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Original Research Paper

Impact of Distillery Spentwash Irrigation on Yield of Some Root Vegetables

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ABSTRACT

Cultivation of some root vegetables was made by irrigation with distillery spentwash of different dilutions. The primarily treated spentwash (PTSW) of 50% and 33% dilutions was analysed for its plant nutrients such as nitrogen, phosphorus, potassium and other physical and chemical parameters. Experimental soil was tested for its chemical and physical properties. Seeds of root vegetables were sown in the prepared land and irrigated with raw water (RW), and 50% and 33% spentwash. The impact of spentwash on the yield of root vegetables at their maturity periods was investigated. It was noticed that the yield of all the vegetables was maximum in the case of 33%, moderate in 50% spentwash and minimum in raw water irrigation.

INTRODUCTION

Molasses is the chief source for production of alcohol in distilleries by fermentation method. About 40 billion litres of wastewater annually is discharged from distilleries, called raw spentwash (RSW), which is characterized by high biochemical oxygen demand (BOD: 5000-8000mg/L) and chemical oxygen demand (COD: 25000-30000mg/L) (Joshi et al. 1994), ugly colour and bad smell. Discharge of RSW into open land or nearby water bodies results in a number of environmental pollution problems including threat to plant and animal life. The RSW is highly acidic and contains easily oxidisable organic matter (Patil et al. 1987). Spentwash also contains very high amount of organic nitrogen and nutrients (Ramadurai & Gearard 1994). Biomethanation plant in distilleries can reduce oxygen demand of RSW, resulting in spentwash called primarily treated spentwash (PTSW). Primary treatment to RSW increases nitrogen (N), potassium (K) and phosphorus (P) contents, and decreases calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-) and sulphate (SO_4^{2-}) (Mahamod Haron & Bose 2004). The PTSW is rich in potassium (K), sulphur (S), nitrogen (N), phosphorus (P) as well as biodegradable organic matter.

Because of its fertiliser constituents in ample amounts, spentwash has been widely tried for irrigation of various crops, which not only provide pure irrigation but also the nutrients, thus, eliminating the need of fertilizers from outside (Samual 1986, Sahai et al. 1983). However, spentwash contains an excess of various forms of cations and anions, which may be injurious to plant growth, hence they are reduced to safe level by dilution. Diluted spentwash increase the uptake of nutrients, height, growth and yield of leafy vegetables (Basavaraju & Chandraju 2008a), nutrients of cabbage and mint leaf (Chandraju et al. 2008b), nutrients of top vegetables (Basavaraju & Chandraju 2008b), and pulses, condiments and root vegetables (Chandraju et al. 2008c). However, not much information is available on the impact of distillery spentwash on the yield of root vegetables. Therefore, the present study was carried out to find the effect of spentwash irrigation on yield of root vegetables.

MATERIALS AND METHODS

Physico-chemical parameters and amount of nitrogen (N), potassium (K), phosphorus (P) and sulphur (S) present in the primarily treated spentwash and its 50% and 33% dilutions were analysed by standard methods. The PTSW was used for irrigation with a dilution of 33% and 50%. Before initiation, a composite soil sample was collected at 25 cm depth, air-dried, powdered and analysed for physico-chemical properties.

Root vegetables selected for the present investigation were, potato (*Solanum tuberosum*), sweet potato (*Ipomoea batatas*), radish (*Raphanus sativus*), carrot (*Daucus carota*), beet root (*Beta vulgaris*) and onion (*Allium cepa*). The seeds were sown and irrigated with raw water (RW), 50% and 33% spentwash at the dosage of twice a week, and rest of the period with raw water as required. At the maturity time, vegetables were harvested and the yields were recorded by taking the average weight.

RESULTS AND DISCUSSION

Chemical composition of PTSW and its 50% and 33% dilutions are given in Table 1, while that of

Table 1: Chemical composition of distillery spentwash.

Chemical parameters	Units	PTSW	50% SW	33% SW
pH	-	7.65	7.73	7.75
Electrical conductivity	µS	28800	19660	10020
Total solids	mg/L	46140	26170	20870
Total dissolved solids	mg/L	35160	16060	10140
Total suspended solids	mg/L	10540	5680	4380
Settleable solids	mg/L	10070	4340	3010
COD	mg/L	40530	18316	10228
BOD	mg/L	16200	7818	4800
Carbonate	mg/L	Nil	Nil	Nil
Bicarbonate	mg/L	13100	7400	4200
Total phosphorus	mg/L	30.26	12.20	6.79
Total potassium	mg/L	7200	3700	2400
Calcium	mg/L	940	600.0	380.0
Magnesium	mg/L	1652.16	884.16	542.22
Sulphur	mg/L	74.8	35.0	22.6
Sodium	mg/L	480	260	240
Chlorides	mg/L	5964	3272	3164
Iron	mg/L	9.2	6.40	5.20
Manganese	mg/L	1424	724	368
Zinc	mg/L	1.28	0.72	0.41
Copper	mg/L	0.276	0.134	0.074
Cadmium	mg/L	0.039	0.021	0.010
Lead	mg/L	0.16	0.09	0.06
Chromium	mg/L	0.066	0.032	0.014
Nickel	mg/L	0.165	0.084	0.040
Ammonical Nitrogen	mg/L	743.68	345.24	276.64

PTSW→Primarily treated distillery spentwash the experimental soils in Table 2. The yields were high in case of 33% spentwash irrigation, moderate in 50%, while very poor in raw water for all types of root vegetables (Table 3). The yield was maximum in case of beet root (89.2%) followed by onion (85.5%), carrot (84.5%), potato (77.1%) and radish (59.3%) and sweet potato (40.6%). In other studies, use of spentwash for irrigation has been reported to be beneficial to sugarcane (Zalwadia et al. 1997), rice (Devarajan & Oblisami 1995), wheat and rice yield (Pathak et al. 1998), quality of groundnut (Amar Singh et al. 2003), and physiological response of soybean (Ramana et al. 2000).

Table 2: Characteristics of the experimental soil.

Parameters	Units	
Coarse sand	%	9.72
Fine sand	%	40.80
Slit	%	25.28
Clay	%	24.2
pH (1:2)	%	8.16
Electrical conductivity	µS	526
Organic carbon	%	0.61
Available nitrogen	ppm	340
Available phosphorus	ppm	130
Available potassium	ppm	80
Exchangeable calcium	ppm	140
Exchangeable magnesium	ppm	220
Exchangeable sodium	ppm	90
Available sulphur	ppm	240
DTPA iron	ppm	200
DTPA manganese	ppm	220
DTPA copper	ppm	5
DTPA zinc	ppm	50

Twelve presowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield (Singh & Raj Bahadur 1998). Diluted spentwash increases growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Ravi & Srivastava 1990). The application of diluted spentwash also increased the uptake of zinc (Zn), copper (Cu), iron (Fe) and manganese (Mn) in maize and wheat as compared to control (Pujar 1995).

Diluted spentwash could be used for irrigation without adversely affecting soil fertility (Kaushik et al. 2005, Kuntal et al. 2004, Raverkar et al. 2000), seed germination and crop productivity (Ramana et al. 2001). The diluted spentwash irrigation improved the physical and chemical properties of the soil and increased soil microflora (Devarajan 1994, Kaushik et al. 2005, Kuntal et al. 2004). The soil, tested after the harvest of vegetables in the present study, shows that there is enrichment of plant nutrients (N.P.K) in soil with no adverse effect on other parameters.

Table 3: Average weight of root vegetables at different irrigations (average weight of ten numbers).

Name of vegetable	Average weight of vegetable (in g)		
	RW	50%SW	33%SW
Potato	175	225	310
Sweet potato	690	820	970
Radish	135	185	215
Carrot	110	182	203
Beet root	325	520	615
Onion	62	85	115

WR→Raw water; 50% SW→50% Distillery spentwash;
33% SW→33% Distillery spentwash

In 33% spentwash irrigation the plants are able to absorb maximum amount of nutrients, both from the soil and the spentwash, resulting in good yield. This concludes that the spentwash can be conveniently used for the cultivation of root vegetables without external (either organic or inorganic) fertilizers. This minimizes the cost of cultivation, and hence, may elevate economy of farmers.

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REFERENCES

Amar, B. Singh, Ashisk Biswas and Sivakoti Ramana 2003. Effect of distillery effluent on plant and soil enzymatic activities and groundnut quality. J. Plant Nutri. Soil Sci., 166: 345-347.

Basavaraju, H.C. and Chandraju, S. 2008a. Impact of distillery spentwash on the nutrients of leaves vegetables: An investigation. Asian J. Chem., 20(7): 5301-5310.

Basavaraju, H.C. and Chandraju, S. 2008b. An investigation of impact of distillery spentwash on the nutrients of top vegetables. Int. J. Agri. Sci., 4(2): 691-696.

Chares, S. 1985. Vinasse in the fertilization of sugarcane. Sugarcane, 1: 20.

Chandraju, S., Basavaraju, H.C. and Chidankumar, C.S. 2008a. Investigation of impact of irrigation of distillery spentwash on the growth, yield and nutrients of leafy vegetable. Chem. Env. Res., 17(1&2).

Chandraju, S., Basavaraju, H.C. and Chidankumar, C.S. 2008b. Investigation of impact of irrigation of distillery spentwash on the nutrients of cabbage and mint leaf. Indian Sugar, 39: 19-28.

Chandraju, S., Basavaraju, H.C. and Chidankumar, C.S. 2008c. Investigation of impact of irrigation of distillery spentwash on the nutrients of pulses. Asian J. Chem., 20(8): 6342-6348.

Devarajan, L. and Oblisami, G. 1995. Effect of distillery effluent on soil fertility status, yield and quality of rice. Madras Agri. J., 82: 664-665.

Devarajan, L., Rajanan, G., Ramanathan, G. and Oblisami, G. 1994. Performance of field crops under distillery effluent irrigations. Kisan World, 21: 48-50.

Joshi, H.C., Kalra, N., Chaudhary, A. and Deb, D.L. 1994. Environmental issues related with distillery effluent utilization in agriculture in India. Asia Pac. J. Environ. Develop., 1: 92-103.

Kaushik, K., Nisha, R., Jagjeeta, K. and Kaushik, C.P. 2005. Impact of long and short term irrigation of a sodic soil with distillery effluent in combination with bio-amendments. Bioresource Technology, 96: 1860-1866.

Kuntal, M. Hati, Biswas, A.K., Kalikinkar Bandypadhyay and Misra, K. 2004. Effect of post-methanation effluent on soil physical properties under a soybean-wheat system in a vertisol. J. Plant Nutri. Soil Sci., 167: 584-590.

Mohamed Haron A.R. and Bose, Subash Chandra M. 2004. Use of distillery spentwash for alkali soil reclamation, treated distillery effluent for ferti-irrigation of crops. Indian Farm, March: 48-51.

Patil, J.D., Arabatti, S.V. and Hapse, D.G. 1987. A review of some aspects of distillery spentwash (vinasse) utilization in sugarcane. Bartiya Sugar, May: 9-15.

Pathak, H., Joshi, H.C., Chaudhary, A., Chaudhary, R., Kalra, N. and Dwivedi, M.K. 1998. Distillery effluent as soil amendment for wheat and rice. J. Indian Soc. Soil Sci., 46: 155-157.

Pujar, S.S. 1995. Effect of Distillery Effluent Irrigation on Growth, Yield and Quality of Crops. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad.

Ramadurai, R. and Gearard, E.J. 1994. Distillery effluent and downstream products. SISSTA, Sugar Journal, 20: 129-131.

Ramana, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B.R. 2000. Physiological response of soybean (*Glycine max* L.) to foliar application of distillery effluent. Ann. Plant Soil Res., 2: 1-6.

Raverkar, K.P., Ramana, S., Singh, A.B., Biswas, A.K. and Kundu, S. 2000. Impact of post methanated spentwash (PMS) on the nursery raising, biological parameters of *Glyricidia sepum* and biological activity of soil. Ann. Plant Res., 2(2): 161-168.

Ramana, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B.R. 2001. Effect of distillery effluent on seed germination in some vegetable crops. Bioresource Technology, 82(3): 273-275.

Singh, Y. and Raj Bahadur 1998. Effect of application of distillery effluent on maize crop and soil properties. Indian J. Agri. Sci., 68: 70-74.

Ravi, R. and Srivastava, M.M. 1990. Eco-physiological response of *Pisum sativum* and *Citrus maxima* to distillery effluents. Intl. J. Eco. Environ. Sci., 16-23.

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

Samuel, G. 1986. The use of alcohol distillery waste as a fertilizer. Proceedings of International American Sugarcane Seminar, pp. 245-252.

Zalwadia, N.M., Raman, S. and Patil, R.G. 1997. Influence of diluted spentwash of sugar industries application on yield and nutrient uptake by sugarcane and changes in soil properties. J. Indian Soc. Soil. Sci., 45: 767-769.