report of Blackwell et al. (1979). The nitrogen, phosphorus and potassium content of the treated distillery effluent was 464, 260 and 8000 mg/L respectively. Similar results have also been observed by Jabeen & Saxena (1990), Kannan (2002) and Suthar et al. (2005). From the present investigation, it is evident that some of the parameters have exceeded the ISI limits (1977) for discharge of industrial effluent on land for irrigation.

Germination and seedling growth parameters: The ability of a crop to germinate and establish under environmental stress is an early indication of tolerance. During germination any disturbance in the environment in which the seed occurs ultimately affects the growth and yield of crop (Dixit et al. 1986). In the present study, seed germination percentage was found to decrease gradually in *V. radiata* and *V. unguiculata* with increase in concentrations of distillery effluent. Both *V. radiata* and *V. unguiculata* recorded the highest germination percentage (100%) in T_2 (25%) effluent concentration, and gradually declined above T_3 (50%) effluent concentration. Lower concentration of the effluent increased the germination percentage. The results were in conformity with findings of Balashouri & Pramiladevi (1990) in *V. radiata* and *Cajanus cajan*, Tamizhiniyan et al. (1998) in cowpea, and Pragasam & Kannabiran (2001) in *V. mungo*. There was significant reduction in the percent germination in T_4 (75%) and T_5 (100%) effluent concentrations in both the plants studied. Similar reduction in percent germination due to high amount of total dissolved solids that disturbed the osmotic relations and other metabolic constituents in the crop plants were also found by Sahai & Srivastava (1986), Srivastava & Sahai (1987), Rajaram & Janardhanan (1988) and Ramana et al. (2001). The root and shoot length were found to be highest in *V. radiata* and *V. unguiculata* at T_2 (25%) effluent concentration, while the lowest was at T_5 (100%) concentration. Inhibition of seedling growth at higher concentration (100%) has also been observed in paddy by Behera & Mishra (1982) and Sahai et al. (1983), in *Pennisetum typhoides*, *P. mungo*, Mung bean, Urd bean and Soyabean by Rajaram & Janardhanan (1988), in *V. radiata* by Vijayakumari & Kumudha (1990), in *P. aureus* by Kannan

Table 1: Physico-chemical characteristics of distillery effluent in comparison with ISI limits.

Parameters	Untreated	Treated	ISI limits
Colour	Dark brown	Reddish dark brown	-
Odour	Burnt sugar	Unpleasant	-
Turbidity	High	High	-
Temperature (°C)	75°C	32°C	-
pH	3.90	8.41	5.5-9.0
EC (dS/m)	46.8	31.6	-
BOD (mg/L)	37,500	2100	100
COD (mg/L)	96,556	9561	-
Suspended solids (mg/L)	7988	2800	200
Total solids (mg/L)	88532	21566	-
Sulphate as SO_4 (mg/L)	3600	280	1000
Chloride (mg/L)	5150	3700	-
Sodium (mg/L)	400	400	-
Potassium (mg/L)	12,000	8,000	-
Calcium (mg/L)	3400	1500	-
Phosphorus (mg/L)	480	260	-
Nitrogen (mg/L)	904	464	-

a)*Vigna radiata* R.(Wilczek) var Pusa baisaki.



b)*Vigna unguiculata* C.(Walp) var CS1.

T_1 - Control
T_2 - 25% Effluent treatment
T_3 - 50% Effluent treatment
T_4 - 75% Effluent treatment
T_5 - 100% Effluent treatment

Fig. 1: Effect of different concentrations of distillery effluent on seedling growth.

(2001) in treated distillery effluent.

The promotion of seedling growth at lower concentration of the effluent may be due to the presence of optimum levels of plants nutrients in the effluent (Sahai et al. 1983, Rajaram & Janardhanan 1988), or due to enhanced plant nutrients such as N, P, K, Ca present in effluent (Rajannan et al. 1998). Root and shoot length in the present investigation was completely inhibited at T_5 (100%) effluent concentration. At higher concentration of the effluent, N, P, K, chlorides, sulphates and organics inhibit seedling growth by altering the osmotic relations (Sahai & Srivastava 1986).

Seedling vigour index in the present study showed a gradual decline with the progressive increase in effluent concentration. *V. radiata* showed a higher degree of decline when compared to *V. unguiculata*. The decline in seedling vigour index was similar to the earlier findings of Salunke &

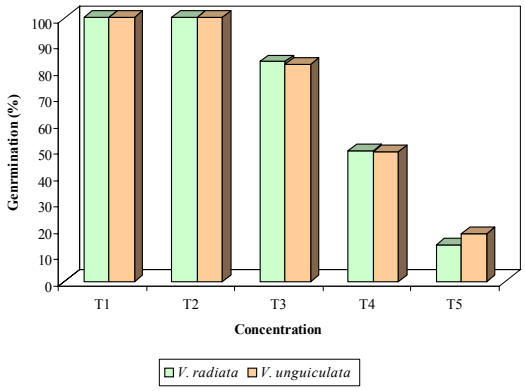


Fig. 2a: Effect of different concentrations of distillery effluent on seed germination of *V. radiata* and *V. unguiculata.*

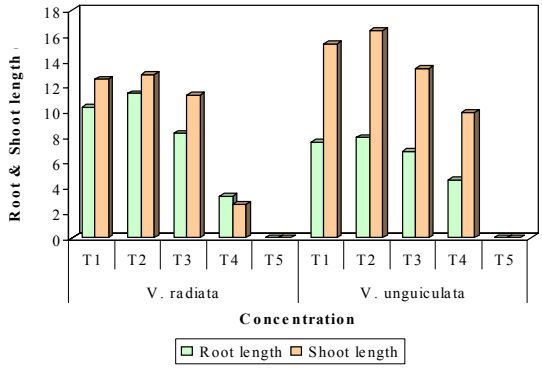


Fig. 2b: Effect of different concentrations of distillery effluent on seedling growth of *V. radiata* and *V. unguiculata.*

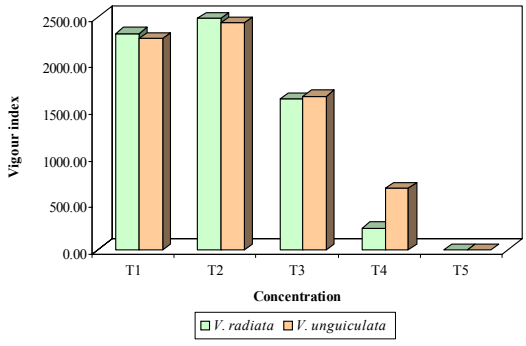


Fig. 2c: Effect of different concentrations of distillery effluent on vigour index of *V. radiata* and *V. unguiculata*.

Karande (1999) in *Vigna radiata*, and Kannan (2001) in *Pennisetum typhoides*.

On the basis of this preliminary work, it can be suggested that the distillery effluent can be used for irrigational purpose after proper dilution with water, which will be one of the solutions for combating environmental pollution prob-

lems. Further studies on growth performance and yield properties of soil are needed to corroborate the present findings.

REFERENCES

APHA 1985. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington DC.

Abdul Baki, A. and Anderson, J.D. 1973. Vigour index determination of soybean seed by multiple criteria. Crop Sci., 3: 630-633.

Balashouri and Pramiladevi 1994. Effect of tannery effluent on germination and growth of selected pulse and cereal crop plants. J. Ecotoxicol. Environ. Monit., 4(2); 115-120.

Behera, B.K. and Misra, B.N. 1982. Analysis of the effect of industrial effluent on growth and development of rice seedlings. Environ. Res., 28: 10-20.

Blackwell, B.R., Malkay, W.B., Murray, F.E. and Oldium, N.K. 1979. Review of craft foul condensate: Sources, quantities, chemical composition and environmental effects. Tappi, 62: 33-37.

Chhonkar, P.K., Datta, S.P., Joshi, H.C. and Pathak, H. 2000. Impact of Industrial effects on soil health and agriculture - Indian experience: Part I, Distillery and paper mill effluents. JCSIR, 59: 350-361.

Dixit, A., Lakshman, M. and Srivastava, S.K. 1986. Effect of cardboard factory effluent on seed germination and early seedling growth of rice (*Oryza sativa*) seeds. Seed. Res., 14(1): 66-71.

Indian Standard Institution 1977. Tolerance limits for discharge of industrial effluents on land for irrigation. No. 3307, Indian Standard Institution, New Delhi.

ISTA 1985. International rules for seed testing. Seed Sci. and Tech., 13: 421-463.

Jabeen, S. and Saxena, P.K. 1990. Effect of industrial effluent on growth behaviour of *Pisum sativum*. Geobios, 17: 197-201.

Jagdale, H.N. and Savant, N.K. 1979. Influence of spentwash (distillery waste) on growth and chemical composition of immature sugarcane (*Saccharum officinarum* L.) cultivar CO 740. Indian Sugar, 29: 433-440.

Kannan, J. 2001. Effect of distillery effluent on crop plants. Adv. Plant. Sci., 14(1): 127-132.

Kannan, J. 2002. Effect of distillery effluent irrigation on soil biological properties on which ground crops were raised. Adv. Plant Sci., 15(11): 439-443.

Pragasam, A. and Kannabiran, B. 2001. Effect of distillery effluent on the morphology, biochemistry and yield of *Vigna mungo*. Adv. Plt. Sci., 14(2): 547-552.

Rajannan, G., Devarajan, L. and Oblisami, G. 1998. Impact of distillery effluent irrigation on growth of banana crop. In: National Seminar on Application of Treated Effluent for Irrigation, REC, Tiruchirapalli, March 23, pp. 56.

Rajaram, N. and Janardhanan, K. 1988. Effect of distillery effluent on seed germination and early seedling growth of soybean, cowpea, rice and sorghum. Seed Res., 16(2): 173-177.

Ramana, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B.R. 2001. Efficacy of distillery effluent on seed germination and seedling growth in mustard, cauliflower and radish. Proc. Nat. Acad. Sci., India. 71: B(III) 129-135.

Sahai, R., Jabeen, S. and Saxena, P.K. 1983. Effect of distillery effluent on seed germination, seedling growth and pigment content of rice. Ind. J. Ecol., 10: 7-10.

Sahai, R. and Neelam 1987. Effect of fertilizer factory and distillery effluent on seed germination, seedling growth, pigment content and biomass of *Phaseolus radiatus* Linn. Indian, J. Ecol., 14: 21-25.

Sahai, R. and Srivastava, V. 1986. Effect of distillery waste on the seed germination, seedling growth and pigment content of *Cajanus cajan* L. Indian Bot. Soc., 65: 206-211.

Salunke, K.J. and Karande, S.M. 1999. Effect of pulp and paper mill effluent on the seed germination and early seedling and growth in mung bean. Proc. Nat. Conference on Industry and Environment, Karad, Dec. 28-30, Ed. Trivedy, R.K., Publ. Daya Publishing House, Delhi.

Sugar India. 2005. Anekant Prakashan, Jayaringapur, Kolhapur.

Suthar, S.S., Sharma, S., Verma, P., Suthar, S., and Pareek, G. 2005. Impact of distillery effluent on seed germination and seedling growth of some plants. Nature Environ. and Poll. Tech., 4(3): 413-418.

Thamizhiniyan, P., Sundaramoorthy, P. and Lakshmanachary, A.S. 2000. Effect of sugar mill effluent on germination, growth and pigment contents of groundnut (*Arachis hypogaea* L.) and paddy (*Oryza sativa* L.). Indian J. Applied and Pure Bio., 15(27): 151-155.

Uppal, J. 2004. Water utilization and effluent treatment in the Indian alcohol industry - An overview. In: Indo Workshop and Promoting Efficient Water in Agrobased Industries, New Delhi, 15-16.

Vijayakumari, K. and Kumudha, P. 1990. Effect of distillery effluent on seed germination and early seedling growth in some crop plants. Geobios, 17: 206-211.