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Research in Plant Biology, 2(3): 16-23, 2012
ISSN : 2231-5101
www.resplantbiol.com

Regular Article

Distillery Spentwash as an Effective Liquid Fertilizer and Alternative Irrigation Medium in Floriculture

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Germination growth and yields of Aster (*Asteraceae)* and Daisies (*Asteraceae*) flowering plants were made by irrigated with distillery spentwash of different concentrations. Diluted spentwash (1:1, 1:2, and 1:3) were analyzed for plant nutrients such as nitrogen, phosphorous, potassium and other physical and chemical characteristics. Experimental soil was tested for its chemical and physical parameters. Aster and Daisies seeds were sowed in different pots and irrigated with raw water (RW), 1:1, 1:2 and 1:3 spentwash. The nature of germination growth and yields of seeds was studied. It was found that, the germination growth and yields 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.

Key words: Distillery spent wash, Aster and Daisies seeds, Irrigation.

Flowers are widely used throughout the globe for various purposes such as Perfumes, Beauty and Hygiene products, Food and Drink, medicines and also used as repelling wildlife and hence floriculture is become commercially popular. Aster *(Asteraceae)* is a genus of flowering plants in the family Asteraceae. The name Aster comes from the ancient Greek word meaning 'star', referring to the shape of the flower head. Many species and a variety of hybrids and varieties are popular as garden plants because of their attractive and colorful flowers. Asters can grow in all hardiness zones. The genus Aster is generally restricted to the Old World species, with Aster amellus being the type species of the genus, as well as of the family Asteraceae. The New World species have now been reclassified in the genera Almutaster, Ionactis and Symphyotrichum, though all are treated within the tribe Astereae. Regardless of the taxonomic change, all are still widely referred to as "Asters" in the horticultural trades. In the UK there are only two native members of the genus: Goldilocks, which is very rare, and Aster tripolium, the Sea aster. Aster alpines spp. vierhapperi is the only species native to North America.

Daisies are simple yet sophisticated and one of the most beautiful flowers in the floral world. Daisies convey cheer and exuberance in spades. Not surprisingly, daisies are popular both for gifting and growing in gardens. It belongs to the family of Compositae, now known as Asteraceae in flowering plants. Daisies are native to North and Central Europe. The origin of the word Daisy is Anglo Saxon "day's eage" literally meaning "day's eye". It was called this because daisies open at dawn as the day is just beginning. A Daisy symbolizes innocence and purity. It can also symbolize new beginnings. The flower meaning of daisy is "loyal love" "I will never tell".Daisies is hardy perennials. It can be grown very easily. Daisies are commonly grown from seed. Generally Daisies are not bothered by insects and disease. These are not affected by mowing and is therefore often considered a weed on lawns, though many also value the appearance of the flowers, and also used in the folk medicine. In ancient Rome, the surgeons who accompanied Roman legions in to the battle would order their slaves to pick sacks full of Daisies in order to extract their juice. Bandages were soaked in their juice and would then be used to bind sword and spear cuts. Daisies have traditionally been used for making daisy chains in children's games.

Ethanol is produced by the fermentation of molasses in distilleries. Now a day's demand of ethanol's increasing due to its usage as fuel blended with petrol and diesel. As a result more numbers of distilleries are coming out. 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 et al.,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 oxidisable organic matter with very high BOD and COD (Patil et al., 1987). Also, spentwash contains high organic nitrogen and nutrients (Ramadurai and Gearard, 1994). By installing biomethenation plant in distilleries, reduces the oxygen demand of RSW, the resulting spentwash 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-}) (Mahamod Haroon 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 et al., 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 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 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 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 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 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). Mineralization of organic material as well as nutrients present in the spent wash was responsible for increased availability of plant nutrients (Chandraju et al, 2011). Diluted spentwash increase the uptake of nutrients, height, germination and growth of flowering plants for vegetables(Chandraju et al., 2007; Basvaraju and Chandraju, 2008), and yields of condiments (Chandraju and Chidan kumar, 2009), yields of some root vegetables in untreated and spentwash treated soil (Chidan kumar et al., 2009), yields of top vegetables (creepers) (Chidan kumar et al.,2009), yields of tuber/root medicinal plants(Nagendraswamy et al., 2010), yields of leafy medicinal plants (Nagendraswamy et al., 2010). And also increases the germination growth and yields of flowering plants (Chandraju et al., 2011).

However, no information is available on the studies of distillery spentwash irrigation on the germination growth and yields of Aster and Daisies flowering plants. Therefore, the present investigation was carried out to study the influence of different concentration of spent wash on the germination growth and yields of Aster and Daisies seeds.

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 and 1:3. A composite soil sample collected prior to spentwash 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 and Daisies. The seeds were sowed in different pots 50cm(h), 30cm (dia)] and irrigated 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 (by applying 5-10mm/cm^2 depends upon the climatic condition). Cultivation was conducted in triplicate; in each case germination growth and yields were recorded.

Table: 1 Chemical characteristics of distillery Spent wash

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 spentwash

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 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- %

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 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 (Ca), magnesium (Mg), sodium (Na), DTPA iron (Fe), manganese (Mn), copper (Cu) and zinc (Zn) were analyzed and tabulated Table-3. It was found that the soil composition is fit for the cultivation of plants, because it fulfils all the requirements for the growth and yields of plants. It was found that the germination growth and yields of both plants 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.

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,

Discussion

Germination growth and yields of Aster (*Asteraceae*) and Daisies (*Asteraceae*) flowering plants were very good in both 1:2 and 1:3 spentwash as compared to 1:1 SW and raw water. Table-5, this could be due to more absorption of plant nutrients (NPK) present in spentwash 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 and Daisies plants. The soil was tested after the harvest; found that there was no adverse effect on soil characteristics Table-4. In 1:1 SW germination growth and yields was very poor, the plants dies after some days. This may be due to the high concentration of SW. It is found that the germination growth and yields of both plants were largely influenced in case of 1:2 and 1:3 SW irrigations than with 1:1 SW and raw water. But 1:3 SW irrigation shows more uptakes of nutrients when compared to 1:2 SW in both plants Table-6. 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 soil.

Aster plants in different irrigations

RW **1:1 SW** **1:2 SW** **1:3 SW**

Daises Aster plants in different irrigations

RW **1:1 SW** **1:2 SW** **1:3 SW**

Table 5. Growth of Aster and Daisies at different irrigations (cm)

Name of the plant	**RW** **15th 22nd 2 9th** **(Day)**	**1:1 SW** **15th 22nd 29th** **(Day)**	**1:2 SW** **15th 22nd 29th** **(Day)**	**1:3 SW** **15th 22nd 29th** **(Day)**
Aster *(Asteraceae species)*	01, 08 , 16	01, 03, 03	01, 09, 18	01, 10, 20
Daisies *(Asteraceae species)*	01, 09, 17	01, 04, 04	01, 10, 19	01, 10, 21

Table : 6 Yields of Aster and Daisies Flowers at different irrigations (Average number is taken from the five 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 *(Astereaceae species)*	60	16cm	--	--	45	13cm	55	15cm
Daisies *(Astereaceae species)*	55	15cm	--	--	35	14cm	60	16cm

Acknowledgement

Authors are grateful to The General Manager, Nijaveedu Sugars Limited. Koppa, Maddur Tq., Karnataka, for providing spent wash.

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