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Effect of industrial effluents on morphophysiological Parameters in chilli and tomato of davangere

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Abstract
Industrialization adversely affect our environment specially plant resources. Soil sciences and plant nutrition due to its toxicity to humans and also dependent upon the relative in soil plant system. However, the present work showed the effect of industrial effluents on morpho-physiological parameters on plant growth. This study comprises of chlorophyll content, presence of nutrients and stomatal index of industrial and non-industrial areas Chilli and Tomato. The present investigation suggests that the effluent can be used for vegetablecrops cultivation safely only after proper treatment of effluents.

Keywords: Chlorophyll, Morpho-physiological parameters, Stomatal index

Introduction
Environment pollution is a matter of great concern and has been accepted as global problem because of its adverse effect on human health, plants, animals and exposed materials (Irshad *et al*, 1977). Land pollution occurs from different degradable and non-degradable materials. These materials may be solid waste, trash, chemicals and leaf litter etc. (Nawaz *et al*, 2006). The use of waste wastes industrial effluent as well as municipal sewage forirrigation has emerged in the recent past as important way utilization. Waste water takes the advantage of the presence of considerable quantities of nitrogen and essential elements. Industrial effluents often contain various toxin metals, harmful gases and several organic and inorganic compounds (Ravi *et al*, 2014). The utility of industrial waste water for irrigation of vegetables and other crops in well documented. Therefore, the present investigation has been attempted to study the impact of industrial effluent waste on vegetable growth. The analyzed parameters compared with the parameter got by fresh water irrigation of vegetable growth. The factory effluents are may be constantly adding up toxic substance ground water reservoir at a very high rate directly or indirectly farmer using the water for vegetable cultivation. Most of waste water discharged into the surrounding water bodies were found the deteriorates of water quantity and disturbed the ecological balance.
Chilli (*Capsicum annum* L.) is one of the important valuable crops in India. Chilli requires warm and humid climate for its best growth and dry weather during maturations of fruits. In the plains of India, summer of spring-summer season prevails from February to June. It grows well in black soil, sandy loams are under irrigated condition.
Tomato (*Lycopersicon esculentum* Mill.) is one of the important crop, it is edible often red fruit/berry. Tomato is warm reason crop. Grows well is these retain that are free from frost. Colour development in tomato red colour is due the pigment lycopene. Sandy loam soil with a well-drained clay loam soils are suited for heavy yield.

Materials and Methods
Chilli and Tomato sample were collected from different location around industrial and non-industrial area in Davangere. Water and soil samples were collected in well clean, sterilized plastic bottle from both areas. Immediately pH and Electrical conductivity (EC) of both samples were measured in laboratory then samples were stored at 4^0C for physico-chemical analysis and they were analyzed according to the standard methods. Morphological parameters, stomatal index and estimation of chlorophyll content in both chilli and Tomato of industrial and non-industrial area.

Results and Discussion

In water sample result the pH is 7 acidic in both industrial and non-industrial area and the conductivity is water with less impurity and impurities are more water increases in conductivity. Biological oxygen demand test in non-industrial area the BOD level is 2.0 mg/L. There will not be much organic waste present in water. In industrial area BOD level is 5.2 mg /L usually it may indicate organic matter is present and bacteria are decomposing this waste. Generally, when BOD levels are high and they are taking that oxygen from the oxygen dissolved in the water. If there is no organic waste present in the water, there won't be many bacteria present to decompose it and thus the BOD will tend to be lower and DO level will tend to be higher and in COD test non- industrial area 9 mg/L in which pollution potential of waste water and organic matter present in it less and in industrial area 18 mg/L decomposition of organmatter and the oxidation of inorganic chemical such ammonia and sulphate and natural waters contaminated by domestic or industrial waste.

The physico-chemical parameters of effluent water samples were presented in Table 1. It was noticed that maximum growth of vegetable crops at fresh water irrigation rather than the effluent concentration. The effluent water and polluted water soil decreases in yield. The higher concentration of effluent decrease enzyme dehydrogenizes activity that is considered as on one of the biochemical change which may have germination growth.

Table 1: The Pysico-chemical parameter of effluent water sample (industrial area) and non-industrial area water sample result

Sl. No.	Name of parameters	Non–industrial area	Industrial area
1.	pH	7.0	7.0
2.	Conductivity	125 µs /cm	1140 µs /cm
3.	BOD	2.0 mg/L	5.2 mg/L
4.	COD	9 mg / L	18 mg / L

In the year 2011, Sangannavar and Kalshetty reported the factory effluents contain high EC, Cr, Cu, Cd, Mn and Zn is more in disposal of effluent in river water, as on land, for irrigation. Leaves are the primary photosynthetic organs of most plants, Stomata role in carbon dioxide in take and oxygen. The balance that plant must achieve between water loss and carbon dioxide uptake. Environmental conditional factors that may cause a variation in the number of stomata on leaf's surface. The difference in stomata on leaves grown under in carbon dioxide enriched environmental to those grown under normal atmospheric condition. Relative humidity and light intensity during leaf development affect the value of stomatal index. The stomatal index found in the industrial area chilli is 25% and stomatal index of non-industrial area chilli is 25.28% and stomatal index found present in industrial area tomato is 20% and stomatal index found in non- industrial area is 20.5% and is shown in the (Table 2-5).

Table 2: Stomatal index of industrial area chilli

Number of observation	Number of stomata	Number of epidermal cells
1	27	63
2	24	72
3	26	78
Total	**71**	**213**
Stomatal index (SI)	**25 %**	

Table 3: Stomatal index of non-industrial area chilli

Number of observation	Number of stomata	Number of epidermal cells
1	40	120
2	43	129
3	48	144
Total	**133**	**393**
Stomatal index (SI)	**25.28 %**	

Table 4: Stomatal index of industrial area tomato

Number of observation	Number of stomata	Number of epidermal cells
1	15	60
2	17	68
3	18	72
Total	**50**	**200**
Stomatal index (SI)	**20 %**	

Table 5: Stomatal index non-industrial area tomato

Number of observation	Number of stomata	Number of epidermal cells
1.	30	120
2.	17	68
3.	25	100
Total	72	278
Stomatal index (SI)	**20.57 %**	

Chlorophyll is an important component in photosynthesis which enables plants to convert carbon dioxide and water in the presence of energy from sun to produce carbohydrates this is used in all plant essential growth and development processes, which gives rise to the plants distinctive green colour. In the year 2014, Noori *et al* reported that Chlorophylls and Caroteniods reduces while increasing root and aerial parts prolin, water soluble carbohydrates and catalase were seen in treated plans. A stress that interferes with this metabolic process may be produce responses that could be detected by using specialized methods and equipment and such responses may possibility response stress. The elevated levels of most metals in plants will interference with chlorophyll content and induce stress. The fresh plant leaves were collected from both industrial and non- industrial area and total chlorophyll present in industrial area chilli is 0.2002 mg/g and non- industrial area chilli is 0.285 mg/g and amount of chlorophyll present industrial area tomato is 0.188 mg/g and non- industrial tomato is 0.358 mg /g and estimation of chlorophyll a and chlorophyll b is shown in (Table 6 & 7).

Table 6: Quantitative estimation of Chlorophyll content of chilli

Samples	OD at 663 nm	OD at 645 nm	Total chlorophyll /g tissue
Industrial area chilli	0.45	0.34	0.22 mg/g
Non-industrial area chilli	0.52	0.47	0.285mg/g

Table 7: Chrophyll content of Tomato

Samples	OD at 663 nm	OD at 645 nm	Total chlorophyll /g tissue
Industrial area tomato	0.36	0.27	0.188 mg/g
Non-industrial area tomato	0.60	0.60	0.358 mg/g

The chlorophyll content in vegetable plants presented. The chlorophyll content in vegetables at sewage recorded little less than fresh water irrigation. In 2013, Bafana and Rathi, the biochemical parameter like total chlorophyll, Chl-a, Chl-b was not affected significantly. While Chl-a was significantly affected, so it was suggested that undiluted pharmaceuticaleffluents should be diluted before being irrigation. The germination percentage of seed, seeding growth and chlorophyll content showed a gradual decline with increase in effluent concentration by Nagajyothi *et al*, (2009). Recently, Suresh *et al*, (2014) mentioned at higher effluent concentration were found and decreased chl-a, chl-b and total chlorophyll and protein contents, but dilute effluent favored the plant growth and biochemical content.

Soil test is the analysis of the soil sample to determine the nutrient and contained content, composition and other characteristics such as the acidity or pH level. A soil can determine fertility, or the expected growth potential of the soil which indicates nutrient deficiency potential toxicities from excessive fertility and inhibitions from the presence of non-essential trace minerals. Using sewage waste water can cause environmental problems such as soil sickness, soil and ground water contamination and phytotoxicity by Pathrol and Angoorbala (2013). Some micro and macro nutrients is present in the soil collected from industrial area and non- industrial area in shown in the (Table 8-11).

Table 8: Soil sample result (non-industrial) area

Standard ratings	pH	EC (mmhos/ cm)	Organic carbon (%)	Available P_2O_5 (Kg/acre)	Available K_2O (Kg/acre)
	6.8	0.12	0.73	7.0	20
	6.3 - 8.3	1 – 2	0.51- 0.75	9 - 22	51-120

Table 9: Available Micro Nutrients

Name and its Critical limits (ppm)	Analytical value (ppm)
Zn (0.60)	5.478
Cu (0.20)	0.786
Mn (2.00)	3.066
Fe (4.50)	3.164

Table 10: Soil sample result of industrial area

Standard rating	pH	EC (mmhos/cm)	Organic Carbon (%)	Available P_2O_5 (kg/acre)	Available K_2O (Kg / acre)
	7.0	0.09	0.60	11.6	60
	6.3 to 8.3	1to 2	0.51 to 0.75	9 to 22	51 to 120

Table 11: Available Micro Nutrients of industrial area

Name and its critical limits (ppm)	Analytical value (ppm)
Zn (0.60)	2.580
Cu (0.20)	0.592
Mn (2.00)	0.930
Fe (4.50)	2.654

The vegetables in fresh water irrigation showed growth promotion, overall development of the chlorophyll content. But reduction concentration vegetable growth at higher concentration of effluent water may be due to higher concentration of effluent water may be due to high amount of dissolved solids present in it. The low amount oxygen in dissolved form due to the presence of higher concentration of solids in industrial effluent reduces the energy supply through anaerobic respiration resulting in restriction of vegetable plants growth. The decreased in chlorophyll content in vegetable plant growth at effluent water cultivation is due to the inhibitory effects of toxicants of effluent on chlorophyll synthesis in green vegetables from the findings of the investigated dates is known that effluents normally highly toxic to growth as well as they reduce in chlorophyll content of green vegetables. But it is clearly known growth and chlorophyll content could be favorable as ground water used for irrigation purpose.

The vegetable chilli and tomato collected from different location around industrial and non-industrial area show difference in characters such as leaf size, leaf shape, colour of leaves and fruit, size flower and length of plant (Table 12 &13).

Table 12: Morphological parameters of both industrial and non-industrial area chilli

Parameters	Industrial area chilli	Non- industrial area chilli
Length of root	1.8 cm	4.7 cm
Number of root hairs	32	61
Leaf size	Small	Medium
Leaf colour	Green	Green
Number of fruits	-	5
Number of flower	1	3

Table 13: Morphological parameters of both industrial and non-industrial area tomato

Parameters	Industrial area tomato	Non- industrial area tomato
Length of root	8 cm	11.9 cm
Number of root hairs	25	97
Leaf size	Small	Large, medium
Leaf colour	Green, light green with white spots	Green, yellow
Number of fruits	1	5
Number of flower	-	3

Conclusion

In the present study the effect of industrial effluents on two important vegetable crops Chilli and Tomato carried out. Industrial effluents are slightly negative impact on the physico-chemical parameters, morphological parameters leaf shape, colour of leaves, fruit, size flower and length of plant. In the both industrial and non-industrial areas atmospheric condition showed slightly variations in stomatal index on leaves grown under in carbon dioxide enriched environmental to those grown under normal atmospheric condition. At effluent concentration there will be decrease in the biochemical parameters like total chlorophyll contents. On the basis of overall performance exhibited in these analyses of vegetable crops Chilli and Tomato, proper treatment of effluent is necessary to minimize the pollution effects before it is discharged to the land.

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