IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402, p- ISSN: 2319-2399.Volume 19, Issue 3 Ser. 2 (March 2025), PP 26-30
www.iosrjournals.org

Biochemical Effects of Wheat (*Triticum Aestivum* L.) Genotypes Under Drought Stress

SNEHA KUMARI[1], VINAY BHUSHAN KUMAR[2], MANOJ KUMAR[3]
[1]Univ. Dept. of Botany, Patliputra University, Patna-800020
[2] Dept. of Botany, TPS College, Patliputra University, Patna-800001
[3] Dept. of Botany, College of Commerce, Science & Arts, Patliputra University, Patna-800020
Corresponding Email: vinaykumar10121976@gmail.com

ABSTRACT
One of the most significant staple foods, wheat (Triticum aestivum L.), is grown all over the world and originates in southwest Asia. For the vast majority of people on the planet, wheat is the second most important cereal crop beneath rice. For around two billion people of the global population, it is the most essential staple meal. With the exception of the southern and northeastern states, wheat is grown across India. Nearly 80% of India's wheat is produced in the major wheat-producing states of Uttar Pradesh, Haryana, Bihar, Punjab, and Rajasthan. Eighty percent of India's yearly rainfall falls during the summer monsoon months (June to September), which is when the country's agricultural sector depends on seasonal rainfall. El Nino-Southern Oscillation (ENSO) and interannual variability in monsoonal precipitation have a major impact on the Indian monsoon and the incidence of drought. Because of its enormous population, India is more vulnerable to drought in terms of food security. Because of the various morphological, physiological, and biochemical alterations at the cellular and molecular levels, wheat's drought response is an extremely complicated process. In this study, the effects of drought stress on two wheat genotypes DBW 187 and HD 2967 at the seedling stage were assessed. Drought stress causes reduction in nutrient content and change in biochemical parameters across wheat genotypes. According to the study, wheat genotypes are negatively impacted by drought stress at the seedling stage.

Keywords: *Wheat, Drought, Soluble sugar, Nutrient content, Chlorophyll content*

Date of Submission: 13-03-2025 Date of Acceptance: 27-03-2025

I. INTRODUCTION:

Wheat *(Triticum aetivum* L.) is one of the most important staple food crops of the family *Poaceace* (*Gramineae*). It was originated from the southwest Asia and now cultivated worldwide. Wheat is the second important cereal crop after rice for majority of the world's populations. On the other hand, it is the third most produced cereal after maize and rice. It is the most important staple food of about two billion people (36% of the world population). Worldwide, wheat provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally (Breiman and Graur, 1995). Wheat is cultivated throughout the world, with different varieties sown according to various climatic conditions. According to Foreign Agriculture Service, United State Development of Agriculture, world's leading wheat producing countries are as follows. The impacts of drought condition on grain development and yield of crops depend on their severity and the stage of plant growth during which they occur. Seedling emergence is one stage of growth that is sensitive to water deficit. Therefore, seed germination, vigor and coleoptiles length are prerequisites for the success of stand establishment of crop plants (Farooq et al. 2014). Under semiarid regions, low moisture is limiting factor during germination. The rate and degree of seedling establishment are extremely important factors in determine both yield and time of maturity. Some researches demonstrated the importance of coleoptiles length (protective sheath that covers the shoot during emergence) in achieving optimum fall and establishment, particularly when seed is planted deep to reach moisture in dry soils. Consequently, there is need to improve the genetic tolerance of crops at the seedling stages. Selection for drought tolerance at early stage of seedlings is most frequently carried out by including chemical drought induced molecules like poly ethylene glycol (PEG 6000) in the medium. Lagerwerff indicated that PEG can be used to modify the osmotic potential of nutrient solution culture and thus induce plant water deficit in a relatively controlled manner, appropriate to experimental protocols. Polyethylene glycol molecules with a MW 6000 (PEG6000) are inert, non-ionic and virtually impermeable chains that have frequently been used to induce water stress without causing physiological damage and maintain uniform water potential throughout experiment periods. Molecular of PEG 6000 are small enough to influence the osmotic potential but large enough to not be absorbed by plant and not expected to penetrate intact plant tissues rapidly. Because PEG does not enter the apoplast, water is withdrawn from the cell. Therefore, PEG solution mimic dry soil more closely than solutions of low MW Osmotica, which infiltrate the cell wall with solutes (Kapoor et al. 2020).

Drought causes severe effect on wheat genotypes resulting in biochemical changes leads to activation of defense mechanism to combat the stress, the effect of drought on wheat genotypes of Eastern India is not much explored hence it becomes important to screen better performing wheat genotype under drought stress.

II. MATERIALS & METHODS:

Plant material, growth conditions and drought treatment: The current study was performed at Dept. of Botany, College of Commerce, Arts & Science, Patliputra University, Patna. The Wheat seeds (HD2967, DBW187) were collected from ICAR-RCER, Patna. Wheat genotypes were grown in hydroponic medium (Hoagland medium) under suitable growth conditions. After six days of germination the wheat seedlings were subjected to drought stress (10% & 20% PEG 6000MW)**.** After stress treatment the samples were harvested.

Total Chlorophyll estimation:

Each genotype's 0.05g leaf samples were cut into tiny pieces and put in a test tube. Each test tube received 10 ml of DMSO. The samples underwent four hours of 60°C incubation. According to Lichtenthaler and Wellburn, absorbance was measured at 470, 645, and 663 nm (1983).

Total Soluble sugar estimation:

Dried leaves were crushed with with 80% ethanol. Total sugar hydrolyzed to glucose and measured at 620 nm with anthrone reagent and calculated with standard (Yemm and willis, 1954)

Estimation of Ca and K content:

0.5gm powdered soil and plant samples were twice digested in 0.01% nitric acid (ion-free) and filtered through ash-free Whatman filter paper. The filtrate was then utilized for flame photometer measurements of K and Ca.

STATISTICAL ANALYSIS:

Statistical analyses of the data were performed with GraphPad Prism 5.0 (GraphPad Software, Inc.) for complete randomized block design. The experiments were performed in triplicate (n = 3). Data presented as mean ± standard error (SE)

III. RESULTS & DISCUSSION:

Total Chlorophyll content:

Total Chlorophyll content was measured in wheat genotypes. Both genotypes showed decrease in Chlorophyll content subjected to PEG stress. HD2967 showed 1.81, 1.55, 1.15 mg/g FW while DBW187 showed 1.85, 1.41 mg/g FW under Control, 10% and 20% of PEG stress.

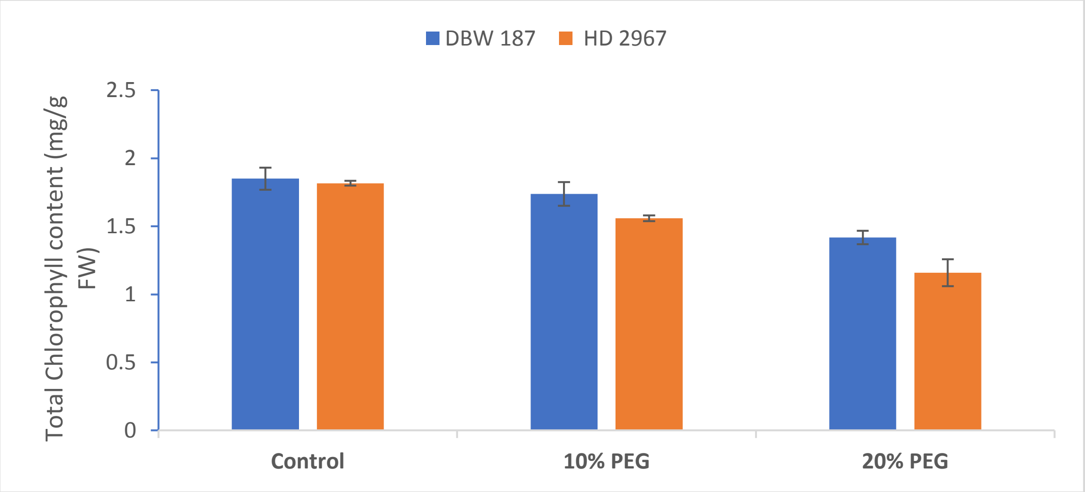

Fig.1: Total Chlorophyll content of HD2967 and DBW187 under drought conditions (10% & 20% PEG)

Total Soluble sugar:

Total Soluble sugar was measured in wheat genotypes. Both genotypes showed increase in Soluble sugar subjected to PEG stress. Soluble sugar of HD2967 showed 0.62, 0.97, 1.47 mg/g DW while DBW187 showed 0.64, 1.14, 1.62 mg/g DW under Control, 10% and 20% of PEG stress.

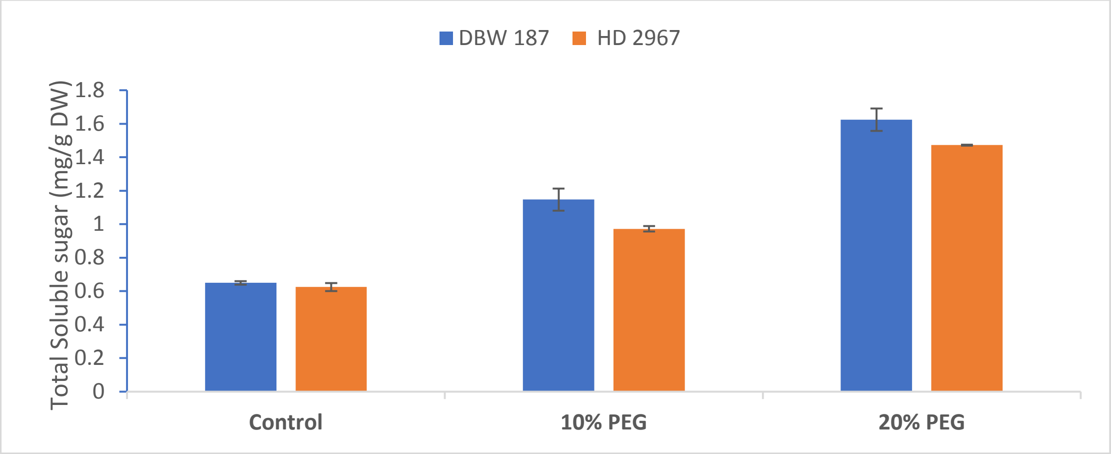

Fig.2: Total Soluble sugar of HD2967 and DBW187 under drought conditions (10% & 20% PEG)

Estimation of Ca content:
Ca content of whole seedling was measured in wheat genotypes. A decrease in Ca content was observed in both genotypes. HD2967 showed 263, 234, 194 ppm while DBW187 showed 274, 254, 219 ppm under Control, 10% and 20% of PEG stress.

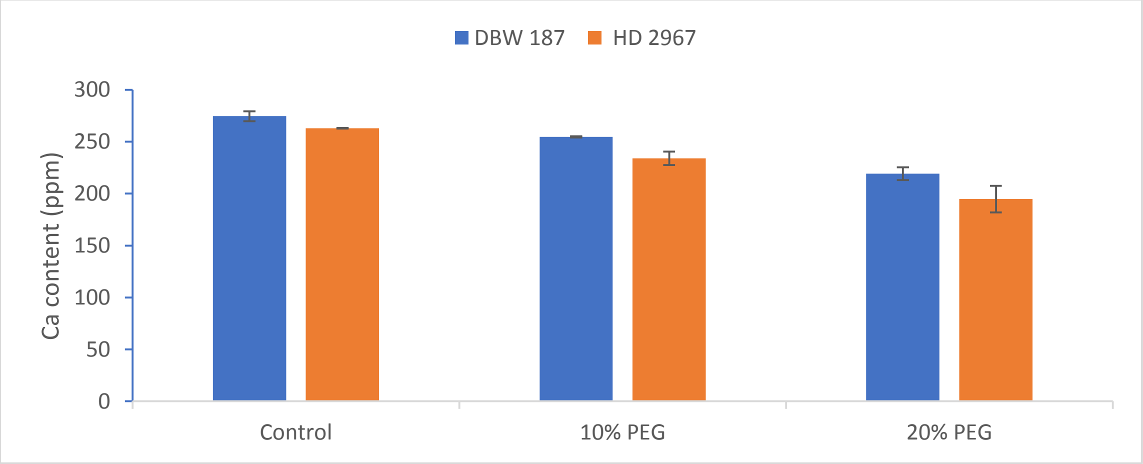

Fig.3: Ca content of HD2967 and DBW187 under drought conditions (10% & 20% PEG)

Estimation of K content:
K content was measured in wheat genotypes. Both genotypes showed decrease in K content subjected to PEG stress. DBW187 showed 611, 522, 484 ppm while HD2967 showed 600, 499, 446 ppm under Control, 10% and 20% of PEG stress.

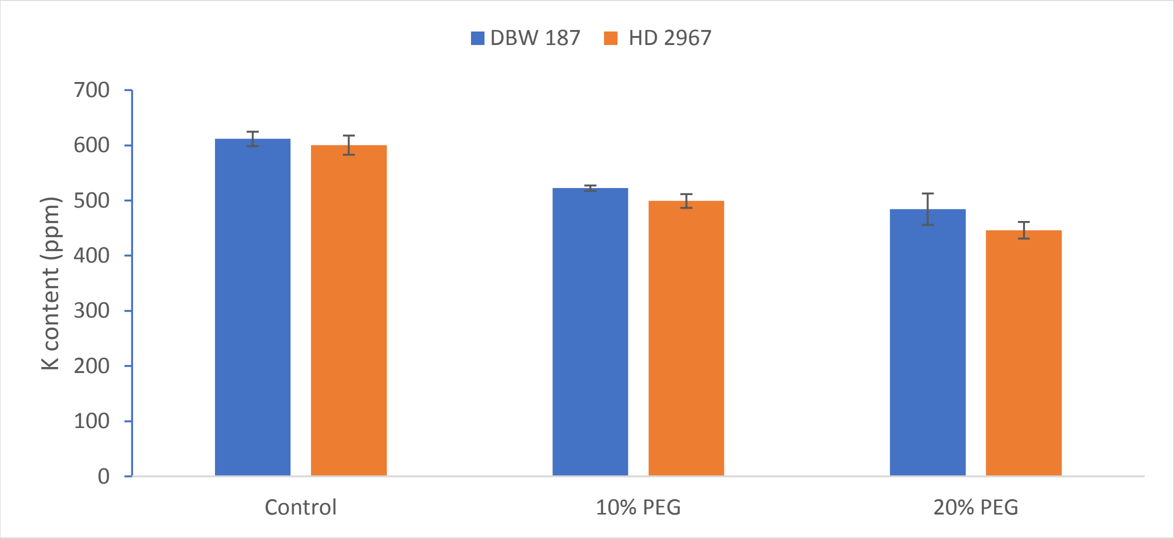

Fig.4: K content of DBW187 and HD2967 under drought conditions (10% & 20% PEG)

IV. CONCLUSION:

The present study showed drought stress causes increase in Total soluble sugar content and decrease in Chlorophyll content and nutrient content (Ca and K Content) across wheat genotypes. The present study showed DBW187 as better performing wheat genotype in comparison to HD2967 under drought conditions. The findings will be helpful in identification of drought tolerance related genes for understanding their specific role in stress tolerance mechanism.

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