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Studies on the impact of irrigation of distillery spentwash on the nutrients of creeper medicinal plants

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ABSTRACT

Cultivation of some creeper medicinal plants was made by irrigation with distillery spentwash of different concentrations. The spentwash *i.e.*, primary treated spentwash (PTSW), 50% and 33% spentwash were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical characteristics. Experimental soil was tested for its chemical and physical parameters. Seeds of creeper medicinal plants (Namadhari and Mayhco) were sowed in the prepared land and irrigated with raw water (RW) 50% and 33% spentwash. The impact of distillery spentwash on proximate principles (moisture, protein, fat, fiber, carbohydrate, energy, calcium, phosphorous and iron), Vitamin content (carotene and Vitamin-C), mineral and trace elements (magnesium, sodium, potassium, copper, manganese, zinc, chromium and nickel) of creeper medicinal plants were investigated. It was found that the uptake of nutrients of all creeper medicinal plants were maximum in case of 33% spentwash irrigation than 50% spentwash and raw water irrigations.

Key words : Distillery spent wash, Creeper medicinal plants, Nutrients, Proximate principles, Harvest

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 08 (eight) liters of wastewater is discharged for every liter of ethanol production in distilleries, known as raw spentwash (RSW), which is characterized by high biological oxygen demand (BOD: 5000-8000mg/L) and chemical oxygen demand (COD: 25000-30000mg/L), undesirable color and foul smell (Joshi *et al.*,1994). Discharge of raw spentwash into open land or near by water bodies is a serious problem since it results in a number of environmental, water and soil pollution including threat to plant and animal lives. The RSW is highly acidic and contains easily oxidisable organic matter with very high BOD and COD (Patil *et al.*, 1987). Also, spentwash contains high organic nitrogen and nutrients (Ramadurai and Gearard, 1994). By installing biomethenation plant in distilleries, reduces the oxygen demand of RSW, the resulting spentwash is called primary treated spent wash (PTSW) and primary treatment to RSW increases the nitrogen (N), potassium (K), and phosphorous (P) contents and decreases the calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-), and sulphate (SO_4^{2-}). The PTSW is rich in potassium (K), sulphur (S), nitrogen (N), phosphorous (P) as well as easily biodegradable organic matter and its application to soil has been reported to increase yield of sugar cane (Zalawadia *et al.*, 1997), rice (Devarajan and Oblisami, 1995), wheat and rice (Pathak *et al.*, 1998) and physiological response of soybean (Ramana *et al.*, 2000). Diluted spentwash could be used for irrigation purpose 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 further increased soil microflora (Devarajan, 1994; Kaushik *et al.*, 2005; Kuntal *et al.*, 2004). Twelve pre-sowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield (Singh and Raj Bahadur, 1998). Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Rani and Srivastava, 1990). Increased concentration of spentwash causes decreased seed germination, seedling growth and chlorophyll content in Sunflowers (*Helianthus annuus*) and the spent wash could safely used for irrigation purpose at lower concentration (Rajendra, 1990; Ramana *et al.*, 2001). The spent wash 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 (Sahai *et al.*,

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1983). The spent wash could be used as a complement to mineral fertilizer to sugarcane (Chares, 1985). The spentwash contained N, P, K, Ca, Mg and S and thus valued as a fertilizer when applied to soil through irrigation with water (Samuel, 1986). The application of diluted spentwash increased the uptake of Zinc (Zn), Copper (Cu), Iron (Fe) and Manganese (Mn) 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 (Pujar, 1995). Mineralization of organic material as well as nutrients present in the spentwash were responsible for increased availability of plant nutrients. Diluted spentwash increase the uptake of nutrients, height, growth and yield of leaves vegetables (Chandraju and Basvaraju, 2007; Basvaraju and Chandraju, 2008), nutrients of cabbage and mint leaf (Chandraju *et al.*, 2008)· nutrients of top vegetable (Basvaraju and Chandraju, 2008), pulses, condiments, root vegetables (Chandraju *et al.*, 2008), and yields of condiments (Chidankumar and Chandraju, 2009). However, not much information is available on the influence of distillery spentwash irrigation on the nutrients of creeper medicinal plants. Therefore, the present investigation was carried out to study the influence of different proportions of spentwash on the nutrients of creeper medicinal plants.

MATERIALS AND METHODS

Field work was conducted at land in Duddagere village near Mysore, Mysore Dt., Karnataka. Before cultivation, a composite soil sample was collected from the experimental site at 25cm depth at different parts, mixed and dried under sunlight. The sample was analyzed by standard procedures (Table 1). The PTSW was used for irrigation with a dilution of 33% and 50%. The physical and chemical characteristics and amount of nitrogen(N), potassium (K), phosphorous (P) and sulphur (S) present in the PTSW, 50% and 33% distillery spentwash were analyzed using standard procedures (Tables 2 and 3). Creeper medicinal plants selected for the present investigation were Amruthaballi *(Tinospora cordifolia*), Asthisamharka (*Cissus quadrangularis*) *and* Basale (*Basella rubra*). The seeds/ sets were sown and irrigated (by applying 5-10mm/cm^2 depends upon the climatic condition) with raw water (RW), 50% and 33% SW at the dosage of twice a week and rest of the period with raw water as required. Trials were conducted for three times and at the time of maturity. Plants were harvested and proximate principle, vitamins, minerals and trace elements were analysed (Table 4).

RESULTS AND DISCUSSION

Characteristics of experimental soils such as pH, electrical conductivity, the amount of organic carbon, available nitrogen (N), phosphorous (P), potassium (K), sulphur (S), exchangeable calcium (Ca), magnesium (Mg), sodium (Na), DTPA iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) were analyzed and tabulated (Table 1). It was found that the soil composition is fit for the cultivation of plants, because it fulfils all the requirements for the growth of plants.

Table 1 : Characteristics of experimental soil

Parameters	
Coarse sand[c]	9.85
Fine sand[c]	40.72
Slit[c]	25.77
Clay[c]	23.66
pH (1:2 soln)	8.41
Electrical conductivity[a]	540
Organic carbon[c]	1.77
Available Nitrogen[b]	402
Available Phosphorous[b]	202
Available Potassium[b]	113
Exchangeable Calcium[b]	185
Exchangeable Magnesium[b]	276
Exchangeable Sodium[b]	115
Available Sulphur[b]	337
DTPA Iron[b]	202
DTPA Manganese[b]	210
DTPA Copper[b]	12
DTPA Zinc[b]	60

Units: a – μS, b – mg/L , c- %

Chemical composition of PTSW, 50% and 33% SW such as pH, electrical conductivity, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), settelable solids (SS), chemical oxygen demand (COD), biological oxygen demand (BOD), carbonates, bicarbonates, total phosphorous (P), total potassium (K), ammonical nitrogen (N), calcium (Ca), magnesium (Mg), sulphur (S), sodium (Na), chlorides (Cl), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), cadmium (Cd), lead (Pb), chromium (Cr) and nickel (Ni) were analyzed and tabulated (Table 2). Amount of N, P, K and S contents are presented in Table 3.

In the case of all leafy medicinal plants, uptake of all the parameters were very good in both 50% and 33% spentwash as compared to raw water. In both 33% and 50% spentwash irrigation, the uptake of the nutrients

Table 2 : Chemical characteristics of distillery spentwash at different dilution

Chemical parameters	PTSW	50%PTSW	33% PTSW
pH	7.57	7.63	7.65
Electrical conductivity[a]	26400	17260	7620
Total solids[b]	47200	27230	21930
Total dissolved solidsb	37100	18000	12080
Total suspended solids[b]	10240	5380	4080
Settleable solids[b]	9880	4150	2820
COD[b]	41250	19036	10948
BOD[b]	16100	7718	4700
Carbonate[b]	Nil	Nil	Nil
Bicarbonate[b]	12200	6500	3300
Total Phosphorous[b]	40.5	22.44	17.03
Total Potassium[b]	7500	4000	2700
Calcium[b]	900	590	370
Magnesium[b]	1244.16	476.16	134.22
Sulphur[b]	70	30.2	17.8
Sodium[b]	520	300	280
Chlorides[b]	6204	3512	3404
Iron[b]	7.5	4.7	3.5
Manganese[b]	980	495	288
Zinc[b]	1.5	0.94	0.63
Copper[b]	0.25	0.108	0.048
Cadmium[b]	0.005	0.003	0.002
Lead[b]	0.16	0.09	0.06
Chromium[b]	0.05	0.026	0.012
Nickel[b]	0.09	0.045	0.025
Ammonical Nitrogen[b]	750.8	352.36	283.76
Charbohydrates[c]	22.80	11.56	8.12

Units: a – µS, b – mg/L, c- %, PTSW - Primary treated distillery spentwash

Table 3 : Amount of N, P, K and S (Nutrients) in distillery Spentwash

Chemical parameters	PTSW	50% PTSW	33%PT SW
Ammonical Nitrogen[b]	750.8	352.36	283.76
Total Phosphorous[b]	40.5	22.44	17.03
Total Potassium[b]	7500	4000	2700
Sulphur[b]	70	30.2	17.8

Unit: b – mg/L, PTSW - Primary treated distillery spentwash

such as fat, calcium, zinc, copper and vitamins carotene and vitamin c were almost similar but the uptake of the nutrients and parameters such as protein, fibre, carbohydrate, energy, magnesium and phosphorous were much more in the case of 33% spentwash irrigation than 50% and raw water irrigation (Table 4). This could be due to the more absorption of plant nutrients present in spentwash by plants at higher dilution. It was also found that no negative impact of heavy metals like lead, cadmium and nickel in creepers medicinal plants. Amruthaballi (*Tinospora cordifolia*), Asthisamharka (*Cissus quadrangularis,* Basale (*Basella rubra*).

Conclusion:

It is found that the nutrients uptake in all the leafy medicinal plants were largely influenced in case of both 33 and 50% SW irrigation than with raw water. But 33% distillery spentwash showed more uptakes of nutrients when compared to 50% SW in all leafy medicinal plants. This could be due to the maximum absorption of nutrients by plants at highly diluted conditions.

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Table 4 : Nutritive values of creeper medicinal plants

Parameters	*Amruthaballi (Tinospora cordifolia)*			*Basale (Basella rubra)*			*Asthisamharka (Cissus quadrangularis)*		
	RW	50% SW	33% SW	RW	50% SW	33% SW	RW	50% SW	33% SW
Fat [a]	0.2	0.25	0.3	0.3	0.33	0.36	0.6	0.64	0.7
Acid insoluble ash [a]	0.25	0.25	0.25	0.25	0.26	0.26	0.5	0.5	0.5
Protein [a]	1.8	2.0	2.3	2.4	2.85	3.4	2.5	2.7	3.0
Fibre [a]	0.3	0.32	0.32	0.4	0.41	0.42	1.9	2.1	2.4
Carbohydrate [a]	1.9	2.0	2.2	4.2	5.3	5.8	5.8	6.0	6.5
Energy [b]	25.0	27.0	30.0	30.0	33.0	37.0	45.0	50.0	57.0
Calcium [c]	80.0	85.0	93.0	160.0	169.0	177.0	125.0	140.0	156.0
Magnesium [c]	60.0	66.0	73.0	80.0	85.0	93.0	80.0	85.0	96.0
Sodium [c]	20.0	22.0	24.0	15.0	18.0	23.0	25.0	28.0	33.0
Potassium [c]	12.0	14.0	17.0	2.0	3.0	4.2	0.2	0.32	0.45
Iron [c]	0.8	0.9	0.98	8.5	8.7	9.3	0.2	0.31	0.33
Phosphorous [c]	25.0	30.0	40.0	30.0	36.0	46.0	25.0	28.0	34.0
Zinc [c]	0.20	0.23	0.26	0.2	0.24	3.0	0.2	0.22	0.24
Manganese [c]	0.30	0.32	0.33	0.25	0.28	0.3	0.2	0.22	0.25
Copper [c]	0.05	0.06	0.08	0.04	0.045	0.047	0.05	0.05	0.059
Chlorides [c]	20.0	25.0	31.0	40.0	46.0	51.0	30.0	36.0	46.0
Lead [c]	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cadmium [c]	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chromium [c]	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003
Nickel [c]	0.001	0.001	0.001	0.002	0.002	0.002	Nil	nil	nil
Sulphur [c]	40.0	43.0	48.0	60.0	63.0	68.0	70.0	74.0	80.0
Carotene [d]	100	125.0	131.0	7000.0	7125.0	7235.0	80.0	90.0	110.0
Vitamin C [c]	15.0	17.0	20.0	80.0	88.0	97.0	30.0	36.0	47.0

Units: a- g; b- kCal; c- mg; d- µg; RW=Raw water; SW = spentwash

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REFERENCES

Basavaraju, H.C. and Chandraju S. (**2008**). 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. (**2008**). An Investigation of Impact of distillery spentwash on the nutrients of Top Vegetables. *Internat. J. agric. Sci*., **4** (2): 691-696.

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

Chandraju, S. and Basavaraju, H.C. (2007). Impact of distillery spentwash on seed germination and growth of leaves Vegetables: An investigation. SISSTA. *Sugar J.,* **38**: 20-50.

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

Chidankumar, C.S. and Chandraju, S. (2009). Impact of distillery spentwash Irrigation on the yields of some condiments: An investigation, *Sugar Tech.*, **11**(3) 303-306.

Deverajan, L. and Oblisami, G. (1995). Effect of distillery effluent on soil fertility status, yield and quality of rice. *Madras agric. 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 Technol.*, **96** : 1860-1866.

Kuntal, M.H. Ashish, K.B. Kalikinkar, B. 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**. 5. 584-590.

Lindsay, W.L. and Norvel, W.A. (1978). Development of DTPA soil test for Zn, Fe, Mn & Cu, Soil Sci. *Soc. AM.J*, **42**:421-428.

Patil, J.D. Arabatti, S.V. and Hapse, D.G. (1987). A review of some aspects of distillery spentwash (vinase) utilization in sugar cane, *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 crop. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad (Karnataka).

Ramadurai, R. and Gerard, **E.J.** (**1994**). Distillery effluent and downstream products, *SISSTA*, *Sugar J.,* **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. *Bio-resource Technol.*, **82** (3) : 273-275.

Rani, R. and Srivastava, M.M. (1990). Eco-siological response of *Pisum sativum* and *Citrus maxima* to distillery effluents. *Internat. J. Eco. Environ. Sci.*, **16**-23.

Rajendran, K. (1990). Effect of distillery effluent on the seed germination, seedling growth, Chlorophyll content and mitosis in Helianthus. *Annuus-Indian Botanical Contactor*, **7**:139-44.

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.

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

Zalawadia, 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.

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