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STUDY OF PROTEINS AND CARBOHYDRATE CONTENT OF CROPS (BRINJAL AND TOMATO) GROWN ON IRRIGATION WITH POLLUTED RIVER WATER

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ABSTRACT

Polluted river water used for irrigation will have effects on the growth performance, germination and some metabolic syntheses in plants. Through the studies on the protein and sugar content during germination stage, it is possible to know the response and tolerance of two crops (brinjal and tomato) to pollutants. To study this aspect, the physico-chemical parameters of river water from a polluted river were studied in order to understand the level of pollution at this site. It was found that the river water has high content of total dissolved solids (TDS), nitrates, nitrites, however they are satisfactory as per the standards of IS: 3307, (1965) for irrigation purposes. The germination of brinjal and tomato were observed under various concentrations of river water after seven days of germination and analysis of protein and sugar content was carried out.

INTRODUCTION

Sewage discharges are the most common sources of pollution in river waters. However, such sewage waste water, can be used for irrigating the crops, thereby, minimizing the environmental pollution, and utilizing its mineral potential as well, bringing about economization of fertilizers. (Shah *et al.* 2005). The limits of pollution tolerance may vary from plant to plant, as well from the stage of development of the plant. Rate of assimilation, translocation and utilization of available nutrients indicates the growth potential of plants in the applied conditions. The nutrients are utilized and converted to organic matter, and so study of the organic contents is important to evaluate the adaptability of plants to stressed environmental conditions. Many a times water used for irrigation purposes is contaminated which alters the yields of crop plants (Bhosale, 1985). Germination of seed is the awakening of the dormant embryo to a metabolically active state. The seed carries all the information for the germination, growth, morphogenesis and procreation of species. The germination of seeds is one of the critical phases in the life cycle of plants as it is subjected to several environmental stresses. The factors inducing stress on the germination of seeds and growth of the seedlings include temperature, soil texture, salinity and alkalinity.

The Mula Mutha river water has high BOD, COD, nitrates, nitrites, and phosphates. Gunale (1981) have reported similar results by analysis of chemical parameters of Mula Mutha river water. In the present

study, river water at the Manjari village site is used for irrigation of the selected crops ie. Brinjal (*Solanum melongena* L.) and Tomato (*Lycopersicon esculentum* Mill.). To study the effect on organic metabolism under various concentrations of river water, it was proposed to study the sugars and protein contents of the hypocotyl of the germinating seedlings of Brinjal and Tomato. Mane *et al.* (1999) carried out similar studies on germination of crops like soybean, mustard, safflower, fenugreek, under various concentrations of pulp and paper mill waste water. Arora *et al.* (1996) have observed significant reduction in germination percentage, length and total biomass in *Hordeum vulgare* L. that was germinated under the effect of tannery effluent.

Diluted effluent from chemical industry was effective in promoting germination, growth and protein content and hence water is suitable for irrigation purposes (Chidaunbalam *et al.* 1996) and similarly diluted paper mill effluent was found suitable for crops like *Glycine max*, *Vigna sinensis* and *Lycopersicon esculentum* (Singh *et al.* 2005). But Srivastava *et al.* (1995) concluded that ordnance factory effluent was deleterious to the germination of seeds, and as concentration of effluent increases, the deleterious effect on the growth performance of the seeds has a positive correlation.

Sodium in irrigation water may become a problem in the soil as the total salinity may increase. Percentage sodium and Sodium Absorption Ratio were also calculated and it was found that the water does not have a sodium hazard potential.

MATERIALS AND METHODS

Physical and chemical analysis of Mula-Mutha river water at Manjari site

The physico-chemical analyses were conducted in the Chemistry and Environmental Science Laboratories of the Vasantdada Sugar Institute, Manjari, Pune. The results are the mean of three readings and are analyzed statistically. The analysis of water sample was done for various physical and chemical parameters like pH, DO, BOD, COD, hardness, calcium, magnesium, sodium, potassium, nitrates and nitrites etc. following the methods in Standard methods for water and wastewater analysis, APHA-AWWA WPCF (1998).

Germination studies

Petriplate technique was adopted for germination studies. Pure seeds of brinjal (*Solanum melongena*,L.) and tomato (*Lycopersicon esculentum*, Mill.), were collected from Damani seeds Pvt. Ltd., Pune. Petri dishes were sterilized, with germination papers and non-absorbent cotton and were used for germinating the seeds.

Sterilization and sowing of seeds

Viable, healthy and uniform seeds were selected and surface sterilized before using for experiments. Seeds were first washed with running tap water for 10 minutes followed by 0.05% $HgCl_2$ treatment for five minutes and washed with sterile water for 10 minutes. The seeds (20 per plate) were then placed equidistantly. 10 mL of various concentrations were poured in the respective Petridishes. The control was irrigated with an equal volume of distilled water. The petridishes were placed in dark room at room temperature ie. at 28 ± 2^0C.

The experiment was carried out in three sets with each petriplate having 20 seeds.

Water treatments for irrigation

The germination percentage was studied for different treatments, of river water diluted with distilled water (00, 20, 40, 60, 80, 100%).

Organic metabolism study

The hypocotyl of the germinated seedlings of Brinjal and Tomato were separated after seven days of germination and then anayzed for the sugars and protein estimations.

Proteins were estimated by Folin Phenol method proposed by Lowry *et al.* (1951).

Reducing sugars were estimated by Shaffer-Somogyi micro method. The hypocotyls were washed, oven dried and weighed, for carrying out the estimation. All the data presented in table no. 2 and 3, were analyzed statistically according to Panse and Sukhatme (1985).

RESULTS

Physico-chemical analysis of river water at Manjari site

The results of the physico-chemical analysis of river water at Manjari site are presented in Table 1.

Sodium absorption ratio (SAR) & % Na

Sodium in irrigation water may become a problem in the soil as the total salinity may increase. An increased

salinity may significantly reduce the free amino acid fractions in the crops (Labanauskas, 1981). Sodium renders soil less permeable to air and water and soils may become plastic and sticky. The percentage of sodium in irrigation waters should not exceed 50 - 60. Indian standard recommendation for percentage of sodium is maximum of 60. For irrigation waters, SAR of 8 is considered satisfactory and 12-15 is marginal. The %Na for Mula-Mutha river water at Manjari site was 23.3% and the SAR value was 4.39.

So, the water does not have a potential for sodium hazard and can be safely used as an irrigant.

Protein content

The results for protein content of Brinjal and Tomato are depicted in Table 2 and Fig 1, for Brinjal and Fig 2, for Tomato. The protein content in the hypocotyls of brinjal was more than control in 40% to 100% of river water irrigation, and was less than control at 20% of river water irrigation.

The protein content in hypocotyls of tomato was less than control in all the concentrations and was equal to control at 40%.

Reducing sugars content

The results for reducing sugars content for Brinjal and Tomato are depicted in Table 3 and Fig 3, for Brinjal and Fig 4, for Tomato. The reducing sugars in hypocotyls of brinjal were more than control and were gradually increased from 40% to 100% concentration of river water treatments. The reducing sugars were slightly less than control only in 20% concentration.

The reducing sugar concentration in hypocotyl of tomato was more than control for all concentrations (20% to 100%) of river water treatments.

Table 1. Physico-chemical characteristics of the Mula-Mutha River water at Manjari site

S.No.	Parameter	Observed values (mg/L)
1.	Temperature	26.17 ± 0.6
2.	Turbidity	73.7 ± 16.21
3.	pH	7.02 ± 0.17
4.	Electrical Conductivity (EC)	0.46 ± 0.024
5.	Dissolved Oxygen (DO)	2.96 ± 2.13
6.	Chemical Oxygen Demand (COD)	52.07 ± 16.73
7.	Biological Oxygen Demand (BOD)	114.76 ± 20.15
8.	Alkalinity	214 ± 22
9.	Hardness (as $CaCO_3$)	126.67 ± 13.19
10.	Calcium (as $CaCO_3$)	40.23 ± 0.35
11.	Magnesium	21.37 ± 3.89
12.	Sodium (as Na)	24.39 ± 5.21
13.	Potassium (as K)	18.73 ± 16.7
14.	Sulfates (as SO_4)	336.7 ± 62.36
15.	Chlorides	20.99 ± 4.53
16.	Total Solids (TS)	254.3 ± 174.3
17.	Total Dissolved Solids (TDS)	310 ± 30
18.	Total Suspended Solids (TSS)	460 ± 20
19.	Nitrates (as NO_3)	0.66 ± 0.06
20.	Nitrites (as NO_2)	0.062 ± 0.003
21.	Phosphorus (as PO_4)	3.94 ± 0.131
22.	Sodium Absorption ratio (SAR)	4.39 ± 0.002

All values are expressed in mg/L except pH, electrical conductivity, temperature, movement and turbidity. (EC as mS/cm and turbidity as NTU)
All values are mean of three determinants.
± indicates standard deviation.

DISCUSSIONS

The protein synthesis was stimulated in hypocotyls of brinjal till 60% of river water treatments and protein synthesis was inhibited at higher levels (80% and 100%) of concentrations of river water irrigation. The protein synthesis was stimulated in hypocotyls of tomato only upto 40% concentrations of river water treatments however; it was inhibited at all higher levels (60% to 100%) of river water treatments for tomato.

The reducing sugar content was increased in hypocotyl of brinjal upto 60% concentration of river water treatments and was slightly less at all higher concentrations of river water irrigation. The reducing sugar content in hypocotyl of tomato was increased upto 60% and it was slightly reduced at all higher concentrations of river water treatments.

The river water does not possess sodium hazard. Thus, the river water can be suitably used for irrigation purposes, and with suitable dilutions it would prove more beneficial.

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Table 2. Effect of increasing concentrations of Mula Mutha river water irrigation on protein content in *Solanum melongena* L. and *Lycopersicon esculentum* Mill.

Treatments	Protein content			
	Brinjal (*Solanum melongena* L.)		Tomato (*Lycopersicon esculentum* Mill.)	
	mg/100g dry wt.	% protein content	mg/100g dry wt.	% protein content
Control	420	100.0	2100	100.0
20%	350	83.3	2070	98.6
40%	530	126.2	2100	100.0
60%	820	195.2	1470	70
80%	710	169.0	1080	51.4
100%	640	152.4	984	46.9

Table 3. Effect of increasing concentrations of Mula Mutha river water irrigation on reducing sugars content in *Solanum melongena* L. and *Lycopersicon esculentum* Mill.

Treatments	Reducing sugars content g/100g dry wt.			
	Brinjal (*Solanum melongena* L.)		Tomato (*Lycopersicon esculentum* Mill.)	
	mg/100g dry wt.	% protein content	mg/100g dry wt.	% protein content
Control	0.11	100.0	0.114	100.0
20%	0.065	59.1	0.22	192.9
40%	0.11	100.0	0.44	385.96
60%	0.198	180	0.44	385.96
80%	0.165	150	0.221	193.86
100%	0.17	154.5	0.216	189.47

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