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Sprouting and Growth studies of Rose (*Rosa)* and Hibiscus (*Hibiscus rosasinenis*) flowering plants irrigated by distillery spentwash

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Sprouting and growth of Rose (*Rosa)* and Hibiscus (*Hibiscus rosasinenis*) flowering plants was made by irrigated with distillery spentwash of different concentrations. The spentwash i.e., primary treated spentwash (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. Rose and Hibiscus sets were planted in different pots and irrigated with raw water (RW), 1:1, 1:2 and 1:3 spentwash. The nature of sprouting and growth was studied. It was found that the sprouting and growth 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.

Key words: Distillery spentwash, Rose, Hibiscus, Sprouting, Growth, Irrigation, Soil.

Rose (*Rosa)* belongs to Rosaceae family. Roses have a long storied history. The Chinese and Egyptians are thought to have first cultivated roses, around 5000 years ago. (http://PFaf.org/user/plantaspx? Latin Name -Rosa% 20 Chinese). Selecting plants on the basis of flower color. During the Middle Ages, monks and apothecaries grew roses for their medicinal value (Britannica.com). The rose has been valued for its beauty and fragrance and has a long history of symbolism and meaning. Rose is the national flower of England and the United States, and the state flower of US states (American Heritage Dictionary). The leaves most rose species are 5-15cm long, pinnate, with (3, 5, 9 and 13) leaflets and basal stipules the leaflets usually have a serrated margin and often a few prickles on the undesirable of the stem. Roses are of great economic importance, both as a crop for florists use and for use in perfumes. Roses are best known as ornamental plants grown for their flowers in the garden (www.foodnet.org/Market/Uganda/reports/ Roses.PDF2009commercialisation) and some time indoors. They have been also used for commercial perfumery and commercial cut. Some are used as landscape plants for hedging and for other utilitarian purposes such as game over. They also have minor medicinal uses.(Sunset western garden book 1995; 606-607). Roses are also used as both domestic and commercial cut flowers. Rose perfumes are made from attar of roses are rose oil which is a mixture of volatile essential oils obtained by steam distilling the crushed petals of roses. An associated product is rose water which is used of cooking cosmetics medicines and in religious practices. Geraniol ($C_{10}H_{18}O$) the main constituents of attar of roses are to fragrant alcohols geraniol and 1-Citroneliol, and rose camphor and odorless paraffin β-damascenone is also a significant contributor to the scene (Oxford English Dictionary). The fruits of many species have significant levels of vitamins and have been used as a food supplement. Many roses have been used in herbal and folk medicines. Other species have been used for stomach problems and are being investigated for controlling cancer growth.

Hibiscus (*Hibiscus rosasinenis*) tropical flower, it belongs the family Malvaceae. It gets its name from the Greek words. Hibiscus meaning mallow and rosa-sinessis, meaning rose of China. (Lawton, Barbara Perry 2004) Hibiscus: Hardy and Tropical plants for the Grade. It is a small tree an ever green shrub, growing to a maximum of 10 m in the wild. Bark is light grey easily peelable and smoother leaves are ovate, simple spirally arranged, 8-10.5cm long and have a long stalk. The ovoid fruit up to 20seeds are, beaked and split into five parts. Hibiscus flower are used by malayas as a food dye in cooking toddy, agar-agar, jellies, pineapple slices and cooked vegetables. (Nation's Restaurant News Hibiscus blossoms as a food, drink ingredient). A juice drink made of hibiscus flowers was developed and is marketed together by the Malaysian, Agricultural Research and Development Institute. A decoction of hibiscus roots was offered, in Malaya traditional healing for the relief of venereal diseases and fever. This flower decoction was drunk as an antidote to poison. The juice was given to those suffering from seriawan an ailment symptomatically similar to trush, sprue are diphtheria, and also used in expectorant in bronchitis and gonorrhea and relief from headaches and swellings. A preparation from the roots was used as eye drops for sore eyes. (Plants for a future: Hibiscus rosa-Sineasis accessed 07-05-2009). In the Philippines the flower buds, made into pulp were applied to boils mumps and swollen cancerous areas. The Dutch used the fresh flowers with papaya seeds to initiate an abortion of a fetus. Dutch midwives used the mucilage in labor and also gave draughts made of the juice of hibiscus leaves of women in labor. The juice of hibiscus petals and flowers was as a dye by the Chinese and Indians to blacken the eyebrows and hairs. In Jamaica, it was used to polish shoes; hence the name shoe flower is also used as a primary ingredient in many herbal teas, paper making and jams.

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 (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 oxidisable organic matter with very high BOD and COD (Patil, 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, 1997), rice (Devarajan and Oblisami, 1995), wheat and rice (Pathak et al., 1998), Quality of groundnut (Amar BS 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 spentwash had no adverse effect on the germination of maize but improved the growth and yield (Singh and Raj Bahadur, 1998). Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Rani and Srivastava, 1990). 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 (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. Diluted spentwash 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 spentwash 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 plants (Chandraju et al., 2010). Studies on germination and growth of Muster 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 Rose and Hibiscus flowering plants 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 Rose and Hibiscus flowering plants.

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 Rose and Hibiscus. The sets were planted in different pots [50cm(h), 30cm (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.

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 spentwash

Table: 2 Amount of N, P, K and S (Nutrients) in distillery Spentwash

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 (Before harvest)

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 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). 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. It was found that the sprouting and growth 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

Sprouting and growth of Rose (*Rosa)* and Hibiscus (*Hibiscus rosasinenis*) flowering plants were very good in both 1:2 and 1:3 spentwash as compared to 1:1 SW and raw water. Irrigations (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 Rose and Hibiscus plants. The soil was tested after the harvest, found that there was no adverse effect on soil characteristics (Table-4).

Table: 5 Growth of Rose and Hibiscus plants at different irrigations (cm)

Name of the plant	RW 15th 22nd 9th (Day)	1:1SW 15th 22nd 29th (Day)	1:2 SW 15th 22nd 29th (Day)	1:3 SW 15th 22nd 29th (Day)
Rose *(Rosaceae species)*	20, 25, 29	12, 13, 13	21, 26, 28	22, 28, 34
Hibiscus *(Malvaceae species)*	18, 25, 33	10, 11, 11	18, 22, 30	19, 26, 34

Conclusion

It is found that the sprouting and growth 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. This could be due to the maximum absorption of nutrients by plants upon dilution of spent wash. After harvest, it was found that; there was no adverse effect of distillery spentwash irrigation on the soil characteristics. Hence the spent wash can be conveniently used for irrigation purpose with required dilution without affecting environment and soil.

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