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Impact of distillery spentwash irrigation on the yield of Jasmine *(Oleaceae)* flowering plant

S. Chandraju*[1], C. Thejovathi [1] and C. S. Chidan Kumar[2]

[1]Department of Studies in Sugar Technology, Sir M. Vishweswaraya Postgraduate Center, University of Mysore, Tubinakere, Mandya -571402, Karnataka, India
[2]Department of Chemistry, Alva's Institute of Engineering & Technology, Shobhavana Campus, Mijar, Moodbidri -574225, South Canara Dt. Karnataka, India.

Abstract
The yields of Jasmine *(Oleaceae*) flowering plant was investigated by irrigated with different concentrations distillery spentwash. Primary treated spentwash (100% 1:1, 1:2, and 1:3) was analyzed for plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical characteristics. Soil was tested for chemical and physical parameters. Jasmine (*Oleaceae*) sets were planted in different pots and irrigated with raw water (RW), 1:1, 1:2 and 1:3 spentwash. The nature of yields was studied. It was found that the yields of plant was very good (100%) in 1:3 SW irrigation, while very poor (25%) in 1:1 SW, moderate (80%) in 1:2 SW and 95% in RW irrigation growth.

Keywords: Distillery spentwash, Jasmine (Oleaceae), yield, Irrigation, Soil.

INTRODUCTION

Jasmine belongs to genus of shrubs and vines in the olive family (*oleaceae)*, with about 200 species native to tropical and warm temperature regions of the entire World. The leaves can be either evergreen (green all year round) or deciduous (falling in autumn) [1]. Jasmine tea is consumed in China, as it is called jasmine –flower tea. Its chemical constituents include methyl anthranilate, indole, benzyl alcohol, linalool, and skatole; which is used in perfumes and incense. The white jasmine branch is used in painting of ink and color on silk by Chinese artist. In Syria, jasmine is the symbolic flower of Damascus (Jasmine flower guide). In Thailand, jasmine flowers are used as a symbol of mother. Jasmine is the National flower of the Tunisia, Indonesia and Pakistan.

Molasses (one of the important byproducts of sugar industry) is the chief source for the production of ethanol in distilleries by fermentation method. About 08 (eight) liters of wastewater is generated for every liter of ethanol production in distilleries, known as raw spentwash (RSW), which is known for high biological oxygen demand (BOD: 5000-8000mg/L) and chemical oxygen demand (COD: 25000-30000mg/L), undesirable color and foul odor[2]. Discharge of RSW into open field or nearby water bodies' results in environmental, water and soil pollution including threat to plant and animal lives. The RSW is highly acidic and contains easily oxidisable organic matter with very high BOD and COD[3]. Also, spentwash contains high organic nitrogen and nutrients [4]. By installing biomethenation plant in distilleries, reduces the oxygen demand of RSW, the resulting spent wash is called primary treated spentwash (PTSW) and primary treatment to RSW increases the nitrogen (N), potassium (K), and phosphorous (P) contents and decreases calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-), and sulphate (SO_4^{2-})[5]. 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 increase yield of sugar cane [6], rice [7], and wheat and rice [8]. Diluted spentwash could be used for irrigation purpose without adversely affecting soil fertility [9, 10, 11]. The diluted spentwash irrigation improved the physical and chemical properties of the soil and further increased soil micro flora [12]. Twelve pre-sowing irrigations with the diluted spent wash had no adverse effect on the germination of maize but improved the growth and yield [13]. Increased concentration of spentwash 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 [14, 15]. 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 spentwash, which can be used as a substitute for chemical fertilizer [16]. The spentwash could be used as a complement to mineral fertilizer to sugarcane [17]. The spentwash contained N, P, K, Ca, Mg and S and thus valued as a fertilizer when applied to soil through irrigation with water [18]. Diluted spent wash increase the uptake of nutrients, height, growth and yield of leaves vegetables [19]. The yields of pulses, condiments, root, vegetables [20], and condiments [21], some root vegetables in untreated and spentwash treated soil, top vegetables (creepers), tuber/root medicinal plants [22], leafy medicinal plants nutrients of creeper medicinal plants, leafy medicinal plants in normal and spent wash treated soil.

However, no information is available on yields of Jasmine flowering plant irrigated by distillery spentwash. Therefore, the present investigation was carried out to study the influence of different proportions of spentwash on the yields of Jasmine.

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*Corresponding Author
S. Chandraju
Department of Studies in Sugar Technology, Sir M. Vishweswaraya Postgraduate Center, University of Mysore, Tubinakere, Mandya -571402, Karnataka, India

Email: chandraju1@yahoo.com

MATERIALS AND METHODS

Physico-chemical parameters and amount of nitrogen (N), potassium (K), phosphorous (P) and sulphur (S) present in the primary treated diluted spent wash (1:1, 1:2 and 1:3 SW) were analyzed by standard methods [2]. The PTSW was used for irrigation with a dilution of 1:1, 1:2 and1:3. A composite soil sample collected prior to spentwash irrigation was air-dried, powdered and analyzed for physico-chemical properties [24 - 29].

Flowering plants selected for the present investigation were Jasmine. The sets were planted in different pots [30(h), 25(dia)] and irrigated (by applying 5-10mm/cm^2 depends upon the climatic condition) with raw water (RW), 1:1 SW, 1:2 SW and 1:3 SW at the dosage of twice a week and rest of the period with raw water as required. Cultivation was conducted in triplicate; in each case the yields were recorded.

RESULTS

Chemical composition of PTSW, 1:1, 1:2, and 1:3 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-1).

Amount of N, P, K and S contents are presented (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 (Ca), magnesium (Mg), sodium (Na), DTPA iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) were analyzed and tabulated (Table-3 & 4). 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.

Table 1. Chemical characteristics of distillery Spentwash

Chemical parameters	PTSW	1:1 PTSW	1:2 PTSW	1:3 PTSW
pH	7.57	7.63	7.65	7.66
Electrical conductivity[a]	26400	17260	7620	5330
Total solids[b]	47200	27230	21930	15625
Total dissolved solids[b]	37100	18000	12080	64520
Total suspended solids[b]	10240	5380	4080	1250
Settleable solids[b]	9880	4150	2820	3240
COD[b]	41250	19036	10948	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 Nitrogen[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 distillery spent wash

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

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

Unit: b – mg/L, PTSW - Primary treated distillery spentwash

Table 3. Characteristics of experimental soil

Parameters	Values
Coarse sand[c]	9.24
Fine sand[c]	40.14
Slit[c]	25.64
Clay[c]	20.60
pH (1:2 soln)	8.12
Electrical conductivity[a]	530
Organic carbon[c]	1.64
Available Nitrogen[b]	412
Available Phosphorous[b]	210
Available Potassium[b]	110
Exchangeable Calcium[b]	180
Exchangeable Magnesium[b]	272
Exchangeable Sodium[b]	113
Available Sulphur[b]	330
DTPA Iron[b]	204
DTPA Manganese[b]	206
DTPA Copper[b]	10
DTPA Zinc[b]	55

Units: a – µS, b – mg/L , c- %

Table 4. Characteristics of experimental soil
(After harvest)

Parameters	Values
Coarse sand[c]	9.69
Fine sand[c]	41.13
Slit[c]	25.95
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
Exchangeable Calcium[b]	185
Exchangeable Magnesium[b]	276
Exchangeable 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,

Table 5. Yield of Jasmine *(Oleaceae)* Flowers at different irrigations.
(Average number is taken from the 5 plants)

RW		1:1 SW		1:2SW		1:3 SW	
No. of Flowers	Size of Flowers	No.of Flowers	Size of Flowers	No.of Flowers	Size of Flowers	No.of Flowers	Size of Flowers
15	5cm	--	--	25	5.5cm	45	5.8cm

DISCUSSIONS

Yields of Jasmine plant leaves, uptakes of all the parameters were very good in both 1:2 and 1:3 spent wash as compared to1:1, SW and raw water. In both 1:1, 1:2 and 1:3 spent wash irrigation, the uptake of the nutrients such as fat, calcium, zinc, copper and vitamins carotene and vitamin c were almost similar but the uptake of the nutrients and parameters such as protein, fiber, carbohydrate, energy, magnesium and phosphorous were much more in the case of 1:1, 1:2, spent wash irrigation than 1:3, and raw water irrigations (Table-5). This could be due to the more absorption of plant nutrients present in spent wash by plants at higher dilutions. It was also found that no negative impact of heavy metals like lead, cadmium and nickel on the leaves of Jasmine plant. The soil was tested after the harvest; found that there was no adverse effect on soil characteristics (Table-4).

CONCLUSION

It is found that the nutrients uptake in the yields of jasmine(*Oleaceae*) plant were largely influenced in case of both 1:1, 1:2 and 1:3 SW irrigation than with raw water. But 1:3 distillery spentwash shows more uptakes of nutrients when compared to 1:2 SW Jasmine plant. This could be due to the maximum absorption of nutrients by plants at more diluted spentwash. After harvest, soil has tested; found that there was no adverse effect on characteristics. Hence the spentwash can be conveniently used for irrigation purpose with required dilution without affecting environment and soil.

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