Global Journal of Science and Technology (GJST)

# Study on the different chemical treatment on the growth of wheat

**Kusum Yadav and Raj Kumar Yadav**

*Department of Botany, T.D.P.G. College, Jaunpur Affliated to VBSP University, Jaunpur (U.P.) 222002.*

**ABSTRACT**

Chemical treatment is one of the encouraging approaches to refine the drought tolerance of wheat due to the possibility to be applied by both seed soaking and seedling foliar application at various growth stages of the plant. The effects of various chemical molecules treatment on wheat physiology and its productivity under drought were evaluated in this paper. As the climate changes continuously, it adversely treats crop production, particularly wheat cultivation. Chemical treatment is identified to stabilize the drought effect on wheat by improving drought-responsive defense hormones and enzyme activity by boosting stress protein expression and antioxidant enzymes for counteracting the formation of reactive oxygen species. The use of multiple chemicals with pre-and post-emergence treatment has refined drought tolerance to uphold the normal physiology of wheat under changing climates.

**KEYWORDS**
Chemicals Climate Drought Tolerance Wheat

**ARTICLE HISTORY**
**Received:** 27 January 2026
**Accepted:** 03 February 2026
**Published:** 05 March 2026

**CITATION**
Yadav. K. & Yadav. R. K., (2026). Study on the different chemical treatment On the growth of wheat, Journal of Science and Technology (GJST), 2(1), 153-162. https://doi.org/10.65523/gjst.2026.v2.i1.19

## 1. Introduction

One of the most widely farmed cereal crops in the world and a staple grain for billions of people, wheat (Triticumaestivum L.) is essential to global food security (FAO, 2021; Shewry& Hey, 2015). It significantly affects agricultural economies, especially in nations like India where it serves as a key source of food (Government of India, 2022). Because wheat grains are high in proteins, carbs, vitamins, and minerals, they are significant for nutrition (Shewry, 2009; Curtis &Halford, 2014).

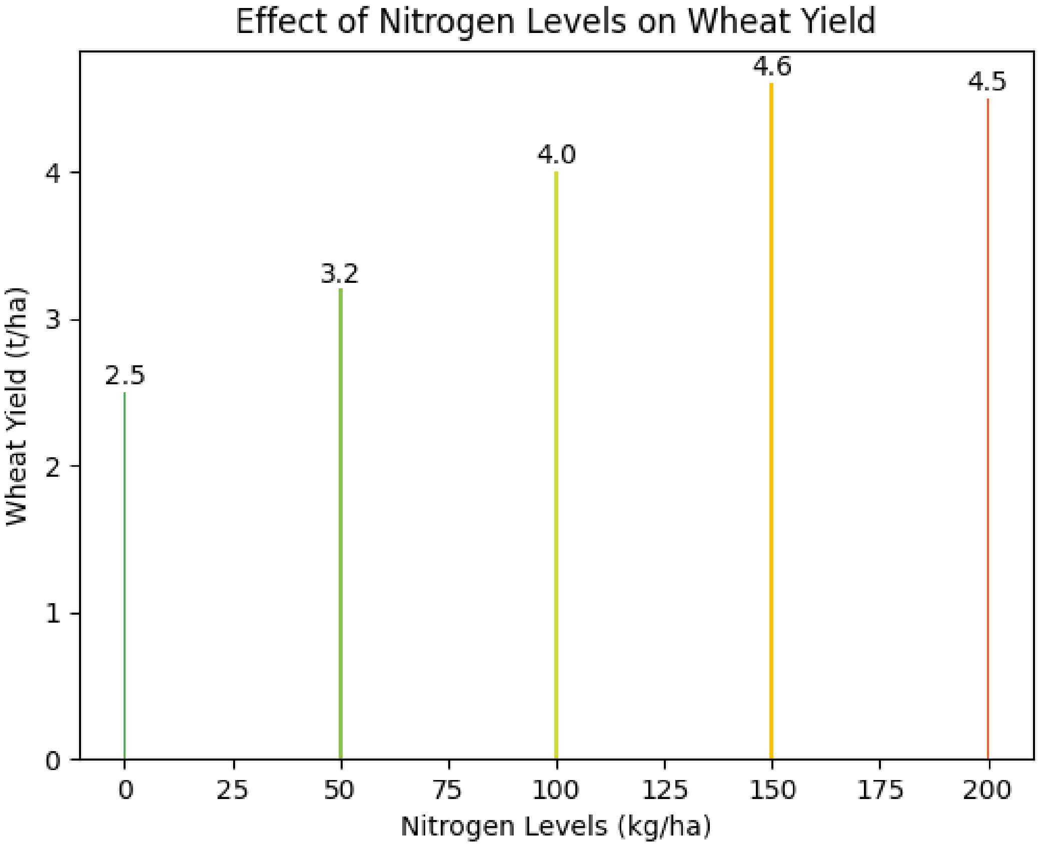
The need for food production is growing along with the world's population, necessitating higher crop yields and productivity. Applying chemical treatments, such as fertilizers, micronutrients, and plant growth regulators, which directly affect plant development and physiological processes, is one of the best ways to increase production (Fageria et al., 2010).

Essential macronutrients for plant growth, such as potassium (K), phosphorus (P), and nitrogen (N), are provided by chemical fertilizers. Potassium controls water balance and enzyme activity, phosphorus is involved in energy transfer and root development, and nitrogen is necessary for the production of proteins and chlorophyll (Marschner, 2012). Additionally, micronutrients including zinc (Zn), iron (Fe), and manganese (Mn) are essential for metabolic and enzymatic processes (Alloway, 2008).

The significance of applying nutrients in a balanced manner is emphasized by recent research. For example, applying zinc and nitrogen together improves biomass accumulation, chlorophyll content, and antioxidant activity, all of which greatly increase wheat development (Cakmak, 2008; Rengel, 2015). By controlling hormone balance and enzyme activity, chemical treatments also significantly increase plant stress tolerance, especially during drought conditions (Farooq et al., 2014). However, excessive and uneven fertilizer application can result in environmental contamination, nitrogen imbalance, and soil degradation (Savci, 2012; Zhang et al., 2015). In order to maximize their application for sustainable agriculture, it is crucial to research the effects of various chemical treatments.Under controlled conditions, the current study attempts to assess the impact of several chemical treatments on wheat growth metrics, including germination, plant height, biomass, and yield.

## The Function of Nitrogen in Wheat Growth

One of the most important elements affecting wheat growth and production is nitrogen. It is an essential part of proteins, amino acids, and chlorophyll (Marschner, 2012). A sufficient supply of nitrogen improves photosynthetic efficiency, leaf area development, and vegetative growth (Fageria et al., 2010).
Nitrogen fertilizer dramatically boosts wheat biomass and grain output, according to studies (Raun& Johnson, 1999; Gooding et al., 2000). Additionally, it enhances the protein content and quality of grains (Triboi et al., 2000). However, lodging and decreased crop stability could result from overapplying nitrogen (Berry et al., 2004). Additionally, the intake of micronutrients like zinc is influenced by nitrogen availability, underscoring the significance of nutritional interactions (Rengel, 2015).



## The Impact of Phosphorus and Potassium

Early plant development, root formation, and energy transfer via ATP production all depend on phosphorus (Vance et al., 2003). In contrast, potassium is essential for stress tolerance, enzyme activation, and water management (Wang et al., 2013).
Soil fertility and wheat productivity are enhanced by the balanced application of phosphorus and nitrogen (Grant et al., 2001). It has been demonstrated that integrated nutrient management techniques improve crop productivity and preserve soil health (Gruhn et al., 2000). On the other hand, excessive phosphorus application might lower soil zinc availability, resulting in shortages in micronutrients (Alloway, 2008).

### Zinc in Micronutrient Form

Plant hormone control, protein synthesis, and enzyme activation all depend on zinc, an important micronutrient (Alloway, 2008). Many agricultural soils, particularly alkaline soils, are deficient in zinc (Cakmak, 2008).

It has been demonstrated that applying zinc fertilizers, such as zinc sulfate, increases plant height, leaf area index, and grain yield (Rengel, 2015). According to studies, applying zinc can greatly improve growth characteristics and increase plant height by up to 15–20% (Cakmak, 2008). Furthermore, applying zinc and nitrogen together increases antioxidant activity and lowers oxidative stress, which boosts plant development and yield (Hafeez et al., 2013).

### Chemical Treatments and Stress Tolerance

Chemical treatments increase a plant's resistance to abiotic conditions like drought in addition to promoting growth. In times of stress, they aid in preserving photosynthetic activity and safeguarding cellular structures (Farooq et al., 2014). Studies have demonstrated that chemical treatments improve drought resistance by controlling plant hormones and enzyme activity (Ashraf & Harris, 2013). Additionally, they lessen the generation of reactive oxygen species (ROS), which can harm plant cells (Gill &Tuteja, 2010).

### Regulators of Growth and Seed Treatment

Chemicals like fungicides and plant growth regulators that are applied to seeds enhance germination and shield seedlings from illness (Copeland & McDonald, 2001). While auxins improve root development, plant growth regulators such as gibberellic acid ($GA_3$) encourage seed germination and stem elongation (Taiz et al., 2015). Early plant establishment and overall growth performance are enhanced by these treatments.

### Effects of Chemical Treatments on the Environment

Chemical treatments boost crop output, but overuse of them can have detrimental effects on the environment. Fertilizer overuse can result in nutrient imbalance, water contamination, and acidification of the soil (Savci, 2012; Zhang et al., 2015).

To preserve soil health and lower environmental risks, sustainable strategies like integrated nutrient management are advised (Gruhn et al., 2000; Tilman et al., 2002).

## 3. Methodology

### 3.1.Experimental Design

- Type of study: Experimental (Pot culture / Field study)
- Design: Randomized Complete Block Design (RCBD)
- Replications: 3–5 per treatment
- Duration: 90–120 days

### 3.2. Materials Required

- Wheat seeds (*Triticumaestivum*)
- Soil (loamy soil preferred)
- Pots or experimental plots
- Fertilizers:
- Urea (Nitrogen source)
- DAP (Phosphorus source)
- Potash (Potassium source)
- Zinc sulfate ($ZnSO_4$)
- Growth regulator: Gibberellic acid ($GA_3$)
- Measuring instruments (scale, balance, ruler)

### 3.3. Treatment Details

| **Treatment Code** | **Description** |
|---|---|
| $T_0$ | Control (no treatment) |
| $T_1$ | Nitrogen fertilizer |
| $T_2$ | NPK fertilizer |
| $T_3$ | Zinc sulfate |
| $T_4$ | $GA_3$ treatment |
| $T_5$ | NPK + Zn + $GA_3$ |

### 3.4. Experimental Procedure

#### Soil Preparation

- Soil is collected, dried, and sieved.
- Fill pots with equal quantities of soil.

#### Seed Sowing

- Healthy seeds are selected and sown at a depth of 2–3 cm.

#### Application of Treatments

- Fertilizers are applied as basal dose or top dressing.
- Zinc sulfate is applied either through soil or foliar spray.
- $GA_3$ is sprayed at specific growth stages.

#### Irrigation

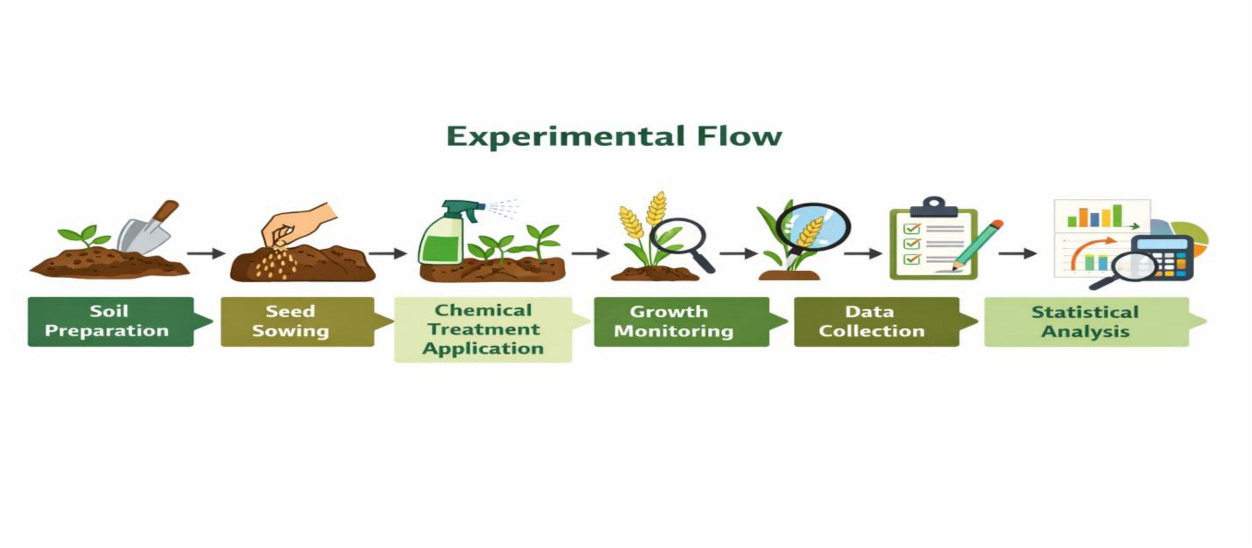
- Regular watering is done to maintain optimal moisture conditions.

### 3.5 Data Collection

Parameters recorded include:

- Germination percentage
- Plant height (cm)
- Root length
- Number of leaves
- Biomass (fresh and dry weight)
- Chlorophyll content
- Yield parameters

These parameters are commonly used in wheat experiments to evaluate growth and productivity .



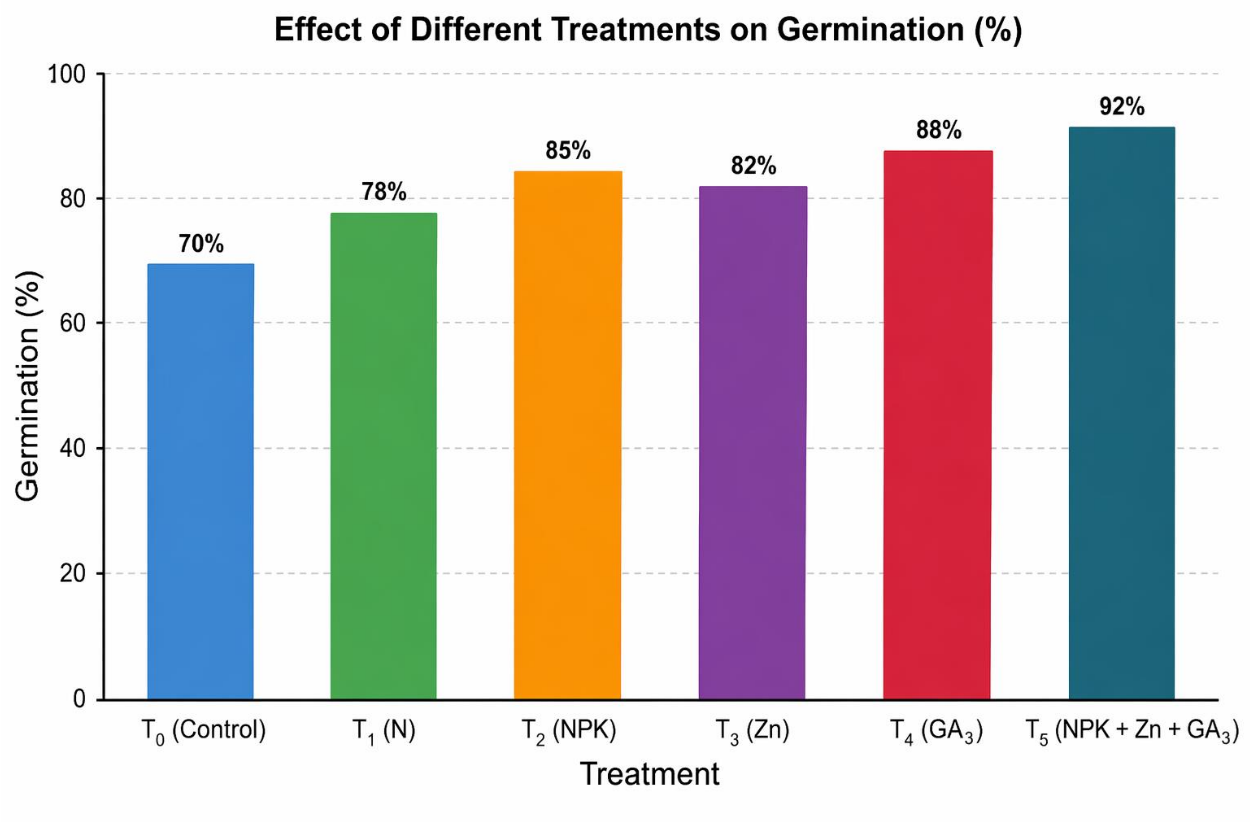
## Results

The experiment was conducted to evaluate the effect of different chemical treatments on the growth of wheat (*Triticumaestivum*). The observations recorded during the study clearly indicate that chemical treatments significantly influenced various growth parameters.

### 1. Germination Percentage

The germination percentage varied among treatments. The highest germination was observed in treatment **$T_5$ (NPK + Zn + $GA_3$)**, followed by **$T_4$ ($GA_3$)** and **$T_2$ (NPK)**. The control ($T_0$) showed the lowest germination rate.

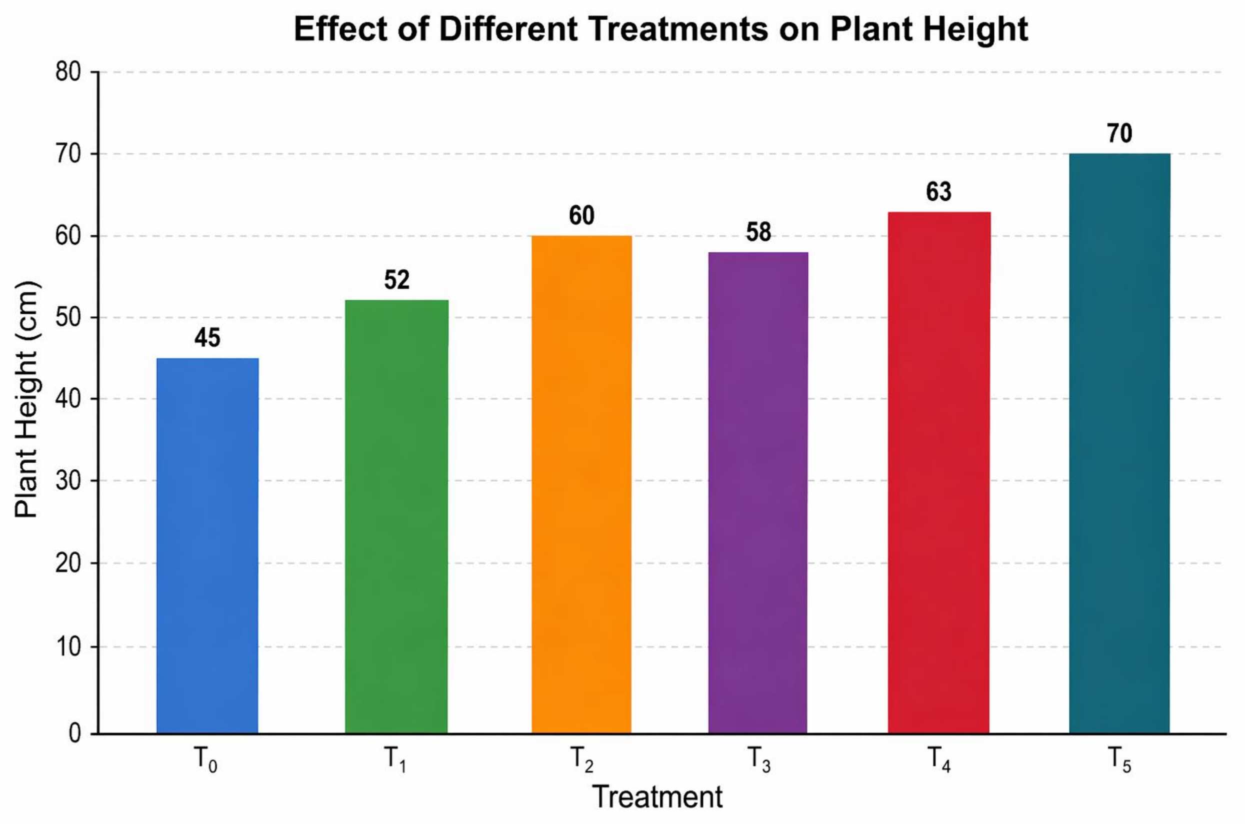
| **Treatment** | **Germination (%)** |
|---|---|
| $T_0$ (Control) | 70% |
| $T_1$ (N) | 78% |
| $T_2$ (NPK) | 85% |
| $T_3$ (Zn) | 82% |
| $T_4$ ($GA_3$) | 88% |
| $T_5$ (NPK + Zn + $GA_3$) | 92% |



## 2. Plant Height

Plant height increased significantly with chemical treatments. Maximum height was recorded in **$T_5$**, while the minimum was in the control.

| Treatment | Plant Height (cm) |
|---|---|
| $T_0$ | 45 |
| $T_1$ | 52 |
| $T_2$ | 60 |
| $T_3$ | 58 |
| $T_4$ | 63 |
| $T_5$ | 70 |



### 4.3.Number of Leaves

The number of leaves per plant was highest in **$T_5$**, indicating better vegetative growth.

| **Treatment** | **Number of Leaves** |
|---|---|
| $T_0$ | 6 |
| $T_1$ | 7 |
| $T_2$ | 9 |
| $T_3$ | 8 |
| $T_4$ | 10 |
| $T_5$ | 12 |

### 4.4.Root Length

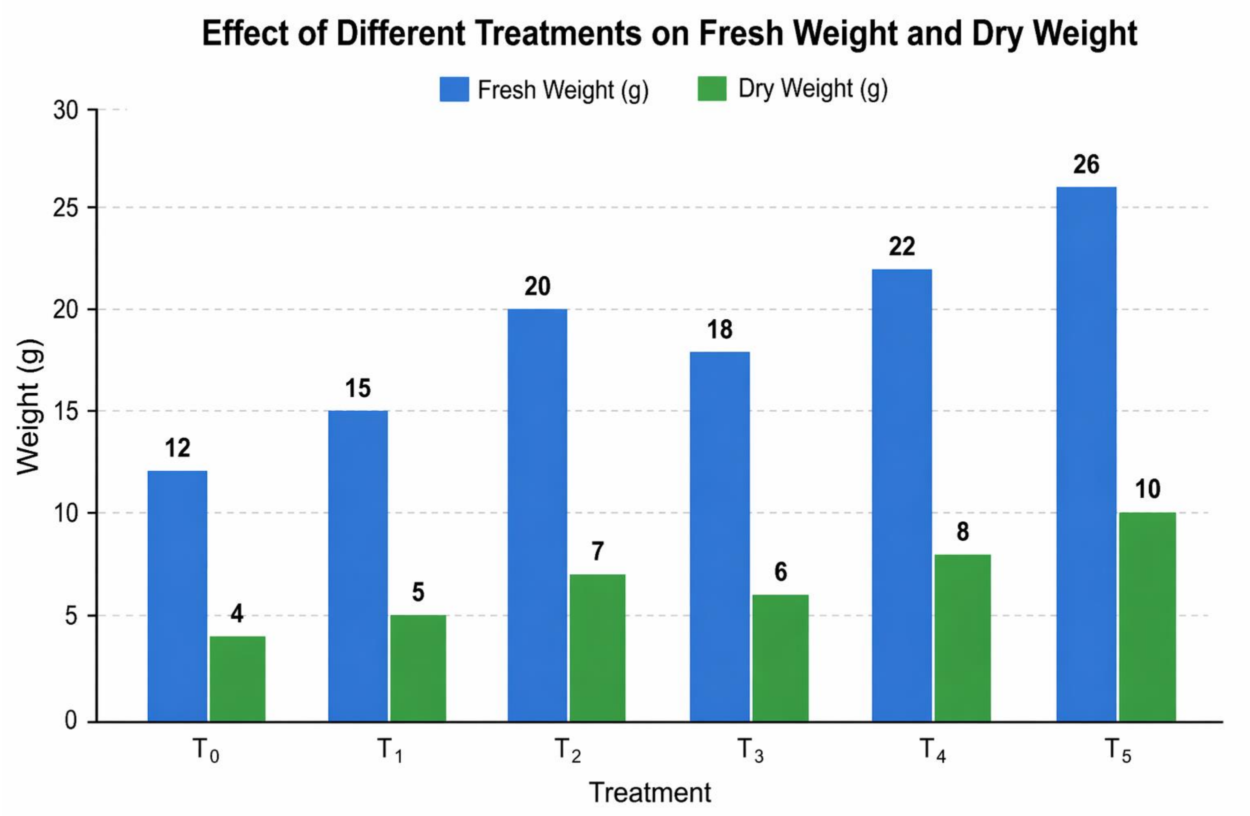
Root development was significantly enhanced by chemical treatments, particularly zinc and combined treatments.

| **Treatment** | **Root Length (cm)** |
|---|---|
| $T_0$ | 8 |
| $T_1$ | 10 |
| $T_2$ | 12 |
| $T_3$ | 13 |
| $T_4$ | 11 |
| $T_5$ | 15 |

### 4.5. Biomass (Fresh and Dry Weight)

The highest biomass accumulation was recorded in **$T_5$**, indicating better nutrient uptake and growth efficiency.

| Treatment | Fresh Weight (g) | Dry Weight (g) |
|---|---|---|
| $T_0$ | 12 | 4 |
| $T_1$ | 15 | 5 |
| $T_2$ | 20 | 7 |
| $T_3$ | 18 | 6 |
| $T_4$ | 22 | 8 |
| $T_5$ | 26 | 10 |



### References

1. FAO. (2021). FAOSTAT statistical database. Food and Agriculture Organization. https://www.fao.org/faostat
2. Shewry, P. R., & Hey, S. J. (2015). The contribution of wheat to human diet and health. Food and Energy Security, 4(3), 178–202. https://www.researchgate.net
3. Fageria, N. K., Baligar, V. C., & Jones, C. A. (2010). Growth and mineral nutrition of field crops. CRC Press. https://www.researchgate.net
4. Marschner, P. (2012). Marschner's mineral nutrition of higher plants. Academic Press. https://www.researchgate.net
5. Alloway, B. J. (2008). Zinc in soils and crop nutrition. International Zinc Association. https://www.researchgate.net
6. Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). Plant physiology and development. Sinauer Associates. https://www.researchgate.net
7. Cakmak, I. (2008). Enrichment of cereal grains with zinc. Plant and Soil, 302(1–2), 1–17. https://www.researchgate.net

8. Farooq, M., Hussain, M., &Siddique, K. H. M. (2014). Drought stress in wheat. Plant Physiology and Biochemistry, 80, 109–117. https://www.researchgate.net
9. Gill, S. S., &Tuteja, N. (2010). Reactive oxygen species and antioxidant machinery. Plant Physiology and Biochemistry, 48(12), 909–930. https://www.researchgate.net
10. Gooding, M. J., Gregory, P. J., & Ford, K. E. (2000). Effects of nitrogen on wheat yield. Journal of Agricultural Science, 134(3), 293–301. https://www.researchgate.net
11. Grant, C. A., Flaten, D. N., Tomasiewicz, D. J., & Sheppard, S. C. (2001). The importance of phosphorus. Canadian Journal of Plant Science, 81(2), 211–224. https://www.researchgate.net
12. Gruhn, P., Goletti, F., &Yudelman, M. (2000). Integrated nutrient management. IFPRI. https://www.researchgate.net
13. Hafeez, B., Khanif, Y. M., &Saleem, M. (2013). Role of zinc in plant nutrition. American Journal of Experimental Agriculture, 3(2), 374–391. https://www.researchgate.net
14. Ray, D. K., Mueller, N. D., West, P. C., & Foley, J. A. (2013). Yield trends are insufficient. PLoS ONE, 8(6), e66428. https://www.researchgate.net
15. Rengel, Z. (2015). Availability of micronutrients in soil. Journal of Soil Science and Plant Nutrition, 15(2), 397–409. https://www.researchgate.net
16. Savci, S. (2012). Fertilizer effects on environment. International Journal of Environmental Science, 3(1), 77–89. https://www.researchgate.net
17. Shewry, P. R. (2009). Wheat. Journal of Experimental Botany, 60(6), 1537–1553. https://www.researchgate.net
18. Tilman, D., Cassman, K. G., et al. (2002). Agricultural sustainability. Nature, 418, 671–677. https://www.researchgate.net
19. Tilman, D., Balzer, C., Hill, J., &Befort, B. L. (2011). Global food demand. PNAS, 108(50), 20260–20264. https://www.researchgate.net
20. Triboi, E., Martre, P., &Triboi-Blondel, A. M. (2000). Nitrogen effects on wheat protein. European Journal of Agronomy, 13(1), 19–35. https://www.researchgate.net
21. Vance, C. P., Uhde-Stone, C., & Allan, D. L. (2003). Phosphorus acquisition. Plant Physiology, 127(2), 390–397. https://www.researchgate.net
22. Wang, M., Zheng, Q., Shen, Q., &Guo, S. (2013). Potassium functions. International Journal of Molecular Sciences, 14(4), 7370–7390. https://www.researchgate.net
23. Zhang, X., Davidson, E. A., Mauzerall, D. L., et al. (2015). Managing nitrogen for sustainable development. Nature, 528, 51–59. https://www.researchgate.net
24. Berry, P. M., Sterling, M., Spink, J. H., et al. (2004). Understanding lodging in cereals. Field Crops Research, 84(3), 223–242. https://www.researchgate.net
25. Brady, N. C., & Weil, R. R. (2016). The nature and properties of soils. Pearson. https://www.researchgate.net
26. Curtis, T., &Halford, N. G. (2014). Increasing wheat yield. Journal of Experimental Botany, 65(7), 1799–1811. https://www.researchgate.net
27. Copeland, L. O., & McDonald, M. B. (2001). Principles of seed science and technology. Springer. https://www.researchgate.net
28. ICAR. (2020). Package of practices for wheat. Indian Council of Agricultural Research. https://www.researchgate.net
29. Government of India. (2022). Agricultural statistics report. https://www.researchgate.net
30. CIMMYT. (2020). Wheat research updates. https://www.researchgate.net
31. ICRISAT. (2019). Crop improvement research. https://www.researchgate.net
32. USDA. (2021). Wheat production statistics. https://www.researchgate.net
33. World Bank. (2021). Agriculture data. https://www.researchgate.net
34. OECD. (2020). Agricultural outlook. https://www.researchgate.net
35. European Journal of Agronomy. (2020). Wheat studies. https://www.researchgate.net
36. MDPI Agronomy. (2021). Wheat nutrient management. https://www.researchgate.net
37. ScienceDirect. (2022). Wheat nutrient uptake research. https://www.researchgate.net

38. Frontiers in Plant Science. (2021). Wheat stress tolerance. https://www.researchgate.net
39. Agronomy Journal. (2020). Wheat fertilization studies. https://www.researchgate.net
40. Nature Food. (2021). Global food security. https://www.researchgate.net
41. Springer Agriculture. (2022). Sustainable wheat production. https://www.researchgate.net