**Influence of Crop Geometry and Nitrogen Levels on Growth and Yield of Black Wheat (*Triticum aestivum* L.)**


***ABSTRACT***

To evaluate the influence of crop geometry and nitrogen levels on growth and yield of black wheat (*Triticum aestivum* L.) a field experiment was conducted during *Rabi* season of 2022-23 at research area of cereal and pulses section, at Agricultural Research Farm of United University, Prayagraj-211012, Uttar Pradesh, India. The experiment consisted of three, doses of nitrogen (@75, @100, @125 kg/ha) and three spacing (15 cm x 10 cm, 20 cm x 10 cm, 25 cm x 10 cm). The experiment was arranged in a statistical design of Randomized Block Design (RBD) with three replications. Report of study indicate that, among different nitrogen levels the application of Nitrogen @125 kg/ha + 25 cm x 10 cm spacing produced significantly superior plant height (103.55 cm) and plant dry weight (30.55 g). However, the application of Nitrogen @125 kg/ha + 25 cm x 10 cm spacing was found to be significantly maximum number of effective tillers/plant (19.400), spike length (10.88 cm), test weight (37.60 g) and number of grain/spike (58.93), grain yield (8.55 t/ha), straw yield (9.61 t/ha) and harvest index (46.98%) was produced by the application of Nitrogen @125 kg/ha + 25 cm x 10 cm spacing. Thus the application of the RDF + 25 cm spacing helped in increase in yield over control.



***Key words:*** Black wheat, crop geometry, nitrogen, growth and yield.


**Introduction**

Among cereals, wheat (*Triticum aestivum* L.) is one of the most important staple foods across the world with current annual global production of over 680 million tones providing approximately one-fifth of the total calorific input of the world population (**Rasheed *et al.*, 2014**). Wheat (*Triticum ssp*.) is consumed in the form of bread, cookies/biscuits, noodles, and other functional foods. This crop still needs to be improved for its micronutrients including bioactive compounds.

Black wheat, also known as purple wheat, is a type of wheat that has a dark, almost black color. It is rich in anthocyanins, which are powerful antioxidants that have been linked to a range of health benefits, including reduced inflammation, improved cardiovascular health, and cancer prevention. Black wheat is also high in fiber, protein, and other essential nutrients, making it a

nutritious addition to the diet. While black wheat is not yet widely grown or commercially available, it has generated significant interest among researchers and consumers alike, and there is ongoing research to explore its potential uses and benefits**(Ficco *et al*. 2014, Abdel-Aal *et al.* 2006, Hosseinian *et al*. 2008).**Wheat is a widely cultivatedgrass for its seed, a cerealgrain which is a worldwide staplefood**(Shewry, 2009).** Wheat is grown on maximum land area than any other food crop218.5 m ha (**FAOSTAT, 2022)**. In 2017, world's wheat production was 759.7 million tones, it isthe second most-produced cereal after maize **(Anonymous, 2022**).

In India, wheat is the second rice is the second-most significant food crop that is grown and consumed by the majority of people (almost 65%). **Mishra *et al.*, 2005**) It tops the dietary shares in northern India's Gangetic plains region. (**Joshi *et al.*,2007**). The meteoric success of food production in India over the years is attributedmainly due to increased production and productivity of wheat crop, which is largelydue to the introduction of highyielding crop varieties, fertilizers, assured irrigationand improved agronomic practices.

Crop geometry can have a significant impact on the growth and development of wheat crops. Proper crop geometry can help to optimize sunlight exposure, improve nutrient uptake, and increase grain yield. For example, planting wheat in a uniform row spacing and plant density can help to reduce competition among plants and promote more efficient use of resources. Additionally, planting wheat in a specific pattern or direction can also help to improve crop growth and yield **(Singh *et al.*, 2019).**

Nitrogen is an essential nutrient for wheat crops and plays a critical role in plant growth and development. Adequate nitrogen levels can help to improve grain yield, protein content, and overall crop quality. However, excessive nitrogen levels can lead to lodging, reduced grain quality, and increased susceptibility to diseases and pests. Therefore, it is important to carefully manage nitrogen levels to optimize crop growth and yield (**Inwati*et al.*, 2018**).

## Material and Method

### Experimental site

An experiment was conducted during *Rabi* season 2022-23 at the Agronomy Research Farm of United University, Rawatpur, Jhalwa, Prayagraj, 211012, Uttar Pradesh, India. The field was well leveled having good soil condition. Geographically, Rawatpur, Jhalwa, Prayagraj falls in subtropical climate and is situated at 25.39$^{o}$ N latitude, 81.75$^{o}$ E longitude with an altitude of

113 meters above mean sea level. The experimental was carried out by using Randomized Block Design (RBD), with nine different treatment combinations and three replications. The details of treatment combinations of three crop spacing 15 x 10 cm, 20 x 10 cm, 25 x 10 cm and three levels of nitrogen - @75, @100 and @125 kg/ha with the control (RDF-120:60:40). The observation recorded, plant height (cm),plant dry weight (g), number of effective tillers per plant, number of grain per spike, spike length (cm), test weigh (g).and yield parameters were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design **(Gomez, K. A. and Gomez, A. A. 1984).**

**Results and Discussion**

**Growth parameters of black wheat**

Significantly highest growth parameters at harvest treatment $T_9$ (25 x 10 cm + Nitrogen @125 kg/ha) was recorded highest plant height (103.55 cm), dry weight (30.60 g) which is significantly superior all over the $T_8$ (25 x 10 cm + Nitrogen @100 kg/ha) and $T_7$ (25 x 10 cm + Nitrogen @75 kg/ha) was statistically at par with treatment $T_9$ (25 x 10 cm + Nitrogen @125 kg/ha).

Spacing can have a significant impact on the growth of wheat plants. When wheat plants are spaced too closely together, they may grow taller in an effort to compete for sunlight, which can result in weaker stems and lower yields. On the other hand, when wheat plants are spaced too far apart, they may not grow as tall and can be more susceptible to disease and pest damage. Finding the optimal spacing for wheat plants can help to maximize yields and produce healthier plants**(Singh *et al.*, 2019).**Nitrogen is an essential nutrient for plant growth and development, and it can have a significant impact on the height of wheat plants. When wheat plants are provided with adequate levels of nitrogen, they tend to grow taller and produce more biomass. However, if nitrogen levels are too high, it can lead to excessive vegetative growth and may negatively impact yield. Conversely, if nitrogen levels are too low, it can stunt plant growth and reduce yields. Finding the optimal nitrogen level for wheat plants can help to maximize yields and produce healthier plants**(Inwati*et al.*, 2018).**

**Yield attribute and yield andof black wheat**

Significantly highest yield at harvest treatment $T_9$ (25 x 10 cm + Nitrogen @125 kg/ha) was recorded highest number of effective tillers/plant (19.40), spike length (10.88 cm), test weight (37.60 g), number of grain/spike (58.93), grain yield (8.55 t/ha), straw yield (9.61 t/ha),

biological yield (18.16t/ha) and harvest index is non-significant which is significantly superior all over the $T_8$ (25 x 10 cm + Nitrogen @100 kg/ha) and $T_7$ (25 x 10 cm + Nitrogen @75 kg/ha) was statistically at par with treatment $T_9$ (25 x 10 cm + Nitrogen @125 kg/ha).Crop geometry has been shown to have a significant impact on the yield and yield attributes of wheat. Optimal crop geometry can increase yield by improving light interception, reducing lodging, and increasing the number of productive tillers. This can lead to an increase in grain yield, grain weight, and the number of grains per spike**(Singh*et al.*, 2019;Inwati et al., 2018).**

## Conclusion

Nitrogen levels can have a significant impact on the yield and yield attributes of wheat. Proper nitrogen fertilization can increase yield by improving grain weight and increasing the number of grains per spike. However, excessive nitrogen fertilization can lead to lodging, reduced grain quality, and decreased yield.



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**Table 1. Growth parameters of black wheat**

| T. No. | Treatment combination | At harvest | | | |
|---|---|---|---|---|---|
| | | Plant height (cm) | Plant dry weight (g) | Crop growth rate ($g/m^2/day$) | Relative growth rate (g/g/day) |
| $T_1$ | 15 x 10 cm + Nitrogen @75 kg/ha | 96.06 | 27.85 | 4.48 | 0.0012 |
| $T_2$ | 15 x 10 cm + Nitrogen @100 kg/ha | 100.45 | 27.89 | 5.22 | 0.0012 |
| $T_3$ | 15 x 10 cm + Nitrogen @125 kg/ha | 101.92 | 28.32 | 5.27 | 0.0013 |
| $T_4$ | 20 x 10 cm + Nitrogen @75 kg/ha | 102.04 | 28.57 | 6.05 | 0.0013 |
| $T_5$ | 20 x 10 cm + Nitrogen @100 kg/ha | 102.25 | 28.62 | 6.26 | 0.0015 |
| $T_6$ | 20 x 10 cm + Nitrogen @125 kg/ha | 102.42 | 29.34 | 6.34 | 0.0019 |
| $T_7$ | 25 x 10 cm + Nitrogen @75 kg/ha | 102.68 | 29.54 | 6.75 | 0.0020 |
| $T_8$ | 25 x 10 cm + Nitrogen @100 kg/ha | 103.13 | 30.48 | 7.73 | 0.0021 |
| $T_9$ | 25 x 10 cm + Nitrogen @125 kg/ha | 103.55 | 30.60 | 8.09 | 0.0024 |
| $T_{10}$ | Control | 79.32 | 23.15 | 4.32 | 0.0008 |
| | F-test | S | S | NS | NS |
| | SEm(±) | 4.60 | 1.08 | 1.23 | 0.0003 |
| | CD (p=0.05) | 13.67 | 3.20 | - | - |

**Table 2.Effect of yield attributes and yield black wheat**

| T. No. | Treatment combination | Yield and yield attribute | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No. of effective tillers | Spike length (cm) | Test weight (g) | No. of grain spike$^{-1}$ | Grain yield (t/ha) | Straw yield (t/ha) | Biological yield (t/ha) | Harvest index (%) |
| $T_1$ | 15 x 10 cm + Nitrogen @75 kg/ha | 17.667 | 9.48 | 34.18 | 54.27 | 6.58 | 8.15 | 14.72 | 43.33 |
| $T_2$ | 15 x 10 cm + Nitrogen @100 kg/ha | 17.667 | 10.04 | 34.73 | 56.83 | 6.76 | 8.33 | 15.57 | 44.01 |
| $T_3$ | 15 x 10 cm + Nitrogen @125 kg/ha | 17.733 | 10.18 | 34.95 | 56.83 | 7.21 | 8.86 | 15.62 | 44.13 |
| $T_4$ | 20 x 10 cm + Nitrogen @75 kg/ha | 17.800 | 10.23 | 35.00 | 57.04 | 7.24 | 8.87 | 16.09 | 44.81 |
| $T_5$ | 20 x 10 cm + Nitrogen @100 kg/ha | 18.600 | 10.37 | 35.47 | 57.70 | 7.27 | 8.88 | 16.13 | 44.86 |
| $T_6$ | 20 x 10 cm + Nitrogen @125 kg/ha | 18.733 | 10.40 | 35.87 | 58.55 | 7.31 | 9.26 | 16.57 | 44.99 |
| $T_7$ | 25 x 10 cm + Nitrogen @75 kg/ha | 18.867 | 10.45 | 37.02 | 58.63 | 7.49 | 9.35 | 16.98 | 45.14 |
| $T_8$ | 25 x 10 cm + Nitrogen @100 kg/ha | 19.133 | 10.84 | 37.53 | 58.82 | 7.65 | 9.49 | 17.00 | 46.50 |
| $T_9$ | 25 x 10 cm + Nitrogen @125 kg/ha | 19.400 | 10.88 | 37.60 | 58.93 | 8.55 | 9.61 | 18.16 | 46.98 |
| $T_{10}$ | Control | 9.067 | 8.17 | 28.65 | 44.26 | 5.16 | 6.99 | 12.15 | 42.44 |
| | F-test | S | S | S | S | S | S | S | NS |
| | SEm(±) | 0.87 | 0.48 | 1.58 | 2.60 | 0.35 | 0.41 | 0.54 | 1.74 |
| | CD (p=0.05) | 2.60 | 1.44 | 4.71 | 7.73 | 1.04 | 1.23 | 1.61 | - |