INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN CHEMISTRY AND PHARMACEUTICAL SCIENCES

(p-ISSN: 2348-5213: e-ISSN: 2348-5221)

www.ijcrcps.com

Coden: IJCROO(USA) Volume 3, Issue 6 - 2016

Research Article

SOI: http://s-o-i.org/1.15/ijcrcps-2016-3-6-5

IMPACT OF DISTILLERY SPENT WASH IRRIGATION ON SPROUTING GROWTH AND YIELD OF JASMINE (OLEACEAE) FLOWERING PLANT

S. CHANDRAJU[*1], C. S.CHIDAN KUMAR[2], K.N.RAJESHWARI[1] AND B.AJAY KUMAR[1]

[1]Department of Studies in Sugar Technology, Sir M. Vishweswaraya Post-graduate Center, University of Mysore, Tubinakere, Mandya -571402, Karnataka, India

[2]Department of Engineering Chemistry, Alva's Institute of Engineering & Technology, Shobhavana Campus,Mijar,Moodbidri-574225,South Canara Dt. Karnataka, India.

*Corresponding Author: chandraju1@yahoo.com

Abstract

Sprouting growth and yield of Jasmine (Oleaceae) 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. Jasmine *(*Oleaceae) 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.

Keywords: Distillery spent wash, Jasmine (Oleaceae), Sprouting, Growth, Irrigation, Soil.

Introduction

Jasmine belongs to Oleaceae family. It is a genus of shrubs and vines in the olive family (oleaceae), 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). ("Jasmin".Webster's Third New International Dictionary, Merriam-Webster.2002).Widely cultivated for its flowers, jasmine is enjoyed in the garden, as a house plant, and as cut flowers. The flowers are worn by women in their hair in southern and Southeast Asia. (Sunset Western Garden Book, 1995:606-607). The delicate jasmine flower opens only at night and may be plucked in the morning when the tiny petals are tightly closed, then stored in a cool place until night. The petals begin to open between six and eight in the evening, as the temperature lowers. Jasmine tea is consumed in China, where it is called jasmine – flower tea. Jasmine flower and tea are "mated" in machines that control temperature and humidity ("*Jasmine dichotomum*). It takes four hours or so for the tea to absorb the fragrance and flavor of the jasmine 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 jasmine syrup, most commonly made from an extract of jasmine flowers. In the "United States, this French jasmine syrup is used to make jasmine scones and marshmallows. Jasmine 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 jasmine is more powerful after darksome of the countries producing jasmine essential oil are India, Egypt, China and Morocco. Its chemical constituents include methyl anthranilate, in dole, benzyl alcohol, linalool, and skatole. Many species also yield an absolute, which is used in perfumes and incense. The white jasmine branch is used in painting of ink and color on silk by Chinese artist. In Syria, jasmine is the symbolic flower of Damascus(Jasmine flower guide). In Thailand, jasmine flowers are used as a symbol of mother. Jasmine is the National flower of the Tunisia, Indonesia and Pakistan. In Indian culture jasmine plays a big role. (Data related to Jasmin at wiki species).Throughout most of India, especially in the western and southern states, including Andhra Pradesh, Karnataka, Maharashtra, Tamilnadu, etc.,. Jasmine gave name to the jasmonate plant hormones as methyl jasmonate isolated from the jasmine oil of *Jasminun grandiflorum* led to the discovery of the molecular structure of jasmonates.

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 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 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 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 spent wash 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 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 Jasmine 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 Jasmine.

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 Jasmine. 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 and Discussion

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).

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
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

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 fulfills all the requirements for the growth of plants.

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**- %

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,

Sprouting and growth of Jasmine 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 Jasmine plant. The soil was tested after the harvest, found that there was no adverse effect on soil characteristics (Table-4).

Table 5. Growth of Jasmine plant at different irrigations (cm)

Name of the plant	RW 15^{th} 22^{nd} 29^{th} (Day)	1:1SW 15^{th} 22^{nd} 29^{th} (Day)	1:2 SW 15^{th} 22^{nd} 29^{th} (Day)	1:3 SW 15^{th} 22^{nd} 29^{th} (Day)
Jasmine *(*Oleaceae)	**23, 26, 29**	**10, 11,11**	**23, 25, 27**	**22, 26, 30**

Table 6. Average number of Jasmine (Oleacea) 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
Jasmine *(*Oleaceae species*)*	**15**	**5cm**	**--**	**--**	**25**	**5cm**	**45**	**5cm**

Conclusion

It is found that the nutrients uptake in the Sprouting and growth of jasmine*(*Oleaceae) 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 Jasmine 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.

Acknowledgments

Authors are grateful to The General Manager, N.S.L. Koppa, Maddur Tq., Karnataka, for Providing spent wash.

References

Amar,BS., Ashisk, B., Sivakoti, R., 2003. Effect of distillery effluent on plant and Soil enzymatic activities and ground nut quality. Journal of Plant Nutrition and Soil Science, 166 345-347.

Basavaraju, HC., Chandraju, S.,2008. Impact of distillery spent wash on the Nutrients of Leaves vegetables: An Investigation. Asian J. of Chem.20, (7) 5301- 5310.

Black, C.A**.,** 1965**.**Methods of Soil Analysis. Part 2, Agronomy monograph No. 9. Am. Soc. Agron., Madison, Wisconsin, USA, pp. 15-72.

Chandaraju, S., Nagendra Swamy, R., Chidankumar, C S., and Girija Nagendraswamy., 2010. Influence of distillery spent wash irrigation on the nutrients uptake of herbal medicinal plants in normal and spent wash treated soil. Bio Med Pharmacol J., 3(2) 55-61.

Chandaraju, S., Nagendra Swamy, R., Chidankumar, C S., and Girija Nagendraswamy., 2010. Influence of distillery spent wash irrigation on the nutrients of Ginger (*Zingerber officinale*) and Turmeric (*Curcuma longa*) in normal and spent wash treated soil. . Nat. Env. Poll.Tech.

Chandaraju, S., Nagendra Swamy, R., Chidankumar, C S., and Girija Nagendraswamy., 2010 Studies on the impact of irrigation of distillery spent wash on the nutrients of tuber/root medicinal plants. Indian J. Environ &Eco plan 17(1-2) 113-120.

Chandaraju, S., Nagendra Swamy, R., Girija Nagendraswamy., and Chidankumar, C S., 2010. Studies on the impact of irrigation of distillery spentwash on the nutrients of leafy medicinal plants. 9^{th} Joint Convention of STAI and SISSTA, 3-12.

Chandaraju, S., Siddappa., and Chidan Kumar, C S., 2011 Studies on the germination and growth of Mustard and Caster seeds irrigated by distillery spent wash, Bio-research bulletin 5 1-10.

Chandaraju, 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 Botany 2(3) 38-42.

Chandaraju,S., Nagendra Swamy, R., Girija Nagendraswamy, and Chidankumar, C S., 2010. Studies on the impact of irrigation of distillery spent wash on the nutrients of creeper medicinal plants. Internet J. agric. Sci. 6 (2) 615-619

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

Chandraju, S., Basavaraju, HC., 2008. An Investigation of Impact of distillery Spent wash on the nutrients of Top Vegetables. Internat. J. Agric. Sci, 4 (2)691- 696.

Chandraju, S., Basavaraju, HC., Chidankumar, CS., 2008. Investigation of Impact of Irrigation of distillery spent wash on the nutrients of cabbage and Mint leaf. Indian Sugar, 19-28.

Chandraju, S., Basavaraju, HC., Chidankumar, CS., 2008. Investigation of Impact of Irrigation of distillery spent wash on the nutrients of pulses. Asian J. of Chem.20 (8) 6342- 6348.

Chares, S., 1985. Vinasse in the fertilization of sugarcane. Sugarcane, 1, 20.

Chidankumar, C S., Chandaraju, S., and Nagendra Swamy, R., 2009. Impact of distillery spent wash irrigation on yields of top vegetables (creepers). World Appl. Sci. J., 6(9) 1270-1273.

Chidankumar,C S., Chandaraju, S., and Nagendra Swamy, R., 2009. Impact of distillery spent wash irrigation on the yields of some root vegetables in untreated and spent wash treated soil. SISSTA 40 233-236

Demole, E., 1962. Isolement et determination de la structure du Jasmonate de methyle, constituent odorant caracteristique de I “essence of jasmine Helvchim Act 45 675-85.

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

Deverajan, L., Oblisami, G., 1995. Effect of distillery effluent on soil fertility Status, yield and quality of rice. Madras Agricultural Journal, 82 664-665.

Industrial effluent. Pragathi Prakashan, Merut.

Jackson, M.L., 1973.Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, p. 85.

“Jasmine dichotomous. Natural Resources conservation service Plants Data Base. USDA.

“Jasmine flower Guide.Data related to Jasminum at wikispecies**.**

“Jasmine”.Webster’s Third New International Dictionary, Merriam-Webster.2002. Sunset Western Garden Book, 1995:606-607.

Joshi, HC., Kalra, N., Chaudhary A., Deb DL., 1994. Environmental issues related with distillery effluent utilization in agriculture in India, Asia Pac J Environ. Develop, 1 92-103.

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

Kuntal, MH., Ashis, K., Biswas, AK., 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) 584-590.

Lindsay, W.L., and Norvel, W.A., 1978**.** Development of DTPA soil test for Zn, Fe, Mn and Cu. Soil Sci. Soc. Am. J**.,**42421-428.

Manivasakam, N., 1987.Physico-chemical examination of water, sewage and industrial effluents 2005 pp. xii + 268 pp.

Mohamed Haroon, AR., 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.

Nagendra Swamy, R., Chandaraju, S., Girija Nagendraswamy., and Chidankumar.,C S., 2010. Studies on the impact of irrigation of distillery spent wash on the yields of leafy medicinal plants. Nat. Env. Poll.Tech. 9(4) 743-748.

Nagendra Swamy, R.., Chandaraju, S., GirijaNagendraswamy., and Chidankumar, C S., 2010. Studies on the impact of irrigation of distillery spentwash on the yields of tuber/root medicinal plants. Biomedical Pharmacol J., 3(2) 99-105.

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

Patil JD., Arabatti SV., Hapse DG., 1987. A review of some aspects of distillery spent wash (vinase) utilization in sugar cane, Bartiya sugar May, 9-15.

Piper, C.S., 1966.Soil and Plant Analysis, Han’s Publication, Bombay.

Pujar, S. S., 1995. Effect of distillery effluent irrigation on growth, yield and quality of crops. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Dharwad.

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.,Gerard EJ., 1994. Distillery effluent and downstream products, SISSTA, Sugar Journal. 20 129-131.

Ramana, S., Biswas, AK., Kundu, S., Saha, JK., Yadava, RBR., 2000. Physiological response of soybean (*Glycine max* L.) to foliar application of Distillery effluent. Plant Soil Research, 2 1-6.

Ramana, S., Biswas, AK., Kundu, S., Saha, JK., Yadava, RBR., 2001. Effect of distillery effluent on seed germination in some vegetable crops. Bio-resource Technology, 82(3) 273-275.

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

Raverkar, KP., Ramana, S., Singh, AB., Biswas, AK., 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.

Sahai, R., Jabeen S., Saxena PK., 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., Raj Bahadur., 1998. Effect of application of distillery effluent on Maize crop and soil properties. Indian J. Agri. Science., 68 70-74.

Subbiah, B.V., and Asija, G.L., 1956. A rapid procedure for the estimation of Available nitrogen in soils. Curr. Sci., 25259-260.

Walkley, A.J., and Black, C.A.., 1934. An examination of the method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci.,3729-38.

Zalawadia, NM., Ramana, S., Patil, RG., 1997. Influence of diluted spent wash of sugar industries application on yield and nutrient uptake by sugarcane and changes in soil properties. Journal of Indian Society for Soil Science. 45 76.

Access this Article in Online

Website:
www.icrcps.com

Subject:
Plant Growth

Quick Response Code

How to cite this article:

S. Chandraju, C. S.Chidan Kumar, K.N.Rajeshwari and B.Ajay Kumar . (2016). Impact of distillery spent wash irrigation on sprouting growth and yield of Jasmine (Oleaceae) flowering plant. Int. J. Curr. Res. Chem. Pharm. Sci. 3(6): 30-36.