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Original Article

Effect of Sugar Industry Waste Water on Rural Agricultural Crops

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ABSTRACT

Industrialisation is back born of any developing country, with increasing of industry pollution level also increases. Increase in the pollution level affect and alter the quality parameter of human, flora and fauna. Some of the industries which located even outer circumference of urban area are directly or indirectly affect the ecosystem. In that kind industry sugar industry is one of them. The effluent coming out from the sugar industry contains high percentage of organic and inorganic pollutant. These pollutant effluents if directly discharges to agricultural land it affect the crops. In this regard's an attempted has been made to study the effect of sugar industry waste on *Vigna angularis*, and *Oryza sativa* L. The result show that untreated waste water reduces 50% of the seed germination of both the crops and treated waste water increase up to 99% seed germination. The untreated wastewater also affects the percentage of amino acid, protein and chlorophyll of crops.

Keywords: Biochemical, Contamination, Effluents, Growths, Organic, Waste.

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INTRODUCTION

In the world level sugar cane industry is one of the most important agricultural industries. As a consequence, sugar cane industry has significant wastewater production. Unfortunately, due to the lack of know-how and financial support, most of sugar cane industries in developing countries discharge their wastewater without adequate treatment (Ewa *et al.*, 2011). Similar with other wastewater generated by food processing plants, wastewater from sugar cane industry generally contains organic materials such as carbohydrates and proteins. The waste water generated from the sugar industry affects the human, plant animal and surrounding (Adekunle and Eniola, 2008). Especially when the sugar industry is located on near the urban area it directly affects the agricultural crops. Almost 1500 liters of water will required for process of sugar from sugarcane. From them 1000 liters are come out as effluent from the sugar industry (Ayyasamy *et al.*, 2008).

The effluent come out from the sugar industry containing high degree of organic and inorganic contaminates, which alter the physicochemical parameters of soil and river stream.

In addition, sugar factory effluent discharged in the environment poses a serious health hazard to the rural and semi-urban populations that use stream and river water for agriculture and domestic purposes. Fish mortality and damage to paddy crops due to sugar industry waste-waters entering agricultural land have been reported (Baruah *et al.,* 1993). Sugar factory effluent that has not been treated properly has an unpleasant odor when released into the environment. Farmers using these effluents for irrigation to reduce water demand have found that plant growth and crop yield were reduced and soil health was compromised. Because sugar industry effluents are commonly used for irrigation, it is essential to determine how crops respond when exposed to industrial effluents. In this regard, efforts have been made to determine the effect of industrial effluents on seed germination of various crops such as maize (Choudhury *et al.,* 1987), rice (Singh *et al.,* 1985), wheat (Agarwal *et al.,* 1995), pine (Czabator, 2002), Green gram (Subramani *et al.,* 1999) and catechu (Pandey and Sony, 1994). Seed germination is a critical stage that ensures reproduction and controls the dynamics of plant populations, so it is a critical test of probable crop productivity (Radosevich *et al.,* 1997).

The new buzz word in farming is organic, sustainable or natural farming. In a world where people only think of quantity, today there is more awareness on the quality. The thinking has changed towards healthy and quality foods. The main goal of the work is to study is the effect of sugar industry waste water on local and regular agricultural crops Mung (Vigna angularis), and Paddy (*Oryza sativa* L.). The study is also extended for total amino acid, protein and chlorophyll containing in level of crops.

MATERIAL AND METHOD

Material

The waste water was collected from sugar industry and preserved at 20^{o}C until used. The initial physicochemical parameters of sugar industry waste water were mention. The seed of Mung (Vigna angularis), and Paddy (*Oryza sativa* L.) were sterilized using 0.1% of mercuric chloride solution to remove the microbes after thorough wash.

Method

For bioassays, the effluent was diluted to 0%, 20%, 40%, 60%, 80% and 100% with distilled water. Plant seeds were spread on each sterilized Petri dish lined with blotting paper and then irrigated with 5 mL of the different concentrations of sugar industry effluent. Each treatment consisted of three replicate plates with forty seeds per plate. Observations were recorded at 24 hr intervals, the germinated seeds were counted and the number of germinated seeds was expressed as a percentage.

Analytical method

Physico-chemical parameters of sugar industry wastewater , temperature (^{o}C), colour (visibility), pH (log scale), electrical conductivity (EC), dissolved oxygen (DO), biological oxygen demand (BOD), total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), chloride, alkalinity, total hardness, calcium, magnesium, sulphate, phosphate and total iron were measured using the standard methods. Calculation and analysis of seed germination speed are as follows: Peak value and germination value were determined by the formulae (APHA 1998).

Peak Value = Cumulative percentage germination on each day/No. of days elapsed since initial imbibitions (1)

Germination value = Peak value × Germination percentage (2)

Fresh weights (g/plant) were taken with the help of an electrical single pan balance. The collected plant materials were kept in hot air oven at 80°C for 24 hours and their dry weight (g/plant) were taken by using an electrical single pan balance. The leaf area was calculated by measuring the length and breadth of the leaf was described by (Abdul J.A, Sirajudeen, 2006).

Estimation of Chlorophyll

Five hundred mg of fresh leaf material was taken and ground with help of pestle and mortar with 10 ml of 80% acetone. The homogenate was centrifuged at 800 rpm for 15 minutes. The supernatant was saved. The residues were re-extracted with 80% acetone. The supernatant was saved and utilized for chlorophyll estimation. Absorbance was read at 645, 663 and 480 nm in the UV-spectrophotometer.

Estimation of Protein

Protein content was determined by the method of Lowery. 0.5 g of plant sample (shoot) was homogenized in 10 ml of 20% Trichloro Acetic Acid (TCA). The homogenate was centrifuged in 10 minutes for 300 g. The supernatant was discharged and the pellet was re-extracted with 5 ml of 0.1 N NaOH. One ml of the extract was taken in a test tube and 5 ml of reagent 'C' (protein reagent) was added. This solution was mixed well and kept in dark for 10 minutes. Later, 0.5 ml of folin phenol reagent was added and the mixture was kept in dark for 30 minutes. The sample was read at 660 nm in the UV-spectrophotometer.

Amino Acid

Amino acid content was determined by the method of Moore and Stein. 0.5 g of plant sample was homogenized in 10 ml of 80% ethanol. The homogenate was centrifuged for 10 minutes at 800 g. One ml of the extract was taken in the test tube and adds 1 ml of 0.1 N HCl to neutralize the sample. To this, one ml of ninhydrine reagent was added and heated for 20 minutes in a boiling water bath. Later, 5 ml of the diluents solution was added and heated again in water bath for 10 minutes. The test tubes were cooled and read the absorbance at 570 nm in a UV-spectrophotometer.

RESULT AND DISCUSSION

Effect on Vigna angularis

The effect of sugar waste water at different percentage (25, 50, 75 and 100%) as well as after treatment for five days, which shown in Fig. 1. The result shows that with increase in effluent percentage the seed germination decrease. When the effluent percentage was 25%, 50%, 75% and 100% the seed germination was 69%, 63%, 58% and 49% on fifth days of experiment (Fig. 1a). The decreases in seed germination are might be due to acidic nature of wastewater. Lower concentration of effluent (25%) was shown to support 100% seed germination in kidney bean, and millet, but osmotic pressure associated with higher concentration of sugar factory effluent were found to reduce the germination in kidney bean and millet (Ajmal and Khan, 1983). It indicates that salt concentration that governs the seed germination and it varies from crop to crop because each crop has their own tolerance to the different salt concentrations. When the treated waste water 25%, 50%, 75% and 100% are supply to same experimental setup for five days. The results show that with increase with percentage of effluent seed germination increases. When treated waste water concentration was 25%, 50%, 75% and 100% the seed germination was 91%, 94%, 96% and 99% was respectively (Fig. 1b).

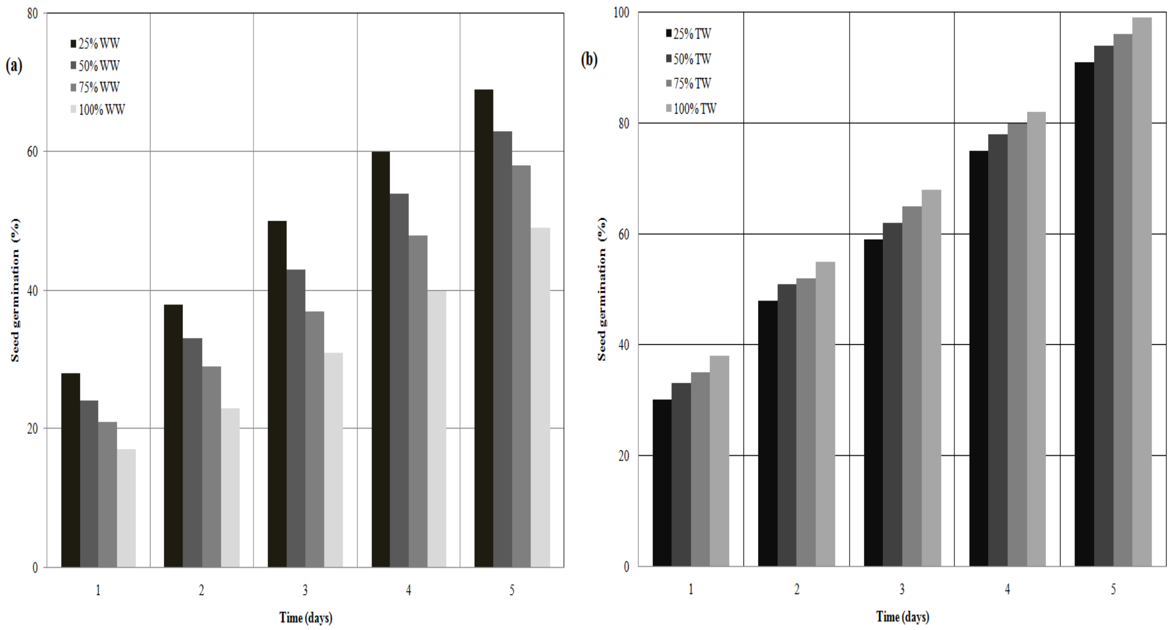

Fig. 1: Effect of sugar industry at different concentration of (a) untreated waste water (b) treated waste water onVigna angularis

The study also indicates that with increase in untreated effluent concentration also affect the total amino acid, protein and chlorophyll of the crops. The results represented in Fig. 2. It was found that when the effluent concentration was 25%, 50% 75% and 100% the total amino acid 7, 6, 5.5 and 4.5 mg/g , protein 9.5, 9, 8.4 and 8mg/g and chlorophyll 0.73, 0.7, 0.68 and 0.66mg/g respectively. Plants treated with higher concentration of the effluent (above 25%) showed lower amount of amino acid, protein and chlorophyll content due to the presence of higher concentration of magnesium and acidic pH in the effluent. The higher magnesium and pH in the effluent is due to clarification process in the sugar industry. The wide narration in the pH value of effluent can affect the rate of biological reaction and survival of various microorganisms. The presence or absence of various ionic special can have direct relation with pH of the effluent. Subsequently such effluent can influence the quality of soil. The reaction between effluent flowing from open drainage system with the soil has direct relevance to the pH effluent. It is therefore necessary to evaluate effluent with respect to the pH value.

Effect on *Oryza sativa* L.

The effect of sugar waste water at different percentage (25, 50, 75 and 100%) as well as after treatment for five days, which shown in Fig. 3. The result shows that with increase in effluent percentage the seed germination decrease. It was observed that when untreated wastewater was 25%, 50% 75% and 100% the seed germination was 50%, 45%, 41% and 39% respectively (Fig. 3a). The decrease in seed germination is might be due to the disturbance of the osmotic relations of the seed and water, thus reducing the amount water and retarding seed germination by enhanced salinity and conductivity of the solutes. Furthermore, the germinated seeds will not get any oxygen due to organic and inorganic chemicals present in the effluent. Similar findings were also noted by (Nath and Sharma, 2002). The increase of salinity and conductivity is may due to from heat

exchangers and evaporator, which are cleaned with caustic soda and hydrochloric acid in order to remove the formation of the deposits of scales on the surface of the tubing. Most of the sugar factories soda and acid wash contribute considerable amounts of organic and inorganic pollutions and may cause shock loads to waste water. Further treat waste water again tested for the seed germination with same concentration.

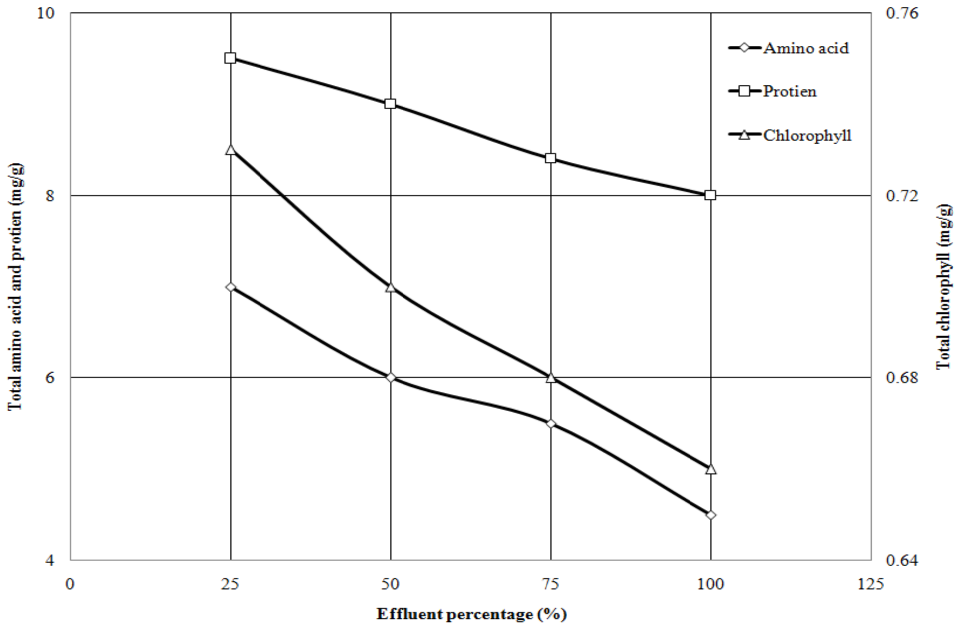

Fig. 2: Effect of sugar industry untreated waste water on total amino acid, protein and chlorophyll of Vigna angularis

The result shows that when treated waste water was 25%, 50%, 75% and 100% the seed germination was 88%, 90%, 94% and 97% was observed (Fig. 3b). The increase in germination percentage might be due to the reduction in level of toxic metabolites by dilution and better utilization of nutrients present in the effluent (Malla *et al.*, 2005).

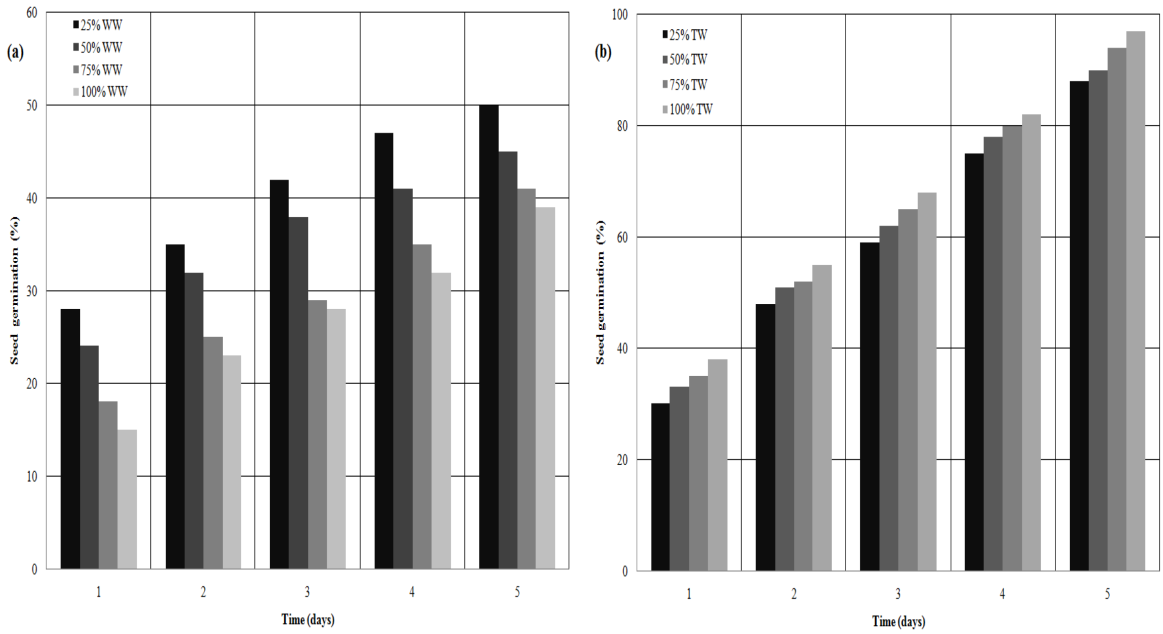

Fig.3: Effect of sugar industry at different concentration of (a) untreated waste water (b) treated waste water on *Oryza sativa* L.

The amino acid, protein and chlorophyll has been also studied for paddy which is represented in Fig. 4. From the result it was observed that when the untreated wastewater percentage are 25, 50, 75 and 100% the amino acid 6.5, 6.1, 5.2 and 4.1mg/g, protein 9, 8.4, 7.9 and 7.2mg/g and chlorophyll 0.71, 0.67, 0.59 and 0.52mg/g respectively. The decrease in biochemical parameters are might be due to high concentrations of effluent may be associated with mineral ions (Kisku *et al.*, 2002). It may also due to the formation of enzymes chlorophyllase which is responsible for chlorophyll degradation. The increase in protein contains increase with low concentration of waste water and increase with concentration decrease the protein contain. This may due to high concentration of cation and anion present in waste water. The level of amino acids decreased upto 75% concentration of effluent this may be due to the inverse relationship between protein and amino acids where protein content was increased and amino acid were low. Initial rise in amino acids content may be due to higher protease enzyme activity which suggests that proteins are in continuous state of turnover and amino acids newly incorporated into proteins are not in association. The breakdown of protein into amino acids is also adversely affected due to effluent toxicity. Hence poor availability of nitrogen may be a causative factor for reduction in protein content.

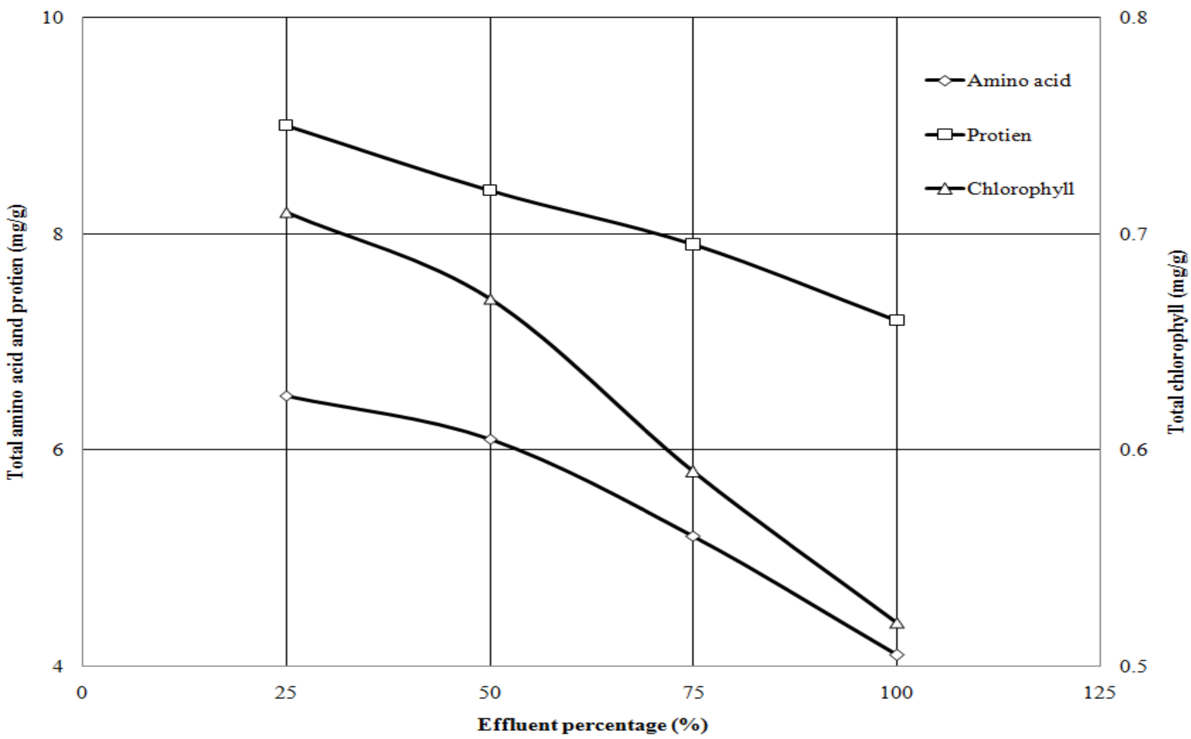

Fig. 4: Effect of sugar industry untreated waste water on total amino acid, protein and chlorophyll of Oryza sativa L.

CONCLUSION

Sugar industry waste water has major effect on the agricultural crops. Effluent contains high degree of biological oxygen demand, chemical oxygen demand, suspended solid, metal, chemical salts, pH as well as high odour. Waste water generated from the sugar industry reduced the when the effluent concentration was 25%, 50%, 75% and 100% the seed germination were 69%, 63%, 58% and 49% and with treated waste water seed germination was 91%, 94%, 96% and 99% on fifth days of experiment for Vigna angularis. Similarly for *Oryza sativa* L. untreated wastewater was 25%, 50% 75% and 100% the seed germination was 50%, 45%, 41% and 39% and with treated waste water 88%, 90%, 94% and 97% were found. The amino acid, protein and chlorophyll were also reduced with untreated effluent.

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