I J R B A T, Issue (Special-17), June 2021: 627-633
A Double-Blind Peer Reviewed & Refereed Journal
e-ISSN 2347 – 517X
Original Article
INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY
© www.ijrbat.in

THE IMPACT OF DISTILLERY EFFLUENTS ON FERTILITY OF SOIL AND GROWTH CHARACTERISTICS OF CAJANUS CAJAN L. (Pigeon pea).

Kantu M. Khalkar
G. Department of Botany and Research Centre, M.V.P Samaj's K.T.H.M. College, Nashik, 422002 (M.S.) India
E-Mail: kkhalkar@gamil.com

ABSTRACT:
The distillery industries are high income paid as well as high pollution loaded industry. In Maharashtra, there is maximum number of distilleries producing alcohol which is about 188.69 Lac liters per year. It is also estimated that about 18 liters of waste water is released for every liter of alcohol. The distillery effluent reaches rivers, wells and affects the quality of surface, ground water & Soil. The effluent affected water & Soil may have certain impact on growth characteristics of crop and microbial diversity.

The distillery effluent was collected from industry and preserved at 20 ^{0}C until used. The initial physicochemical parameters of distillery effluent were studied by standard method. The seeds Pigeon pea were sterilized using 0.1% of mercuric chloride solution to remove the microbes after thorough wash. For biochemical tests, using five soil pots whose dimension are 30cm height x 20cm width. Red soil was collected without any contamination by distillery factory effluent and sieved (4mm mesh). About 4 kg of soil was taken in separate pots. Five different concentrations (viz., 0%, 25%, 50%, 75%, and 100%) of effluent were prepared and poured into each pot. Control was also maintained and irrigated with tap water.

The physicochemical parameters of the distillery effluents are very high which affect not only the crop growth but decreases the fertility of the soil. The investigation was carried out with different concentration of effluent for seed germination, growth, and seed myocflora, dry & fresh matter of crop. It is concluding that distillery effluent is harmful for the pigeon pea growth. With treated effluent reduces 50% of seed germination due high organic and inorganic pollutant contains. From the experiment it was found that control effluent gives 99% of seed germination where 100% directly discharge gives 50% pigeon pea seed germination. It also decreases the growth, dry matter and seed mycoflora of pigeon pea plant. The high physicochemical parameter of effluent reduced the fertility and productivity of soil

Keywords: Distillery effluents, mycoflora, *Cajanus cajan, growth.* pollutants.

INTRODUCTION:

The industries effluents are the major source of water pollution, which disturb the life cycle of the living thing on Earth. The physicochemical parameters of some industry are very high which affect not only the crop growth but decreases the fertility of the soil. In that regard's distillery industry is one of them.

Environmental pollution caused by the release of a wide range of compounds as a consequence of industrialization has assumed serious proportions (Jain et al., 2005). All the industries consume huge quantity of water and throw back almost an equal quantity of effluent which contains highly toxic materials in dissolved or suspended form (Kolhe et al., 2008). Water pollution disturbs the natural balance of ecosystem inside, resulting in the death of various aquatic species. Moreover, it also reduces the potential of water as a resource for the various uses (Pandey and Gopal, 2003). This is because pollution causes the water to become unsuitable for various uses and also difficult and more expensive to treat to accept

quality for use. Aquatic organisms, including fish, accumulate pollutants directly from contaminated water and indirectly via food chain (Sasaki et al., 1997). Various kinds of pollutants build up in food chain and are responsible for adverse effects and death in the aquatic organisms. Fish are widely used to evaluate the health of aquatic ecosystem and physiological changes serve as biomarkers of environmental pollution (Camargo and Martinez, 2007). Moreover, certain insects and plankton species are recognized as bio-indicator species of aquatic pollution.

Distillery industries are high income paid as well as high pollution loaded industry. The ethanol produced from molasses which comes out from sugarcane industry waste (Baskar et al., 2003). In distillery industry processing, cleaning the floor, cooling water and spend wash around 60 to 100 liters of waste water generated to produce 1 liters of alcohol. The raw spent wash generated after fermentation and distillation is acidic in nature having dark brown colour with unpleasant odour, high COD and BOD (1,00,000 and 45,000 mg/l) as well as high dissolved and suspended solid. Spent wash as a distillery waste is posing disposal problem. Regular application of distillery effluent may affect soil physical and chemical properties viz., infiltration rate, hydraulic conductivity, water retention capacity, electrical conductivity, pH, availability of nutrients and also results in adverse effects on microbial biomass and population which might alter the fertility status of the soil. The various metallic and nonmetallic elements act as nutrients but at the higher concentration they show toxic effects on seed germination and seedling growth, ultimately adversely affecting plant growth and yield. Om et al. (1994), while studying the combined effect of different concentrations of wastes of distillery and sugar mill, observed inhibition of seed germination, seedling growth and biomass in okra (*Abelmoschus esculentus* L.). In the distillery effluent, various metals/nonmetals individually may not be toxic to the plant but in combination they may be toxic. On the other hand Zalawadia et al. (1996) studied the inhibitory effect of distillery effluent in combination with fertilizer on plants as well as on soil properties. Experiments conducted by Dutta and Boissya (1999) for studying the effect of low concentration of paper mill effluent on growth and field.

NPK contents in rice showed increase in growth and yield of crop. The time has come to look back to time tested effect of polluted water on the crop. One thing is certain those crops grown with wastewater are healthy and beneficial since they recharge the soil. Billions of microorganisms are activated in healthy soil for the benefit of the farming community. Some time waste water acts as a good soil conditioner and improves the physical, chemical and biological properties of the soil. The regular and untreated discharges distillery industry effects the crop growth and also effect the fertility and productivity of soil.

The main goal of this work is to study the effect of distillery effluent on germination of Pigeon pea (*Cajanus cajan* L). The growth rates of seed are measure with their root length, fresh and dry weights are also studied.

Table 1: Average physicochemical parameter of distillery effluents

MATERIAL AND METHOD:

Material

The distillery effluent was collected from industry and preserved at 20 ^{0}C until used. The initial physicochemical parameters of distillery effluent were mention in Table 1. .The seeds of

Pigeon pea (*Cajanus cajan* L*)* was sterilized using 0.1% of mercuric chloride solution to remove the microbes after thorough wash.

Method

For biochemical tests, using five soil pots whose dimension are 30cm height x 20cm width respectively. Red soil was collected without any contamination by distillery factory effluent and sieved (4mm mesh). About 4kg of soil was taken in separate pots. Five different concentrations (viz., 0%, 25%, 50%, 75%, and 100%) of effluent were prepared and poured into each pot. Control was also maintained and irrigated with tap water.

Effect of distillery effluents on seed mycoflora:

About 30 seeds of Pigeon pea (*Cajanus cajan L)* plants were placed on the moist plates for studying seed mycoflora. The seeds were dipped in the effluent for nearly 2 minutes and the filter paper was also moistened with distillery effluent. The seeds kept in the plates without treatment of effluent served as control. Observations for the presence of fungal species on the seeds were recorded after one week onwards. Percentage appearance was then calculated (Deshpande and Kulkarni, 1988).

Analytical method

Physico-chemical parameters of distillery industry waste water , temperature (o C), colour (visibility), pH (log scale), electrical conductivity (EC), dissolved oxygen (DO), biological oxygen demand (BOD), total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), chloride, alkalinity, total hardness, calcium, magnesium, sulphate, phosphate and total iron were measured using the standard methods (APHA 1998).

Calculation and analysis of seed germination speed are as follows: Peak value and germination value were determined by the formulae,

Peak Value = Cumulative percentage germination on each day/No. of days elapsed since initial imbibitions (1)

Germination value = Peak value × Germination percentage (2)

RESULT AND DISCUSSION:

The study reveals that the physicochemical characteristics of distillery effluent have high load of pollutants. The effluent was dark brown in colour. Odour of samples was alcoholic in nature. It is one of the most complex and cumbersome waste having very high value of solids, electrical conductivity, hardness, calcium and magnesium compounds, chlorides, BOD and COD content and highly acidic pH, while D.O. was found very less and contains high organic load of nutrient elements such as copper, potassium and zinc.

The work focus on the effect of distillery industry effluents on the seed germination of Cajanus cajan *L.* (Pigeon pea) crop. The investigation was carried out with different concentration of effluent for seed germination, root length, shoot length, fresh weight and dry weight of crops.

Effect on Pigeon pea crops:

To determine the effect of effluent on Pigeon pea crop was carried out with different percentage of sample for 20 days. The result represent in Figure 2. The result indicate that when the effluent percentage is zero the Pigeon pea growth is maximum 98%. When the percentage of effluent increase from 25%, 50%, 75%, and 100% the seed germination were 92%, 80%, 55%, and 18%. For the Pigeon pea crop normal pH and electrical conductive water is suitable. In this study, distillery industry effluent discharged soil had relatively higher clay and

silt contents than the control soil. Other studies have found the same, like long term application of sewage effluents (Abdelnainm et al., 1987) and cotton ginning mill effluents (Narasimha et al.,1999). However, increased water holding capacity and electrical conductivity in the test soil may be due to accumulation of organic wastes and salts in the distillery industry effluents. Likewise, similar results were observed in soils discharged with effluents from cotton ginning mills

Table 2:-Effect of Distillery effluent on root length, Fresh weight, Dry weight of Pigeon pea.

(Narasimha et al., 1999), paper mills (Medhi et al., 2005) and sewage irrigated soils (Renukaprasanna et al., 2002). High electrical conductivity was also observed in soils treated with distillery effluents (Devarajan et al., 2002) and sodium based black liquor from fiber pulping for paper making (Xiao et al., 2005). In contrast, soils polluted with cement dust from cement industries had low water holding capacity and high electrical conductivity (Kumar and De Brito, 1995). The slight drop in the pH of the test soil is explained in terms of release of effluents with acidic in nature, containing agro based chemicals from distillery industry. Same was noticed in the discharges of distillery cane residues from distillery industry (Zende, 1996), application of sewage effluents (Bhogal et al., 2002) to soils decreased the pH.

Due acidic nature of effluent it affects the root length of Pigeon pea crops. The root length fresh weight and dry weight reduction decrease with increase in effluent concentration which is mention in Table 2.

The shoot length was also decrease with increase in the effluent concentration. When effluent was on control the shoot length of Pigeon pea was 10.5 ± 0.51 cm on 25 days. With increase in concentration the shoot length fall continuously for the experimental duration, that is mention on Table.2

Effect of distillery effluents on seed mycoflora: -

The studies were carried out by blotter test. Pigeon pea (*Cajanus cajan L.)* seeds were treated with distillery effluents. Seeds kept in distilled water plates served as control. Results are presented in Table – 3. It was seen that total 05 fungal species were recorded and it was interesting to note that some species were suppressed or some of them appeared due to distillery effluent treatment. For example. *Aspergillus niger* was suppressed due to distillery effluent while *Aspergillus flavus*, *Fusarium oxysporium* & *Trichoderme viride* appeared on the effluent treated seeds.

Table 3 : Percentage occurrence of fungal species tolerant to the distillery effluents on seed mycoflora of . Pigeon pea (*Cajanus cajan L)*

CONCLUSION:

The study reveals that the physicochemical characteristics of distillery effluent have high load of pollutants. The effluent was dark brown in colour. Odour of samples was alcoholic in nature. It is one of the most complex and cumbersome waste**.**

It is concluding that distillery waste water is harmful for the Pigeon pea crops growth. With treated effluent reduces 50% of seed germination due high organic and inorganic pollutant contains. From the experiment it was found that control effluent gives 99% of seed germination where 100% directly discharge gives 18 % Pigeon pea seed germination. The root length was decreases for 8.5cm Pigeon pea and 8.3 for at 100% effluent. Effect of distillery effluents on seed mycoflora . It was seen that

total 06 fungal species were recorded and it was interesting to note that some species were suppressed or some of them appeared due to distillery effluent treatment. The high physicochemical parameter of effluent reduced the fertility and productivity of soil. It also decreases the biochemical parameter of crops.

REFERENCE:

Aneja K.R., *Experiments in microbiology, Plant pathology and Tissue culture,* (1993). Wishwa Prakashan , New Delhi. PP 471.

Abdelnainm EM, Rao MS, Wally TM, Nashar EMB (1987). Effect of prolonged sewage irrigation on some physical properties of sandy soil. Biological Wastes 22:269–274.

Ajmal M, Khan AU, (1983). Effects of sugar factory effluent on soil and crop plants. Environmental Pollution Series A: Ecological and Biological 30:135-141.

APHA (American Public Health Association) (1998) Standard methods for the examination of water and wastewater. 20th edition, American Public Health Association, Water Pollution Control Federation. Washington, DC.

Annadurai, K., Kavimani, R. and Masilamani, P (1999). Effect distillery effluent and organic amendment on rice yield and soil fertility status Madras *Agriculture Journal* (Publ.2000) **86**(10-12): 572-577.

Baskar M, Kayalvizhi C, Bose, MSC (2003). Eco-friendly utilization of distillery effluent in agriculture – A Review. Agric. Rev. 24 :16-30.

Chuasavathi T, Treloges V (2001). An important of Yasothon soil fertility (Oxic Paleustults) using municipal fermented organic compost and Panicum maximum TD 58 grass. Pakistan J. Biol. Sci. 4 (8):968–972.

Deshmukh VL, Kaswala RR, Patil RG, Kaswala AR (2004). Effect of different sludges materials on physico-chemical properties of vertisol. J. Maharashtra Agric. Unive., 29 (1):9-11.

Devarajan L, Satisha GC, Nagendran K (2002). Distillery effluent – a source for fertigation and composting of pressmud and other biodegradables. In: Paper Presented at the 24th Symposium, 17th World Congress of Soil Science, Thailand, 14–21 August 2002.

Labana S, Lal B, Sarma PM, Bhattacharya D, Thakur IS (2005) Microbial diversity: Application of microorganisms for biodegradation of xenobiotics. Current Science. 89(1):101- 112.

Kaushik A, Kadyan BR, Kaushik CP (2004). Sugar mill effluent effects on growth, photosynthetic pigments and nutrient uptake in wheat seedlings in aqueous vs. soil medium. Water, Air and soil Pollution 87: 39-46.

Kolhe AS, Ingale SR, Sarode AG, (2008). Physico-chemical analysis of sugar mill effluents. Int. Res. J. Sodh, Samiksha and Mulyankan. 4(1):307-311.

Monanmani K, Chitraraju G, Swaminathan K (1990). Effect of alcohol and chemical industrial effluents on physical & biological properties of soil. Pollut. Res. 9:79–82.

Narasimha G, Babu GVAK, Rajasekhar Reddy B (1999). Physicochemical and biological properties of soil samples collected from soil contaminated with effluents of cotton ginning industry. Journal of Environmental Biology 20:235–239.

Pandey AC, Gopal K (2003). River pollution and its impact on fisheries resources: An overview. In: River pollution in India and

its Management, K. Gopal and A Agarwal (Eds). APH Publishing Corporation. 209-236.

Renukaprasanna M, Channal HT, Sarangamath PA (2002). Characterization of city sewage and its impact on soils and water bodies. In: Paper Presented at the 24th Symposium, 17th World Congress of Soil Science, Thailand, 14–21August 2002.

Zende GK (1996) Sugar Industry by Product and Crop Residues in Increasing Soil Fertility and Crop Productivity in Sugar Cane Agro Industrial Alternations, 351–36

Zalawadia, N.M. and Raman, S. (1994). Effect of distillery wastewater with graded fertilizer levels on sorghum yield and soil properties *Journal of the Indian Society of Soil Science.* 42(4): 575-57.

Table 1: Average physicochemical parameter of distillery effluents

Sr. No.	Parameters	Parameter
01	Odour	Strong alcoholic
02	Colour	Dark brown
03	PH	5.8
04	Dissolved oxygen	1.8 mg/l
05	Biological oxygen demand	5754 mg/l
06	Chemical oxygen demand	2782 mg/l
07	Oil and Grease	16 mg/l
08	Temperature	60 ^{0}C
09	Electrical Conductivity	2.68 cm-1
10	Total Dissolved Solid	1188 mg/l
11	Total Suspended Solids	635mg/l
12	Chloride	378 mg/l
13	Calcium	40 mg/l
14	Magnesium	338 mg/l
15	Iron	3.1 mg/l
16	Zinc	0.49 mg/l
17	Copper	0.12 mg/l
18	Potassium	67 mg/l

* Except Colour, PH, Conductivity and Temperature all value is in mg/lit.

Table 2:-Effect of Distillery effluent on root length, Fresh weight, Dry weight of Pigeon pea.

Sr. No.	Effluent %	Shoot length (cm)	Root length(cm)	Fresh Wt (mg)	Dry Wt (mg)
01	Control	11.5	4.2	24	20
02	25 %	10.00	4.2	20	16
03	50 %	6.5	3.2	18	10
04	75 %	5.0	1.5	10	07
05	100 %	Nil	Nil	Nil	Nil

Table : Percentage occurrence of fungal species tolerant to the distillery effluents on seed mycoflora of . Pigeon pea (*Cajanus cajan L)*

Sr. No.	Fungal species	Control %	Effluents %
1	*Aspergillus sclerotium*	14.20	20.00
2	*Aspergillus flavus*	28,57	20.00
3	*Aspergillus niger*	21.80	20.00
4	*Fusarium oxysporium*	-	-
5	*Rhizopus stolonifer*	14.20	20.00
6	*Trichoderme viride*	20.00	