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Studies of Distillery Spent Wash Irrigation on Germination and Growth of *Chrysanthemum indicum* and *Polianthes tuberosa* Flowering Plants

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ABSTRACT

Germination and growth of *Chrysanthemum indicum* (Asteraceae) and *Polianthes tuberosa* (Agavaceae) seeds were made by irrigation with distillery spent wash of different concentrations. The spent wash i.e., primarily treated spent wash (PTSW), 1:1, 1:2, and 1:3 was analyzed for its plant nutrients such as nitrogen, phosphorus, potassium and other physical and chemical characteristics. Experimental soil was tested for its physico-chemical parameters. Seeds of *Chrysanthemum* and *Polianthes* were sown in different pots and irrigated with raw water (RW), differently diluted spent wash. The nature of germination of seeds and growth was studied. It was found that the germination 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 irrigations. Hence, spent wash can be used as irrigation medium at regular dilution.

INTRODUCTION

Chrysanthemums, often called mums or Chrysanths, are the genus *Chrysanthemum* constituting approximately 30 species of perennial flowering plants in the family Asteraceae, which is native to Asia and northeastern Europe. The name *Chrysanthemum* is derived from the Greek, chrysos (gold) and (flower). Chrysanthemums were first cultivated in China as a flowering herb in 15^{th} century BC. The plant is particularly significant during the Double Ninth Festival. *Chrysanthemum* leaves are steamed or boiled and used as greens, especially in Chinese cuisine. Other uses include using the petals of the plant to mix with a thick snake meat soup in order to enhance the aroma. It is economically important as a natural source of insecticide. The flowers are pulverized, and the active components called pyrethrins, contained in the seed cases, are extracted and sold in the form of an oleoresin. Pyrethrins attack the nervous system of all insects, and inhibit female mosquitoes from biting. They are considered to be amongst the safest insecticides for use. *Chrysanthemum* plants have been shown to reduce indoor air pollution by the NASA Clean Air Study. Extracts of *Chrysanthemum* plants (stem and flower) have a wide variety of potential medicinal properties, including anti-HIV-1 (Collins et al. 1997), antibacterial and antimycotic.

Polianthes tuberosa belongs to the family Agavaceae. It is a perennial plant, extracts of which are used as a middle note in perfumery. The common name derives from the Latin tuberose, meaning swollen or tuberous in reference to its root system. It consists of about 12 species. Polianthes means "many flowers" in Greek language. It is a night blooming plant thought to be native to Mexico along with every other species of *Polianthes*. It is prominent in Indian culture and mythology. The flowers are used in wedding ceremonies, garlands, decoration and various traditional rituals. Its Hindi name is Rajnigandha. In parts of South India, it is known as Sugandharaja, which translates to king of fragrance smell. The tuberose is also used traditionally in Hawaii to create leis and was considered a funeral flower in Victorian times. Its scent is described as a complex, exotic, sweet and floral. It grows in elongated spikes up to 45cm long which produce clusters of fragrant waxy white flowers that bloom from the bottom towards the top of the spike. It has long, bright green leaves clustered at the base of the plant and smaller, clasping leaves along the stem.

Molasses (one of the important byproducts of sugar industry) is the chief source for the production of ethanol in distilleries by fermentation method. About 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 BOD (5000-8000mg/L), COD (25000-30000 mg/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 oxidizable organic matter with very high BOD and COD (Patil et al. 1987). Installing of biomethenation plant in distilleries reduces the oxygen demand of RSW, the resulting spent wash is called primarily treated spent wash (PTSW), and primary treatment to RSW increases the nitrogen (N), potassium (K), and phosphorus (P) contents and decreases calcium (Ca), magnesium (Mg), sodium (Na), chloride (Cl^-), and sulphate (SO_4^{2-}) (Mohamed Haroon & Subash Chandra Bose 2004). PTSW is rich in potassium (K), sulphur (S), nitrogen (N), phosphorus (P) as well as easily biodegradable organic matter, and its application to soil has been reported to increase yield of sugar cane, wheat and rice (Pathak et al. 1998), quality of groundnut (Amar et al. 2003) 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), seed germination and crop productivity (Kuntal et al. 2004). The diluted spent wash irrigation improved the physical and chemical properties of the soil (Chandraju et al. 2007, 2010, 2011) and further increased soil microflora (Raverkar et al. 2000, Ramana et al. 2001, Devarajan et al. 1994). Twelve pre-sowing irrigations with the diluted spent wash had no adverse effect on the germination of maize but improved the growth (Singh & Raj Bahadur 1998). Diluted spent wash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas (Rani & 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 be used for irrigation purpose at lower concentration (Rajendran 1990). The spentwash 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. However, no information is available on germination and growth of *Chrysanthemum* and *Polianthes* plants irrigated with distillery spent wash. Therefore, the present investigation was carried out to study the influence of different proportions of spent wash on the germination and growth of *Chrysanthemum* and *Polianthes*.

Table 1: Chemial 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 phosphorus[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

a - µS, b - mg/L, c - %, PTSW - Primarily treated distillery spent wash.

MATERIALS AND METHODS

Physico-chemical parameters and amount of nitrogen (N), potassium (K), phosphorus (P) and sulphur (S) present in the primarily treated diluted spent wash were analyzed by standard methods. 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. Flowering plants selected for the present study were *Chrysanthemum* and *Polianthes* (Fig. 1). The sets were planted in different pots of 30''(height), 25''(dia) and irrigated by applying 5-10mm/cm^2 depending upon the climatic condition, and 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, and in each case sprouting and growth were recorded.

RESULTS AND DISCUSSION

Chemical composition of PTSW (1:1, 1:2, 1:3) such as pH, electrical conductivity, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), settleable solids (SS), COD, BOD, carbonates, bicarbonates, total phosphorus (P), total potassium (K), ammonical nitrogen (N), calcium (Ca),

Polianthes tuberosa (Agavaceae)

Chrysanthemum (Asteraceae)

Fig. 1: The pants used in the study.

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) is given in Table 1. Characteristics of experimental soils before and after harvest are given in Tables 2 and 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.

Germination, growth of *Chrysanthemum* and *Polianthes* plants, and uptake of all the nutrients 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 constituents such as calcium, zinc, copper, vitamins carotene and vitamin C were almost similar and parameters such as protein, fiber, carbohydrate, energy, magnesium and phosphorus were much more in the case of 1:1 and 1:2 spent wash irrigation than 1:3 and raw water irrigations (Table 4). This could be due to more absorption of nutrients present in spent wash by the plants at higher dilutions. It was also found that thare was no negative impact of heavy metals like lead, cadmium and nickel on the leaves of *Chrysanthemum* and *Polianthes* plants. The soil was tested after the harvest and it was found that there was no adverse effect on soil characteristics.

Table 2: Characteristics of experimental soil (before harvest).

Parameters	Values
Coarse sand[c]	9.24
Fine sand	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 3: 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.

CONCLUSION

It was found that the nutrients uptake in the sprouting, and growth of *Chrysanthemum* and *Polianthes* plants 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 uptake of N, P and K when compared to 1:2 SW. After harvest, soil shows no adverse effect on its characteristics. Hence, the spent wash can be conveniently used for irrigation with required dilution without affecting environment and soil.

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REFERENCES

Amar, B.S., Ashik, B. and Sivakoti, R. 2003. Effect of distillery effluent on plant and soil enzymatic activities and groundnut quality. Journal of Plant Nutrition and Soil Science, 166: 345-347.

Collins, R.A., Ng, T.B., Fond, W.P., Wan, C.C. and Yeung, H.W. 1997. A comparison of humanodeficiency virus type1 inhibition by partially purified aqueous extracts of Chinese medicinal Herbs. Lifesciences 60(23): PL 345-351.

Chandraju, S. and Basavaraju, H.C. 2007. Impact of distillery spent wash on seed germination and growth of leaves vegetables: An investigation. Sugar Journal (SISSTA), 38: 20-50.

Chandraju.S., Siddappa and Chidan Kumar C.S. 2010. Studies on the germination and growth of musterd and aster seeds irrigated by distillery spent wash, Bioresearch Bulletin, 5: 1-10.

Chandraju.S., Siddappa and Chidan Kumar C.S. 2011. Studies on the germination and growth of cotton and groundnut seeds irrigated by distillery spent wash. Current Botony, 2(3):38-42.

Table 4: Growth of *Chrysanthemum* and *Polianthes* plants (cm) at different irrigations.

Name of the plants	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
Chrysanthemum	23, 26, 29	07, 09, 11	22, 24, 27	24, 28, 32
Polianthes	24, 25, 27	06, 08, 09	21, 26, 28	25, 27, 31

Devarajan, L., Rajanna, G., Ramanathan, G. and Oblisami, G. 1994. Performance of field crops under distillery effluent irrigations. Kisan World, 21: 48-50.

Joshi, H.C., Kalra, N., Chaudhary, A. and Deb, D.L. 1994. Environmental issues related with distillery effluent utilization in agriculture in India. Asia Pac. J. Environ. Develop., 1: 92-103.

Jackson, M.L. 1973. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Kaushik, K., Nisha, R., Jagjeeta, K. and Kaushik, C.P. 2005. Impact of long and short term irrigation of a sodic soil with distillery effluent in combination with bio-amendments. Bioresource Technology, 96(17): 1860-1866.

Kuntal, M.H., Ashis, K., Biswas, A.K. and Misra, K. 2004. Effect of post-methanation effluent on soil physical properties under a soybean-wheat system in a vertisol. Journal of Plant Nutrition and Soil Science, 167(5): 1860-1866.

Lindsay, W.L. and Norvel, W.A. 1978. Devalopment of DTPA soil test for Zn, Fe, Mn,and Cu. Soil Science. Soc.Am., J., 42: 421-428.

Manivasakam, N. 1987. Phisico-chemical Examination of Water, Sewage and Industrial Effluent. Pragathi Prakashan, Meerut.

Mohamed Haroon, A.R. and Subash Chandra Bose, M. 2004. Use of distillery spent wash for alkali soil reclamation, treated distillery effluent for fertile irrigation of crops. Indian Farm, March, 48-51.

Patil, J.D., Arabatti, S.V. and Hapse, D.G. 1987. A review of some aspects of distillery spent wash (vinase) utilization in sugar cane. Bartiya Sugar May, 9-15.

Pathak, H., Joshi, H.C., Chaudhary, A., Chaudhary, R., Kalra, N. and Dwivedi, M.K. 1998. Distillery effluent as soil amendment for wheat and rice. Journal of Indian Society for Soil Science, 46: 155-157.

Piper, C.S. 1966. Soil and Plant Analysis. Hans Publication, Bombay.

Rajendran, K. 1990. Effect of distillery effluent on the seed germination, seedling growth, chlorophyll content and mitosis in *Helianthus annuus*. Indian Botanical Contactor, 7: 139-144.

Ramadurai, R. and Gerard, E.J. 1994. Distillery effluent and downstream products, SISSTA, Sugar Journal, 20: 129-131.

Ramana, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B.R. 2000. Physiological response of soybean (*Glycine max* L.) to foliar application of distillery effluent. Plant Soil Research, 2: 1-6.

Raverkar, K.P., Ramana, S., Singh, A.B., Biswas, A.K. and Kundu, S. 2000. Impact of post methanated spent wash (PMS) on the nursery raising, biological parameters of *Glyricidia sepum* and biological activity of soil. Ann. Plant Research, 2(2): 161-168.

Ramana, S., Biswas, A.K., Kundu, S., Saha, J.K. and Yadava, R.B.R. 2001. Effect of distillery effluent on seed germination in some vegetable crops. Bioresource Technology, 82(3): 273-275.

Rani, R. and Srivastava, M.M. 1990. Eco-physiological response of *Pisum sativum* and *Citrus maxima* to distillery effluents. Int. J. of Ecology and Environ. Science, 16-23.

Sahai, R., Jabeen, S. and Saxena, P.K. 1983. Effect of distillery waste on seed germination, seedling growth and pigment content of rice. Indian Journal of Ecology, 10: 7-10.

Samuel, G. 1986. The use of alcohol distillery waste as a fertilizer. Proceedings of International American Sugarcane Seminar, 245-252.

Singh, Y. and Raj Bahadur 1998. Effect of application of distillery effluent on maize crop and soil properties. Indian J. Agric. Science, 68: 70-74.

Subbiah, B.V. and Asija, C.L. 1956. A rapid procedure for the estimation of available nitrogen in soils. Curr. Sci., 25: 259-260.

Walkley, A.J. and Black, C.A. 1934. An examination of the method for termining soil organic matter and proposed modification of the chromic acid titration method. Soil Sci., 37: 29-38.