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Impact of distillery spentwash irrigation on the yields of some top vegetables: An investigation

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ABSTRACT

Cultivation of some top vegetables was made by irrigation with distillery spent wash of different proportions. The spent wash i.e., primary treated spent wash (PTSW), 50% and 33% spent wash were analyzed for its plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical parameters. Experimental soil was tested for its chemical and physical parameters. Top vegetables seeds (Namadhari and Mayhco) were sowed in the prepared land and irrigated with raw water (RW), 50% and 33% spent wash. The impact of spent wash on the yields of vegetables at their maturity periods was investigated.

Key words: Distillery spent wash, Yields, Impact, Top vegetables, Seeds, Soil.

INTRODUCTION

Molasses (one of the important byproducts of sugar industry) is the chief source for the production of alcohol in distilleries by fermentation method. About 40 billion liters of waste water annually discharged in distilleries, known as raw spent wash (RSW), which is characterized by high biological oxygen demand (BOD: 5000-8000mg/l) and chemical oxygen demand (COD: 25000-30000mg/l) (Joshi,1994) , ugly color and bad 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 spent wash is a great problem. The RSW is highly acidic and contains easily oxidisable organic matter with very high BOD and COD (Patil, 1987). Also, spent wash contains highest content of organic nitrogen and nutrients (Ramadurai and Gearard, 1994). By installing biomethenation plant in distilleries, reduces the oxygen demand of RSW, the resulting spent wash 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-}) (Mohammad Haron 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 Zalwadia, 1997), rice (Devarajan and Oblisami, 1995), wheat and rice yield (Pathak et al.,), quality of groundnut (AmarSingh *et al.*, 2003) and physiological response of soybean (Ramana et al., 2000). Diluted spent wash 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 spent

wash irrigation improved the physical and chemical properties of the soil and further increased soil microflora (Devarajan, 1994; Kaushik *et al,* 2005; Kuntal *et al.,* 2004). Twelve pre sowing irrigations with the diluted spent wash had no adverse effect on the germination of maize but improved the growth and yield (Singh and Raj Bahadur, 1998). Diluted spent wash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Ravi and Srivastava, 1990). Increased concentration of spent wash causes decreased seed germination, seedling growth and chlorophyll content in sunflowers (Helianthus annuus) and the spent wash could safely used for irrigation purpose at lower concentration (Rajendra, 1990; Ramana *et al.,* 2001). The spent wash 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 spent wash increased the uptake of Zinc, Copper, Iron and Manganese 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 spent wash was responsible for increased availability of plant nutrients. Diluted spent wash increase the uptake of nutrients, height, growth and yield of leaves vegetables (Chandraju *et al.,* 2007; Basvaraju and Chandraju, 2008), nutrients of cabbage and mint leaf (Chandraju *et al.,* 2008) , nutrients of top vegetable (Basvaraju and Chandraju,2008), pulses, condiments and root vegetables (Chandraju *et al.,* 2008). However, not much information is available on the impact of distillery spent wash on the yields of top vegetables. Therefore the present investigation was carried out to investigate the impact of different proportions of spent wash on the yields of top vegetables.

MATERIAL AND METHODS

Physico-chemical parameters and amount of nitrogen, potassium, phosphorous and sulphur present in the primary treated spent wash 50% and 33% spent wash were analyzed by standard methods (Tables 1 and 2). The PTSW was used for irrigation with a dilution of 33% and 50%. Before initiation, the A composite soil sample was collected at 25 cm depth, air-dried, powdered and analyzed for physico-chemical properties (Table 3).

Top vegetables selected for the present investigation were, Brinjal (*Solanum melongena*), Beans (*Phaseous coccineus*), Cauli flower (*Brassica oleracea Var. botrytis*), Cucumber (*Cucumis sativas*), Chillies (*Green*), Capsicum (*GiantChillies*), Clusterbeans (*Cyamopsistet-ragonolba*), Cabbage (*Leaf*), Cabbage (*Brassica oleracea Var. Capitata*), Ladies finger (*Abelmoschus esculentus*).The seeds were sowed and irrigated with raw water (RW), 50% and 33% spent wash at the dosage of twice a week and rest of the period with raw water as required. At the maturity time, vegetables were harvested; the yields were recorded by taking the average weight (Table 4).

RESULTS AND DISCUSSION

Chemical composition of PTSW, 50% and 33% spent wash 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, ammoniacal nitrogen, calcium, magnesium, sulphur, sodium, chlorides (Cl), iron, manganese, zinc, copper, cadmium, lead, chromium and nickel were analyzed and tabulated (Table 1). Amount of N, P, K and S contents are presented in Table 2.

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

Table 1: Chemical composition of distillery spent wash

Chemical 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	600.0	380.0
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
Ammonical Nitrogen	mg/L	743.68	345.24	276.64

PTSW - Primary treated distillery spent wash
50% SW - 50% Distillery spent wash
33% SW - 33% Distillery spent wash

Table 2: Amount of N, P, K and S (Nutrients) in distillery Spent wash

Chemical parameters	Units	PTSW	50% SW	33% SW
Ammonical Nitrogen	mg/L	743.68	345.24	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 distillery spent wash
50% SW - 50% Distillery spent wash
33% SW - 33% Distillery spent wash

Table 3: Characteristics of experimental soil

Parameters	Units	
Coarse sand	%	9.72
Fine sand	%	40.80
Slit	%	25.28
Clay	%	24.2
pH (1:2 soln)	%	8.16
Electrical conductivity	µS	526
Organic carbon	%	0.61
Available Nitrogen	ppm	340
Available Phosphorous	ppm	130
Available Potassium	ppm	80
Exchangeable Calcium	ppm	140
Exchangeable Magnesium	ppm	220
Exchangeable Sodium	ppm	90
Available Sulphur	ppm	240
DTPA Iron	ppm	200
DTPA Manganese	ppm	220
DTPA Copper	ppm	5
DTPA Zinc	ppm	50

(Ca), magnesium (Mg), sodium (Na), DTPA iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) were analyzed and tabulated (Table 3).

The yields were very high in the case of 33% spent wash irrigation for all the vegetables (Table-4) than compare with 50% spent wash and RW. However, the percentage yield is maximum in the case of Ladies finger (108%) and minimum in the case of Cabbage (Leaves) (35.4%), {Chillies green (89.5),Beans (81.8%),Cluster beans (75%), Cauli flower (64.9%),Cucumber (61.8%), Capsicum-Giant chillies (48.3%), Brinjal (45.5%),Cabbage (60.3%)}.

The soil was tested after the harvest of vegetables, shows that, there is enrich in the plant nutrients (N.P.K) in the soil and no adverse effect on other parameters.

Table 4: Average weight of vegetables at different irrigation

Name of vegetable	Average weight of vegetable (in Kg.)		
	RW	**50%SW**	**33%SW**
Brinjal [b](*Solanum melongena*)	0.165	0.195	0.230
Beans[c] (*Phaseous coccineus*)	0.022	0.031	0.040
Cauli flower[a](*Brassica oleracea Var. botrytis*	1.850	2.400	3.350
Cucumber[a](*Cucumis sativas*)	1.150	1.350	1.860
Chillies [c](*Green*)	0.019	0.028	0.036
Capsicum [b](*Giant chillies*)	0.145	0.180	0.215
Cluster beans[c](*Cyamopsistetragonolba*)	0.024	0.033	0.042
Cabbage [a](Leaves)	2.470	2.980	3.350
Cabbage [b](*Brassica oleracea Var. Capitata*)	0.390	0.510	0.620
Ladies finger[c] (*Abelmoschus esculentus*)	0.041	0.062	0.085

a - Average weight of ten numbers.
b- Average weight of twenty numbers.
c- Average weight of fifty numbers.
RW - Raw water
50%SW- 50% Distillery spent wash
33%SW- 33% Distillery spent wash

CONCLUSION

It was noticed that the yields of all the vegetables were maximum in the case of 33% , moderate in 50% spent wash and minimum in raw water irrigation. This concludes that, the spent wash can be conveniently used for the cultivation of top vegetables without external (organic or inorganic) fertilizers. This saves the cost of cultivation and elevates the economy of the farmers as well as the country. Also, it was found that the soil was enriched in N.P.K contents results increase in soil fertility the harvest of vegetables, Hence the distillery spentwash can be conveniently used repeatedly for the growth of top vegetables.

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