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Effect of Distillery Effluent on Different Wheat Cultivars

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Abstract:

It is well known that various industrial effluents have detrimental effects on different component of the environmental. The various toxic chemicals, heavy metals, acids, pesticides, persistent organic compounds and toxic salts discharged by the effluents of these industries are accumulated in the soil gradually, resulting in contamination of soil, water and food. The laboratory experiments were conducted to study the effect of different concentrations of distillery effluent (0, 6.25, 12.5, 25, 50, 75 and 100%) on seed germination (%), vigor-index (VI), plant shoot length and root length of three different cultivars of wheat. The distillery effluent has less inhibitory effect on seed germination at low concentration (25%). The other reported plant parameters also followed the similar trend. At higher concentration effluent has a detrimental effect on all the studied cultivars of wheat WH-147, PBW-343 and PBW-373.

Keywords: Distillery, Effluent Wheat cultivars, Germination, Vigor-index, Shoot and root length.

1.0 Introduction:

Enhance industrialization and urbanization from last 20-30-years has resulted in pollution of all the components of the environment that is the air, the water, the soils and even our food. The contamination of the environment has occurred through effluents of variety of industries like distilleries, paper mills, refineries, food industries, tannery industries and many more. The various toxic chemicals, heavy metals, acids, pesticides, persistent organic compounds and toxic salts discharged by the effluents of these industries are accumulated in the soil gradually, resulting in environment contamination. The disposal of waste water from different industries and domestic sewage causes contamination of different components of the environment. In India, the abundance of soils with low organic matter content, favours the use of industrial wastewaters containing organic matter as an organic amendment and nutrient supply to soil (Garg & Kaushik, 2008). The waste water discharged by these industries not only affects the surface and groundwater, but also seriously affect the soil properties (Ghosh, 2005). The effluents of different industries used for irrigation, seriously damage the seed germination and seedling growth of various crops but effects varies from crops to crops. Various researchers have carried out studies regarding the effects of different industrial effluents on different crop species (Kaushik *et al.*, 2005; Garg & Kaushik, 2006 & 2008; Nagajyothi et al 2009; Malaviya & Sharma, 2011; Medhi et al 2011).

The breweries and distilleries are considered as a major polluter of the environment. Distilleries are one of the 17 most polluting industries listed by the Central Pollution Control Board. At present, there are 319 distilleries in India with an installed capacity of 3.29 billion litre of alcohol (Malaviya & Sharma, 2011). According to Uppal, 2004 eight-fifteen litre of waste water discharged in the environment for one litre of alcohol produced having very high BOD and COD (approximately 50,000 mg/l and 95,000 mg/l respectively). As distillery is an agro based industry so the effluents may consist of inorganic and organic nutrients and which may be beneficial for various crops depending upon the concentration (Pandey et al, 2007) and gaining importance in agricultural sector.

There are various reports related to the effect of effluents on plants whereas studies related to inhibitory effects of effluents scanty in case of different wheat cultivars grown in this region. Hence the objective of this study was to assess the effects of distillery effluents on the seed germination and growth performance of different cultivars of wheat commonly grown in Haryana, at different concentrations of distillery effluents at laboratory scale and in pot culture experiments.

2.0 Materials and Methods:

2.1. Distillery effluents:

The distillery effluent used in the present study was collected in pre-cleaned plastic containers from Associated Distillery Ltd. located near Hisar (Haryana), India. The effluents were kept in refrigerator to avoid any change in characteristics and used in further study when required.

2.2. Wheat cultivars:

The seeds of different cultivars of wheat (Triticum aestivum) viz, WH-147, PBW-343 and PBW-373 were procured from the certified local seed supplier. Before performing the experiments, the percent germination of these cultivars was checked and was found to be between 90-100%.

2.3. Germination experiments:

For germination tests, twenty seeds of each wheat cultivar were placed in sterilized glass petri dishes of uniform size lined with filter paper. The filter papers were then moistened with 5ml of tap water for control and with the same quantity of various concentrations of the distillery effluents (6.25%, 12.5%, 25%, 50%, 75% and 100%) in same tap water. The Petri dishes were incubated at 20 ± 1 _C in an incubator. Germination was recorded daily at a fixed time and the emergence of the radicle was taken as a criterion of germination. The experiment was terminated after ten days. All the experiments were carried out in triplicate and the results were averaged. For observing seedling growth, five ten days old seedlings were picked from each of the sets and the length of the root and shoot were recorded.

2.4. Pot culture experiments:

Pots of 15cm (diameter) · 14cm (height) size were filled with equal amounts of sandy loam soil of medium fertility and twenty seeds of each wheat cultivar i.e. WH-147, PBW-343 and PBW-373 were sown in respective pots. The pots were irrigated with selected concentrations (6.25%, 12.5%, 25%, 50%, 75% and 100%) of the distillery effluents. For each treatment, 50ml of each of these concentrations were applied to the respective pot at five day interval, throughout the study period. Each treatment had three replications. A control set, irrigated with tap water was also maintained for comparison. After germination seeds were thinned to five seedlings per pot in all the pots except for those where number of germinated seeds was five or less than five.

3.0 Results and Discussion:

Agriculture is the main occupation of the people of Haryana. About 70% of the population is depended upon agriculture for their livelihood. The state of Haryana has a geographical area of 44.20 lakh hectare. About 86% of the geographical area is cultivable, of which 96% has already been brought under plough. There are two main types of crops in Haryana: Rabi and Kharif. The major Kharif crops of Haryana are rice, jowar, bajra, maize, cotton sugarcane and groundnut. The major Rabi crops are wheat, tobacco, pulses, rapeseed and mustard. Wheat is the major crop grown in winter season in Haryana, but different cultivars are used in different parts depending upon soil type and irrigation facilities. Wheat is the main staple food of Haryana including Northern India. In the present investigation, the effect of distillery effluents in various concentrations (6.25%, 12.5%, 25%, 50%, 75% and 100%) on seed germination (%), vigor index, shoot length and root length of three wheat cultivars (Triticum aestivum) viz. WH-147, PBW-343 and PBW-373 has been explored. The results of seed germination and seedling growth experiment show that germination count generally decreased with increase in effluent concentration. Table 1 shows the effect of distillery effluent on germination (%) of different wheat cultivars.

Table 1: Effect of distillery effluents on germination (%) of different wheat cultivars

Concentration	WH-147	PBW-343	PBW-373
0* (Control)	100 ± 0.00	100 ± 0.00	100 ± 0.00
6.25	98 ± 0.00	95 ± 0.00	95 ± 0.00
12.5	95 ± 13.00	90 ± 10.00	90 ± 12.10
25.0	90 ± 17.00	90 ± 14.22	90 ± 10.11
50.0	85 ± 13.13	80 ± 11.11	80 ± 20.00
75.0	75 ± 12.10	70 ± 12.10	70 ± 11.11
100	65 ± 19.10	60 ± 14.31	60 ± 10.00

*Tap water [n = 3, mean ± S.D.]

The maximum phytotoxicity on germination percentage was observed (65%, 60% and 60%) at 100% effluent concentration in different wheat cultivars i.e. WH-147, PBW-343 and PBW-373

respectively. The distillery effluent did not showed any inhibitory effect on seed germination at low concentration in all the three wheat cultivars. So our observations are consistent with the findings of Ramana et al 2002 for effects of distillery effluents in different crops. He has also reported that at higher distillery effluent concentration germination was inhibited in different crops. Further, results also showed that WH-147 is more tolerant to distillery effluents as compare to other wheat cultivars i.e. PBW-343 and PBW-373 respectively. According to Ungar, 1987 the germinating ability of different crops at high osmotic pressure differs with variety and species. The osmotic pressure of the effluent is higher at high concentrations which retard germination (Ramana et al., 2002; Rodger et al., 1957).Vigor index also showed a decreasing trend with increasing distillery effluent concentration. Seed vigor is an important quality parameter which needs to be assessed to supplement germination and viability tests to gain insight into the performance of a seed lot in the field or in storage. The inhibitory effect on root and shoot length was observed with increasing concentration of effluents (Table 2).

Table 2: Effect of distillery effluent on shoot and root length (in cm) of different wheat cultivars.

Concentration	WH-147		PBW-343		PBW-373	
	SL	RL	SL	RL	SL	RL
0*	8.96 ±10.1	3.84 ±0.00	8.76 ±0.15	3.80 ±0.30	8.54 ±0.10	3.68 ±0.75
6.25	8.60 ±17.1	3.60 ±0.20	7.40 ±0.10	2.66 ±0.50	7.00 ±0.70	3.90 ±0.54
12.5	7.10 ±20.22	2.40 ±0.11	6.40 ±0.20	2.80 ±0.60	6.90 ±0.80	3.60 ±0.30
25.0	7.10 ±11.00	2.20 ±0.30	8.00 ±0.10	2.90 ±0.60	6.00 ±0.20	4.60 ±0.20
50.0	5.00 ±13.00	1.20 ±0.20	5.10 ±0.15	1.40 ±0.20	5.20 ±0.20	1.10 ±0.30
75.0	3.60 ±11.50	0.26 ±0.30	5.10 ±0.30	0.56 ±0.80	5.90 ±0.55	2.00 ±0.60
100	2.90 ±19.00	0.15 ±0.70	2.50 ±0.22	0.20 ±0.50	2.60 ±0.78	1.10 ±0.80

*Tap water; SL = Shoot length; RL = Root length [n = 3, Mean ± SD]

From the result it can be concluded that up to 25% concentration of effluents there was no significant effect on root and shoot length of different wheat cultivars with control. The diluted distillery effluents are beneficial for different crops as reported by various researchers (Pathak et.al.1998; Singh et.al, 2003 and Ramana et.al, 2000). With increasing concentration of effluent there was decrease in root and shoot length of all the studied wheat cultivars. If we compare the shoot and root lengths of all the three cultivars, the latter was more affected at higher concentration of effluent. Supply of the undiluted (100%) effluent produced significant inhibition in seed germination and seedling growth parameters. Our results are in consistent with the findings of Pandey et al, 2008 in which they have shown the adverse impacts of concentrated distillery effluents on rice and maize crops. Similarly inhibitory effects of distillery effluent have also been reported in brassica by Malaviya and Sharma, 2011; in pigeon pea and black gram by Pandey, 2006; in pea and wheat by Pandey et al, 2009 and in wheat, garden pea, black gram and mustard by Nath et al 2007. Probably presence of high salt content and heavy metals may have inhibitory impacts on seed germination and growth ((Lauchli and Luttge, 2000 and Kabata-Pendias and Pendias, 1992). In conclusion the present investigation shows that at lower concentration distillery effluent has no devastating impact on germination and seed growth of different wheat cultivars. But at higher concentration it adversely effects the germination as well as seed growth so precaution should be taken while using distillery effluent for irrigation purpose.

4.0 Conclusion:

Our findings have shown that higher concentration of distillery effluent inhibit the germination and growth of different cultivars of wheat. Differential responses of wheat cultivars to distillery effluent treatment were noted. PBW-373 was most sensitive followed by WH-147 and PBW-343. There was no significant effect on germination and growth of different wheat cultivars at 25% distillery effluent treatment. The findings of present investigation are significant and may be very useful for agricultural experts and farmers.

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