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Influence of distillery spentwash irrigation on the yields of leafy medicinal plants in normal and spentwash treated soil

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ABSTRACT

Cultivation of some leafy medicinal plants was made by irrigation with distillery spentwash of different proportions. The spentwash *i.e.*, primary treated spentwash (PTSW) 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 leafy medicinal plants, namely, Coriander (*Coriandrum sativum*), Dill (*Anethum graveolens*), Pudina /Spearmint (*Mentha viridis*), Fenugreek/Methi (*Trigonella foenum-graecum*) (Namadhari and Mayhco) were sowed in the prepared land and irrigated with raw water (RW) and 33% spent wash. Influence of spentwash in normal and spentwash treated soils on the yields were recorded at their respective maturity. It was found that the yields of all medicinal plants were high in 33% spentwashthan raw water irrigation. Further, the yields were very high in spentwash treated soil (plot-2) than normal soil (plot-1) and raw water irrigations for all plants.

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Key words : Distillery spentwash, Medicinal plants, Nutrients, Proximate principles, 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 eight (08) liters of waste water is discharged for every lifer of ethanol production in distilleries, known as 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), undesirable color with 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 RSW is highly acidic and contains easily oxidizable organic matter with very high BOD and COD (Patil *et al.*, 1987). Also, spent wash contains highest content of organic nitrogen and nutrients (Ramadurai and Gearard, 1987). 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-}) (Mahamod Haroon and Subhash Chandra Bose,2004). 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 be beneficial to increase sugar cane (Zalawadia *et al.*, 1997), rice (Devarajan and Oblisami,1998), wheat and rice yield (Pathak *et al.*,1998), quality of groundnut (Amar *et al.*, 2003) 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 *et al.*, 1994). Twelve pre sowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved

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the growth and yield (Singh and 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 spentwash could safely used for irrigation purpose at lower concentration (Rajendran,1990; Ramana *et al.*,2001). 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 spent wash, which can be used as a substitute for chemical fertilizer (Sahai *et al.*, 1983). The spent wash could be used as a complement to mineral fertilizer to sugarcane (Chares, 1985). The spent wash 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 was responsible for increased availability of plant nutrients. Diluted spent wash increases the uptake of nutrients, height, growth and yield of leafy vegetables (Chandraju *et al.*, 2008; Basavaraju and Chandraju, 2008), nutrients of cabbage and mint leaf (Chandraju *et al.*, 2008), nutrients of top vegetable (Basavaraju and Chandraju, 2008), pulses, condiments and root vegetables (Chandraju *et al.*, 2008), nutrients of pulses in normal and treated soil (Chidankumar and Chandraju, 2008).

However, no information is available on the studies of distillery spentwash irrigation on the yields of leafy medicinal 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 leafy medicinal plants in normal and spentwash treated soils.

MATERIALS AND METHODS

Physico-chemical parameters and amount of nitrogen (N), potassium (K), phosphorous (P) and sulphur (S) present in the primary treated spentwash and 33% spentwash were analyzed by standard methods (Tables 1 and 2). The PTSW 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 (33%)for four times with an intervals 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).

Leafy medicinal plants selected for present investigation were Coriander (*Coriandrum sativum*), Dill (*Anethum graveolens*), Pudina /Spearmint (*Mentha viridis*), Fenugreek/Methi (*Trigonella foenum-graecum*). Seeds/sets were sowed and irrigated with raw water (RW) and 33% spentwash in both plots at the dosage of twice a week and rest of the period with raw water. At the maturity time, medicinal plants were harvested 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 PTSW and 33% spentwash 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 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 (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 3).

The yields of all plants were very good in 33% spentwash as compared to raw water in both fields (plots 1 and 2). However, yields were high in plot-2 than plot-1 in all types of irrigations for all plants and there was no negative impact of spentwash on the yields of plants (Tables 4).

It was noticed that the yields of all leafy medicinal plants were largely influenced in case of 33% diluted spentwash irrigation than with raw water in spentwash treated soil than normal soil. 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 enriched the soil fertility and hence the diluted

Table 1 : Chemical composition of distillery spentwash

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

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

Table 2 : Amounts of N, P, K and S (nutrients) in distillery spentwash

Chemical parameters	PTSW	33%PT SW
Ammonical nitrogen[b]	750.8	283.76
Total phosphorous[b]	40.5	17.03
Total potassium[b]	7500	2700
Sulphur[b]	70	17.8

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

Table 3: Average weight of creeper medicinal plants at different irrigation (Average weights were taken from 25 plants)

Name of plants	Plot-1	Plot-2
Coriander (*Coriandrum sativum*)	0.225	0.316
Dill (*Anethum graveolens*)	0.911	1.242
Pudina /Spearmint (*Mentha viridis*)	0.193	0.246
Fenugreek/Methi (*Trigonella foenum-graecum*)	0.196	0.262

Table 4 : Characteristics of experimental soils

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

Plot-1: Normal Soil; Plot-2: Spentwash treated Soil
Units: a- %; b- µS; c-ppm

spentwash (33%) is effective eco-friendly irrigation medium for cultivation of leafy medicinal plants without any adverse effect.

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