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RESEARCH ARTICLE

Effect of soil irrigation with paper mill effluent on vegetative growth and biochemical content in plant parts of *Brassica campestris* cvT-59

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SUMMARY

Brassica campestris cv T-59 was grown in soil irrigated with different diluted doses of paper mill effluent, two months crop exhibited a decline in vegetative growth and yield in terms of length of root, shoot, number of leaves, leaf area, number of flower and pod and grain, while, total carbohydrate, nitrogen content in plant parts was increased and total protein level was variably influenced *i.e*., decline at 100 per cent an increase at 10 per cent. Level of chlorophyll in leaf was also increased at 10 per cent dose.

Key Words : Paper mill effluent, *Brassica campestris*, Growth, Yield, Chlorophyll, Protein, Sugars, Nitrogen

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In recent years, considerable attention has been made to industrial waste which are usually discharged on land or into sources of water. This have adverse impact on agriculture and cause environmental degradation. On the other hand, a huge amount of waste water generated from paper and distillery industries has an important role to play in the content of scarcity of fresh water resources for irrigating agricultural land. Besides, being a useful source of plant nutrient (N, P, K, S etc.), these effluents often contain high amounts of various organic and inorganic materials as well as toxic trace elements, the utilization of industrial wastes for agricultural purposes could also provide a solution to the disposal problems. The use of Industrial waste water results in the reduction of crop yield (Chandra *et al.*, 2009; Chidankumar *et al.*, 2009 and Shenbagavalli *et al.*, 2011). The waste water of paper mill, contain potentially harmful agents in the environment (Chonker *et al.*, 2000) The disposal of waste water is a major problem faced by industries, due to its generation of high volume of effluent and with limited space for land based treatment and disposal. Excessive accumulation of heavy metals in agricultural soils through waste water irrigation may not only results in soil contamination, but also effect food quality and safety (Hati *et al.*, 2007;

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Bharagava *et al.*, 2008 and Chopra *et al.*,2009). Therefore, the present paper attempts to analyze the impact of soil irrigation with paper mill effluent on growth, yield and level of some biochemical components in plant parts of *Brassica campestris* cv T-59 after two months of sowing.

MATERIAL AND METHODS

The experiments was conducted in 2013-14 at D.A.V. College, Muzaffarnagar. Seeds of *Brassica campestris* cv. T-59 were sown in soil kept in polybags. After seedlings emergence, crop was irrigated with different dilutions of effluent (10%-100%) at alternate days upto three months and thereafter ten plants of each cultivar and of each treated dose were analysed for growth (root and shoot), yield (grains), biomass and biochemical components (total nitrogen, sugar, protein, carbohydrate and chlorophyll). Data of length and biomass (fresh and dry weight) of root and shoot are averages of ten plants and they are represented in graph.

Biochemical analysis :

For detailed studies on biochemical changes in plant parts, two concentrations of effluents (10% and 100%) also have been selected. The following methods and material have been used for analysis.

Chlorophyll :

Was estimated as per the standard method of Arnon (1949).

Total protein :

Shoot and root protein was estimated by Bradfords method- Bradford (1976) using Coomassive Brillient blue dye *a*nd reading the absorbance at 595 nm.

Total carbohydrate :

Dry sample (10 mg each) was digested with 5 ml of 2.5 N. HCl for 3 hours and cooled at room temp. It was neutralised with solid sodium carbonate until the effervescence ceased and made up the volume to 10 ml with distilled water. The hydrolysate was centrifuged at 3000 rpm to obtain a clear supernatant. From this supernatant three aliquots of 0.2 ml of each were made and maintained the final vol. to 1 ml with the help of 0.8 ml of distilled water. 4 ml of Anthrone reagent (Hedge *et al.*, 1962) was mixed in each replicate, kept in boiling water bath for 8 minutes, cooled rapidly in freeze and read the absorbance at 630 nm. The amount of total sugars was calculated as mg glucose equivalents per g dry weight.

Total nitrogen :

Estimation of nitrogen was done according to spectrophotometric method of Snell and Snell (1954) using Nessler's reagent and reading absorbance 430 nm. Data obtained in biochemical analysis are average of three experiments done in triplicates and kept in table.

RESULTS AND DISCUSSION

Fig. 1 and 2 represents the effect of paper mill effluent treatment to soil, on growth and yield of *Brassica campestris* cv. T-59. It shows a decline in vegetative growth after 2 months of sowing. Maximum decline in root length, 48 per cent of control, in shoot length, 34 per cent of control, in fresh weight of plant , 10 per cent of control, in dry weight of plant, 4 per cent of control at dose V (50%) while in case of number of

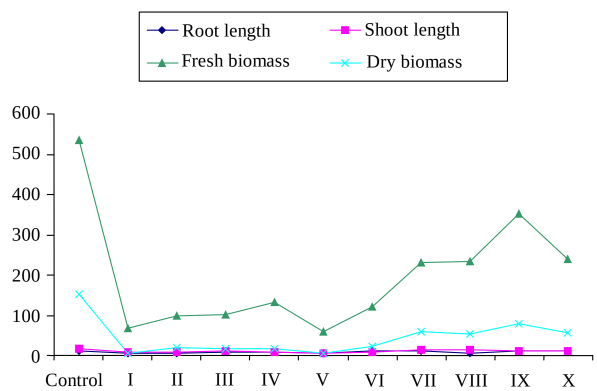

Fig. 1: **Soil treatment effect of paper mill effluent on growth of *Brassica compestris* cv T-59**

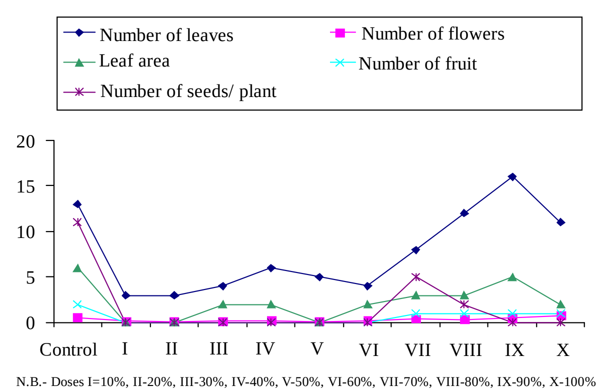

Fig. 2: **Soil treatment effect of paper mill effluent on yield of *Brassica compestris* cv T-59**

leaves, 23 per cent of control at 10 per cent concentration and in leaf area 22 per cent of control at 20 per cent and 50 per cent concentration. At 10 per cent, 20 per cent and 50 per cent effluent concentration there was no flower formed, while at rest doses a reduced number of flowers was present. Single fruit was developed after 70 per cent, 80 per cent, 90 per cent and 100 per cent concentration treatment while other samples had no fruit development. Only at two treatment 70 per cent and 80 per cent, the production of seeds are 45 per cent and 18 per cent of control, respectively. A decreased growth and yield is present and further a slightly recovery is reported at 70 per cent effluent concentration yet it remain lower than control as it is reported by the physico-chemical study by Medhi *et al.* (2011). This may be due to the higher salt content, acts as a limiting factor for vegetative growth. Higher effluent concentration found to be responsible for the inhibition in plant growth (Kumar and Chopra, 2012). Decreased flowering and podding could be due to, too much nitrogen present in effluent while phosphorous deficiency is sometimes associated with poor flower production or flower abortion (El Naggar, 2005). The K, Fe, Mg and Mn contents could benefits pod formation and yield of the plant as it does for soyabean (*Glycin max* L.) as reported by Hati *et al.*, 2007).

At lower dose (10%) chlorophyll ‘a’ Chlorophyll ‘b’ and total chlorophyll is 138 per cent, 159, 148 per cent of control. In root, total protein, total carbohydrate, total nitrogen is 127 per cent, 157 per cent, 119 per cent of control, whereas in shoot total protein, total carbohydrate, total nitrogen is 77 per cent, 578 per cent, 161 per cent of control, respectively (Table 1).

At higher dose (100%), chlorophyll ‘a’, chlorophyll ‘b’ and total chlorophyll is 75 per cent, 90 per cent, 82 per cent of control. In root and shoot, total protein, total carbohydrate, total nitrogen is 87 per cent, 295 per cent, 195 per cent of control and 98 per cent, 1454 per cent, 150 per cent of control, respectively.

Thus, the above biochemical constituents have a sharp increase at treatment of 10 per cent and 100 per cent dose. Our findings are in accordance to result of Rath *et al.* (2011); Kalaiselvi *et al.*, 2009 and Kumar and Chopra (2012). The increment in chlorophyll content is likely due to the presence of significant amount of Fe, Mg and Mn in effluent which is associated with the synthesis of chlorophyll in plants. The deficiency of Fe, Mn and Mg in plants may causes significant changes in plant metabolism and induces chlorosis and necrosis, early leaf fall and low reutilization as earlier reported by Porra (2002). Interestingly It is observed that the nitrogen content is related to flowers and pod development (Kumar and Chopra, 2012).

Above changes in growth and yield along with biochemical component are well related to paper mill effluent. It seems that irrigation of effluent treatment is beneficial for plant but it is at a particular dilution of effluent. However, this effluent may contain harmfull constituents that will cause a damage to soil and plant itself. So it is very crucial, how it shold to manage to maintain the fertility of soil and growth of plant. Further experiments should be conducted in this direction.

Table 1 :Soil treatment effect of selected doses of paper mill effluent on the level of certain biochemical components accompaning the plant growth of *Brassica compestris* cv. T-59

Biochemical components	Plant parts	*Brassica compestris* cv. T-59		
		Control	Lower 10% of effluent	Higher 100% of effluent
Chlorophyll 'a' mg/g fresh weight ± S.D.		3.71±0.08	5.11±0.005	2.80±0.18
Chlorophyll 'b' mg/g fresh weight ± S.D.	Leaf	3.27±0.01	5.19±0.20	2.94±0.12
Total chlorophyll mg/g fresh weight ± S.D.		6.98±0.08	10.30±0.20	5.74±0.14
Total protein mg/g fresh weight ± S.D.	Root	33.0±1.56	42.05±1.68	28.55±0.68
	Shoot	43.31±1.80	33.23±1.36	42.28±0.22
Total carbohydrate mg/g fresh weight ± S.D.	Root	17.42±5.15	27.30±1.56	51.35±2.29
	Shoot	4.81±1.37	27.82±0.90	69.94±1.19
Total nitrogen mg/g fresh weight ± S.D.	Root	0.57±0.019	0.68±0.02	1.11±0.017
	Shoot	0.18±0.03	0.29±0.017	0.27±0.03

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