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Original Research Paper

Studies on the Effect of Effluent from a Rubber Latex Centrifuging Industry on Protein Content in *Vigna unguiculata* L. Walp. and *Abelmoschus esculentus* (L.) Moench.

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ABSTRACT

The present study was carried out to evaluate the effect of different concentrations of the treated centrifugal rubber latex factory effluent on protein content in *Vigna unguiculata* L. Walp. and *Abelmoschus esculentus* (L.) Moench. The increasing demand of irrigation water leads to research exploring the viable alternatives. The present study also aimed in this direction. The physico-chemical analysis of the effluent indicated its acidic nature as well as presence of appreciable amount of dissolved solids, suspended solids, ammoniacal nitrogen, total nitrogen, sulphate and potassium together with high BOD and COD. Different dilutions of the effluent such as 25, 50, 75% and undiluted effluent were used for treatment. The results indicated that there is a marked difference in the response of these two genotypes to effluent treatment. *Abelmoschus esculentus* is tolerant and the treatment showed a favourable result with respect to protein, as evidenced by a high amount of protein treated population. In *Vigna unguiculata* the protein content showed reduction in all the treated population. The study recommended that after proper dilution the effluent can be used as an effective source of irrigation water.

INTRODUCTION

The progressive adoption of urbanization and industrialization resulted in pollution of both land and water bodies. One of the effective mechanisms to minimize the load of waste water is its utilization for irrigation purposes (Kalaiselvi et al. 2010).

Studies on the harmful nature of industrial effluents in relation to plant growth is relevant in this situation due to discharge of these effluents to water bodies which are the main source of irrigation. Some of the effluents contain considerable amount of nutrient also (Gautam & Bishnoi 1992). The elements may become toxic beyond the tolerance limit and cause adverse effect on plant growth. The interactions that occur in soil-plant system are complex in nature. The assimilation of trace elements by plants varies greatly as a function of soil conditions. High metal concentration in soil do not always indicates correspondingly high levels of these metals in the plants as it depends on several other factors such as pH, cation exchange, organic matter, humidity, etc. (Albasel & Cottenie 1985).

Augusthy & Mani (2001) conducted physico-chemical analysis of the rubber factory effluent and revealed the presence of high amounts of total suspended and dissolved solids, sulphates, phosphates and total nitrogen in significant quantities. Sharma & Singh (1999) evaluated rubber factory effluent and found that it contains heavy metals, copper and zinc. The effects of various industrial effluents on seed germination, growth and yield of crop plants have been studied by many workers (Ozoh & Oladimeji 1984, Rahman et al. 2002, Street et al. 2007). However, no detailed experiments have been performed on the plant growth and biochemical changes using rubber factory effluent. The induction of the stress response leads to the expression of a group of proteins referred to as stress proteins, thought to protect the cell (Morange 1997).

In the present paper an attempt has been made to evaluate the effect of different dilutions of a centrifugal rubber latex factory effluent on the protein content in two vegetable crops *Vigna unguiculata* L. Walp. and *Abelmoschus esculentus* (L.) Moench.

MATERIALS AND METHODS

Healthy viable seeds of *Vigna Unguiculata* and *Abelmoschus esculentus* were collected from District agricultural farm, Kozha. Treated effluent from Neerakal Rubber Factory Pvt. Ltd. was collected from the discharge unit of the rubber processing sewage system in a clean Jerrycan. The wastewater samples used for DO and BOD determination were collected directly into DO bottles and fixed with manganous sulphate. The effluent was stored under refrigeration. All samples were analysed as per the standard methods (APHA 1995).

The effluent without any dilution was considered as 100

percent. Various concentrations of the effluent such as 25, 50 and 75 percent were prepared by adding required amount of water to the 100 percent effluent.

Dry seeds were allowed to soak in various concentrations of the effluent for 24 hours. The seeds were then sown in polybags of 30 × 50cm size filled with potting mixture of composition 1:1:1 soil:sand:cowdung. Both, experimental and control sets in distilled water, were maintained in triplicate. Thirty two days old seedlings were taken for analysis for biochemical parameters during the vegetative phase and, 46-day old seedlings for analysis during the flowering phase. Fresh tissues samples collected from seedlings receiving different concentrations of effluent were collected for analysis. Protein was analysed by the method suggested by Lowry et al. (1951).

RESULTS AND DISCUSSION

The physico-chemical characteristics of the effluent were found within the discharge limit prescribed by the Kerala State Pollution Control Board (Table 1). The pH of the treated effluent was found to be 6.10 i.e., slightly acidic in nature due to the use of acid in latex coagulation. The quantity of acid used for coagulation of the latex, specifically in skim latex after centrifugation operation, is generally higher than the actual requirement. The COD and BOD were 49.33 mg/L and 18.33 mg/L respectively. Ademoroti (1980) reported that high BOD and COD as an indication of pollution and low BOD and COD indicated high quality of water.

The dissolved solids, suspended solids, ammoniacal nitrogen, total nitrogen, sulphate and potassium were 1621.67, 10.67, 1.33, 81.33, 562.0 and 77.33 mg/L respectively. These parameters were found to be within the limit specified by the Kerala Pollution Control Board. Sulphate in the effluent may be further decreased when open up to land area due to filtration by soil and plants and by the sulphate reduction process. Similar characterization of rubber effluent was attempted in many earlier studies (Asia & Akporhonor 2007, Karim & Bachik 1989). In the present study the effluent has been utilized for irrigation to crop plants after different degrees of dilution.

The protein content in the seedlings of *Abelmoschus esculentus* was found to be increased in the population raised by the treatment with effluent compared to the control during both vegetative and reproductive stages. The protein content showed a decrease with increase in the concentration of effluent treated. Similar effect of sugar mill effluent on protein content was reported by Baskaran et al. (2009) in *Vigna radiata*. They attributed this increase to the adsorption of necessary elements present in the effluent by plants. Behra (1980) and Neelam (1985) also reported similar results under

Table 1: Physico-chemical characteristics of treated effluent from Neerackal Latex Pvt. Ltd., Kottayam, Kerala.

Parameter	Estimated amount in effluent sample (All Parameters are expressed in mg/L, except pH)
1. pH	6.10
2. Oil and Grease	6.00
3. COD	49.33
4. BOD	18.33
5. Dissolved solids	1621.67
6. Suspended solids	10.67
7. Ammoniacal nitrogen	1.33
8. Total nitrogen	81.33
9. Chloride	Trace
10. Sulphate	562.00
11. Sulphide	103.00
12. Potassium	77.33
13. Phosphate	3.30
14. Sodium	1.60
15. Copper	Trace
16. Iron	Trace
17. Calcium	56.00
18. Magnesium	13.00
19. Zinc	0.85
20. Boron	0.48

effluent stress. The induction of the stress response leads to expression of a group of proteins referred to as stress proteins, which are thought to protect the cell (Gabara et al. 2003). Higher levels of BOD, COD and total phosphates affected the total protein that increased in treated plants as compared to control plants.

A serious threat of rubber wastewater towards environmental protection is high concentration of nitrogen in effluent (Mitra et al. 2010). In the present study increase in the protein content in treated population is attributed to the nitrogen and potassium present in the effluent. The study indicated that the treatment with effluent has a favourable impact expressed in terms of protein content.

Protein content in case of *Vigna unguiculata* indicated a decrease in all the treated population when compared with the control in samples of leaves estimated during both vegetative phase and reproductive phase. Pulver & Ries (1973) and Joshi & Tandom (2003) reported that treatment with paper mill effluent reduces the protein content in case of *Vigna radiata*, *Glycine max* and *Cicer arietinum* due to the effect of effluent on protease activity. Swaminathan & Vaidheeswaran (1991) opined that with the reduction in the rate of nitrogen absorption and amount of nitrogen present in the plants, the total physiological activities decreased resulting in gradual reduction in protein content of the plants treated with effluent. Khosla (1980) opined that the reduction in protein content is due to the effect of increase in ani-

Table 2: Protein content (%) in *Abelmoschus esculentus* and *Vigna unguiculata* during the vegetative and fruiting phase after treatment with various concentrations of centrifugal rubber latex factory effluent.

Treatment Concentration (%)	*Abelmoschus esculentus*		*Vigna unguiculata*	
	Vegetative (mean ± S.D.)	Reproductive (mean ± S.D.)	Vegetative (mean ± S.D.)	Reproductive (mean ± S.D.)
Control	34.29±5.98	37.89±4.06	64.57±12.10	67.61±47.61
25	41.46±6.41	38.16±5.91	63.34±7.81	54.69±17.38
50	42.83±6.71	50.75±12.69	59.33±7.16	51.01±6.62
75	40.23±3.83	34.62±7.08	56.95±5.53	49.04±15.94
100	40.42±5.26	32.21±22.42	50.62±19.72	48.18±6.83

ons and cations present in the effluent. Lasa et al. (2000) reported that the magnesium content in the effluent is responsible for the reduction in the protein content of treated plants at higher concentrations of the effluent.

The present study indicated that there is a genotype specific variation in the response towards irrigation effect of the effluent. Karr et al. (1984) found that the degree to which toxicity symptoms are expressed by plants depends on a number of factors, ions present, amount and form of organic matter and the plant genotype.

CONCLUSION

It is concluded from the study that irrigation with diluted effluent of centrifugal rubber latex factory indicated that there is a genotype specific variation and it produced favourable effect on *Abelmoschus esculentus* at low concentrations of treatment, while in *Vigna unguiculata,* the treatment induces reduction in protein content. Thus, utilization of treated rubber effluent form viable alternative for irrigation purposes only after proper dilution and removal of physico-chemical constituents to bring them within the specified limit and to be within the tolerance limit of the sensitive genotype.

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