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RESEARCH ARTICLE

Irrigational Impact of Distillery Spentwash on the Yields of Mustard *(Brassica nigra)* and Castor *(Ricinus communis)* Oil Seed Plants

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Abstract: Cultivation of Mustard (*Brassica nigra*) and Castor (*Ricininus Indicum*) seeds was made by irrigated with distillery spentwash of different concentration. The spentwash *i.e*. primary treated spentwash [PTSW] 1:1, 1:2 and 1:3 spentwash were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and physicochemical characteristics. Experimental soil was tested for its physical and chemical parameters. Mustard and castor seeds were sowed in the prepared land and irrigated with raw water (RW), 1:1, 1:2 and 1:3 (SW: RW) spent wash. The influence of spent wash on the yields of oil seed plants at their respective maturity was investigated. It was found that the yields of oil seed plants were more in 1:3 spentwash irrigation than raw water and 1:1, 1:2 spentwash irrigation. Hence, spentwash can be conveniently used as irrigation medium at a specified dilution with out polluting atmosphere,water and soil.

Keywords: Distillery spentwash, Castor seed, Mustard seed, Yield, Irrigation

Introduction

Ethanol is produced by the fermentation of Molasses in distilleries, since the demand of ethanol of is increasing in recent days due to its usages as fuel blended with petrol and diesel, a large number of distilleries coming up. About 8 (eight) liters of waste water is generated for every liter of ethanol production in distilleries, known as raw spentwash(RSW) which is characterized by high biological oxygen demand (BOD:5000-8000 mg/L) and chemical oxygen demand (COD:25000-30000 mg/L)[1], undesirable color. Discharge of raw spentwash into open land or near by water bodies is dangerous, since it results in number of environmental, water and soil pollution including threat to plant and animal lives. The RSW is highly acidic and contains easily oxdisable organic matter with very high BOD and COD[2]. Also, spent wash contains high organic nitrogen and nutrients[3], By installing biomethenation plant in distilleries, reduces the oxygen demand of RSW, the resulting

spentwash is called primary treated spent wash (PTSW) and primary treated to RSW increases the nitrogen (N), phosphorous (P) and potassium (K) and decreases calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-), and sulphate[4], The PTSW is rich in potassium (K), sulphur (S), nitrogen (N), phosphorous(P), as well as easily bio degradable organic matter and its application to soil has been reported to increase the yield of sugarcane[5], rice[6] wheat, rice yield[7], quality of groundnut[8] and physiological response of soybean[9]. Diluted spentwash could be used for irrigation purpose without adversely affecting soil fertility[10-12], seed germination and crop productivity[13]. The diluted spentwash irrigation improved the physical and chemical properties of the soil and further increased soil micro flora[14]. Twelve pre-sowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield[15]. Diluted spent wash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas[16] .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[17]. The spent wash contained in excess of various forms of cations, 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 substitute for chemical fertilizer[18]. The spentwash could be used as a compliment to mineral fertilizer to sugarcane[19]. 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[20]. The application of diluted spentwash compared to control and the highest total uptake of these were found at lower dilution levels than at higher dilution levels[21]. Mineralization of organic material as well as nutrients present in the spentwash was responsible for increased availability of plant nutrients. Diluted spentwash increases the yield of leafy vegetable[22-26], yields of herbal medicinal[27] yields of raddish[28a]. However no information is available on the studies of yields of Mustard (*Brassica nigra*) and Castor (*Ricinus communus*) oil seed plants. Therefore, the present investigation was carried out to study the influence of different concentration of spentwash on the yeilds of Mustard (*Brassica nigra*), Castor (*Ricinus Communis*) plants.

Experimental

Field work was conducted at own land in Halebudanur village near Mandya, Karnataka. Before cultivation, a composite soil sample was collected from experimental site at 25 cm depth at different sites, mixed and dried under sunlight. The sample was analyzed by standard procedures (Table 1). The PTSW was used for irrigation with a dilution of 1:1, 1:2 and 1:3 ratios. The physical and chemical characteristics and amount of nitrogen (N) Potassium (K), Phosphorous (P) and sulphur (S) present in the PTSW, 1:1, 1:2 and 1:3 distillery spentwash were analyzed[28b] using standard procedures (Tables 2 and 3).

Table 1. Physicochemical properties of soil

Parameters	Values
Coarse sand[c]	9.85
Fine sand[c]	40.72
Slit[c]	25.77
Clay[c]	23.66

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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
Exchangable Calcium[b]	185
Exchangable Magnesium[b]	276
Exchangable 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-%

Table 2. Chemical characteristics of distillery spentwash at different dilution

Chemical parameters	PTSW	1:1 PTSW	1:2 PTSW	1:3 PTSW
pH	7.57	7.63	7.65	7.66
Electrical conductivity	26400	17260	7620	5330
Total solids	47200	27230	21930	15625
Total dissolved solids[b]	37100	18000	12080	64520
Total suspended solids[b]	10240	5830	2820	1250
Settleable solids[b]	9880	4150	4700	3240
COD[b]	41250	19036	4700	2140
BOD[b]	16100	7718	4700	2430
Carbonate[b]	Nil	Nil	Nil	Nil
Bicarbonate[b]	12200	6500	3300	1250
Total Phosphorous[b]	40.5	22.44	17.03	10.80
Total potassium[b]	7500	4000	2700	1620
Calcium[b]	900	590	370	190
Magnesium[b]	1244.16	476.16	134.22	85
Sulphur[b]	70	30.2	17.8	8.4
Sodium[b]	520	300	280	140
Chlorides[b]	6204	3512	3404	2960
Iron[b]	7.5	4.7	3.5	2.1
Manganese[b]	980	495	288	160
Zinc[b]	1.5	0.94	0.63	0.56
Copper[b]	0.25	0.108	0.048	0.026
Cadmium[b]	0.005	0.003	0.002	0.001
Lead[b]	0.16	0.09	0.06	0.003
Chromium[b]	0.05	0.026	0.012	0.008
Nickel[b]	0.09	0.045	0.025	0.012
Ammonical Nitroge [b]	750.8	352.36	283.76	178
Carbohydrates[c]	22.80	11.56	8.12	6.20

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

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

Chemical Parameters	PTSW	1:1PTSW	1:2 PTSW	1:3 PTSW
Ammonical Nitrogen[a]	750.8	352.36	283.76	160.5
Total Phosphorous[a]	40.5	22.44	17.03	11.2
Total Potassium[a]	7500	4000	2700	1800
Sulphur[a]	70	30.2	17.8	8.6

Unit: a- mg/L, PTSW: Primary treated spentwash

Table 4. Characteristics of experimental soil

Parameters	Values
Coarse sand[c]	9.69
Fine sand[c]	41.13
Slit[c]	25.26
Clay[c]	24.26
pH (1:2 soln)	8.27
Electrical Conductivity[a]	544
Organic Carbon[c]	1.98
Available Nitrogen[b]	434
Available Phosphorous[b]	218
Available Potassium[b]	125
Exchangable Calcium[b]	185
Exchangable Magnesium[b]	276
Exchangable Sodium[b]	115
Available Sulphur[b]	337
DTPA Iron[b]	212
DTPA Manganese[b]	210
DTPA Copper[b]	12
DTPA Zinc[b]	60

Units: a – µS, b-mg\L, c-%

Oil seed plants selected for the present investigation was Mustard and Castor. The seeds were sowed and irrigated (by applying 5-10 mm^3/cm^2 depends upon the climatic condition) with raw water (RW), 1:1,1:2 and 1:3 SW at the dosage of twice a week and rest of the period with raw water depend upon the climatic condition. Trials were conducted for three times and average yield were recorded (Table 5).

Table 5. Average Weight of Oil seed plants (Average 25 plants) Average weight (kg)

Name of oil seed plants	RW	1:1 PTSW	1:2 PTSW	1:3PTSW
Castor (Ricinus Communis)	0.5155	0.4585	0.4900	0.8500
Mustard(Brasica nigra)	0.2900	0.2508	0.2750	0.4560

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. Chemical composition of PTSW, 1:1,1:2 and1:3 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 both cases, the yield was 100% in 1:3 SW, 25% in 1:1 SW, 80% in 1:2 SW and 95% in RW irrigations. Yield was very poor in 1:1 SW irrigation compare with RW, 1:2 and 1:3 irrigations. Maximum yield was observed in 1:3 SW compare to RW, 1:1 and 1:2 irrigations.

Conclusion

It was found that the yield of was good (100%) in 1:3 SW irrigation, while very poor in 1:1SW (25%), moderate in 1:2 SW (80%) and 95% in RW irrigations. In 1:3 SW irrigation the plants are able to absorb maximum amounts of nutrients both from the soil land the spent wash resulting yields. This concludes that, the Spentwash can be conveniently used for the cultivation of oil seed plants without external (either organic or inorganic) fertilizers. This minimizes the cost of cultivation and hence elevates the economy of the farmers.

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