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ANALYSIS OF EFFECTS ON BIOCHEMISTRY OF GLYCINE MAX CROP IRRIGATED WITH INDUSTRIAL WASTE WATER OF KOTA, RAJASTHAN

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ABSTRACT

The use of industrial waste water in agricultural lands for irrigation of crops is an important way of utilizing waste water now a days. The aim of this study was to determine the effects of industrial effluents on biochemical parameters of crop plant. Water samples were collected from a common outlet of different industries of Kota. The biochemical parameters studied were phenol, protein, starch, total soluble sugar, pigments (chlorophyll a, chlorophyll b, carotenoids, and total chlorophyll) and antioxidative enzymes like catalase and peroxidase. Plants irrigated with industrial waste water were compared with control for these parameters. Results showed that industrial waste water irrigated crops significantly affect some biochemical contents. The study concluded that, common effluent water of various industries (from Kota district of Rajasthan), was contaminated with heavy metals. Study showed that industrial waste water irrigation stress increases chlorophyll, carotenoid, protein and catalase activity and decreases phenol, total soluble sugar, starch and peroxidase activity in crop as compared to control water irrigated crop. Changes in both biochemical parameters and enzymatic activies values is seen in *Glycine* crop.

KEYWORDS: industrial waste water, biochemical parameters, *Glycine max*.

INTRODUCTION

Effluents from various industries are one of the major sources of pollution. Present idea is based on taking advantages of the presence of considerable quantities of Nitrogen and phosphorous along with other essential nutrients (Niroula 2003).[21] There can be both beneficial and damaging effects of waste water irrigation on various crops and vegetables. (Raman et al. 2002, Saravanamoorthy and Ranjitha Kumari 2007).[22][23]Therefore, it is necessary to study the impact of industrial waste water on crop system before they are recommended for irrigation (Thamizhiniyan et al. 2009).[24],[1]

The industrial development in recent years has resulted in a rapid increase in the production and consumption of various chemicals by human beings. The Production, use and disposal of numerous chemicals cause contamination of soils as well as ground water and surface water. This continuous process results in bioaccumulation and finally results in severe reverberations, including the loss of food sources, mutagenic and carcinogenic effects to mankind.[2]

In many cities of India, industries are located and operated within cities. The location of industries indirectly affects human health by releasing toxin such as metals at higher than safe limits into industrial effluents with adverse consequences on the ecosystem.[3] Environmental pollution is a issue of great concern. Therefore has been accepted as a global problem because of its adverse effects on human health, animals and plants.

Biochemistry deals with the structures, functions and interactions of biological macromolecules, such as proteins, phenols, carbohydrates and lipids, which provide the structure of cells and perform many of the functions associated with life. So, this study was proposed to compare the data on biochemical aspects in the plants grown under control and industrial waste waters.

To investigate the effect of effluents present in the industrial waste water, the present study was proposed. The very common crop *Glycine max* grown in the Kota region was selected to study biochemical characteristics of the plants irrigated with control water and industrial waste water.

MATERIALS AND METHODS

Experimental Plant

Glycine max (L.) Merr. (Soyabean)(RUBL211592).

Study Area

The district Kota lies between 24°25’ and 25°51’ North latitudes and 75°31’ and 77°26’ East longitudes with total area of 5767.97 Sq Km. The city has extreme climate. Temperature varies between 6°C – 48°C during winter and summer; the average rain fall is about 880 mm and humidity annually ranges from 8 – 88%. Summers are full of dust storms. wind velocity varies from 2 to 22 Km/hour. Geomorphologically Kota city is situated in northern part of malwa Plateau. The only perennial river “Chambal” originating from the hills of western Madhya Pradesh passes through the district.

Kota is a prime industrial town of Rajasthan with historical importance of its own.[4] Many large and small scale industries are present due to availability of river water and power. Kota district is a power production centre of the country where coal based Kota Super Thermal Power Station is situated. A popular cost effective building stone i.e. Kota stone is being excavated, cut to various sizes and polished in more than 200 units generating huge amount of slurry waste containing mainly CaO, MgO and SiO2. Few large scale industries including DCM Shriram Consolidated Limited (DSCL), Multimetals Limited, Samtel Glass Limited, Chambal Fertilizers and Chemicals Limited (CFCL), Shriram Fertilizers and Metal India, Shriram Rayons and a number of Kota stone cutting polishing units further enhance the heavy metal burden in the Atmosphere.[5]

Collection of plants and water samples

The study was conducted with waste water released from industries at Kota, Rajasthan. Waste water samples were collected from common outlet point in Kansua nalla of combined effluents from industries and water sample of control water were collected from tap water used for drinking purpose. Effluent samples were collected in plastic container of 5-liter capacity. All the containers were tightly capped and carefully brought to laboratory under cold conditions. The seeds of *Glycine max* (soyabean) were purchased from registered seed center.

Two plots of 6.5 × 4.5 m^2 size were prepared. Seeds of *Glycine max* were sown in each plot. Uniform irrigation schedule was followed for both plots to maintain similar moisture condition throughout the lifecycle of plants. Names of the both plots were given as *Glycine* control and *Glycine* industrial waste water respectively. Plant samples collected were washed with distilled water to remove dust particles. Fresh leaf material was used for estimation of different biochemical contents.

Experiments

Fresh leaves were used for estimation of chlorophyll,[6] protein,[7] carbohydrate,[9] phenol,[8] starch[10] and the two antioxidative enzymes viz., peroxidase and catalase.[11][12]

Chlorophyll a, chlorophyll b, carotenoids and total chlorophyll was estimated by Arnon's method (1949). Protein content in leaves was measured by method described by Lowry *et al* (1951). Phenol content in leaf was measured by method described by Bray and Thorpe (1954). Carbohydrate was estimated in leaf by phenol- sulphuric acid method (Dubois *et al)* 1951. Peroxidase and catalase in leaf was estimated by methods used by Putter and Aebi.

Observation Table

Table 1: Showing comparison of biochemical characteristics of *Glycine max* crop irrigated with control water and industrial waste water.

S. No.	Parameters	Glycine(Control)	Glycine(Industrial Waste water)
1	Chlorophyll a(mg/gm)	4.04±0.141	4.79±0.194
2	Chlorophyll b(mg/gm)	4.54±0.205	6.93±0.091
3	Total Chlorophyll (mg/gm)	8.59±0.065	11.72±0.12
4	Carotenoid (mg/gm)	2.076±0.228	2.55±0.273
5	Protein (mg/gm)	3.13±0.25	3.31±0.24
6	Starch (mg/gm)	3.02±0.22	1.62±0.172
7	Phenol (mg/gm)	0.237±0.034	0.173±0.092
8	Total Soluble Sugar (mg/gm)	6.79±0.299	1.84±0.216
9	Catalase (µMolar/L/gm)	0.55±0.17	0.65±0.0611
10	Peroxidase (µMolar/L/gm)	3.85±0.205	3.56±0.19

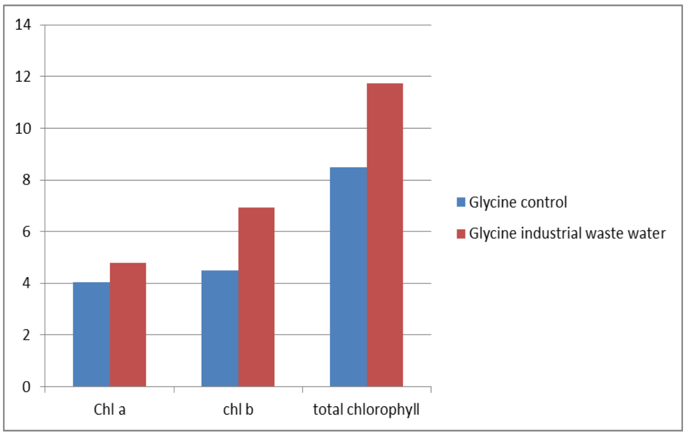

Fig. 1: Effect on industrial water irrigation on pigment composition of *Glycine* crop.

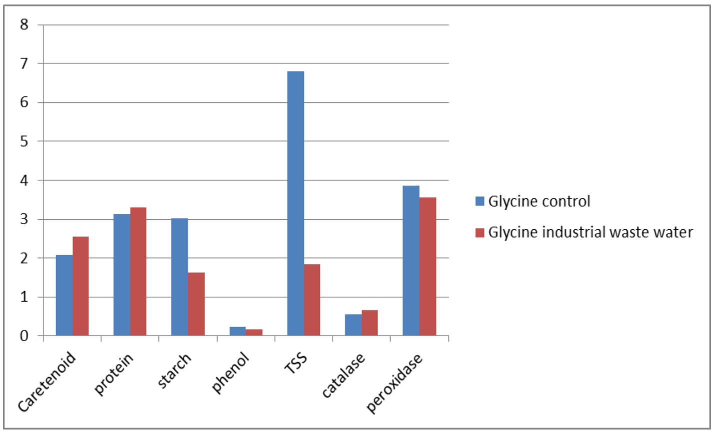

Fig. 2: Graph representing comparative study of various biochemical parameters.

RESULTS AND DISCUSSION

In *Glycine max* crop irrigated with industrial waste water the chlorophyll, carotenoid and protein amount was 11.72±0.12, 2.55±0.273 and 3.31±0.24 mg/gm respectively, whereas control water crop have amount as 8.59±0.065, 2.076±0.228 and 3.13±0.25 mg/gm respectively. This shows increased amount of chlorophyll, carotenoid and protein in industrial water crop. The enhancement of protein content of crop plants might be increased due to the increased rate of amino acid synthesis which may be attributed to the higher rates of both RNA-ase and transaminase activity.[13]

The increase in protein levels in leaves of plants irrigated with industrial waste water, appear to cause, at the level of cellular detoxification reactions that take place through phytochelatins to neutralize toxic substances for the plant.[14]

The increase of total chlorophyll content was probably due to stimulation of photosynthesis, where chlorophyll biosynthesis occur.[15]

The increase of chlorophyll can be explained by the fact that the leaves secrete many enzymes; this part of the plant is home to several metabolisms including photosynthesis. Moreover, the defense system of leaves towards xenobiotics consists of detoxification enzymes, which results in a high catalytic activity, to reduce the stress of the xenobiotic.[16] An increase in carotenoid content was suggested to be a defense strategy of the plants to combat metal stress.[17]

The phenol, starch and total soluble sugar value in industrial waste water irrigated crop was 0.173±0.092, 1.62±0.172 and1.84±0.216 mg/gm respectively, whereas control crop values were 0.237±0.034, 3.02±0.22 and 6.79±0.299 mg/gm respectively. The above data show decrease in total carbohydrate and phenol value in industrial waste water irrigated crop as compared to control water crop. The decrease in starch content may be due to the lowered activity of phosphorylase and the increased activity of beta-amylase and invertase with effect of effluent.[18]

Heavy metals also modify carbohydrate level in crop significantly. Total soluble sugar level decreases in plants irrigated with water having high copper, cadmium and other heavy metals content. This observed decline in carbohydrate level was may be due to role these heavy metals on enzymatic reactions related to the cycle of carbohydrate catabolism.[25]

Excess heavy metals reduced biomolecules and metabolic activities due to inhibition in uptake and translocation of Zn and Cu, wilting and plasmolysis in root cells have been well documented (Pandey and Sharma, 2002; Parida et al., 2003; Pandey et al., 2008).[19]

The value of catalase and peroxidase enzyme activity was 0.55±0.17 and 3.85±0.205 µMolar/L/gm for crop irrigated with control water and 0.65±0.0611 and 3.56±0.19 µMolar/L/gm for crop irrigated with industrial waste water. These values showed that catalase enzyme activity increases and peroxidase activity decreases in *Glycine* crop. The increase in catalase activity might be due to the increase in toxic effect of H_2O_2 and ROS produced as a result of membrane damage at higher level of heavy metals. Catalase and peroxidase are the enzymes of oxido-reductase group and usually their level goes up during any type of stress that may be even heavy metal stress while extreme higher levels of heavy metal severely inhibit their activity.[20]

From this study we can concluded that, common effluent of various nature of industries (from Kota district of Rajasthan), was contaminated with heavy metals. It posed toxic effects on biochemical response of *Glycine max* crop grown in Kota region. So industrial waste water should not be used directly for irrigation purpose. It may have some beneficiary effects on crop, but can also adversely affect the crop, enzymes and its nutrients. It is suggested that waste water have to be diluted before it is used for irrigation. After dilution, the effluent characteristics will become within the prescribed limits and pollution load of the effluent may be decreased.

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