Asian Journal of Chemistry; Vol. 23, No. 4 (2011), 1585-1587

ASIAN JOURNAL OF CHEMISTRY

www.asianjournalofchemistry.co.in

Distillery Spentwash Irrigation on the Yields of Radish (*Raphanus sativus*), Onion (*Allium cepa*) and Garlic (*Allium sativum*)

S. CHANDRAJU[1,*], R. NAGENDRASWAMY[2], C.S. CHIDANKUMAR[3] and GIRIJA NAGENDRASWAMY[4]

[1]Department of Studies in Sugar Technology, Sir M. Visweswaraya Postgraduate Center, University of Mysore, Tubinakere, Mandya-571 402, India
[2]Department of Chemistry, Government First Grade College, Hanagodu, Mysore-571 105, India
[3]Department of Chemistry, Bharathi College, Bharathi Nagar-571 422, India
[4]Department of Chemistry, Maharani's Science College, Mysore-570 005, India

*Corresponding author: E-mail: schandraju@gmail.com

(*Received*: 29 May 2010; *Accepted*: 4 December 2010) AJC-9363

Cultivation of radish (*Raphanus sativus*), onion (*Allium cepa*) and garlic (*Allium sativum*) medicinal plants was made by irrigation with distillery spentwash of different dilutions. The spentwash *i.e.*, primary treated spentwash and 33 % spentwash were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical parameters. Experimental soils *i.e.*, normal soil (plot-1) and spentwash treated (plot-2) soils were tested for their chemical and physical parameters. The seeds (Namadhari and Mayhco) were sowed in the prepared land and irrigated with raw water and 33 % spentwash. Influence of spentwash in normal and spentwash treated soils on the yields were investigated at their respective maturity. It was found that the yields of all plants were high in 33 % than raw water irrigation. Further, the yields were very high in spentwash treated soil (plot-2) than normal soil (plot-1) and raw water irrigations all plants.

Key Words: Distillery spentwash, Medicinal plants, Yields, Normal soil, Spentwash Treated soil.

INTRODUCTION

Molasses (one of the important byproducts of sugar industry) is the chief source for the production of ethanol in distilleries by fermentation method. About 8 L of waste water is discharged for every litre of ethanol production in distilleries, known as raw spentwash (RSW), which is characterized by high biochemical oxygen demand (BOD: 5000-8000 mg/L) and chemical oxygen demand (COD: 25000-30000 mg/L)[1], undesirable colour and foul smell. Discharge of raw spent wash into open land or near by water bodies resulting in a number of environmental, water and soil pollution including threat to plant and animal lives. Hence, discharge of spentwash is a major problem.

The raw spentwash is highly acidic and contains easily oxidizable organic matter with high BOD and COD[2]. Also, spentwash contains highest content of organic nitrogen and nutrients[3]. By installing biomethenation plant in distilleries, reduces the oxygen demand of raw spentwash (RSW), the resulting spentwash is called primary treated spentwash (PTSW) and primary treatment to raw spentwash increases the percentage of nitrogen, potassium and phosphorous contents and decreases the calcium, magnesium, sodium, chloride and sulphate[4]. The primary treated spentwash is rich in potassium, sulphur, nitrogen, phosphorous as well as easily biodegradable organic matter and its application to soil has been reported to be beneficial to increase sugarcane[5], rice[6], wheat and rice yield[7], quality of groundnut[8] and physiological response of soybean[9]. Diluted spentwash could be used for irrigation purpose without adversely affecting soil fertility[10-12], seed germination and crop productivity[13]. The diluted spentwash irrigation improved the physical and chemical properties of the soil and further increased soil microflora[14]. Twelve pre sowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield[15]. Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas[16]. Increased concentration of spentwash causes decreased seed germination, seedling growth and chlorophyll content in sunflowers (*Helianthus annuus*) and the spentwash could safely used for irrigation purpose at lower concentration[17,18]. The spentwash contained an excess of various forms of cations and anions, which are injurious to plant growth and these constituents should be reduced to beneficial level by diluting the spentwash, which can be used as a substitute for chemical fertilizer[19]. The spentwash could be used as a complement to mineral fertilizer to sugarcane[20]. The spentwash contain N, P, K, Ca, Mg and S

and thus valued as a fertilizer when applied to soil through irrigation with water[21]. The application of diluted spentwash increased the uptake of zinc, copper, iron and manganese in maize and wheat as compared to control and the highest total uptake of these were found at lower dilution levels than at higher dilution levels[22]. Mineralization of organic material as well as nutrients present in the spentwash was responsible for increased availability of plant nutrients. Diluted spentwash increase the uptake of nutrients, height, growth and yield of leafy vegetables[23,24], nutrients of cabbage and mint[25], nutrients of top vegetables[26], pulses, condiments and root vegetables[27], nutrients of pulses in normal and treated soil[28].

However, no information is available on the studies of distillery spentwash irrigation on the yields of radish (*Raphanus sativus*), onion (*Allium cepa*) and garlic (*Allium sativum*) plants in normal and spentwash treated soil. Therefore, the present investigation was carried out to investigate the influence of different concentration of spentwash on the yields of radish (*Raphanus sativus*), onion (*Allium cepa*) and garlic (*Allium sativum*) plants in normal and spentwash treated soils.

EXPERIMENTAL

Physico-chemical parameters and amounts of nitrogen, potassium, phosphorous and sulphur present in the primary treated spentwash and 33 % spentwash were analyzed by standard methods (Table-1). The primary treated spentwash was used for irrigation with a dilution of 33 % in plot-1 and plot-2. Before initiation, plot-2 soil was treated with diluted spentwash for four times with an interval of one week, each time land was ploughed and exposed to sunlight. A composite soil samples from both plots were collected at 25 cm depth, air-dried, powdered and analyzed for physico-chemical properties (Table-3).

The plants selected for the present investigation were radish (*Raphanus sativus*), onion (*Allium cepa*) and garlic (*Allium sativum*). The seeds were sowed and irrigated with raw water and 33 % spentwash in both plots at the dosage of twice a week and rest of the period with raw water depends upon the climatic condition. Plants were harvested at their respective maturity and yields were recorded. Cultivation of plants was repeated for three times, in each case, average yields were recorded (Table-4).

RESULTS AND DISCUSSION

Chemical composition of primary treated distillery spentwash and 33 % spentwash such as pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, settelable solids, chemical oxygen demand, biological oxygen demand, carbonates, bicarbonates, total phosphorous, total potassium, ammonical nitrogen, calcium, magnesium, sulphur, sodium, chlorides, iron, manganese, zinc, copper, cadmium, lead, chromium and nickel were analyzed and tabulated (Table-1). Amounts of N, P, K and S contents are presented in Table-2.

Characteristics of experimental soils (plot-1 and plot-2) such as pH, electrical conductivity, the amount of organic carbon, available nitrogen, phosphorous, potassium, sulphur exchangeable calcium, magnesium, sodium, DTPA iron, manganese, copper and zinc were analyzed and the results are tabulated in Table-3.

TABLE-1
CHEMIAL COMPOSIION OF DISTILLERY SPENTWASH

Chemical parameters	PTSW	33 % PTSW
pH	7.57	7.65
Electrical conductivity (μS)	26400	7620
Total solids (mg/L)	47200	21930
Total dissolved solids (mg/L)	37100	12080
Total suspended solids (mg/L)	10240	4080
Settleable solids (mg/L)	9880	2820
COD (mg/L)	41250	10948
BOD (mg/L)	16100	4700
Carbonate (mg/L)	Nil	Nil
Bicarbonate (mg/L)	12200	3300
Total phosphorous (mg/L)	40.5	17.03
Total potassium (mg/L)	7500	2700
Calcium (mg/L)	900	370
Magnesium (mg/L)	1244.16	134.22
Sulphur (mg/L)	70	17.8
Sodium (mg/L)	520	280
Chlorides (mg/L)	6204	3404
Iron (mg/L)	7.5	3.5
Manganese (mg/L)	980	288
Zinc (mg/L)	1.5	0.63
Copper (mg/L)	0.25	0.048
Cadmium (mg/L)	0.005	0.002
Lead (mg/L)	0.16	0.06
Chromium (mg/L)	0.05	0.012
Nickel (mg/L)	0.09	0.025
Ammonical nitrogen (mg/L)	750.8	283.76
Charbohydrates (%)	22.80	8.12

PTSW: Primary treated distillery spentwash.

TABLE-2
AMOUNTS OF N, P, K AND S (NUTRIENTS)
IN DISTILLERY SPENTWASH

Chemical parameters	PTSW	33 % PTSW
Ammonical nitrogen (mg/L)	750.8	283.76
Total phosphorous (mg/L)	40.5	17.03
Total potassium (mg/L)	7500	2700
Sulphur (mg/L)	70	17.8

PTSW: Primary treated distillery spentwash.

TABLE-3
CHARACTERISTICS OF EXPERIMENTAL SOILS

Parameters	Plot-1	Plot-2
Coarse sand (%)	9.85	10.98
Fine sand (%)	40.72	42.74
Slit (%)	25.77	26.43
Clay (%)	23.66	18.46
pH (1:2 soln) (%)	8.41	8.32
Organic carbon (%)	1.77	1.98
Electrical conductivity (μS)	540	471
Available nitrogen (ppm)	402	518
Available phosphorous (ppm)	202	256
Available potassium (ppm)	113	108
Exchangeable calcium (ppm)	185	198
Exchangeable magnesium (ppm)	276	240
Exchangeable sodium (ppm)	115	195
Available sulphur (ppm)	337	310
DTPA iron (ppm)	202	242
DTPA manganese (ppm)	210	250
DTPA copper (ppm)	12	15
DTPA zinc (ppm)	60	75

Plot-1: Normal soil. Plot-2: Spentwash treated soil.

The yields were high in 33 % spentwash irrigation compared to raw water in both fields (plots 1 and 2) for all plants. However considerable increase in yields was noticed in plot-2 than plot-1 in all types of irrigations for all plants and there was no negative impact of spentwash (Table-4).

TABLE-4
AVERAGE WEIGHT OF PLANTS AT DIFFERENT IRRIGATION (kg) (AVERAGE WEIGHT IS TAKEN FROM 25 PLANTS)

Name of plants	Plot-1	Plot-2
Radish (*Raphanus sativus*)	0.349	0.486
Onion (*Allium cepa*)	0.136	0.219
Garlic (*Allium sativum*)	0.085	0.124

Plot-1: Normal soil. Plot-2: Spentwash treated soil.

Conclusion

It was noticed that the yields of all plants were largely influenced in case of 33 % diluted spentwash irrigation than with raw water in spentwash treated soil (plot-2) than normal soil (plot-2). This concludes that, the spentwash treated soil is enriched with the plant nutrients such as nitrogen, potassium and phosphorous. It further concludes that, the subsequent use of diluted spentwash for irrigation, enriches the soil fertility and hence the diluted spentwash (33 %) is effective and eco-friendly irrigation medium for cultivation of radish (*Raphanus sativus*), onion (*Allium cepa*) and garlic (*Allium sativum*) plants without any adverse effect.

REFERENCES

1. H.C. Joshi, N. Kalra, A. Chaudhary and D.L. Deb, *Asia Pacific J. Environ. Develop*., **1**, 92 (1994).
2. J.D. Patil, S.V. Arabatli and D.G. Hapse, Bartiya Sugar, May, pp. 9-15 (1987).
3. R. Ramadurai and E.J. Gearard, *SISSTA Sugar J*., **20**, 129 (1994).
4. A.R. Mohamed Haroon and M.S.C. Bose, Indian Farm, March issue, p. 48 (2004).
5. N.M. Zalawadia, S. Raman and R.G. Patil, *J. Indian Sac. Soil Sci.*, **45**, 767 (1997).
6. L. Deverajan and G. Oblisami, *Madras Agric*., **82**, 664 (1995).
7. H. Pathak, H.C. Joshi, A. Chaudhary, R. Chaudhary, N. Kalra and M.K. Dwivedi, *J. Indian Soc. Soil Sci.*, **46**, 155 (1998).
8. A.B. Singh, A. Biswas and S. Ramana, *J. Plant Nutr. Soil Sci*., **166**, 345 (2003).
9. S. Ramana, A.K. Biswas, S. Kundu, J.K. Salia and R.B.R. Yadava, *Ann. Plant Soil Res*., **2**, 1 (2000).
10. A. Kaushik, R. Nisha, K. Jagjeeta and C.P. Kaushik, *Bioresour. Tech*., **96**, 1860 (2005).
11. K.M. Hati, A.K. Biswas, K. Bandypadhyay and A.K. Misra, *J. Plant Nutr. Soil Sci*., **167**, 584 (2004).
12. K.P. Raverkar, S. Ramana. A.B. Singh, A.K. Biswas and S. Kundu, *Ann. Plant Res*., **2**, 161 (2000).
13. S. Ramana, A.K. Biswas, S. Kundu, J.K. Saha and R.B.R. Yadava, *Bioresour. Tech*., **82**, 273 (2002).
14. L. Devarajan, G. Rajanan, G. Ramanathan and G. Oblisami, *Kisan World*, **21**, 48 (1994).
15. Y. Singh and R. Bahadur, *Indian J. Agric. Sci.*, **68**, 70 (1998).
16. R. Rani and M.M. Srivastava, *Int. J. Ecol. Environ. Sci.*, **16**, 23 (1990).
17. K. Rajendran, *Indian Bot. Contact*., **7**, 139 (1990).
18. R. Sahai, S. Jabeen and P.K. Saxena, *Indian J. Ecol.*, **10**, 7 (1983).
19. S. Chares, *Sugarcane*, **1**, 20 (1985).
20. G. Samuel, Proceedings of International American Sugarcane Seminar, pp. 245-252 (1986).
21. S.S. Pujar, M.Sc. (Agric.) Thesis, University of Agricultural Sciences, Dharwad, India (1995).
22. R.K. Somashekar, M.T.G. Gowda, S.L.N. Shettigar and K.P. Srinath, *Indian J. Environ. Health*, **26**, 136 (1984).
23. H.C. Basavaraju and S. Chandraju, *Asian J. Chem*., **20**, 5301 (2008).
24. H.C. Basavaraju and S. Chandraju, *SISSTA Sugar J.*, **39**, 107 (2008).
25. S. Chandraju and H.C. Basavaraju, *SISSTA Sugar J.*, **38**, 20 (2007).
26. S. Chandraju and H.C. Basavaraju, *J. Agric. Sci*., **5**, 108 (2009).
27. S. Chandraju and H.C. Basavaraju and C.S. Chidankumar, *Indian Sugar*, **58**, 19 (2008).