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Distillery spent wash is an effective eco-friendly irrigation medium

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ABSTRACT

Field experiment was conducted to study the variation of fertility of soil by the application of different proportions of distillery spent wash. Primary treated spent wash (PTSW), 50% and 33% spent wash were analyzed for physico-chemical parameters and plant nutrients. The experimental soil was analyzed for its physico-chemical parameters. Spent wash of different proportions were applied to the soil at regular intervals, ploughed and exposed to atmosphere. Spent wash treated soil fertility were again analyzed. It was found that the fertility increased in the order 33%>50%>PTSW treated soil.

Key words : Distillery spent wash, Plant nutrients, Soil, Fertility, Parameters.

INTRODUCTION

In India about 40 billion liters of waste water is discharged from distilleries during the production of ethanol by the fermentation of Molasses.

Molasses (one of the important byproducts of sugar industry) is the chief raw material for the production of alcohol in distilleries. They produce about 40 billion liters of wastewater known as raw spentwash, which is characterized by high biological oxygen demand (BOD: 5000-8000mg/l) and chemical oxygen demand (COD: 25000-30000mg/l) (Joshi *et al.*, 1994). Generally spentwash is discharged into open land or near by water bodies results number of environmental hazards including threat to plant and animal lives. The raw spentwash is highly acidic and containing easily oxidisable organic matter (Patil *et al.*, 1987). Spentwash contains highest content of nitrogen and plant nutrients (Ramadurai and Gearard, 1994). By adopting biomethenation plant in distilleries, reduces the oxygen demand of raw spentwash, this is called primary treated spentwash and is rich in nitrogen (N), potassium (K), and phosphorous (P) and decrease in calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-), and sulphate (SO_4^{2-}) (Mohamed Haron and Subash Chandra Bose, 2004). Also it contains easily biodegradable organic matter and its application to soil has been reported to be beneficial to increase the yield of sugar cane (Zalawadia *et al.*, 1997), rice (Deverajan and Oblisami, 1995), wheat (Pathak *et al.*, 1998), quality of groundnut (Amar B Singh *et al.*, 2003) and physiological response of soyabean (Ramana *et al.*, 2000). Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Rani and Vastava, 1990). The spentwash consists 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 spentwash, which can be used as a substitute for chemical fertilizer (Sahai *et al.*, 1983). The spentwash could be used as a complement to mineral fertilizer to sugarcane (Chares, 1985) and thus valued as a fertilizer when applied to soil through irrigation water (Samuel, 1986). Higher percentage of spentwash irrigation causes decrease in seed germination, seedling growth and chlorophyll content in sunflowers (Helianthus annuus) and the spentwash could be safely used for irrigation purpose at lower concentration (Rajendran, 1990 and Ramana *et al.*, 2001) without adversely affecting soil fertility and crop productivity (Raverkar *et al.*, 2000, Kuntal *et al.*, 2004 and Kaushik *et al.*, 2005). 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 Bahadue, 1998). The diluted spentwash irrigation improved the physical and chemical properties of the soil and further increased soil microflora (Deverajan *et al.*, 1994, Kuntal *et al.*, 2004 and Kaushik *et al.*, 2005). Application of diluted spentwash increased the uptake of Zinc (Zn), Copper (Cu), Iron (Fe) and Manganese (Mn) in maize and wheat, the highest total uptake of these were found at lower dilution than at higher dilution levels (Pujar, 1995). The diluted spentwash increase the uptake of nutrients, height, growth and yield of leaves vegetables (Chandraju and Basavaraju, 2007, Basavaraju and Chandraju, 2008, and Chandraju *et al.*, 2008), nutrients of pulses (Chandraju *et al.*, 2008), condiments and root vegetables (Chandraju *et al.*, 2008), top vegetables (Basavaraju and Chandraju, 2008), cabbage and mint (Chandraju *et al.*, 2008). Hence, the present investigation

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is carried out to study the variation in soil fertility by the application of different proportions of spent wash at different intervals to the vacant land *i.e.*, the safe and effective means of spent wash treatment to fulfill both a practical utility and a social responsibility.

MATERIALS AND METHODS

A composite soil samples were collected from the experimental field at 25 cm depth, the samples were air dried, powdered and analyzed for Physico-chemical parameters by standard methods (Table 1). PTSW, 50% and 33% spent wash were also analyzed for their physico-chemical parameters (Table 2) and plant nutrients (Table 3) by standard methods. PTSW, 50% and 33% spent wash were applied to the three different Blocks (blck-1, block-2 and block-3, respectively) once a week. The soil is exposed to sunlight, ploughed and application of spent wash is continued for a period of six weeks by repeating exposure to sun light and plough. At the end of sixth week, again a composite soil samples were collected from the treated blocks (block-1, 2 and 3) and were analyzed for Physico-chemical parameters (Table 4) and plant nutrients (Table 5) as mentioned above.

RESULTS AND DISCUSSION

Table 1 shows the physico-chemical parameters of experimental soil (block-1, 2 and 3) such as pH, electrical conductivity, amount of organic Carbon, available N, P, K, S, exchangeable Ca, Mg, Na, DTPA iron, Mn, Cu and Zn. Table 2 shows the physico-chemical parameters of PTSW, 50% and 33% spent wash. *i.e.*, pH, electrical conductivity, total solids (TS), total dissolved solids (TSD), chemical oxygen demand (COD), biological oxygen demand (BOD), carbonates, bicarbonates, Mg, S, Na, Chlorides, Fe, Mn, Zn, Cu, Cd, Pb, Cr, and Ni and also indicates changes in the parameters of PTSW, 50 per cent and 33% spent wash. The amounts of N, P, K and S content in different dilutions of spent wash are presented in Table 3.

Table 1: Physico-Chemical parameters of the experimental soil

Parameters	Units	Sample values
Coarse sand	%	9.72
Fine sand	%	40.80
Silt	%	25.28
Clay	%	24.20
pH value (1:2 solution)	--	8.16
Electrical conductivity	µS	526.00
Organic carbon	%	0.61
Available nitrogen	ppm	340.00
Available phosphorous	Ppm	130.00
Available potassium	Ppm	80.00
Exchangeable calcium	Ppm	140.00
Exchangeable magnesium	Ppm	220.00
Exchangeable sodium	Ppm	90.00
Available sulphur	Ppm	240.00
DTPA Iron	Ppm	200.00
DTPA Manganese	Ppm	220.00
DTPA Copper	Ppm	5.00
DTPA Zink	ppm	50.00

Table 2 : Physico-chemical parameters of the distillery spent wash

Parameters	Units	PTSW	50 % SW	33 % SW
pH	---	7.65	7.73	7.75
Electrical conductivity	µS	28800	19660	10020
Total solids	mg/L	46140	26170	20870
Total dissolved solids	mg/L	35160	16060	10140
Total suspended solids	mg/L	10540	5680	4380
Settleable solids	mg/L	10070	4340	3010
COD	mg/L	40530	18316	10228
BOD	mg/L	16200	7818	4800
Carbonate	mg/L	Nil	Nil	Nil
Bicarbonate	mg/L	13100	7400	4200
Total phosphorous	mg/L	30,26	12.20	6.79
Total potassium	mg/L	7200	3700	2400
Calcium	mg/L	940	600	380
Magnesium	mg/L	1652.16	884.16	542.22
Sulphur	mg/L	74.8	35.0	22.6
Sodium	mg/L	480	260	240
Chlorides	mg/L	5964	3272	3164
Iron	mg/L	9.2	6.40	5,20
Manganese	mg/L	1424	724	368
Zinc	mg/L	1,28	0.72	0.41
Copper	mg/L	0.276	0.134	0.074
Cadmium	mg/L	0.039	0.021	0.010
Lead	mg/L	0.16	0.09	0.06
Chromium	mg/L	0.066	0.032	0.014
Nickel	mg/L	0.165	0.084	0.040
Ammoniacal nitrogen	mg/L	743.68	345.24	276.64

PTSW—Primary treated spent wash,
50%SW—50% spent wash 33%SW—33% spent wash.

Table 4 indicates the changes in the physico-chemical parameters of soil of different blocks (block-1, 2, and 3). The amounts of N, P, K and S content in block-1, 2 and 3 are presented in Table 5. It is observed that the increase in the plant nutrients such as N, P, K and S were maximum in block-3 compare to block-2 and block-1. This indicated that, 33% spent wash treated soil was more fertile than 50% and PTSW. However, pH of block-1 was slightly acidic than block-2 and block-3.

Table 3 : Plant nutrients (N, P, K and S) in distillery spent wash

Chemical parameters	Units	PTSW	50%SW	33%SW
Ammoniacal nitrogen	mg/L	743.68	345.68	276.64
Total phosphorous	mg/L	30,26	12.20	6.79
Total potassium	mg/L	7200	3700	2400
Sulphur	mg/L	74.8	35.0	22.6

PTSW—Primary treated spent wash.
50%SW—50% spent wash, 33%SW—33% spent wash

Table 4 : Physico-chemical parameters of treated soil with different proportion of spent wash (after 6th week)

Chemical parameters	Units	Characteristics of soil		
		Block-1	Block-2	Block-3
pH	---	7.65	7.73	7.75
Electrical conductivity	µS	28800	19660	10020
Course sand	%	9.85	9.82	10.23
Fine sand	%	40.62	40.24	40.18
Silt	%	25.8	25.4	25.3
Clay	%	23.7	24.3	19.8
Taxonomic name	--	Typic Rhodustalf	Typic Rhodustalf	Ty[pic Rhodustalf
Textural class	--	Loamy sand	Loamy sand	Loamy sand
Organic carbon	%	1.78	1.21	0.94
Available nitrogen	ppm	404	380	385
Available phosphorous	ppm	202	206	208
Available potassium	ppm	113	95	88
Available sulphur	ppm	336	325	320
Exchangeable magnesium	ppm	275	265	260
Exchangeable calcium	ppm	185	180	165
Exchangeable sodium	ppm	125	120	118
DTPA Iron	ppm	234	230	232
DTPA Manganese	ppm	254	250	252
DTPA Zinc	ppm	72	74	76
DTPA Copper	ppm	16	18	20

Block-1: Soil treated with P.T.S.W, Block-2: Soil treated with 50% S.W., Block-3: Soil treated with 33% S.W.

Table 5 : Plant nutrients (N, P, K and S) in treated soil with different proportion of spent wash (after 6th week)

Chemical parameters	Units	Block -1	Block -2	Block-3
Ammoniacal nitrogen	mg/L	540	520	510
Total phosphorous	mg/L	180	170	165
Total potassium	mg/L	108	104	102
Sulphur	mg/L	252	248	246

Block -1: Soil treated with P.T.S.W, Block -2: Soil treated with 50% S.W., Block -3: Soil treated with 33% S.W.

Conclusion:

By considering the plant nutrients of different blocks, it was found that, the fertility of soil increased in the order 33%> 50%>PTSW treatment. This could be due to the maximum absorption of plant nutrients by the soil at more diluted conditioned spent wash. Hence, distillery spent wash was diluted to required proportion (33%) with water and can be conveniently used without adversely affecting the environment, soil and water as irrigation medium for the effective cultivation of crops in agriculture. This makes the beneficial usage of spent wash, which avoids the additional requirements of fertilizer in agriculture and improves economy of farmers and in turn to the Nation.

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