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THE EFFECT OF DYE FACTORY EFFLUENT ON GROWTH, YIELD AND BIOCHEMICAL ATTRIBUTES OF BENGAL GRAM (*CICER ARIETINUM* L.)

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ABSTRACT : The effect of dye factory effluent was studied with respect to germination and growth of Bengal gram *Cicer arietinum* L. In lower concentration the germination percentage and growth are relatively higher than the control, but gradual decrease in the germination of seeds, seedling growth with increase in effluent concentration was observed. The best germination, seedling growth, number of root nodules, yield and biochemical attributes was observed in 20% concentration with growth promoting effect and significantly better than control. Beyond 20% effluent, root and shoot length decreased. Thus the dye factory effluent can be safely used for irrigation purposes with proper treatment and dilution at 20%.

Key words: Effluent, Bengal gram and Seed germination

INTRODUCTION

Industrial pollution is one of the problems presently facing in India and several efforts are being vigorously pursued to control it in various industries spanning length and breadth of the country. Textile industry is an important contributor to national economy. Due to rapid changes in customer's demands, textile finishing industries are challenged to use high quantity of dyes and auxiliaries (Wang *et al*., 2002). Effluent generated by the industries is one of the sources of pollution. Contaminated air, soil and water by effluents from the industries are associated with heavy disease (WHO, 2002) and this could be part of the reasons for the current shorter life expectancy in the country (WHO, 2003) when compared to the developed nations.

Untreated effluents are highly toxic to the plant, fishes or other aquatic organisms at higher pH and the sulphide in the effluents are of environmental concern (WHO, 2000) because they can lead to poor air quality of an area if not properly taken care of thus becoming threat to vegetation, human and materials. The same is applicable to other parameters such as BOD, COD that has been identified to raise health issue if water is available for human use is not of the required level (WHO, 1993). Textile industries are major sources of these effluents due to the nature of their operations which requires high volume of water that eventually results in high waste water generation (Ghoreishi and Haghishi, 2003). Seed germination is a fascinating process. The industrial effluents possess various organic and inorganic chemical compounds. The presence of these chemicals will show detrimental effects on the development of plant, germination process and growth of seedling. Early reports suggested that effluents from industries inhibit seed germination and seedling growth. So in the present investigation, an attempt has been made to understand the effect of dye factory effluent on seedling growth, germination, number of root nodules, yield and biochemical attributes of cow pea (*Cicer arietinum*).

MATERIALS AND METHODS

The raw effluent was collected from Slochana dying factory, Pallipalayam, Namakkal District, Tamil Nadu, from the discharge point using BOD bottles and sterile containers for laboratory analysis.

Physical and chemical parameters such as pH, total solids, total dissolved solids, total suspended solids, BOD, COD, chlorides, total chromium, sulphate, nitrate, zinc, phenolic substances, oil and grease concentration of the effluent were studied using gravimetrical method (APHA, 1995).

The seeds of cow pea were surface sterilized with 0.1% mercuric chloride for one to two minutes, washed under running tap water for 3 min. to remove surface contamination and in distilled water for 2min. and dipped in different concentration (20, 40,60, 80 and 100%) of dye factory effluent with three replicates. After 24 hours, the seeds were transferred to germination towels and allowed to germinate for five days. During the germination period, the growth parameters like germination percentage, root and shoot length, number of root nodules, yield and biochemical attributes such as total chlorophyll and seed proteins were measured and noted. The total chlorophyll content was measured by using the method of Arnon (1949), the protein content by the method of Lowery *et al* (1951). Data obtained were subjected to the analysis of variance and F test to find out the significance.

RESULTS AND DISCUSSION

The physical and chemical characteristics of the dye effluent were tabulated in the Table1. The % of seed germination showed dramatic variation with respect to different concentrations of the effluent (Table. 2 & 3). At lower concentrations the germination and other parameters were high and subsequently higher concentrations show minimal growth and germination rate. The inhibition of seed germination occurs at higher levels of total solids; due to the presence of excess amount of the salts and conductivity of the effluent and it causes depletion of acids from the TCA cycle, which reduces the respiration rate cumulating in reduction in germination (Kirkby, 1968) being absorbed by seed while soaked in the different concentrations of effluent before germination (Handus, 1976; Neelam and Sahai, 1988). In this study, a positive response was shown by the crop plants to all the concentrations of dye factory but the performance of 20% concentration of effluent in enhancing the growth, yield and biochemical attributes of *Cicer arietinum* was remarkable, which was followed by 40, 60, 80 and 100% concentrations. The similar results have been reported in different crops (Neelam, 1986; Vijayakumari and Kumudha, 1990; Tiwari et al., 1993; Vijayarengan and Lakshmanachary, 1993; Albino Wins and Murugesan, 2010).

Table. 1 Physico-chemical characteristics of dye factory effluent

Characteristics	Concentrations
Colour	Green, Pink, Violet to Brown
Odour	Unpleasant
pH	8.70
Electrical conductivity (dsm-1)	1.95
Total dissolved solids (mg / I)	2082
Total suspended solids (mg / I)	1830
Biochemical oxygen demand (BOD) (mg / I)	1125
Chemical oxygen demand (COD) (mg / I)	1375
Chloride (mg / I)	726
Total Chromium (mg / I)	6.2
Sulphate (mg / I)	625
Nitrate (mg / I)	104
Zinc (mg / I)	0.60
Phenolic substances (mg / I)	0.03
Oil and grease (mg / I)	4.2

In the present study, the germination ratio, length of root and shoot, number of root nodules, yield and bio chemical contents are noted and tabulated in the tables 2 and 3. From the above table the growth was maximum in lower concentration. At 20% concentration, the plant showed maximum root and shoot length and number of root nodules after 90th day than the control. But higher concentration of effluent, the length root and shoot and number of root nodules were inhibited. This might be due to the presence of elevated amount of total dissolved solids. These solids may inhibit the uptake of necessary elements like K and Mg etc. by plants (Thabaraj *et al.*, 1964). The maximum total chlorophyll and protein contents and yield attributes are recorded at 20% effluent concentration which could be due to the best growth of seedlings at this concentration. Retardation of plant growth is also due to the presence of high concentrations of toxic and heavy metals and other toxic compounds (Sahai *et al.*, 1983). But the presence of K, Na and Ca etc. in the diluted effluent influences the growth of a plant in less concentration (Rajannan and Oblisami, 1979).

Table. 2 Effect of dye factory effluent on seed germination, root length, shoot length and number of root nodules

(%)Effluent concentration	Germination (%)	Root length				Shoot length				Number of Root Nodules			
		30th Day	60 th Day	90 th Day	Mean	30th Day	60 th Day	90 th Day	Mean	30th Day	60 th Day	90 th Day	Mean
Control	100	9.7	10.9	12.7	11.1	19.0	37.7	41.5	32.7	15.5	8.0	6.7	10.0
20	100	10.7	12.3	14.8	12.6	20.8	38.6	42.6	34.0	16.5	9.5	7.5	11.6
40	98	8.2	10.5	11.2	9.96	18.5	30.2	39.7	29.5	12.7	9.0	4.4	8.7
60	85	8.4	8.7	10.8	9.30	17.4	28.4	34.7	26.8	10.0	6.0	3.2	6.4
80	60	7.5	7.8	9.4	8.23	15.7	20.1	28.2	21.3	7.0	5.8	2.5	5.2
100	40	6.2	6.5	8.5	7.06	11.0	19.0	20.1	16.7	5.2	2.5	1.0	2.9
Stage mean		8.45	9.45	11.2		17.1	29.0	34.5		11.2	6.8	4.2	
SEd	**2.3**	**0.21**	**0.21**	**0.26**		**0.19**	**0.17**	**0.20**		**0.19**	**0.19**	**0.14**	
CD (0.05)	**5.0**	**0.44**	**0.45**	**0.56**		**0.42**	**0.38**	**0.46**		**0.42**	**0.42**	**0.31**	

Table. 3 Effect of dye factory effluent on total chlorophyll, seed protein, yield attributes

Effluent concentration (%)	Total Chlorophyll				Seed Protein (mg/g fr. wt)	Yield attributes	
	30th Day	60th Day	90th Day	Mean		No. of Pods / plant	No. of Seeds / plant
Control	1.99	2.05	1.90	1.98	18.20	25.0	12.0
20	2.01	2.22	1.98	2.07	18.84	27.0	15.0
40	1.89	2.01	1.75	1.88	18.14	20.0	10.0
60	1.66	1.77	1.34	1.59	17.24	15.0	6.0
80	1.32	1.56	1.22	1.37	16.50	10.0	3.0
100	1.01	1.12	1.01	1.05	-	-	-
SEd	**0.006**	**0.006**	**0.004**		**0.038**	**3.145**	**2.357**
CD (0.05)	**0.013**	**0.014**	**0.010**		**0.084**	**6.852**	**5.136**

After the 90th day the root and shoot lengths, number of root nodules, total chlorophyll, protein and yield attributes such as no. of pods per plant, no. of seeds per pod and hundred seed wt were also significantly higher than the control. It shows that the organic substance present in the effluents of dye factory supports the growth of plants with some limitations. If excess amount of organic matters serve as toxic material, it will prevent the growth of experimental plant.

The chemicals present in the dye factory effluents are not only poisonous to humans but also found toxic to the growth of plants and aquatic life (WHO, 2002) and they may also result in food contamination (Novick, 1999). So, 20% concentrated dye factory effluent may meet the quality criteria normally prescribed for irrigation water.

CONCLUSION

The dye factory effluent after proper dilution (up to 20%) can be used for irrigation purposes and can serve as a liquid fertilizer. This kind of approach will prevent the water and soil pollution some extent and also will help to get high yield of the crop plants.

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