RESEARCH PAPER International Journal of Agricultural Sciences, June to December, 2009, Vol. 5 Issue 2 : 408-410

Effect of distillery spentwash irrigation on the yields of top vegetables (Creepers) cultivated in untreated and treated soil

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ABSTRACT

Cultivation of top some vegetables (creepers) by distillery spentwash irrigation in untreated and treated soil was studied. The primary treated distillery spentwash (PTSW) and 33% spentwash were analyzed for their additive plant nutrients such as nitrogen, phosphorous, potassium, sulphur and other physical and chemical parameters. Untreated soil (plot-1) and treated soil (plot-2) were tested for chemical and physical parameters. The top vegetable (creepers) seeds (Namadhari and Mahyco) were sown in the prepared pit dimension of 2' x 2' in both plot-1 and plot-2. Seeds were irrigated with raw water and 33% spentwash. The nature of yields were studied and compared. Irrigation with 33% spentwash showed more yield for all vegetables in plot-2 as compared to plot-1 that spent wash treated soil was enriched with plant nutrients.

Key words : Top vegetables (creepers), Distillery spentwash, Yield, Untreated soil, Treated soil

INTRODUCTION

Ethanol is manufactured by the fermentation of molasses (one of the important byproducts of sugar industry) distilleries. In India, about 40 billion liters of waste water is annually discharged from distilleries, known as raw spentwash, which is characterized by undesirable color, foul odor, high biological oxygen demand (BOD: 5000-8000mg/l) and chemical oxygen demand (COD: 25000-30000mg/l) (Joshi *et al*., 1994). Raw spentwash is normally discharged into open land or near by water bodies resulting environmental, soil and underground water pollution (including threat to plant and human/animal lives). The raw spentwash is highly acidic and containing easily oxidisable organic matter. Distillery spentwash has highest content of nitrogen and plant nutrients (Ramadurai and Gerard, 1994). By installing biomethenation plant in distilleries, reduce the oxygen demand of raw spentwash. The resulting spentwash obtained is called primary treated spentwash (PTSW) and primary treatment to raw spentwash 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-}) (Mahamod Haroon *et al*., 2004). 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 be beneficial to increase sugar cane (Zalawadia *et al*., 1997), rice (Devarajan and Oblisami, 1995), wheat and rice yield (Pathak *et al*., 1998) and ground nut quality and physiological response of soybean (Ramana *et al*., 2000). Diluted spentwash increases the growth of peas shoot length, leaf number per plant, leaf area and chlorophyll content. The spentwash (SW) contained an excess of various forms of cations and anions, which are harmful to plant growth. The concentration of these constituents should be reduced to beneficial level by diluting the SW, which can be used as a substitute for chemical fertilizer. The spentwash could be used as a complement to mineral fertilizer to sugarcane. The spentwash contained nitrogen, phosphorous, potassium, calcium, magnesium and sulphur and thus valued as a fertilizer when applied to soil through irrigation water. Higher concentration of spentwash causes delay in seed germination, seedling growth and chlorophyll content in sunflower (*Helianthus annuus*) and the spentwash could safely used for irrigation purpose at low concentration. Diluted spentwash could be used for irrigation purpose without adversely affecting soil fertility (Kuntal *et al*., 2004; Raverkar *et al*., 2000) and crop productivity (Ramana *et al*., 2000). 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). The diluted effluent irrigation improved the physical and chemical properties of the soil and further increased soil microflora (Kuntal *et al*., 2004; Devrajan and Rajanna, 1994). 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 (Ramana *et al*., 2001; Rajendran,

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1990) than at higher dilution levels. Diluted spentwash increase the uptake of nutrients of cabbage and mint leaf, condiments and root vegetables, leaf vegetables (Chandraju *et al*., 2008), nutrients of pulses in untreated and treated soil (Chidankumar and Chandraju, 2008). The present investigation has been carried out to study the impact of 33% SW irrigation on the yields of top vegetables in untreated and treated soil.

Table 2 : Amount of N, P, K and S (nutrients) in spentwash (mg/L)

Chemical parameters	PTSW	33% SW
Ammonical nitrogen	743.68	276.64
Total phosphorous	30.26	6.79
Total potassium	7200	2400
Sulphur	74.8	22.6

PTSW - Primary treated spentwash, SW - Spentwash

MATERIALS AND METHODS

Physico-chemical parameters and amount of nitrogen (N), potassium (K), phosphorous (P) and sulphur (S) present in PTSW and 33% SW were analyzed (Tables 1 and 2). PTSW was used for irrigation with a dilution of 33% in the plots 1 and 2. Before initiation of the field work, plot 2 soil was treated with 33% SW for four times with an intervals of one week, each time land was ploughed and exposed to sunlight. A composite soil samples from both plot-1(untreated) and plot 2 (treated) were collected from the experimental site at 25 cm depth. The soil samples were air dried, powdered and analyzed for physico-chemical properties (Table 3). The top vegetable (creepers) seeds selected for field experiment were ash guard (*Benincasa hispida*), bitter gourd (*Momordica charancia*), pumpkin (*Cucurbita maxima*), bottle gourd (*Lageneria vulgaris*), snake gourd (*Trichosanthes anguinea*) and Ridge gourd (*Luffa acutangula*). The seeds were shown in the prepared block field and irrigated with 33% SW at the dosage of twice a week and rest of the period with raw water. The natures of yields of all vegetables were recorded at their respective maturity.

Table 1: Chemical composition of distillery spentwash

Chemical parameters	PTSW	33% SW
pH	7.36	7.24
Electrical conductivity[a]	28800	10020
Total solids[b]	46140	20870
Total dissolved solids[b]	35160	10140
Total suspended solids[b]	10540	4380
Settleable solids[b]	10070	3010
COD[b]	40530	10228
BOD[b]	16200	4800
Carbonate[b]	Nil	Nil
Bicarbonate[b]	13100	4200
Total phosphorous[b]	30.26	6.79
Total potassium[b]	7200	2400
Calcium[b]	940	380.0
Magnesium[b]	1652.16	542.22
Sulphur[b]	74.8	22.6
Sodium[b]	480	240
Chlorides[b]	5964	3164
Iron[b]	9.2	5.20
Manganese[b]	1424	368
Zinc[b]	1.28	0.41
Copper[b]	0.276	0.074
Cadmium[b]	0.039	0.010
Lead[b]	0.16	0.06
Chromium[b]	0.066	0.014
Nickel[b]	0.165	0.040
Ammonical nitrogen[b]	743.68	276.64

PTSW - Primary treated spentwash, SW - Spentwash
Units: a- µS; b- mg/l

Table 3 : Characteristics of experimental soils

Parameters	Plot-1	Plot-2
Coarse sand[a]	9.72	10.94
Fine sand[a]	40.80	42.86
Slit[a]	25.28	26.32
Clay[a]	24.2	19.88
Organic carbon[a]	0.61	0.93
Electrical conductivity[b]	526	451
pH (1:2 soln)	8.16	8.15
Available nitrogen[c]	340	460
Available phosphorous[c]	130	180
Available potassium[c]	80	65
Exchangeable calcium[c]	140	150
Exchangeable magnesium[c]	220	190
Exchangeable sodium[c]	90	180
Available sulphur[c]	240	230
DTPA Iron[c]	200	240
DTPA Manganese[c]	220	260
DTPA Copper[c]	5	8
DTPA Zinc[c]	50	65

Units: a- %; b- µS; c- ppm Plot-1: Untreated soil;
Plot-2: Treated soil

RESULTS AND DISCUSSION

It was found that the yields of all vegetables were in the order 33% SW (Plot 2),>33% SW (Plot 1)> RW (Plot 2)> RW (Plot 1) (Table 4).

Among 33% SW and RW irrigation in both untreated and treated soil, the growth of all top vegetable was highly

Table 4 : Average weight of vegetables at different irrigations (kg)

Name of vegetables	Plot-1		Plot-2	
	RW	33%SW	RW	33%SW
Ash gourd[a]	20.840	30.850	24.750	35.650
Pumpkin[a]	14.870	22.650	18.650	28.540
Bottle gourd[b]	3.840	5.480	4.350	7.280
Snake gourd[b]	1.950	3.640	2.840	4.120
Bitter gourd[c]	0.180	0.280	0.240	0.540
Ridge gourd[c]	0.640	1.540	1.320	2.630

a- Average wt. from five numbers: b-Average wt. from ten numbers
c- Average wt. from twenty numbers; RW- Raw water; SW- Spentwash

potential and high yield in the case of 33% SW as compared to RW. Also, in treated soil (plot 2) growth and yield were much greater than the untreated soil (plot 1). This concludes that, the spentwash treated soil is enriched with the plant nutrients N.P.K. Subsequent use of spentwash for irrigation enriches the soil fertility without any adverse effect and hence spentwash (33%) can be conveniently used for the irrigation of leafy vegetable plants.

Acknowledgment :

Authors are thankful to The General Manager and staff of the Chamundi Distilleries Pvt. Ltd. Maliyur, T.Narasipur Tq. Mysore Dist. for providing facilities.

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Received : February, 2009; Accepted : March, 2009