



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

**Ravendra Kumar<sup>a++</sup>, Lalit Kumar Sanodiya<sup>a#</sup>  
and Ravin Singh<sup>a++\*</sup>**

<sup>a</sup> Faculty of Agriculture and Allied Sciences, United University, Prayagraj-211012, Uttar Pradesh, India.

## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JSRR/2024/v30i51919

## **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/113956>

**Original Research Article**

**Received: 02/01/2024**

**Accepted: 07/03/2024**

**Published: 12/03/2024**

## **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

<sup>++</sup> M.Sc. Scholar;

<sup>#</sup> Assistant Professor;

<sup>\*</sup>Corresponding author: E-mail: [robinsingh6804@gmail.com](mailto:robinsingh6804@gmail.com);

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.

**Keywords:** Black wheat; crop geometry; nitrogen; growth and yield.

## 1. 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 [1]. Wheat (*Triticum* spp.) 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 [2,3,4]. Wheat is a widely cultivated grass for its seed, a cereal grain which is a worldwide staple food [5]. Wheat is grown on maximum land area than any other food crop 218.5 m ha [6]. In 2017, world's wheat production was 759.7 million tones, it is the second most-produced cereal after maize [7].

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%) [8]. It tops the dietary shares in northern India's Gangetic plains region [9]. The meteoric success of food production in India over the years is attributed mainly due to increased production and productivity of wheat crop, which is largely due to the introduction of high yielding crop varieties, fertilizers, assured irrigation and 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 [10].

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 [11].

## 2. MATERIALS AND METHODS

### 2.1 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° N latitude, 81.75° 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 grains per spike, spike length (cm), test weight (g) and yield parameters were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design [12].

### 3. RESULTS AND DISCUSSION

#### 3.1 Growth Parameters of Black Wheat

Significantly highest growth parameters at harvest treatment T<sub>9</sub> (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<sub>8</sub> (25 x 10 cm + Nitrogen @100 kg/ha) and T<sub>7</sub> (25 x 10 cm + Nitrogen @75 kg/ha) was statistically at par with treatment T<sub>9</sub> (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 [10]. 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 [11].

#### 3.2 Yield Attribute and Yield Andof Black Wheat

Significantly highest yield at harvest treatment T<sub>9</sub> (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<sub>8</sub> (25 x 10 cm + Nitrogen @100 kg/ha) and T<sub>7</sub> (25 x 10 cm + Nitrogen @75 kg/ha) was statistically at par with treatment T<sub>9</sub> (25 x 10 cm + Nitrogen @125 kg/ha).Crop geometry has been shown to have a significant impact on the yield

**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 <sup>2</sup> /day)	Relative growth rate (g/g/day)
T <sub>1</sub>	15 x 10 cm + Nitrogen @75 kg/ha	96.06	27.85	4.48	0.0012
T <sub>2</sub>	15 x 10 cm + Nitrogen @100 kg/ha	100.45	27.89	5.22	0.0012
T <sub>3</sub>	15 x 10 cm + Nitrogen @125 kg/ha	101.92	28.32	5.27	0.0013
T <sub>4</sub>	20 x 10 cm + Nitrogen @75 kg/ha	102.04	28.57	6.05	0.0013
T <sub>5</sub>	20 x 10 cm + Nitrogen @100 kg/ha	102.25	28.62	6.26	0.0015
T <sub>6</sub>	20 x 10 cm + Nitrogen @125 kg/ha	102.42	29.34	6.34	0.0019
T <sub>7</sub>	25 x 10 cm + Nitrogen @75 kg/ha	102.68	29.54	6.75	0.0020
T <sub>8</sub>	25 x 10 cm + Nitrogen @100 kg/ha	103.13	30.48	7.73	0.0021
T <sub>9</sub>	25 x 10 cm + Nitrogen @125 kg/ha	103.55	30.60	8.09	0.0024
T <sub>10</sub>	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 <sup>-1</sup>	Grain yield (t/ha)	Straw yield (t/ha)	Biological yield (t/ha)	Harvest index (%)
T <sub>1</sub>	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 <sub>2</sub>	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 <sub>3</sub>	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 <sub>4</sub>	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 <sub>5</sub>	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 <sub>6</sub>	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 <sub>7</sub>	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 <sub>8</sub>	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 <sub>9</sub>	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 <sub>10</sub>	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	-

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 [10,11].

#### 4. 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.

#### 5. ACKNOWLEDGEMENT

I respectfully and humbly express my deep sense of reverence and gratitude to my

supervisor, Dr. Lalit Kumar Sanodiya, (Assistant Professor), Department of Agronomy, Faculty of Agricultural Sciences & Technology, United University, Prayagraj, for his inspiring and ingenious guidance, incisive and articulate criticism, cordial discussion, unwavering zeal, and constant encouragement which assisted me to overcome every challenge that came my way during the period of this I will always be incredibly grateful to him for his kind words and compassion shown to me.

From the result it was concluded that application of 25 x 10 cm + Nitrogen @125 kg/ha treatment T<sub>9</sub> recorded higher seed yield, higher gross returns, net returns, and benefit cost ratio.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Rasheed A, Xia X, Yan Y, Appels R, Mahmood T, He Z. Wheat seed storage proteins: Advances in molecular genetics, diversity and breeding applications. *Journal of Cereal Science*. 2014;60(1):11-24.
2. Ficco DB, De Simone V, Colecchia SA, Pecorella I, Platani C, Nigro F, De Vita P. Genetic Variability in Anthocyanin Composition and Nutritional Properties of Blue, Purple, and Red Bread (*Triticum aestivum*L.) and Durum (*Triticum turgidum* L. *ssp.turgidumconvar.durum*) Wheats. *Journal of Agricultural and Food Chemistry*. 2014;62(34):8686-8695.
3. Abdel-Aal EM, Young JC, Rabalski I. Anthocyanin composition in black, blue, pink, purple, and red cereal grains. *Journal of Agricultural and Food Chemistry*. 2006; 54(13):4696-4704.
4. Hosseinian FS, Li W, Beta T. Measurement of anthocyanins and other phytochemicals in purple wheat. *Food Chemistry*. 2008;109(4):916-924.
5. Shewry PR. Wheat. *Journal of Experimental Botany*. 2009; 60:1537-1553.
6. FAOSTAT. Food and Agriculture Organization, Statistics Division, United Nations; 2017.
7. Anonymous. World food situation: FAO cereal supply and demand brief. Rome, Italy: United Nations, Food and Agriculture Organization. 20172016. Accessed on:14 December 2016.
8. Mishra B, Shorean J, Chatrath R, Sharma AK, Gupta RK, Sharma RK, Singh R, Rane J, Kumar A. Cost effective and sustainable wheat production technology. Directorate of wheat research, Karnal, Technical Bulletin. 2005;8(1).
9. Joshi AK, Mishra B, Chatrath R, Ortiz Ferrara G, Singh RP. Wheat improve mentin India: present status, emerging challenges and future prospects. *Euphytica*. 2007;157,431-446.
10. Singh A, Brar SK, Gandhi N. Effect of spacing and different sowing methods on yield of wheat. *Journal of pharmacognosy and phytochemistry*, 2019SP4:42-44.
11. Inwati KD, Yadav J, Yadav JS, Giriraj, Pandey A. Effect of Different Levels, Sources and Methods of Application of Nitrogen on Growth and Yield of Wheat. *International Journal of Current Microbiology and Applied Sciences*. 2018; 7(2):2398-2407.
12. Gomez KA, Gomez AA. *Statistical Procedures for Agricultural Research*, Edn2; 1984.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:  
<https://www.sdiarticle5.com/review-history/113956>