Investigation of Impact of Irrigation of Distillery Spentwash on the Nutrients of Pulses

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Cultivation of pulses was made by irrigation with distillery spentwash of different proportions. The distillery spentwash *i.e.*, primary treated spentwash, 50 % and 33 % distillery spentwash 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. The pulses seeds (Namadhari and Mayhco) were sowed in the prepared land and irrigated by using raw water, 50 and 33 % distillery spentwash. The impact of distillery spentwash on proximate principles (moisture, protein, fat, fibre, carbohydrate, energy, calcium, phosphorous and iron), vitamin content (carotene and vitamin C), mineral and trace elements (magnesium, sodium, potassium, copper, manganese, zinc, chromium and nickel) of pulses were investigated.

Key Words: Distillery spentwash, Pulses, Nutrients.

INTRODUCTION

Molasses (one of the important byproducts of sugar industry) is the chief source for the production of alcohol in distilleries. About 40 billion liters of wastewater annually produced known as raw spentwash (RSW), which is characterized by high biological oxygen demand (BOD: 5000-8000 mg/L), chemical oxygen demand (COD: 25000-30000 mg/L)[1], ugly colour and bad smell. Raw spentwash is normally discharged into open land or near by water bodies resulting in a number of environmental problems including threat to plant and animal lives. Hence discharge of spentwash is an headache due to pollution nature. The RSW is highly acidic and containing easily oxidisable organic matter with very high BOD and COD[2]. Distillery spentwash contains highest content of organic nitrogen and nutrients[3]. By installing biomethenation plant in distilleries, reduce the oxygen demand of RSW. The resulting spentwash obtained is called primary treated spentwash (PTSW) and primary treatment to RSW increases the nitrogen,

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potassium and phosphorous contents and decreases the calcium, magnesium, sodium, chloride and sulphate[4]. The PTSW is rich in potassium, sulphur, nitrogen, phosphorous as well as easily biodegradable organic matter and its application to soil has been reported to be beneficial to increase sugar cane[5], rice[6], wheet and rice yeild[7] and ground nut quality[8] and physiological response of soyabean[9]. Diluted distillery spentwash could be used for irrigation purpose without adversely affecting soil fertility[10-12] and seed germination and crop productivity[13]. The diluted effluent irrigation improved the physical and chemical properties of the soil and further increased soil microflora[10,11,14]. Twelve pre-sowing irrigations with the diluted distillery spentwash had no adverse effect on the germination of maize but improved the growth and yield[15]. Diluted distillery spentwash increases the growth of peas found that shoot length, leaf number per plant, leaf area, chlorophyll content[16]. Increased concentration of distillery spentwash in diluted distillery spentwash causes decreased seed germination, seedling growth and chlorophyll content in sunflowers (*Helianthus annuus*) and the distillery spentwash could safely used for irrigation purpose at low concentration of distillery spentwash[13,17]. The distillery spentwash contained an excess of various forms of cations and anions, which are injurious 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[18]. The distillery spentwash could be used as a complement to mineral fertilizer to sugarcane[19]. The distillery spentwash 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 distillery spentwash 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[21]. Mineralizations of organic material as well as nutrients present in the distillery effluent were responsible for increased availability of plant nutrients[22]. The diluted distillery spentwash increase the uptake of nutrients, height, growth and yield of leaves vegetables[23-26] and nutrients of top vegetables[27,28]. However, not much information is available on the impact of distillery spentwash on the nutrients of pulses. Therefore the present investigation is carried out to study the impact of different concentration of distillery spentwash on the nutrients of pulses.

EXPERIMENTAL

The fieldwork was conducted during December 2006 at the field of Chamundi Distilleries Pvt. Ltd. Maliyur, Mysore District, India. Before cultivation of plants, a composite soil sample was collected from the experimental site at 25 cm depth at different parts, mixed and dried under sunlight. The soil sample was analyzed for physico-chemical properties using standard procedures (Table-1).

TABLE-1
CHARACTERISTICS OF 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 zinc	ppm	50.00

The PTSW was used for the irrigation with dilution of 50 and 33 %. The physical and chemical parameters and amount of nitrogen, potassium, phosphorous and sulphur present in the PTSW, 50 and 33 % distillery spentwash were analyzed using standard procedures (Tables 2 and 3).

The pulses selected for field experiment were black gram (*Phaseolus mungo* Roxb), cow pea (*Vigna catjang*), field bean (*Dolichos lablab*) and red gram (*Cajanous cajan*). The seeds were sowed in the prepared block field and irrigated with raw water (RW), 50 and 33 % distillery spentwash at the dosage of twice in a week and rest of the period with RW. The pulses were harvested at the time of maturity, dried under sunlight and proximate principles, vitamins, minerals and trace elements present in the pulses were analyzed.

RESULTS AND DISCUSSION

The results revealed that all the nutrients uptakes were significantly increased by the application of diluted distillery spentwash in all types of pulses. Diluted distillery spentwash irrigation has influenced the nutrient uptake and other quality parameters of pulses to a greater extent. It was found that no uptake of heavy metals like lead, cadmium and nickel in all the pulses (Table-4).

Uptakes of all the parameters were very good for black gram (*Phaseolus mungo* Roxb) (Table-4) in both 50 and 33 % spentwash as compared to raw water. However remarkable uptake of the nutrients such as fat, calcium, sodium, potassium, iron, phosphorous, zinc, manganese, chloride and carotene were observed in the case of 33 % spentwash than 50 % spentwash irrigation.

TABLE-2
COMPOSITION OF THE 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 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 spentwash.
50 % SW = 50 % distillery spentwash; 33 % SW = 33 % distillery spentwash.

TABLE-3
PLANT NUTRIENTS (N, P, K AND S) IN DISTILLERY SPENTWASH

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 spentwash.
50 % SW = 50 % distillery spentwash; 33 % SW = 33 % distillery spentwash.

There was no negative impact of spentwash on the nutrients of cow pea (*Vigna catjang*) (Table-4). Very good uptake of all the parameters in both 50 and 33 % spentwash as compared to raw water were observed, but it was found that, the uptake of the nutrients such as calcium, sodium, potassium, phosphorous, chloride, sulphur and carotene were comparatively good in 33 % distillery spentwash as compared to 50 % spentwash irrigation.

TABLE-4
NUTRITVE VALUES OF DIFFERENT PULSES AT DIFFERENT IRRIGATION

Parameters	Black gram (*Phaseolus mungo* Roxb)			Cow pea (*Vigna catjang*)			Field bean (*Dolichos lablab*)			Red gram dhal (*Cajanous cajan*)		
	RW	50% SW	33% SW	RW	50% SW	33% SW	RW	50% SW	33% SW	RW	50% SW	33% SW
Moisture (g)	13.0	13.4	13.4	13.5	13.7	13.5	12.9	13.0	13.0	13.4	13.6	13.8
Fat (g)	1.3	1.45	1.6	0.8	0.9	0.9	0.8	0.9	1.0	1.69	1.70	1.90
Acid insoluble ash (g)	0.45	0.48	0.47	0.45	0.53	0.50	0.44	0.50	0.47	0.04	0.05	0.05
Protein (g)	23.0	24.3	24.8	23.9	24.6	24.8	24.1	24.9	25.0	22.2	22.4	22.4
Fibre (g)	1.2	1.3	1.4	3.9	4.0	4.2	3.8	3.9	4.0	4.0	4.1	4.3
Carbohydrate (g)	59.0	59.8	60.2	54.0	56.9	57.2	59.8	60.9	61.2	57.6	58.1	60.3
Energy (kcal)	320.0	350.0	355.0	319.0	320.0	330.0	344.0	349.0	354.0	335.0	337.0	340.0
Calcium (mg)	149.0	155.0	165.0	76.8	78.0	80.0	79.0	80.0	85.0	73.0	73.4	75.0
Magnesium (mg)	127.0	130.0	130.0	207.0	215.0	220.0	210.0	215.0	220.0	90.0	92.0	94.0
Sodium (mg)	39.8	40.0	41.2	22.9	24.0	29.0	20.0	27.0	32.0	28.5	28.8	29.2
Potassium (mg)	794.0	809.0	820.0	1090.0	1134.0	1140.0	970.0	990.0	1020.0	1200.0	1250.0	1300.0
Iron (mg)	3.9	4.5	4.9	8.5	8.6	9.0	8.2	8.5	8.8	2.69	2.70	2.72
Phosphorous (mg)	380.0	386.0	395.0	410.0	412.0	425.0	432.2	435.0	438.6	304.0	306.0	308.0
Zinc (mg)	4.2	4.28	4.4	4.4	4.59	4.59	3.2	3.8	3.9	0.9	0.92	0.94
Manganese (mg)	1.10	1.16	1.25	1.30	1.39	1.40	1.29	1.30	1.30	0.69	0.70	0.75
Copper (mg)	1.00	1.02	1.02	0.86	0.88	0.88	0.35	0.37	0.38	1.2	1.4	1.42
Chlorides (mg)	8.0	8.9	10.0	9.6	10.0	12.0	7.0	7.8	10.0	10.0	18.0	20.0
Lead (mg)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cadmium (mg)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chromium (mg)	0.010	0.010	0.010	0.02	0.025	0.025	0.01	0.01	0.01	0.001	0.001	0.001
Nickel (mg)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Sulphur (mg)	170.0	173.0	175.0	164.8	170.0	180.2	130.0	135.0	135.0	180.0	186.0	195.0
Carotene (mg)	37.6	37.8	40.0	11.4	13.0	15.0	10.0	12.0	16.0	180.0	182.0	195.0
Vitamin C (mg)	2.0	2.0	2.0	0.75	0.80	0.90	0.8	0.8	0.9	10.0	11.0	12.0

RW = Raw water; 50%SW = 50 % distillery spentwash; 33% SW = 33 % distillery spentwash.

In the case of field bean (*Dolichos lablab*), there was good uptake of all parameters in both 50 and 33 % spentwash compared to raw water (Table-4). However uptakes of the nutrients such as carbohydrate, calcium, sodium, potassium, chloride and carotene were considerably good in the case of 33 % spentwash than 50 % spentwash irrigation.

It was found that uptake of the nutrients such as fat, carbohydrate, calcium, magnesium, potassium, chloride, sulphur and carotene were very good in the case of 33 % distillery spentwash as compared to 50 % spentwash irrigation in the case of red gram (*Cajanous cajan*) (Table-4). But uptakes of all the parameters were comparatively good in both 33 and 50 % spentwash irrigation than raw water.

Conclusion

It was noticed that the nutrients uptake in all the varieties of pulses were largely influenced in case of both 33 and 50 % diluted distillery spentwash irrigation than with raw water. But 33 % distillery spentwash irrigation shows more uptakes of nutrients than compared with 50 % diluted distillery spentwash in all varieties. This could be due to the maximum absorption of nutrients by plants at highly diluted condition of distillery spentwash.

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