Effects of Pulp and Paper Mill Effluents on Seedling Growth of Wheat (*Triticum Aestivum*)

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***Abstract*-The physico-chemical characteristics of paper mill industry effluent were found to be above the permissible limits prescribed by Indian Irrigation Water Standard. A study was conducted to investigate the effects of different concentrations (10, 25, 50, 75 and 100%) of paper mill effluent on growth and production of wheat. pulp and paper mill waste has inhibiting effect on the germination of crops, The germination per cent was found to be decreasing at higher concentration levels. The presence of higher concentration of soluble salts and heavy metals are toxic to seed germination. The toxic effects of the effluent again affected the seedling growth. The germination of wheat in 100% effluent was recorded 3%, however in 10% effluent germination rate recorded to 96%. In the 25% effluent germination rate was 85%. But in the control germination rate (per cent) was 100%.The increase in concentration decreases the seedling length (cm) of wheat. Similarly the increase in effluent concentration decreases the seedling length (cm) of wheat. The seed germination inhibition in case of diluted effluent is comparatively lower than the seed germination calculated for 100% effluent.**

***Index Terms*- pulp & paper mill Effluent, Chemicals, Seed germination, and wheat.**

I. INTRODUCTION

The paper industry is one of the largest industries in India, consuming large amount of water. [1] The effluent generated is normally considered to be highly polluting and the presence of the chemicals from the effluent may affect soil and in turn the growth and development of plants. [2, 3].The pulp and paper industry is one of the industries, which has generated great concern about the hazardous pollutants, continuously released into the water bodies. A large paper mill discharges high volumes of water [4]**.** Effluent discharged from pulp and paper mills has a mixture ofchemicals used in the digestion lignin and also has wood preservatives found from the effluent of pulpand paper mill are colour, oil and grease, detergents, resin acid, unsaturated fatty acids, chlorinated resin, alcohol, lignin degradation products and poly chlorinated bi-phenyl. The effluents enhance pH, BOD, COD, lignin, total suspended solids, colour, heavy metal ions & other toxic substances & thus change the natural quality of water. The pulp & paper mill effluents using for irrigation purposes in the form of growth, yield and nutrient quality of wheat (*Triticum aestivum*). The paper production process generates a considerable volume of effluents, which must be treated before they can be disposed of in order to meet environmental standards. Therefore, disposal of these wastewater products through irrigation can be an attractive alternative (environmentally as well as economically) for the final destination of these effluents, which currently are drained into surface waters. In addition to eliminating an additional treatment process, the wastewater can be considered a source not only of water but also of supplementary nutrients [5].

The aim of present study to explore effects of pulp and paper mill effluent on wheat growth.

II. MATERIALS & METHODS

Sampling

The effluent sample from the Pulp and Paper mill were collected at the main outlet point where combined effluents from the factory are being disposed of into mill influent water. Water samples at the point of discharge were collected in clean plastic container from the main outlet. The sample was collected i.e. April 2017 from pulp and paper mill, Chhattisgarh. Immediately after collection the water samples were brought to the laboratory and kept in the refrigerator at 4^0C till used for analysis.

Petridis method was followed for germination and early seedling growth. Ten wheat seeds were taken in triplicate at 25^{0}C ± 2, which were repeated thrice. The seeds were kept moist either in different dilutions (10, 25, 50, 75, 100%) of effluent solution was in double distilled water, which served as control. The source of continuous light was from two fluorescent tubes of 40 watts, fitted at a distance of one meter from the Petri dishes. Final counting of germinating s**:**

Culture of wheat in different concentration

Where, A = Culture of wheat in distil water

B = Culture of wheat in 10% effluent

C = Culture of wheat in 25% effluent

D = Culture of wheat in 50% effluent

E = Culture of wheat in 75% effluent

F = Culture of wheat in 100% effluent

Seeds were carried out after seven days of the experiment.

Wheat seeds UP 2425 were soaked overnight in the test solution (effluent) containing HNO_3 (0.1 per cent). On the length day, the effluent on the shoot length and root length were studied by measuring the same. The fresh weight of seedling was measured after 6 days. The dry weight of seedlings was measured after drying the seedlings in an oven at 50^{0}C for 48 hours.

The percentage inhibition in seed germination and seed vigour index was computed as follows:

Seed germination inhibition (percent) = 100 x (N – n/N)

Where N is germination inhibition (percent) in control and n is germination (percent) in treatment.

Seed vigour index = germination (percent) x Seedling length (mm)

The fresh weight of seedling was measured after 6 days. The dry weight of seedling was measured after drying the seedlings in an oven at for 48 hours. [6]

III. RESULTS

The germination of wheat in 100% effluent was recorded 3%, however in 10% effluent germination rate recorded to 96%. In the 25% effluent germination rate was 85%. But in the control (dw) germination rate (per cent) was 100%.The increase in concentration decreases the seedling length (cm) of wheat. Similarly the increase in effluent concentration decreases the seedling length (cm) of wheat. The seed germination inhibition in case of diluted effluent is comparatively lower than the seed germination calculated for 100% effluent

The shoot length of wheat in 100% effluent was recorded 4.0 cm. however in 10% effluent shoot length was recorded 9.0 cm. In the 25% effluent shoot length was recorded 7.2 cm. In the 50% effluent shoot length was recorded 6.1 cm. In the 75% effluent shoot length was recorded 5.1 cm. But in the control shoot length was 24 cm.

There is a significant difference between the effect of diluted and without diluted effluent on the shoot length (cm) of wheat. The seedling weights both fresh and dry weight of wheat was calculated and was noticed that the seedling weight of plant was affected by the effluent concentration. (Table 1, Figure 1)

Parameter	Shoot length	Root length	Total seedling fresh weight (g)	Total seedling dry weight (g)
100 per cent effluent	4.0±0.02	2.8±0.01	0.078±.0054	0.92±.001
75 per cent effluent	5.1±0.03	3.2±0.02	0.098±.0076	0.100±.003
50 per cent effluent	6.1±0.15	3.7±0.03	0.110±0.0081	0.0125±.005
25 per cent effluent	7.2 ±0.17	4.0±0.05	0.130±0.0084	0.0155±0.006
10 per cent effluent	9.0±0.05	4.5±0.09	0.190±0.0092	0.0855±0.007
Control (distil water)	12.4 ±0.056	8.5±0.084	0.325±0.0094	0.2100±0.009

All the values are in ppm mean (n=3) ± standard error.

Table 1. Changes in shoot length, root length, total seedling fresh weight and total seedling dry weight of wheat with various concentration of effluent Control, 100 per cent, 75 per cent, 50 per cent, 25 per cent, 10 percent) in Petri plates after 10 days period.

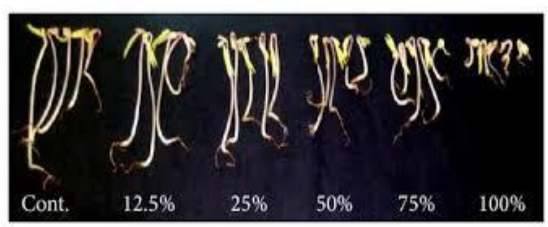

Figure 1: *Effect of pulp and paper mill effluent (with dilution) on seeding growth*

Discussion

It has been observed that pulp and paper mill waste has inhibiting effect on the germination of crops. It had been found that the effluent at 100 per cent v/v concentration has inhibitory effect on the wheat. The germination per cent was found to be decreasing at higher concentration levels. The delayed germination in comparison of control (distill water) might be due to the reduced activity of several enzymes involved in the germination process.

The presence of higher concentration of soluble salts and heavy metals are toxic to seed germination. [7]

The toxic effects of the effluent again affected the seedling growth. The growth of seedling reduces with the increase in the concentration of Ca^{+} and Mg^{++} ions and other heavy metals present in the effluent. As the test solution used in the seedling growth experiment was not artificially related, there were differences in oxygen availability, depending on effluent concentration and corresponding biological activity, which greatly affected the seed growth

Present study reveals that higher percentage of germination and better seedling growth at lower concentration of effluent and might be due to optimum level and availability of nutrients. Nutrients such as N, P, Ca, Zn^{+}, Mg^{+2} etc. present in the diluted effluent might have played a role in promoting the seed growth at lower concentrations, however, at higher concentration of the effluent the soil nutrients are raised to level which probably become toxic resulting in inhibition of root and shoot growth.

From the present result it has been obtained from the germination tests conducted with the treated effluent showed its beneficial effect much better that the deleterious affect of untreated effluent. Not only the germination (per cent) was found increasing but also the seedling growth as the whole was normal.

The use of untreated effluent for seed germination would most likely results in the abnormal seedling. So it would be better to use the diluted effluent as irrigation water. It is necessary to supplement this effluent with the normal irrigation water. This is because of lack of reports available on the effects of using diluted effluent in the long run and its impact on ground water and soil. [8]

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