Nutritional additives of spentwash on pulses production

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ABSTRACT

Cultivation of some pulses by distillery spentwash irrigation in normal and spentwash 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 spentwash treated soil (plot-2) were tested for chemical and physical parameters. The seeds of pulses (Namadhari and Mahyco) were sown in the prepared land dimension of 4' x 6' blocks 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 more yield for all pulses in plot-2 than compare to plot-1 concludes that spentwash treated soil is enriched with plant nutrients.

Key Words: Pulses; Distillery Spentwash; Yield; Untreated soil; Spentwash treated soil.

INTRODUCTION

Ethanol is manufactured by the fermentation of molasses distilleries. In India, about 40 billion liters of waste water is annually discharged from distilleries (or raw spentwash), which is characterized by undesirable color, foul odor, high biological oxygen demand and chemical oxygen demand (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 has 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-}) (Zalawadia *et al.,* 1947) and 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 (Mohamed Haron and Subash Chandra Bose, 2004), rice (Deverajan and Oblisami, 1995), wheat and rice yield (Pathak *et al.,* 1998) and ground nut quality and physiological response of soybean (Ramana *et al.*, 2000). However, higher concentration of spentwash causes delayed 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 (Pujar, 1995; Raverkar *et al.,* 2000; Kaushik, 2005) 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 (Devarajan and Rajanna, 1994; Kaushik, 2005). 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, 1990) than at higher dilution levels. Diluted spentwash increase the uptake of nutrients, leafy vegetables (Chandraju *et al.*, 2008) of cabbage and mint leaf (Chandraju *et al.,* 2008a), condiments and root vegetables (Chandraju *et al.,* 2008b), leaf vegetables (Chandraju *et al.,* 2008c) 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 pulses untreated and spentwash treated soil.

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). 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-1and plot-2 were collected from the experimental site at 25 cm depth. The soil samples were air dried, powdered and analyzed for physico-chemical properties (Table 2). The pulses selected for field experiment were Black gram (*Phaseolus mungo* Roxb), Cow pea (*Vigna cetjang*), Field bean (*Dolichos lablab*), Red gram (*Cajanus cajan*), Bengal gram (*Cier arietinum*), Peas (Pisum sativum), soybean (*Glycine max* Merr.), horse gram (*Dilichosbidlorus*) and Green gram (*Phaseolus aureus* Roxb.). The seeds are sowed 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 nature of yields of pulses was recorded at their maturity.

Table 1. Chemical composition of distillery spentwash (a- µS; b- mg/L)

Chemical parameters	Primary treated spentwash	Spentwash (33%)
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
Ammoniacal Nitrogen[b]	743.68	276.64

Table 2. Characteristics of experimental soils (a- %; b- µS; c- ppm)

Parameters soil	Untreated Soil	Spentwash treated
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

RESULTS AND DISCUSSION

Distillery spent wash is the unwanted residual liquid waste generated during alcohol production and pollution caused by it is one of the most critical environmental issue. Despite standards imposed on effluent quality, untreated or partially treated effluent very often finds access to watercourses. The distillery wastewater with its characteristic unpleasant odor poses a serious threat to the water quality in several regions around the globe. The ever-increasing generation of distillery spent wash on the one hand and stringent legislative regulations of its disposal on the other has stimulated the need for developing new technologies to process this effluent

Table 3. Average weight of pulses (per plant) at different irrigations (kg) (Average weight is taken from ten plants)

Name of pulses	Untreated Soil		Spentwash treated soil	
	Raw water	Spentwash (33%)	Raw water	Spentwash (33%)
Black gram	0.165	0.195	0.185	0.325
Cow pea	0.145	0.215	0.180	0.315
Field bean	0.390	0.620	0.520	0.816
Red gram	0.022	0.040	0.060	0.098
Bengal gram	0.019	0.036	0.048	0.080
Peas0.024	0.042	0.058	0.086	
Soybean	2.470	3.350	3.580	4.150
Horse gram	1.150	1.860	2.140	2.650
Green gram	1.850	3.350	3.640	4.170

efficiently and economically including plant growth and yield (Sarayu Mohana *et al*., 2009). It was found that the growth and yields of all pulses were in the order 33% SW (Plot-2),>33% SW (Plot-1)> RW (Plot-2)> RW (Plot-1) (Table 3). Among 33% SW and RW irrigation in both untreated and spentwash treated soil, the growth of all pulse plants were highly potential and high yield in the case of 33% SW as compared to RW. Also, in plot-2 growth and yield was much greater than 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 pulses without external fertilizers (either organic or inorganic), this elevates the economy of farmers. Spent wash increase soil enzymatic activity (Kalaiselvi and Mahimairaja, 2009) subsequently increase the plant growth and yield.

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