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Original Research Paper

Impact of Distillery Spentwash Irrigation on Nutrients of Some Fruits: An Investigation

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ABSTRACT

Cultivation of some fruit plants was made by irrigation with distillery spentwash of different concentrations. Primarily treated spentwash (50% and 33%) was analysed for plant nutrients such as nitrogen, phosphorus, potassium and other physico-chemical parameters. The plants were cultivated by irrigation with raw water (RW) and 50% and 33% spentwash. The impact of spentwash on proximate principles (moisture, protein, fat, fibre, carbohydrate, energy, calcium, phosphorus and iron), vitamin content (carotene and vitamin-c), mineral and trace elements (magnesium, sodium, potassium, copper, manganese, zinc, chromium and nickel) and nutritive value of ripened fruits were analysed. It was observed that there is good nutrients uptake in 33% in all the fruits than 50% spentwash and raw water.

INTRODUCTION

Molasses based distillery units discharge large quantities of wastewater and are facing problems in the disposal of the same. They produce annually about 40 billion litres of wastewater known as raw spentwash (RSW), which is characterized for its high biochemical oxygen demand (BOD: 25000-30000 mg/L) and chemical oxygen demand (COD: 70,000-100,000 mg/L) (Joshi et al. 1994). Indiscriminate disposal of the spentwash into water and land leads drastic changes of nutrient and biological status of soil and resulting in a number of environmental hazards including threat to human, plant and animal lives. Distillery spentwash contains highest organic nitrogen and nutrients (Patil et al. 1987, Ramadurai & Gearad 1994). Primary treatment to RSW increases the nitrogen (N), potassium (K) and phosphorus (P) contents and decreases calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-) and sulphate (SO_4^{2-}) (Mohamad Haron et al. 2004). The primarily treated spentwash (PTSW) is rich in potassium (K), sulphur (S), nitrogen (N), phosphorus (P) as well as easily biodegradable organic matter, and its application to soil has been reported to be beneficial to increase sugarcane (Zalwadia et al. 1997), rice (Deverajan & Oblisami 1995), wheat yield (Pathak et al. 1998), quality of groundnut (Singh et al. 2003) and physiological response of soyabean (Ramana et al. 2000). Diluted spentwash could be used for irrigation without adversely affecting soil fertility (Kaushik et al. 2005, Kuntal et al. 2004, Raverkar et al. 2000) and seed germination and crop productivity (Ramana et al. 2001). The diluted spentwash irrigation improved the physical and chemical properties of soil and further increased soil microflora (Kaushik et al. 2005, Kuntal et al. 2004, Deverajan et al. 1994). Diluted spentwash increases the growth of shoot length, number of leaves per plant, leaf area, chlorophyll content in peas (Rani et al. 1990). Higher concentration of spentwash affects seed germination, seedling growth and chlorophyll content in sunflower (*Helianthus annuus*), while the spentwash could be safely used for irrigation purpose at low concentration (Ramana et al. 2001, Rajendran 1990). The spentwash also contains excess of various forms of cations and anions, which may be injurious to plants. The concentration of these 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 is used as a supplement to mineral fertilizer to sugarcane (Chares 1985). The spentwash contains N, P, K, Ca, Mg and S and, thus, valued as a fertilizer when applied to soil through irrigation water (Samuel 1986). 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). The diluted spentwash increase the uptake of nutrients, height, growth and yield of leafy vegetables (Basavaraju & Chandraju 2008, Chandraju et al. 2008), nutrients of pulses (Chandraju et al. 2008), top vegetables (Basavaraju & Chandraju 2008), cabbage and mint (Chandraju et al. 2008). However, not much information is available on irrigation with spentwash on fruit plants. Therefore, the present investigation was carried out to investigate the impact of different concentrations of spentwash on the nutrients of musk melon (*Cucumis melo*), water melon (*Citrullus vulgaris*) and tomato ripe (*Lycopersicon esculentum*).

MATERIALS AND METHODS

Experiment was conducted in the field of Chamundi Distilleries Pvt. Ltd., Maliyur, Karnataka. Before initiation, a composite soil sample was collected from the experimental site at 25 cm depth, air-dried and analysed for physico-chemical properties (Table 1). The PTSW was used for the irrigation with suitable dilution, i.e., 33% and 50%. Physical and chemical parameters and amount of nitrogen (N), potassium (K), phosphorus (P) and sulphur (S) present in the PTSW were analysed by standard methods (Table 2). The seeds of musk melon (*Cucumis melo*), water melon (*Citrullus vulgaris*) and tomato (*Lycopersicon esculentum*) were irrigated with raw water (RW), 33% and 50% spentwash at the dosage of twice a week and rest with raw water. The nutrients of matured (ripened) fruits were analysed and presented in Tables 3-5.

RESULTS AND DISCUSSION

The soil characteristics are presented in Table 1 and the chemical composition of 50% and 33% spentwash in Table 2. It was found that nutrients uptake in all the three fruits, musk melon, water melon and ripe tomato, was influenced in both 50% and 33% spentwash than raw water irrigation. In case of musk melon, the magnitude of moisture content, carbohydrate, energy, calcium, magnesium, sodium, potassium, iron, phosphorus, zinc, chloride, sulphur, carotene and vitamin-C were remarkably improved in 33% as compared to 50% spentwash and raw water irrigation (Table 3).

In water melon, the contents of magnesium,

Table 1: Physico-chemical properties of the experimental soil.

Parameters	Units	Sample values
Coarse sand	%	10.94
Fine sand	%	42.86
Slit	%	26.32
Clay	%	19.88
pH value (1:2 solution)	-	8.15
Electrical conductivity	µS	451
Organic carbon	%	0.93
Available Nitrogen	ppm	460
Available Phosphorus	ppm	180
Available Potassium	ppm	65
Exchangeable Calcium	ppm	150
Exchangeable Magnesium	ppm	190
Exchangeable Sodium	ppm	180
Available Sulphur	ppm	230
DTPA Iron	ppm	240
DTPA Manganese	ppm	260
DTPA Copper	ppm	8
DTPA Zinc	ppm	65

Table 2: Physico-chemical properties of distillery spentwash.

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 Phosphorus	mg/L	30.26	12.20	6.79
Total Potassium	mg/L	7200	3700	2400
Calcium	mg/L	940.0	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: Primarily treated distillery spentwash; 50% SW: 50% distillery spentwash; 33% SW: 33% distillery spentwash

sodium, potassium, iron, phosphorus, chloride, sulphur and vitamin-C were greatly improved in 33% compared to 50% spentwash and raw water irrigation (Table 4).

In tomato ripe, the amounts of calcium, magnesium, sodium, potassium, phosphorus, chloride, sulphur, carotene and vitamin-C were increased to greater extent in 33% compared to 50% spentwash and raw water irrigation (Table 5).

The results revealed that all the nutrients uptake was significantly influenced by the application of diluted spentwash than raw water irrigation. But there was no uptake of heavy metals like lead, cadmium and nickel in all the fruits.

CONCLUSION

The nutrients uptake in all the three varieties was good in the case of 33% spentwash irrigation than with 50% spentwash and raw water irrigation. This concludes that, the maximum absorption of plant nutrients from the soil and spentwash at highly diluted spentwash by the plants. Hence, 33% spentwash can be conveniently used for irrigation of fruit plants like musk melon, water melon and tomato.

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Table 3: Nutrients of musk melon (*Cucumis melo*) at different irrigations.

Parameters	Units	RW	50%SW	33%SW
Moisture	g	96.0	95.9	96.5
Fat	g	0.18	0.21	0.22
Acid insoluble Ash	g	0.05	0.08	0.09
Protein	g	0.29	0.29	0.3
Fibre	g	0.38	0.4	0.4
Carbohydrate	g	3.0	3.6	3.7
Energy	k.cal	16.9	18.1	18.4
Calcium	mg	30	34	38
Magnesium	mg	32	34	36
Sodium	mg	104.0	105.2	106.0
Potassium	mg	360	370	375
Iron	mg	1.41	1.42	1.46
Phosphorous	mg	14	14.2	15.2
Zinc	mg	0.27	0.28	0.3
Manganese	mg	0.01	0.02	0.02
Copper	mg	0.028	0.03	0.04
Chlorides	mg	79	81	83
Lead	mg	Nil	Nil	Nil
Cadmium	mg	Nil	Nil	Nil
Chromium	mg	0.005	0.006	0.006
Nickel	mg	Nil	Nil	Nil
Sulphur	mg	32.0	33.2	34.2
Carotene	µg	168	170	173
Vitamin-C	mg	30.0	30.8	31.0
Sulphur	mg	41.0	42.9	43.2
Carotene	µg	Nil	Nil	Nil
Vitamin-C	mg	2.0	2.4	2.6

Table 4: Nutrients of water melon (*Citrullus vulgaris*) at different irrigations

Parameters	Units	RW	50%SW	33%SW
Moisture	g	94.0	95.9	96.0
Fat	g	0.2	0.22	.022
Acid insoluble Ash	g	0.08	0.07	0.07
Protein	g	0.4	0.46	0.5
Fibre	g	0.22	0.22	0.28
Carbohydrate	g	3.1	3.4	3.5
Energy	k.cal	20	22	23
Calcium	mg	10.0	11.4	11.9
Magnesium	mg	12.6	13.8	14.2
Sodium	mg	27.0	28.4	29.6
Potassium	mg	158	161	163
Iron	mg	7.9	8.0	8.4
Phosphorous	mg	12.0	13.4	14.8
Zinc	mg	0.04	0.05	0.05
Manganese	mg	0.02	0.06	0.06
Copper	mg	0.05	0.06	0.07
Chlorides	mg	20.0	22.0	23.4
Lead	mg	Nil	Nil	Nil
Cadmium	mg	Nil	Nil	Nil

Table cont....

...Cont Table 4

Chromium	mg	0.001	0.001	0.001
Nickel	mg	Nil	Nil	Nil
Sulphur	mg	41.0	42.9	43.2
Carotene	µg	Nil	Nil	Nil
Vitamin-C	mg	2.0	2.4	2.6

Table 5: Nutrients of Tomato ripe (Lycopersicon esculentum) at different irrigations.

Parameters	Units	RW	50%SW	33%SW
Moisture	g	90.5	90.8	90.6
Fat	g	0.21	0.22	0.22
Acid insoluble Ash	g	0.02	0.03	0.03
Protein	g	1.5	1.6	1.6
Fibre	g	0.72	0.8	0.8
Carbohydrate	g	3.2	3.7	3.8
Energy	k.cal	18	20	20
Calcium	mg	47.8	48.0	50.4
Magnesium	mg	12	12	14
Sodium	mg	11.4	12.9	16.0
Potassium	mg	140	146	150
Iron	mg	1.2	1.4	1.4
Phosphorous	mg	30.	31	32
Zinc	mg	0.4	0.42	0.42
Manganese	mg	0.25	0.27	0.27
Copper	mg	0.18	0.19	0.19
Chlorides	mg	6.0	7.1	7.2
Lead	mg	Nil	Nil	Nil
Cadmium	mg	Nil	Nil	Nil
Chromium	mg	0.015	0.015	0.015
Nickel	mg	Nil	Nil	Nil
Sulphur	mg	20	20	22
Carotene	µg	349	352	359
Vitamin-C	mg	28	30	32

RW: Raw water; 50% SW: 50% distillery spentwash; 33%SW: 33% distillery spentwash

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