ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 06, pp.33335-33339, June, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

IMPACT OF DISTILLERY SPENTWASH IRRIGATION ON SPROUTING GROWTH AND YIELD OF ASTER (ASTERACEAE) FLOWERING PLANT

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ARTICLE INFO

Article History:
Received 04th March, 2016
Received in revised form
16th April, 2016
Accepted 21st May, 2016
Published online 30th June, 2016

Key words:

Distillery spent wash, Aster (Asteraceae), Sprouting, Growth, Irrigation and Soil.

ABSTRACT

Sprouting growth and yield of Aster (Asteraceae) flowering plant was made by irrigated with distillery spent wash of different concentrations. The spent wash i.e., primary treated spent wash (PTSW), 1:1, 1:2, and 1:3 spent wash were analyzed for their plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical characteristics. Experimental soil was tested for its chemical and physical parameters. Aster (Asteraceae) sets were planted in different pots and irrigated with raw water (RW), 1:1, 1:2 and 1:3 spent wash. The nature of sprouting and growth was studied. It was found that the sprouting and growth 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.

Citation: Chandraju, S., Chidan Kumar, C. S. and Varalakshmi, 2016. "Impact of distillery Spentwash irrigation on sprouting growth and yield of aster (Asteraceae) flowering plant", *International Journal of Current Research*, 8, (06), 33335-33339.

INTRODUCTION

Aster belongs to Asteraceae family. It is known as the daisy and exceedingly large, widespread family of Angiosperm, with about 200 species native to tropical and warm temperature regions of the Old World. The leaves can be either evergreen (green all year round) or deciduous (falling in autumn). ("Aster". Webster's Third New International Dictionary, Merriam-Webster, 2002). There are usually five stamens. The filaments are fused to the corolla, while the anthers are generally connate (syngenesious anthers), thus forming a sort of tube around the style (theca). They commonly have basal and apical appendages. Pollen is released inside the tube and is collected around the growing style, and then as the style elongates, is pushed not of the tube (nudelspritze). The pistil consists of two connate carpels. The style has two lobes. Stigmatic tissue may be located in the interior surface or form two lateral lines. The ovary is inferior and has only one ovule, with basal placentation. Aster is an economically important family. It can be used in cooking oils, lettuce, sunflower seeds, artichokes, sweetening agents, coffee substitutes and tea. Aster tea is consumed in China, where it is called Aster–flower tea. Aster flower and tea are "mated" in machines that control temperature and humidity. (Asterdichotomum). It takes four hours or so for the tea to absorb the fragrance and flavor of the Aster blossoms, and for the highest grades, this process may be repeated as many as seven times. Because the tea has absorbed moisture from the flowers, it must be refired to prevent spoilage. The spent flowers may or may not be removed from the final product, as the flowers are completely dry and contain no aroma. The French are known for their Astersyrup, most commonly made from an extract of Aster flowers. In the "United States, this French Aster syrup is used to make Asterscones and marshmallows. Aster essential oil is in common use. Its flowers are extracted by the labor-intensive method of effleurage or through chemical extraction. It is expensive due to the large number of flowers needed to produce a small amount of oil. The flowers have to be gathered at night because the odor of Aster is more powerful after darksome of the countries producing Aster essential oil are India, Egypt, China and Morocco. Its chemical constituents include methyl anthranilate, in dole, benzyl alcohol, linalool,

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and skatole. Many species also yield an absolute, which is used in perfumes and incense. The white Aster branch is used in painting of ink and color on silk by Chinese artist. In Syria, Aster is the symbolic flower of Damascus. (Aster flower guide). In Thailand, Aster flowers are used as a symbol of mother. Aster is an economically important family. Aster gave name to the Asteronate plant hormones as methyl Asteronate isolated from the Aster oil of Asterinungrandiflorum led to the discovery of the molecular structure of Asteronates.

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 spent wash (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 (Joshi,1994). 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 oxi disable organic matter with very high BOD and COD (Patil, 1987). Also, spent wash contains high 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 calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-), and sulphate (SO_4^{2-}) (MahamodHaroon and Subhash Chandra Bose, 2004). 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 (Zalawadia, 1997), rice (Devarajan and Oblisami, 1995), wheat and rice (Pathak *et al*., 1998), Quality of groundnut (Amar *et al.*) and physiological response of soybean (Ramana *et al*., 2000). Diluted spentwash 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 micro flora (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 (Rani 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 use 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 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 (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). 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, root vegetables (Chandraju *et al*., 2008), and yields of condiments (Chandraju and Chidankumar, 2009), yields of some root vegetables in untreated and spentwash treated soil (Chidankumar *et al*., 2009), yields of top vegetables (creepers) (Chidankumar *et al*., 2009), yields of tuber/root medicinal plants(Nagendraswamy *et al*., 2010), yields of leafy medicinal plants (Nagendraswamy *et al*., 2010) nutrients of creeper medicinal plants (Chandraju *et al*., 2010), yields of leafy medicinal plants in normal and spent wash treated soil (Chandraju *et al*., 2010), nutrients uptake of herbal medicinal plants in normal and spent wash treated soil (Chandraju *et al*., 2010), nutrients of leafy medicinal plants(Chandraju *et al*., 2010), nutrients of ginger and turmeric in normal and spent wash treated soil (Chandraju *et al*., 2010), nutrients of tubers/roots medicinal pl ants (Chandraju *et al*., 2010).Studies on germination and growth of Musterd and Caster seeds (Chandraju *et al*., 2011), Cotton and groundnut seeds (Chandraju *et al*., 2011). However, no information is available on sprouting and growth of Aster flowering plant irrigated by distillery spent wash. Therefore, the present investigation was carried out to study the influence of different proportions of spent wash on the sprouting and growth of Aster.

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 (Manivasakam, 1987). The PTSW was used for irrigation with a dilution of 1:1, 1:2 and1:3. A composite soil sample collected prior to spent wash irrigation was air-dried, powdered and analyzed for physico-chemical properties (Piper, 1996: Jackson, 1973: Walkeley and Black, 1934: Subbaiah and Asija, 1956: Black, 1965: Lindsay and Norvel, 1978). Flowering plants selected for the present investigation were Aster. 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 sprouting, growth 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
Settleablesolids[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
AmmonicalNitrogen[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
AmmonicalNitrogen[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 spent wash

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. Growth of Aster plant at different irrigations (cm)

Name of the plant	RW 15th 22nd 29th (Day)	1:1SW 15th 22nd 29th (Day)	1:2 SW 15th 22nd 29th (Day)	1:3 SW 15th 22nd 29th (Day)
Aster (Asteraceae)	01, 08,16	01, 03,03	01, 09, 18	01, 10, 20

Table 6. Average number of Aster (Asteraceae) Flowers at different irrigations (Average number is taken from the 5 plants)

Name of the Plants	RW		1:1 SW		1:2SW		1:3 SW	
	Number of Flowers	Size of Flowers	Number of Flowers	Size of Flowers	Number of Flowers	Size of Flowers	Number of Flowers	Size of Flowers
Aster *(Asteraceae species)*	15	5cm	--	--	25	5cm	45	5cm

DISCUSSION

Sprouting and growth of Aster 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 Aster 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 Sprouting and growth of Aster (Asteraceae) 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 spent wash shows more uptakes of nutrients when compared to 1:2 SW Aster plant. This could be due to the maximum absorption of nutrients by plants at more diluted spent wash. After harvest, soil has tested; found that there was no adverse effect on characteristics. Hence the spent wash can be conveniently used for irrigation purpose with required dilution without affecting environment and soil

Acknowledgements

Authors are grateful to The General Manager, N.S.L. Koppa, MaddurTq. Karnataka, for providing spentwash.

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