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Impact of treated distillery effluent on growth, yield and quality of spring sunflower (*Helianthus annuus*)

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ABSTRACT

A green house experiment was conducted during summer season of 2011 and 2012 at G.M.V. Rampur Maniharan, Saharanpur (U.P.) to study the effect of treated distillery effluent growth on yield and quality of sunflower (Helianthus annuus). Fourteen treatments with three replications were evaluated in complete randomized design. The results revealed that the tallest plants (160.4 cm), maximum values of head diameter (19.0 cm), seeds/head (820.7), and seed yield (43.03 q ha^{-1}) were obtained with 100% NPK alone. The minimum values of these parameters and yield were recorded with 100% NPK + untreated effluent. The distillery effluent treated with charcoal + bleaching power improved significantly the growth and yield attributes over charcoal and bleaching powder alone treated effluent. The highest content of N, P and K in sunflower seeds were recorded with 100% NPK alone. The combined use of charcoal and bleaching power in treating the distillery effluent proved significantly superior to treatment of effluent with charcoal or bleaching power alone in respect of content of these major nutrients in sunflower seeds. The maximum value of protein content (17.93 %) was recorded with 100% NPK followed by combined use of charcoal + bleaching powder and minimum (14.25%) under 100% NPK + untreated effluent. Similar trend of results was recorded in oil content in sunflower seeds. The maximum acid value (0.42%) was recorded in 100% NPK + untreated effluent and minimum (0.25%) with 100% NPK alone. The values of refractive index were not affected significantly by various treatments.

Keywords: Treated distillery effluent, yield, quality, sunflower

INTRODUCTION

Distillery spent wash is perceived as one of the serious pollution problems of the countries producing alcohol from the fermentation and subsequent distillation of sugar cane molasses. The distillery spent wash is characterized as one of the caramelized and recalcitrant wastes containing extremely high COD, BOD, inorganic solids, color and low in pH. In a developing country like India, distillery industries have become a major source of pollution, as 88% of its raw materials are converted into waste and discharged into the water bodies, causing water pollution. The disposal of large quantities of biodegradable waste without adequate treatment results in significant environmental pollution. This is the major source of aquatic and soil pollution. The utilization of distillery effluent for crop production has become a common practice as the availability of fresh water for irrigation is getting reduced day by day during summer season. Therefore, in such conditions use of distillery effluent has been advocated to be utilized in irrigation thereby meeting the existing demand of water, the most limiting factor in agricultural production. Hence an economically viable and environmentally safe means of disposal is needed to handle such large volumes of PME. Analysis on physicochemical characteristics of distillery waste has been carried out, which stated that molasses is the most common raw material used in distilleries for bio-ethanol production. After alcohol distillation, huge volume of darkish coloured spent wash remains in the stills. The waste water generally known as ‘spent wash’ is one of the most difficult waste products to dispose off, because of low pH and dark brown colour. It has high chemical oxygen demand (COD) and biological oxygen demand (BOD), causing pollution in the receiving water. The distillery effluent i.e. spent wash is of extremely polluting nature. There have been also numerous studies done on impact of distillery effluent on soil and water quality (Ansari *et al.* 2012). Sunflower holds promising position among edible oil seed crops due to its premium oil quality and its short duration crop. Therefore, the main objectives of the present study are to evaluate the dilution effect of different application rates of distillery effluent for agricultural purposes could also provide a solution to the disposal problems. Therefore, a plan has been made to judge the impact of distillery effluent on sunflower crop.

MATERIALS AND METHODS

For the study distillery effluent was collected from Sir Sadi Lal distillery, Muzaffarnagar, Uttar Pradesh. The effluent samples collected in clean plastic containers were treated by using charcoal (0.5/50ml) and bleaching power (0.1g/50ml.). Initial and final colour and pH was observed. A green house experiment was conducted during summer seasons of 2011 and 2012 at G.M.V. Rampur Maniharan, Saharanpur (U.P.). The sandy loam soil was low in organic carbon (4.2 g kg^{-1}) and available nitrogen (210 kg ha^{-1}), medium in phosphorus (22 kg ha^{-1}) and potassium (140 kg ha^{-1}) and was slightly alkaline in reaction (pH 7.5). The experiment was laid out in complete randomized design with three replications. There were fourteen treatments namely: T_1 100% NPK (80 kg N + 50 kg P_2O_5 + 40 kg K_2O ha^{-1}), T_2 100% NPK + untreated effluent, T_3 100% NPk + 25% charcoal treated effluent, T_4 100% NPK + 50% charcoal treated, T_5 100% NPK + 75% charcoal treated, T_6 100% NPK + 100% charcoal treated, T_7 100% NPK + 25% bleaching power treated, T_8 100% NPK + 50% bleaching power treated, T_9 100% NPK + 75% bleaching power treated, T_{10} 100% NPK + 100% bleaching power treated, T_{11} 100% NPK + 250t charcoal + bleaching power treated, T_{12} 100% NPK + 50% charcoal + bleaching power treated, T_{13} 100% NPK + 75% charcoal + bleaching power treated and T_{14} 100% NPK + charcoal + bleaching power treated effluent.

The recommended dose of 80 kg N + 50 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied through urea, diammonium phosphate and muriate of potash, respectively. Half dose of N and full dose of phosphorus and potassium was applied as basal at the time of sowing. Remaining half dose of N was top dressed at the flowering stage of sunflower. Sunflower (var. Jwalamukhi) was sown on 15 February during both the years in pots having 20 kg soil. The crop was thinned at 15 days after sowing. The crop was irrigated with treated effluent as per treatments. The crop was harvested in last week of May in both the years. Growth, yield attributes and seed yield per pot was recorded at harvest. The seed samples were analysed for nitrogen content by micro - Kjeldahl method. Phosphorus and K contents were analysed by Vanadomolybdo yellow colour method and flame photometer in di acid (HNO3 + $HClO_4$) digest (Jackson, 1973). Oil content in seeds was extracted by Soxhlet apparatus with petroleum ether (BP 40.60° C) as solvent. Acid value and refractive index were determined by adopting standard procedures (AOAC, 1980).

RESULTS AND DISCUSSION

Effluent Quality

The pH of the effluent was slightly acidic owing to production of acids during fermentation in distillery. It had considerably high EC indicative of soluble salts. The colours of the effluent were dark brown and alcoholic in odour. The effluent also contained substantial amounts of organic carbon, nitrogen, phosphorus, potassium and other nutrients. The effluent also contained small amounts of micronutrients and heavy metals.

Growth and yield attributes

A gradual reduction in plant height due to effluent application was observed at various concentrations. Such adverse effect on plant height may be attributed to acid effect. Plant slightly improved when plants were irrigated with effluent treated with charcoal or bleaching power. The combined treatment of effluent with charcoal + bleaching powder was most effective in enhancing the plant height. The tallest plants was recorded in 100% NPK alone treatment while minimum value of plant height was recorded in 100% NPK + untreated effluent. Ansari *et al.* (2012) and Singh and Singh (2017) also reported similar results.

Leaves/plant of sunflower decreased with untreated effluent significantly over 100% NPK alone. Number of leaves/plant tended to increase with treated effluents. Among the treated chemicals, the combined use of charcoal + bleaching powder was most effective in improving the number of leaves/plant followed by bleaching powder and charcoal. The minimum number of leaves was recorded in untreated effluent due to its adverse effect on plant growth. (Singh *et al.* 1991, Sukanya *et al.* 2003).The stem girth decreased with increasing effluent level (Table 1) and minimum stem growth (3.80cm) was noted at untreated effluent. On the other hand, treated effluent with charcoal, bleaching powder and charcoal + bleaching powder improved the stem girth significantly over untreated effluent irrigation. Among these treatments, charcoal + bleaching powder treated effluent irrigation proved superior to other treatments in improving the stem girth. Similar results were reported by Ansari *et al.* (2012).

Table 1: Effect of different treatments on growth and yield of sunflower (mean of 2 years)

Treatments	Plant height (cm)	Leave/ plant	Stem growth (cm)	Head diameter (cm)	Seed weight/ head (g)	Test weight (g)	Seed yield /pot (g)
T_1 (100% N.P.K)	100.4	14.7	5.60	19.0	13.67	42.44	53.03
T_2 100% N.P.K + Untreated Effluent	87.0	10.0	3.80	15.1	9.91	36.75	37.80
T_3 100% N.P.K+25% Charcoal treated Effluent	96.3	13.0	4.86	15.3	12.65	40.14	48.05
T_4+ 100% N.P.K+50% Charcoal treated Effluent	95.8	12.3	4.66	15.3	12.39	39.97	47.14
T_5 100% N.P.K+75% Charcoal treated Effluent	93.8	12.3	4.34	15.4	11.84	39.65	45.28
T_6 100% N.P.K+100% Charcoal treated Effluent	93.2	12.3	4.06	15.6	11.62	39.21	44.29
T_7 100% N.P.K+25% BP treated Effluent	98.5	13.7	5.00	16.0	12.87	40.40	48.92
T_8 100% N.P.K+50% BP treated Effluent	98.2	13.0	4.94	16.2	12.79	40.16	48.50
T_9 100% N.P.K+75% BP treated Effluent	96.1	12.3	4.74	16.3	12.60	40.09	47.85
T_{10} 100% N.P.K+100% BP treated Effluent	94.4	12.0	4.40	16.5	12.17	39.80	46.35
T_{11} 100% N.P.K+25% Charcoal + BP treated Effluent	100.3	14.0	5.34	17.1	13.22	41.96	51.20
T_{12}100% N.P.K+50% Charcoal + BP treated Effluent	99.6	14.0	5.26	17.3	13.14	41.27	50.43
T_{13}100% N.P.K+75% Charcoal + BP treated Effluent	99.4	14.0	5.14	17.3	13.07	40.92	49.93
T_{14} 100% N.P.K+100% Charcoal + BP treated Effluent	99.2	13.7	5.06	17.5	12.87	40.60	49.07
CD (P=0.05)	4.87	1.33	0.38	1.10	0.78	3.63	2.42

BP = Bleaching Powder

The reduction in head diameter and seeds weight/head at higher concentration of effluent could be due to addition of higher amounts of acidic solution causing injurious effect to roots of sensitive sunflower plants. These two yield attributes (head diameter and seeds/ weight/ head) significantly improved with treated effluent. Among the chemical used for treatment of the effluent, charcoal + bleaching powder proved superior to other treatments. The maximum head diameter (19.0 cm) and seeds weight / head (13.67 g) was recorded with 100% NPK alone. In contrast minimum values of head diameter (15.1 cm) and seeds weight/head (9.91 g) were recorded with untreated effluent yield. Application of untreated effluent resulted in significant reduction in seed yield of sunflower while the use of treated effluent resulted in significant increase in seed yield (Table 1) over untreated effluent. Application of untreated effluent reduced the yield from 53.03 g pot^{-1} (control no use of effluent) to 37.80 g pot^{-1} with untreated effluent. The treatment effluent did not improve the seed yield as compared to control (T_1). The treated effluent with charcoal + bleaching powder resulted in an increase of about 35.4% over untreated effluent (T_2). Among the chemical treatments, the combined use of charcoal + bleaching powder proved superior to most of the treatments in respect of seed yield of sunflower. The lower yield of sunflower seeds with untreated effluent may be attributed to very high EC, BOD and COD of the distillery effluent.

Content of nutrients in seed

Data in Table 2 show that the concentration of N in sunflower seeds ranged between 2.28 and 2.87%. Application of untreated effluent resulted in minimum concentration of nitrogen (2.28%) in sunflower seeds. Application of treated effluent with various chemicals led to accumulation of nitrogen in seeds of sunflower and maximum

Table 2: Effect of different treatments on content of N, P and K and quality parameter in sunflower seeds (mean of 2 years)

Treatments	Content in seed (%)		
	N	P	K
T_1 (100% N.P.K)	2.87	0.48	2.44
T_2 100% N.P.K + Untreated Effluent	2.28	0.33	2.07
T_3 100% N.P.K+25% Charcoal treated Effluent	2.46	0.43	2.32
T_4+ 100% N.P.K+50% Charcoal treated Effluent	2.41	0.42	2.21
T_5 100% N.P.K+75% Charcoal treated Effluent	2.39	0.40	2.15
T_6 100% N.P.K+100% Charcoal treated Effluent	2.36	0.38	2.12
T_7 100% N.P.K+25% Bleaching Powder treated Effluent	2.49	0.44	2.31
T_8 100% N.P.K+50% Bleaching Powder treated Effluent	2.48	0.44	2.28
T_9 100% N.P.K+75% Bleaching Powder treated Effluent	2.48	0.42	2.25
T_{10} 100% N.P.K+100% Bleaching Powder treated Effluent	2.39	0.41	2.20
T_{11} 100% N.P.K+25% Charcoal + BP treated Effluent	2.58	0.47	2.41
T_{12}100% N.P.K+50% Charcoal + BP treated Effluent	2.57	0.47	2.38
T_{13}100% N.P.K+75% Charcoal + BP treated Effluent	2.55	0.47	2.36
T_{14} 100% N.P.K+100% Charcoal + BP treated Effluent	2.53	0.46	2.35
CD (P=0.05)	0.17	0.03	0.15

BP = Bleaching Powder

value of N content in seeds was recorded with effluent treated with charcoal + bleaching powder. Among the chemicals used for treating the effluent minimum values of N content were recorded with charcoal. The effects of various chemicals used in treatment of effluent on the content of N were undoubtedly due to adequate amount of available N in soil due to effluents. Similar results were reported by Bhat *et al.* (2011) and Datta *et al.* (2000). The content of P in sunflower seeds was maximum with application of 100% NPK without effluent (0.48%) followed by effluent treated with charcoal + bleaching powder (0.47%). The minimum value of P content in seeds (0.33%) was recorded with untreated effluent. The phosphorus content in seeds ranged from 0.33 to 0.48 per cent. The P content in seeds improved with the application of treated effluent. The relatively higher P content in seeds were recorded with effluent treated with charcoal + bleaching powder.Saraswat *et al.* (2015) and Singh *et al.* (2015). Application of untreated effluent was found to reduce the concentration of potassium in sunflower seeds over 100% NPK alone without effluent (T_1) treatment. The maximum (2.44%) and minimum (2.07%) values of K content in seeds of sunflower were recorded under 100% NPK alone (T_1) and use of untreated effluent (T_2), respectively. The use of treated effluent improved the K content in sunflower seeds. Ansari *et al.* (2012).

Quality

The highest acid value (0.418%) was recorded under 100% NPK + untreated effluent and the lowest (0.255%) in 100% NPK alone. But the differences among T_{12}, T_{13} and T_{14} were non-significant. Higher acid value in treatment T_2, T_3, T_4 and T_5 may be due to higher osmotic pressure in root zone, low absorption of water in seed. Acid value of oil is an oil quality parameter. In present study the observed values were less than 1.0. This showed that application of treated effluents did not show much negative impact on acid values. The maximum oil content (41.92%) was recorded in T_0 (control) while minimum (33.52%) oil content was observed in 100% NPK + untreated effluent treatment Application of 100% NPK alone (T_0) proved significant by superior to most of the treatments in respect of oil content refractive index ranged from 1.473 to 1.474 as it is a fixed property (identifying for quality check), so much differences cannot be expected due to various treatments. Protein content in sunflower seeds ranged from 14.25 to 17.93 per cent. The minimum value of protein content was recorded under 100% NPK + untreated effluent. Protein percentage in seeds improved significantly with the use of treated effluent. Among these, treatments, charcoal + bleaching powder proved superior to others in respect of protein percentage in sunflower seeds.

Table 3: Effect of different treatments on quality parameters of sunflower seeds (mean of 2 years)

Treatments	Protein content (%)	Oil control (%)	Acid value (%)	Refractive index
T_1 (100% N.P.K)	17.93	41.92	0.25	1.474
T_2 100% N.P.K + Untreated Effluent	14.25	38.45	0.42	1.473
T_3 100% N.P.K+25% Charcoal treated Effluent	15.37	39.13	0.32	1.474
T_4+ 100% N.P.K+50% Charcoal treated Effluent	15.06	38.52	0.33	1.474
T_5 100% N.P.K+75% Charcoal treated Effluent	14.93	36.95	0.35	1.473
T_6 100% N.P.K+100% Charcoal treated Effluent	14.75	38.52	0.35	1.473
T_7 100% N.P.K+25% BP treated Effluent	15.56	39.97	0.31	1.474
T_8 100% N.P.K+50% BP treated Effluent	15.50	39.59	0.31	1.474
T_9 100% N.P.K+75% BP treated Effluent	15.50	39.03	0.32	1.473
T_{10} 100% N.P.K+100% BP treated Effluent	14.93	37.37	0.34	1.473
T_{11} 100% N.P.K+25% Charcoal + BP treated Effluent	16.12	41.84	0.28	1.473
T_{12}100% N.P.K+50% Charcoal + BP treated Effluent	16.06	41.04	0.28	1.474
T_{13}100% N.P.K+75% Charcoal + BP treated Effluent	15.94	40.39	0.30	1.474
T_{14} 100% N.P.K+100% Charcoal + BP treated Effluent	15.81	40.25	0.30	1.474
CD (P=0.05)	1.16	0.41	0.017	NS

BP = Bleaching Powder

From these results, it may be concluded that the sunflower crop, irrigated with distillery effluent treated with charcoal + bleaching powder produced consistent seed yield and quality of seeds almost equivalent to the application of 100% NPK alone.

REFERENCES

A.O.A.C. (1980) Official Methods of Analysis 13th ed. Association of Official Analytical Chemists. Washington D.C.

Ansari F., Awasthi A.K. and. Srivastava B.P. (2012) Physico-chemical characterization of distillery effluent and its dilution effect at different levels. *Archives of Applied Science Research 4 (4): 1705-1715.*

Bhat, M.A., Agrawal, H.P., Wani M.A. and Wani, J.A. (2011) Long term effect of sewage water irrigation on heavy metal accumulation in soils and crops. *Journal of the Indian Society of Soil Science* **59** *(1) 97-100.*

Datta, S.P., Biswas, D.R., Saharan, M., Ghosh, S.K. and Rattan, R.K. (2000) Effect of long term application of sewage effluents on organic carbon, bio available phosphorus, potassium and heavy metal status of soils and content of heavy metals in crops grown thereon. *Journal of the Indian Society of Soil Science* **48** *836-839.*

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

Saraswat, P.K., Chaudhary, B., Bhati, A.S. and Kumar S. (2015) Effect of sewage water on status of nutrients and heavy metals in soils and vegetable crops. *Annals of Plant and Soil Research* **17***(4): 350-355.*

Singh, R.R., Singh, V. and Shukla, A.K. (1991) yield and heavy metal contents of berseem as influenced by sewage water refinery effluent. *Journal of the Indian Society of Soil Science* **39***: 402-404.*

Singh, S., Singh, V., Singh, J.P., Kumar, A. and Singh, H. (2015) Effect of sewage water irrigation on accumulation of micro nutrients and heavy metals in soils and vegetable crops. *Annals of Plant and Soil Research* **17***(2): 129-132.*

Singh, V. and Singh, H. (2017) Status of nutrients and heavy metals in soils and vegetatble crops irrigated with sewage water. Annals of Plant and Soil Research **19**(1): 7-11.

Sukanya, T.S. and Meli, S.S. (2003) Effect of distillery effluent irrigation on yield and quality of wheat grown on sandy loam in northern transitional zone of Karnataka. *Karnataka Journal of Agricultural Science* **16** *(3): 373-378.*