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Impact of selected industrial effluents on morphological and biochemical characteristics of *Brassica juncea*

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Abstract

The study investigating the impact of selected industrial effluents on some morphological and biochemical characteristics of *Brassica juncea*. The result revealed that most of the morphological and biochemical parameters of *B. juncea* were negatively influenced by application of concentrated effluents. The magnitude of inhibitory effects was maximum for marble industrial effluents while it was minimum for pharma industrial effluents. The pharma industrial effluents showed growth promoting effects on *B.juncea*. The paper industrial effluents also showed inhibitory effects on the test plants for both morphological and biochemical parameters which was less then marble effluents. Among the selected industrial effluents the pharma was less effective that promoted some of the morphologic and biochemical parameters of *B. juncea*.

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Introduction

To meet the challenge of feeding the ever-increasing population of humans, the water and land resources should be used efficiently for crop production. To manage the food requirement, the mechanized agriculture is also playing its role for the welfare of humans. Industries contribute a lot to the deterioration of air, water and even of soil, which depends upon the type of industries installed, the type and nature of raw materials used in the industries and also the processes adopted by the industries. As industrialization and pollution are directly proportional to one another (Dhevagi *et al.,* 2000), some indispensable and obligatory steps must be taken for proper disposal of the wastes and pollutants. The main industrial wastes or pollutants are the effluents which come out from the industries and which contain both organic and inorganic compounds like acids, basis, and other solid suspended materials. When these effluents, are not treated properly, and disposed of to the environment they disturb the ecological localities of living organisms. Pulp and paper industries are leading the list among such industries as they use massive amount of good quality water (Gupta, 1995).

It has been estimated that 250 tons of water is consumed on the production of one ton of paper. These effluents contain certain compounds which are very resistant to decomposition, such as lignin and other phenolic compounds. These compounds have high BOD. They also possess greater quantity of Na and many other salts making them alkaline (basic) in nature. As these effluents are discharged directly into the water body and in the land, they will have worsening effects on the eco-system. Contrary to this, these effluents will have some useful effects on the ecosystem. It is obvious that when the concentration of soluble salts increases, the electrical conductivity of the soil also increases.The desirable boundaries for these discharges on land for the purpose of irrigation are not more than 500mg/1 for biological oxygen demand, 5.5 to 9.0 for pH, 600mg/1 and 60% for chloride, sulphate and Na. For the sustenance of life, the germination of seed and growth are very much important. Seedlings are extremely fragile and are severely affected by environmental conditions. Growth and yields are the parameter of the agriculture crop upon which the effect of the industrial effluents have been extensively investigated, but only in a few cases the effect of industrial effluents have been find out to have impact on germination. This is the first study of this type in the area. The present study was aimed to investigate the effect of three different industrial effluents located in Hayatabad industrial zone, Peshawar KPK on the morphological and biochemical parameters of *B. juncea*.

Materials and methods

The present study deals with the investigation of effects of the selected industrial effluents on various parameters of the *Brassica juncea*. Experiments were carried out in field. Effluents of the following industries located in the industrial estate of Hayatabad Peshawar Khyber Puakhtoon Khwa were obtained at source and used against *B. juncea* crop.

i) Pharmaceutical Industry
ii) Paper Industry
iii) Marble Industry

Experiments were conducted in the botanical garden of Islamia College Peshawar. Clay pots measuring 1x2 feet were used. Each pot was filled with five kg loam soil. A dose of one liter of effluents of each the test industry was provided to every pot from sowing till harvest at an interval of one weak (about 27 doses). In each pot ten seeds were sown. After germinations, five plants were left in each pot. Reading of the following parameters was taken and data recorded.

Parameters

Length of plant stem, Fresh weight of plant, Dry weight of plant, No. of tillers, No. of leaves and Biochemical analysis of seeds. In pot experiments effluent of the three industries were tested against *B.juncea* were pharma industrial effluents, marble

industrial effluents, paper industrial effluents and control. There were five replicates of each treatment.

Statistical analysis

The data were statistically analyzed by applying two ways ANOVA. Proximate Analysis of the seeds also carried out for various parameters.

Results and discussion

Influence of industrial effluent on different parts of Brassica juncea after one month of sowing

The results of pharma effluents showed that it was completely enhanced (8.4, 7.0, 1.354 and 0.147) in comparison to all other treatments (Table 1). This enhancement may be attributed to the presence of some growth promoting chemicals (Arumagam, 2007).

Among these morphological parameters the dry weight was more affected compared to others. In the treatments of pharma effluents both the fresh weight and dry weight were high (1.354 and 0.147) from all other parameters. This might be due to the growth promoting substances (Arumagam, 2007). The LSD value for dry weight showed the significant results (Table 1).

Table 1. Number of leaves, length of stem, fresh weight and dry weight of *B.juncea* after one month of sowing.

Treatments	Numbers of Leaves	Length of Stem	Fresh Weight	Dry Weight
Control	7.4 ab	6.6 a	1.250 ab	0.118 c
Pharma	8.4 a	7.0 a	1.354 a	0.147 bc
Marble	7.2 b	5.0 b	0.874 bc	0.456 b
Paper	4.6 c	4.2 c	0.714 c	0.910 a
LSD value	1.167	0.7226	0.4612	0.3347

Influence of industrial effluent on different parts of Brassica juncea after two months of sowing.

The number of leaves, stem length, fresh weight and dry weight were highly affected (8.0,21.4,29 and 3.1) by the effluents of marble industry as compared to other effluents (Table 2). Marble effluents have high concentration of Phosphorus and Calcium which may be responsible for the reduced growth process of *Brassica juncea* (Channakeshava *et al.,* 2007).The results indicated that the fresh weight was highly reduced and affected more negatively compared to all other parameters. The LSD value for fresh weight showed highly significant results to all other treatments. In the treatments of pharma effluents the results of leaves number and stem length were non-significant. Same results were reported by Channakeshava (2007) and Arumagam (2007) (Table 2).

Table 2. Number of leaves, length of stem, fresh weight and dry weight of *Brassica juncea* after two months of sowing.

Treatments	Numbers of Leaves	Length of Stem	Fresh Weight	Dry Weight
Control	14.6 a	51.8 a	37.598 a	3.926 b
Pharma	14.2 a	51.0 a	31.052 b	4.840 a
Marble	8.0 c	21.4 b	29.264 b	3.008 c
Paper	11.2 b	27.8 c	29.074 b	3.142 bc
LSD value	2.153	20.021	2.5312	0.8405

Influence of industrial effluent on different parts of Brassica juncea after harvest

The results reveal at the time of harvest that the number of leaves, stem length and dry weight of *B. juncea* were more affected by the paper effluents. The results indicate that the effluents of other industries have relatively less negative effect on the growth parameters of *B. juncea*. The high negative effect of the effluents of paper industry may probably be due to the formation of compact layer over the soil surface, which might have affected the root growth and water percolation downward. It was recorded for marble effluents that fresh weight, follicles numbers and seeds number were more affected (21.500, 107.2

and 1393) and showed inhibitory results (Table 3). This was due to the presence of Calcium and Phosphorus in extra amount (Channakeshava *et al.,* 2007).

Proximate composition of brassica juncea grown in industrial effluents

Moisture

The seeds of *B. juncea* plants grown in some industrial effluents were analyzed for the moisture content. The lowest moisture was in pharma effluents (2.2%). The highest value of moisture content (2.3 %) was recorded in seeds of plants grown in paper effluents (Table 4). This may be attributed due to presence of an alkaline pH 7.9 (Bhosale, 2006). The increase in pH can be attributed to increased level of sodium in the soil.. Malleshappa (1979) observed slight reduction in the dry weight of soybean after irrigated by paper mill effluents. Thus, it can be concluded that continuous irrigation of paper mill water affects soil fertility and hence an efficient treatment strategy for paper industry waste water needs to be strengthened before recycling Bhosale (2006). This is the first type of study, there is no previous data available.

Table 3. Number of leaves, length of stem, fresh weight, dry weight, number of follicles and numbers of seeds in *B. juncea* after harvest.

Treatments	Numbers of Leaves	Length of Stem	Fresh Weight	Dry Weight	Number of Follicles	Number of seeds
Control	17.8 a	157.4 a	47.068 b	17.069 ab	229.6 b	3673.6 b
Pharma	17.8 a	122.6 b	66.590 a	21.250 a	390.4 a	6246.4 a
Marble	17.0 a	102.4 c	21.500 c	13.942 bc	107.2 c	1393.6 c
Paper	14.0 a	94.0 c	31.312 bc	9.136 c	142. 6 bc	1677.0 c
LSD value	3.984	18.870	18.52	5.054	87.06	1436.884

Ash

The seeds collected from the plants grown in the industrial effluent were analyzed for ash. The result showed that ash content decreased with altering the water nature. The highest percent of ash was recorded in control (5.6%), while the lowest amount was in the marble effluents (4.6%). Ben *et al.* (1965) studied that the bushels per acre of rice were benefited by the use of pulp effluents. The effluents samples from paper factories were alkaline and contained considerable amount of nitrate, nitrogen (313 to 368 mg/l) diluted paper factory effluent had detrimental effect on the germination and other parameters of the plants compared to the crops irrigated by control water Ramanand and Oblisami (1979) The reduction in growth of seedling was attributed to the greater amounts of Ca, Mg and solid materials in the effluents.

Table 4. Various chemical constituents of *Brassica juncea* grown in industrial effluents.

Treatments	Moisture(%)	Ash(%)	Fat(%)	Protein(%)	Fibre(%)	Carbohydrate(%)
Control	2.3	5.6	41.3	23.5	23.2	4.1
Pharma	2.2	4.9	35.9	26.1	30.3	0.6
Marble	2.4	4.6	35.7	25.7	29.7	1.9
Paper	2.3	5.1	40.7	24.7	24.2	3.0

Crude Fat

The crude fat indicate lowest value (35.7 %) for seeds obtained from plant grown in marble effluents (Table 4). The paper and pharma effluents showed the 40.7% and 35.9% respectively. In certain cases, diluted effluents enhanced the growth of plant and this was reasoned out to the decrease in the concentration of various chemicals in the effluents and presence of root promoting phenolic compounds which might have played a role in influencing the beneficial effect on the plant growth Ramanand and Oblisami (1979).

Protein

The highest protein percentage (26.1%) were found in the seeds collected from the plants that were grown in the pharmaceutical effluents (Table 4). Lipid contents of organisms reduced with increasing concentrations

of effluent. This might be due to the utilization of lipids for energy demand under the stress conditions Amudha and Mahalingam (1999). Regular irrigations with ten and five times diluted effluent increased yield by 59 and 78 per cent, respectively Singh and Bahadur (1997).

Fiber

Analysis of seeds for crude fiber showed lowest value (23.2 %) for control while highest value was recorded for pharma effluents. In general, the waste water (spent wash) has a high organic load (50, 000 mg/l BOD and 95,000 mg/l COD) with high electrical conductivity (15 dS/m) and acidic pH (4.5) after methanation, can provide 2, 40,000, 13,000 and 800 tonnes of K, N, and P respectively Kanchan Bala Verma *et al.* (2004).

Carbohydrates

The seeds collected from the plants grown in control showed the highest percent (4.1) of carbohydrates. The lowest percent of carbohydrate was recorded in the pharmaceutical effluent that was 0.6%. The carbohydrates decreased with increasing concentrations of effluent Amudha and Mahalingam (1999). This decrease indicates that the principal and immediate precursor of organisms when exposed to stress condition is carbohydrate Amudha and Mahalingam (1999).

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