Annals of Biology **40** (2) : 260-263, 2024

**Impact Score : 0.32 (Scopus)**

# Analysis of Total Non-structural Carbohydrates and Protein Contents in Foliar Parts of Wheat Crop Variety PBW-343 to Oil Refinery Effluent Irrigation

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(Received: February 15, 2024; Accepted: March 29, 2024)

**ABSTRACT**

In the current study, total non-structural carbohydrates and protein contents in foliar parts of wheat crop variety PBW-343 were analyzed in relation to irrigation with refinery effluent at various dilutions. The total non-structural carbohydrates varied from 19.01 to 26.48% and contents of protein varied from 3.33 to 25.11% in the foliar parts of this variety in all growth phases. During the seedling, vegetative and post-vegetative growth phases, there was an increase in total non-structural carbohydrates and protein contents in the foliar parts of crop with increase in concentration of effluent in irrigating water but up to 75% concentration of effluent. The irrigating water with 100% effluent concentration had the least favourable impacts on non-structural carbohydrates and protein contents compared to the control water.

**Key words:** Effluent, total non-structural carbohydrates, protein contents

## INTRODUCTION

After thorough waste water treatment, there is a chance that this waste water can be recycled safely in industrial processes and in irrigation to some extent to minimize the disposal issues that different sectors are experiencing. To scale down the effluent disposal issues, various aspects of effluent use and reuse were studied and it was reported that using treated effluent after dilution with normal irrigating water, for irrigation to water intensive crops would also lessen the issue of handling, storing and disposing of effluent (Sangwan, 2023). The use of treated wastewater in agriculture may help to maintain the quantity and quality of water and may lessen the need for fertilizer. In order to alleviate pollution and disposal issues, practically treated effluent from all companies can also be utilized for irrigation (Konwar and Jha, 2019; Cabral *et al.*, 2020; Hayat *et al.*, 2021; Sangwan *et al.*, 2022, 2023). The accumulation of proline caused by heavy metals in the effluent may be the cause of the rise in protein concentrations. Proline has been shown to be crucial for osmoregulation, protecting enzymes from denaturation and for stabilizing the process of protein biosynthesis. It was reported that the osmotic pressure due to effluent had positive effect on biosynthesis of protein contents which could be caused by the presence of some ions that the plants absorbed during their growth. Another possibility is that the majority of nitrogen load present in effluent enriched soil with nitrogen and plants absorbing it from the soil was transported to leaves. Heavy metal ions are highly toxic and non-destructible which are biomagnified in food chain are critical contributors of water pollution. Presence of variety of pollutants which are toxic in nature in effluent adversely affect the crop plants at early stage of plants (Aiman and Malik, 2017; Ayangbenro and Babalola, 2017; Khatoon and Malik, 2021).

To analyze the potential of treated refinery effluent for soil enrichment and providing irrigation water for intensively irrigated crops, such as wheat crops, an alternate approach was taken into account for the current study. The Panipat refinery's treated effluent was used to irrigate wheat for the purposes of the current experiment.

## MATERIALS AND METHODS

The waste water from the oil refinery located at Panipat was collected from the disposal site

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and used to water the wheat crop. The effluent gathered was examined according to APHA-for several physico-chemical characteristics at the Environmental Science Department of M.D. University, Rohtak and Government College, Hisar, Haryana, India. Pot culture experiments in triplicates were repeated for two seasons from 2021 to 2023 at Government College, Hisar using pots of 12 inch in height and 12 inch in diameter filled with healthy soil and 20 healthy plants in each pot. Plants were irrigated with five dilutions of treated refinery with control water. The protein contents and the non-structural carbohydrates were analyzed in foliar parts of wheat crop variety PBW-343. Two-way ANOVA was used for the significance.

## RESULTS AND DISCUSSION

Composition of the refinery effluent compared to control water had slightly higher pH (7.76) than the control. Similarly, levels of inorganic nutrients in effluent were relatively high, though within acceptable limits. Characteristics of the effluent were higher than those of the control water like total dissolved solids (1389.89 mg/l) than the control water (1251.42 mg/l) but lower than the permissible limits. The amount of minerals such as potassium and sodium in the effluent was also found higher than in the control water. Additionally, 13.06 mg/l of carbonates were discovered in the effluent, whereas nil were observed in the control water. However, a large number of bicarbonates (188.79 mg/l) were discovered in the effluent, which caused it to become highly alkaline. Additionally, it was discovered that the effluent had more chloride and sulphate than the control water. The waste water also included 4.42 mg/l of dissolved oxygen, though the effluent's electrical conductivity was lower than the standard.

Protein contents analyzed in the foliar parts of wheat crop variety PBW-343 plants revealed

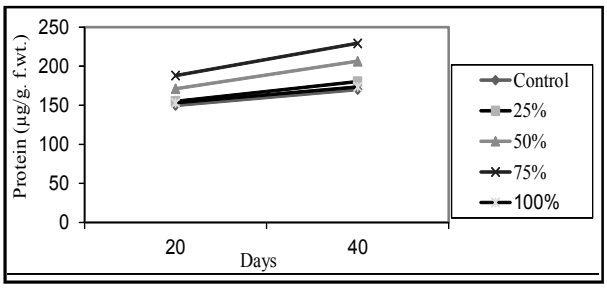


Fig. 1. Protein contents in foliar parts of wheat crop variety PBW-343 at seedling growth stage in response to different concentrations of treated refinery effluent.

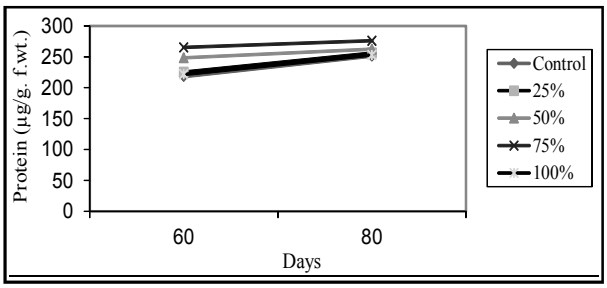


Fig. 2. Protein contents in foliar parts of wheat crop variety PBW-343 at vegetative growth stage in response to treated refinery effluent.

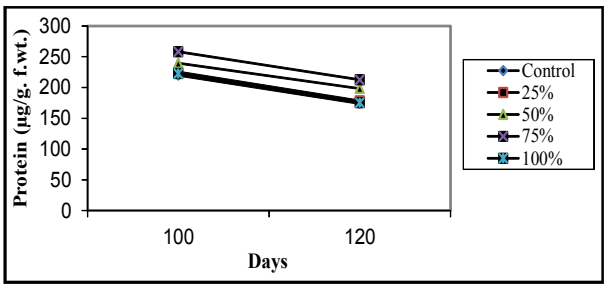


Fig. 3. Protein contents in foliar parts of wheat crop variety PBW-343 at reproductive growth stage in response to treated refinery effluent.

that the protein content increased as effluent concentrations rose (Figs. 1, 2 and 3, and Table 1). Foliar parts of wheat plants watered with refinery effluent had protein contents ranging from149.6 to 188.4 µg/g fresh weight of leaves and stimulatory effect was observed to be 3.34, 14.01 and 25.35% with 25, 50 and 75% effluent concentration at the early vegetative stage

**Table 1.** F value from two-way analysis of variance (ANOVA) for proteins in foliar parts of wheat crop variety PBW-343 plants in relation to effluent concentrations and time

| Parameters | Source of variations | SS | df | MS | F | F-critical (P=0.05) |
|---|---|---|---|---|---|---|
| Proteins | Concentration | 7240.509 | 4 | 1810.126 | 65.78605 | 2.866081 |
| | Time | 33191.37 | 5 | 6638.274 | 241.257 | 2.71089 |
| | Error | 550.3073 | 20 | 27.51536 | | |
| | Total | 40982.19 | 29 | | | |

(Fig. 2). The stimulatory effect on protein amount in foliar part of wheat plant by the effluent was 3.34, 14.01 and 25.35%. Undiluted effluent had the least favourable impact on the protein contents compared to the control. According to the current study, protein contents rose as refinery effluent concentration rose, reaching a peak of 75% effluent concentration during the late vegetative stage. Under irrigation with various effluent dilutions, the protein contents ranged from 250.9 to 276.2 mg/g as fresh weight in foliar parts of wheat crop.

Increase in protein contents in foliar parts of wheat crop variety PBW-343 plants might be a significant adaptive response to water pollution, and the storage of proteins was also brought on by alkaline water stress. Beyond 75% effluent concentration, protein contents may be decreased as a result of negative effects on plant activity, such as a decline in net photosynthetic rate or an increase in root respiration rate which needed large quantity of sugars. It was also reported that heavy metals might hinder the production of particular proteins, with a general trend of declining total protein contents (Aiman and Malik, 2017; Ayangbenro and Babalola, 2017; Khatoon and Malik, 2021).

Galal *et al.* (2021) reported that proteins and carbohydrates amounts were found to be decreased in the tissues of *P. sativum* when cultivated in polluted soils. Galal (2016) also found a decline in soluble protein amounts due to heavy metal stress in *Cucurbita pepo*. It was also reported that a decrease in protein content might had been caused by increasing degradation of protein due to increased activity of enzyme named protease, because this enzyme increased under stress conditions. Increased protein content in wheat crop variety PBW-343 plant leaves at the seedling stage (Fig. 1) may be caused by the additional nutrients present in the treated refinery waste water, while decreased protein content in leaves at the post-flowering stage (Fig. 3) may be caused by the plant's decision to divert protein synthesis to its reproductive organs.

The different dilutions of effluent and various growth stages of the wheat plants had a statistically significant impact on the protein amount of the wheat plant species under study according to a two-way analysis of variance (Table 1). The estimated F values of the wheat plant under study were recorded to be greater than the table values at 0.05% level of significance for both concentration and time. Variations in total non-structural carbohydrates in foliar parts of wheat crop variety PBW-343 plants irrigated with different dilutions of treated effluent of refinery are shown in Figs. 4 and 5. total non-structural carbohydrates in the plant were found to range from 19.02 to 26.47%. The increasing concentration of the effluent had positive effects which lead to increase of total non-structural carbohydrates in foliar parts of wheat crop variety PBW-343 at various growth stages. Different dilutions of effluent led to increase of total non-structural carbohydrates by 1.04, 1.10, 1.15 and 1.04 times more at vegetative stage when compared to control water (Fig. 4). At flowering stage, the contents of total non-structural carbohydrates decreased (Fig. 5). During the post-flowering stages, it increased by 11.40, 19.84, 27.20 and 4.62% with increasing effluent concentrations. Maximum total non-structural carbohydrates were recorded at 75% of the effluent. Total non-structural carbohydrates increased under

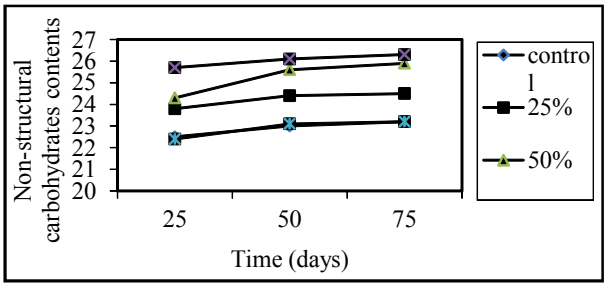


Fig. 4. Variations of total non-structural carbohydrates in foliar parts of wheat crop variety PBW-343 at vegetative growth stage.

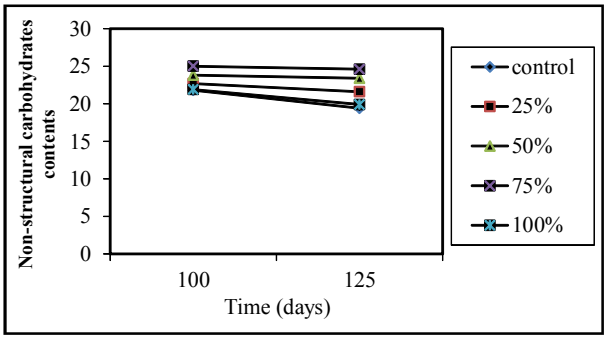


Fig. 5. Variations of total non-structural carbohydrates in foliar parts of wheat crop variety PBW-343 at reproductive growth stage.

**Table 2.** F value from two-way analysis of variance (ANOVA) total non-structural carbohydrates in foliar parts of wheat crop variety PBW-343 plants in relation to effluent concentrations and time

| Source of variation | SS | df | MS | F | F crit |
|---|---|---|---|---|---|
| Time | 191.2085 | 4 | 47.80213 | 90.50409 | 3.006917 |
| Concentration | 102.3191 | 4 | 25.57978 | 48.43037 | 3.006917 |
| Error | 8.450824 | 16 | 0.528175 | | |
| Total | 301.9785 | 24 | | | |

various dilutions of the effluent could have been due to positive effect of photosynthetic activity of the plants. Total non-structural carbohydrates decreased at 100% effluent concentration might be due to the presence of some toxic substances in it, which might decrease the percentage of total non-structural carbohydrates in the leaves.

The different dilutions of effluent and various growth stages of the wheat plants had a statistically significant impact on the non-structural carbohydrates amount of the wheat plant species under study according to a two-way analysis of variance (Table 2). The estimated F values of the wheat plant under study were recorded to be greater than the table values at 0.05% level of significance for both concentration and time.

## CONCLUSION

Analysis of total non-structural carbohydrates and protein contents in foliar parts of wheat crop plants clearly indicated the beneficial impacts of the treated effluent of refinery collected from Panipat, up to a certain dilution. The wheat crop variety PBW-343 plants when irrigated with 75% concentrated effluent water resulted in maximum positive effect on total non-structural carbohydrates percentage and protein contents in foliar parts. The various dilutions of effluent irrigation resulted in increase of total non-structural carbohydrates and protein contents in foliar parts of crop at all growth stages in comparison to control.

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