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STUDIES ON TEXTILE EFFLUENT AFFECTED SOME VEGETABLE CROPS AND THEIR BIOCHEMICAL PARAMETERS

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ABSTRACT

Crop losses due to pollutant stress are on the rises ever since industrial growth is made. Most of industrial effluents contain lot of toxic substances. When these effluents, without proper treatment are discharged to any land mass or aquatic system cause serious problems to all biological life. Many places in Tamilnadu especially the Erode town is a well known textile industrial place and these industries produce several tons of effluents containing toxic dyes and chemicals, which often are discharged into river with or without proper treatment. These water sources are used for irrigation in the agricultural sector, facing great problems of crop loss and low yield. Aim of the study is thus to expose the serious effects of textile effluents on their mode of action on the survival and growth of some vegetable crops, like Tomato, Peas, beans, Fenugreek and Mustard which cause damage to the parts of plants earlier and later to the whole plant. In the present study, the leaves of the effluent treated plants showed drastic alteration in the carbohydrates, protein, ammonia, glutamine, nucleic acids and phenol content. The deviation of all these biochemical constituents indicates the adverse effect of these pollutants on the normal physiology. Hence, measures can be taken to restrict the effect of these effluents on the most significant vegetable crops.

KEY WORDS : Industrial effluent, Irrigation, Low yield, Mode of action, Biochemical constituents.

INTRODUCTION

Rapid industrialization leads to the production of heavy load of wastes. These wastes (effluents) are released in the environment after treatment (developed countries) or mostly without treatment. These effluents are released into some water body or directly on to the lands, which are mostly agricultural. Sometimes these effluents are purposely used for the irrigation due to scarcity of water, especially for raising vegetables and fodder etc (Pavithra and Koushal, 2016), so there is common trend that industries dispose off untreated effluents via open and covered routes into the water ways which degrade water quality (Epstein, 2017). Hence these industrial effluents are the most potential source of water and soil pollution. These effluents contain heavy metals as well as nutrients, which affect plant and soil in variety of ways (Fahmy-Abdullah *et al.,* 2018). Toxic chemicals like cyanides, chlorine, hypochlorites, phenols and heavy metals, all accumulated in living cells causing a reduction of cell activities, inhibition of growth and various deficiencies diseases in plants (Abubacker *et al.*, 2017).

There are hundreds of textile dye units in and around Erode town and most of the effluents are discharged into the river, causing several health hazards. These textile effluents mostly untreated are discharged into the river, which on its cause of movements carry the chemicals to the several places. This river water containing textile waste is used for irrigation of agricultural crops where is poses serious stress problems causing the plants to wilt early or making them more susceptible to pests and finally reducing the yield. Continuous use of effluent containing water for crop irrigation would result in deposit of toxic chemicals in the soil, which will become unsuitable for the cultivation of agricultural crops. Under exposure to high concentration, plants suffer acute injury with extremely visible symptoms, such as chlorisis, decolourisation, necrosis and death of the entire plant. Plants grown at high textile effluent had very leaky root system as evidenced by high K efflux; this leakiness was ameliorated by foliar spray of potassium dihydrogen phosphate (Roy *et al.*, 2018). These results show that high sodium chloride in nutrient solution has a detrimental effect on root membrane integrity. Some Data indicated that high salt causes damage to the root membranes as evidenced by high K efflux. Generally the root permeability of plants was decreased significantly under salt stress. This could be explanation for reduction in water absorption rate and may contribute to a similar reduction in nutrient uptake under salinity condition (Kim *et al.*, 2015). Besides Morphological changes, chemical, biochemical, physiological and structural changes also occur. With a view to understand the definite mode of action of textile effluent, which is a major problem of agricultural sector, on the survival and growth of plants, some of the significant vegetable crops has been taken up in the present study.

MATERIALS AND METHODS

Seeds of the plants under investigation *Lycopersion esculentum* mill (Tomato), *Pisum Sativum*(Peas), *Phaseolus Vulgaris* (Beans), *Trigonella foenumgraccum* (Fenugreek), *Brassica nigra* (Mustard) were obtained from local seed vendors in Erode. These varieties are being cultivated as rain fed crops all over Tamilnadu.

Surface Sterilization of seeds

These seeds were surface sterilized with 0. 1% mercuric chloride solution for 3 minutes, rinsed with distilled water, dried in sunlight and stored in polythene bags (APHA, 2012). Then they were used for experiments under laboratory conditions (Merode and Ayenew, 2016)

Cultivation of Plants

The Surface sterilized seed were sown to depth of 4cm in plastic bags, filled with sand, cow dung and soil mixed in uniform proportion (1:1:1). After sowing the seeds were allowed to grow for 20 days. After germination the seedling were treated with nutrient solution (Knop's Solution-250 ml) (Table 1).

Preparation of Nutrient Medium

50 ml of each of the above mentioned solutions were mixed thoroughly and made up to 1 litre with distilled water. To each polythene bag 250ml of Knop's solution was poured daily. The nutrients which are necessary for plant growth were provided by Knop's solution. After 20 days of germination, selected non-lethal doses of effluents 25, 50, 75 and 100% concentration were prepared and added. The analysis of plants was made after each treatment, to study the changes after the induction of effluent stress.

RESULTS AND DISCUSSION

Carbohydrates content in the leaves of effluent treated plants were reduced. The plants respond to varying degrees. Maximum reduction was found in Mustard, Beans and fenugreek as discussed in (Table 2). The reduction was only marginal in Tomato and ladies finger. A Biochemical effect of the mutant gene was first detected by (Yaseen and Scholz, 2019) and extensive modification of the amino acid composition of the endosperm in such a way as to improve the nutritional value of the

Table 1. Knops Stock Solution.

Chemicals	Amount of chemicals	Volume of distilled water
Potassium chloride (kcl)	250 mg	50 ml
Magnesium Sulphate ($MgSo4.7H_20$)	250 mg	50 ml
Potassium dihydrogenphosphate (KH2PO4)	250 mg	50 ml
Calcium Nitrate (Ca(N03), 4H2O	1000 mg	50 ml
Ferric chloride (Fecl3)	100 mg	50 ml

protein of grain. Following effluent treatment in plants, the protein content was found to be increased. Maximum increase was found in Peas (Gunatilake, 2015). The increase was marginal in Tomato and other plants showed increase to some extent was shown in Table 3. Various Biochemical parameters like proteins, sugar, amino acid, phenol etc., are known to play an important role in pathogenesis. Though a good deal of work has been done on these aspects of various crops but information is available on Biochemical aspects of pearl millet during pathogenesis of downy millet and Glutamine content was increased to a varying extent in the leaves of the stress plants (Armoker *et al.*, 2018). More increase of the glutamine was observed in the stress leaves of Tomato. In other plants the increase was considerable.

Textile effluent is effective in altering the balance between the protein and amino acid pool. This is because free amino acids get incorporated into the polypeptide chain during synthesis and the constituent amino acids are released and protein undergoes breakdown. Effluent stress reduced the protein synthesis barley roots by changing the incorporation of (35. c) methionine into protein (Sultan *et al.*, 2017). The leaves of the stress plants showed a grave alteration in the level of ammonia content profound increase of the ammonia was observed in the stress leaves of cucumber, fenugreek, and gogu. Other plants showed less increase on effluent treatment. Totally a varying trend of response of DNA was noted in the stress leaves (Kale, 2016). The DNA content in the stress leaves was found to be increased when compared to the normal leaves. RNA content in the leaves of effluent treated plants was increased. The plants respond to varying degrees maximum increase was found in Peas, Beans and Tomato. The increase was marginal in fenugreek and ladies finger. Literature indicates that nucleic acids contents were increased in plants infected with several diseases.

Viral diseases have been reported to cause increased RNA. A rise in RNA content of tumor tissues is also reported on rust infected; leaves, marked increase in RNA and DNA Content has been observed (Ali *et al.*, 2019). Phenol content was increased to a varying extent in the leaves subjected to effluent treatment. All stress leaves showed profound increase in phenol level, when compared to normal leaves Phenols are polymerized terminal products of secondary metabolism, not important for life processes. They are synthesized from carbohydrates via either shikimic acid pathway, acetate pathway or modifications of both pathways (Amutha, 2017). The plants reported to infection and also to mechanical injury by accumulation of toxic chemical, which are most phenolics. In cotton, infected with microbes, the level of phenolics compounds increases in the roots and stems phenolic compounds increase in the roots and stem phenolic compound s have been reported to play an important role in plant resistance (Babakhani *et al.*,

Table 2.

S. No.	Vegetable crops	DNA		RNA		Phenol	
		Normal	Stress	Normal	Stress	Normal	Stress
1.	Tomato	1. 19±0. 24	1. 22±0. 16	1. 18±0. 16	1. 66±0. 65	2. 5±0.32	3. 71±0.71
2.	Peas	1. 26±0. 18	2. 13±0. 73	1. 87±0. 88	2. 66±0. 38	2. 44±0.22	3. 16±0.79
3.	Beans	1. 13±0. 76	1. 86±0. 65	1. 65±0. 44	2. 28±0. 92	2. 48±0.17	2. 74±0.42
4.	Fenugreek	1. 17±0. 68	1. 96±0. 14	1. 24±0. 58	2. 37±0.72	2. 86±0.41	3. 54±0.37
5.	Mustard	1. 85±0. 59	2. 25±0. 77	1. 37±0. 18	1. 63±0.61	2. 53±0.21	3. 05±0.41

Table 3.

S. No.	Vegetable Crops	Carbohydrates		Protein		Glutamine		Ammonia	
		Normal	Stress	Normal	Stress	Normal	Stress	Normal	Stress
1.	Tomato (*Lycopersicon esculentum* mill)	8.52±0.29	7. 53±0. 03	2. 83±0. 34	3. 83±0. 62	1. 13±0. 22	1. 73±0. 29	1. 64±0. 33	1. 88±0. 34
2.	Peas (*Pisum Sativum*)	7.6±0. 34	6.2±0. 28	2. 81±0. 68	3. 82±0. 92	1. 16±0. 17	1. 63±0. 12	1. 81±0. 42	2. 18±0. 77
3.	Beans (*Phaseolus vulgaris*)	7. 35±0. 31	6. 83±0. 28	2.15±0.24	2. 77±0. 62	1.2±0. 29	1. 38±0. 17	1. 15±0. 24	1. 79±0. 62
4.	Fenugreek (*Trigonella* (*foenum graecum*)	8. 47±0. 18	8. 06±0. 22	2. 80±0.42	3. 65±0. 77	1. 52±0. 23	1. 76±0. 15	1. 66±0. 33	1. 85±0.35
5.	Mustard (*Brassica nigra*)	8. 40±0. 24	7. 62±0. 10	2. 25±0. 45	2. 82±0. 66	1. 25±0. 36	1. 82±0. 63	1. 96±0. 24	2. 22±0.46

2016 and Dey and Islam, 2015) the increased level of phenols content in effluent treated plants may be attributed to the adaptive response to the stress of effluents (Madhav *et al.,* 2018). The above discussion sheds light on the mode of effect and biochemical response of plants to the effluent stress.

CONCLUSION

Crop losses due to pollutant stress are on rise ever since Industrial growth is made. Most of the Industrial effluents contain lot of toxic substances. When these effluent, without proper treatment are discharged to any land mass or into aquatic system Cause serious problems to all biological life. Many places in Tamilnadu, especially the Erode town is a well known textile industrial place. These industries produce several tones of effluents containing toxic dyes and chemicals, which often are discharged into river with or without proper treatment. These water sources are used for irrigation in the agricultural sector, facing great problems of crop loss and low yield. Aim of the study is thus to expose the serious effect of textile effluents their mode of actions on the survival and the growth of some important vegetable crops, which cause damage to part of plants earlier and later to the whole plant. All living organisms directly are indirectly are high dependent on these plants to full fill their requirements, hence, these measures can be taken to restrict the effect of these effluents on the most significant vegetable crops.

REFERENCES

Abubacker, M.N. and Mehala, T. 2017. Physico-chemical analysis of textile dye effluent using microbial consortia mediated degradation process. *Biolife.* 5(1) : 60-67.

Ali, H., Khan, E. and Ilahil, 2019. Environmental chemistry and ecoto xicology of hazardous heavy metals : Environmental persistence, toxicity, and bioaccumulation. *Journal of Chemistry.* 1-14

Amutha, K. 2017. Sustainable chemical management and zero discharges. *Sustainable Fibres and Textiles.* pp. 347-366.

APHA. 2012. *Standard Methods for the Examination of Water and Wastewater*, 21 the d. American Public Health Association, Washington DC, USA.

Babakhani, M., Zehtabian, G., Keshtkar, A. and Khosravi, H. 2016. Trend of groundwater quality changes, using geostatistics (case study: Ravar Plain). *Pollution.* 2 (2) : 115-129.

Dey, A. and Islam, 2015. A review on textile water characterization in Bangladesh. *Resources and Environment.* 5(1) : 15-44.

Fahmy-Abdullah, M., Sieng, L. W. and Isa, H. M. 2018. Technical efficiency in Malaysia textile manufacturing industry: A stochastic frontier analysis (SFA) approach. *International Journal of Economics and Management.* 12(2) : 407-419.

Karmoker, J., Kumar, S., Kumer Pal, B., Sajal Sorowar, M. 2018. Characterization of wastewater from Jhenaidaharea, Bangladesh: A combined physico-chemical and statistical approach. AIMS *Environmental Science.* 5(6) : 389-401.

Kale, V.S. 2016. Consequence of temperature, p H, turbidity and dissolved oxygen waterquality parameters International Advanced Research. *Journal in Science, Engineering andTechnology.* 3(8): 186-190.

Kim, H. S., Kim, Y. J. and Seo, Y. R. 2015. An overview of carcinogenic heavy metal: Molecular toxicity mechanism and prevention. *Journal of Cancer Prevention.* 20 (4) : 232-240.

Madhav, S., Ahamad, A., Singh, P. and Mishra, P.K. 2018A. review oftextile industry: Wetprocessing, environmental impacts, and effluent treatment methods. *Environmental Quality Management.* 27(3) : 31-41.

Meride, Y. and Ayenew, B. 2016. Drinking water quality assessment and its effects on residents health in Wondogenet campus, Ethiopia. *Environmental. Systems Research.* 5(1) : 1-7.

Pavithra, M. and Kousar, H. 2016. Characterization of certain physico-chemical parameters of textile waste water. *International Journal of Environmental Sciences.* 5(1) : 39-41.

Rostern, N. T. 2017. The effects of some metals in acidified waters on aquatic organisms Oceanography & Fisheries. *Open. Access. Journal.* 4(4) : 1-7.

Roy, C.K., Jahan, M. A. A. and Rahman, S. S. 2018. Characterization and treatment of textile wastewate r by aquatic plants (macrophytes) and algae. *European Journal of Sustainable Development Research.* 2(3) : 29.

Sultana, M. S., Rana, S., Yamazaki, S., Aono, T. and Yoshida, S. 2017. Health risk assessment for carcinogenic and non-carcinogenic heavy metal exposures from vegetables and fruits of Bangladesh Cogent. *Environmental Science.* 3(1) : 1-17.

Yaseen, D. A. and Scholz, M. 2019. Textile dye wastewater characteristics and constituents of synthetic effluents: A critical review. *International Journal of Environmental Science and Technology* 16(2) : 1193-1226.