



Influence of Nitrogen and Zinc on Yield Attributes, Yield and Economics of Wheat (*Triticum aestivum* L.)

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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/IJPSS/2022/v34i2131273

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/89510>

Original Research Article

Received 30 April 2022
Accepted 11 July 2022
Published 14 July 2022

ABSTRACT

The field experiment was conducted at crop research farm (CRF) during *Rabi* season 2021-22 Department of Agronomy, SHUATS, Prayagraj (UP). To study the "Influence of nitrogen and zinc on yield attributes, yield and economics of wheat". The experiment was laid out in Randomized Block Design with 3 replications. The results showed that T9 [nitrogen at (120kg/ha) + zinc at (0.06%)], found more productive as it attained the superior values of yield attributing traits i.e., spikes/m² (435.66), grains/spike (56.63), test weight (41.66 g), grain yield (4.82 t/ha), straw yield (11.66 t/ha) and proved significantly superior over other treatments of different levels of nitrogen and foliar application of zinc and that treatment also fetched the higher values of gross return (132110.00 INR/ha), net return (89650.70 INR/ha) and also found more remunerative due to highest benefit cost ratio (2.11).

Keywords: *Wheat; nitrogen; zinc; yield attributes; yield and economics.*

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1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is a universal staple food for 40 % human population in the world and second most important cereal after rice. It is rich in carbohydrate, protein, fat and minerals (zinc, iron) and also contains good amount of vitamins such as thiamine and vitamin-B [1]. Wheat is also a good source of essential dietary substances like carotenoids, flavonoids and phenolic compounds. In India huge portion of total cultivation devoted under this crop, nearly 29.14 mha area with annual production of 102.19 mt carrying average productivity of 3506.8 kg/ha in year 2018-19 (GOI). "Uttar Pradesh is the largest wheat producing state in India, followed by Punjab, Haryana and Madhya Pradesh. More than 30 percent of area and production of wheat in India is by Uttar Pradesh state alone. Though Uttar Pradesh is leading in area and production of wheat, it's productivity is not the highest, and is less than the national average" [2]. "Being the highest producer of wheat in the country, growth and stability of wheat production in Uttar Pradesh has higher significance. Also, since agriculture is the main source of livelihood to majority of population in Uttar Pradesh where wheat accounts for highest share in gross cropped area, understanding the growth and instability scenario of wheat and the driving forces behind it in the state is of utmost importance" [2].

The yield potential for this crop is low with respect to area under cultivation and plagued with a number of diseases and pests. The production of cereal crop in our country including wheat is not enough to meet the domestic demand of the population. There is scope to enhance the productivity of wheat by proper agronomic practices and fertilizers. With the application of nutrient increasing and optimising genetic potential of the crop is considered as an efficient and economic method of supplementing the nutrient requirement. Application of nitrogen and zinc will enhance the nutrient availability and increases the productivity. Major nutrients like NPK and zinc was found to be advantageous and increases the productivity with its application.

"Nitrogen plays a vital role in all living tissues of the plant. All vital processes in the plant are associated with protein, of which nitrogen is an essential constituent. Nitrogen is a constituent of proteins, enzymes, coenzymes, nucleic acids, phytochromes and chlorophyll. It plays an important role in the biochemical processes of the plant. Therefore, it is one of the most

required nutrients by wheat crops" Kutman et al. [3]. "Consequently, to get more crop production, nitrogen application is essential in the form of chemical fertilizer" Ali et al. [4]. "Yield and yield components of high yielding varieties generally increase with increasing levels of nitrogen" [5].

"Zinc is a requisite in normal growth and development of plants was convincingly established long years back carrying out the above function by being a cofactor of about 300 enzymes, by contributing in biosynthesis of growth hormones and maintaining in intra cellular homeostasis" [6,7]. "It participates in carbohydrate metabolism by getting involved in the most important process of photosynthesis as a co factor in enzymes such as ribulose 1,5-biphosphate carboxylase and carbonic anhydrase one catalysing the fixation of carbon dioxide in photosynthesis and other increasing its absorption" [8].

This research was therefore conducted to determine how different dose of nitrogen and zinc effect on yield attributes, yield and economics of wheat crop. Similarly, suggestion be provided for better management practices to the farmers. Hence, keeping above facts in view, the present experiment "Influence of nitrogen and zinc on yield attributes, yield and economics of wheat (*Triticum aestivum* L.)" was planned.

2. MATERIALS AND METHODS

During *Rabi* season of 2021-22, a field experiment was conducted out at the Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (Allahabad) U.P. in alluvial soil, which is located at 25° 39' 42" N latitude, 81° 67' 56" E longitude and 98 m altitude above the mean sea level. Soil of experimental plot was sandy loam, having nearly neutral soil reaction (pH 6.9), electrical conductivity 0.29 ds/m, available nitrogen (278.93 kg/ha), available phosphorous (10.8 kg/ha) and available potassium (206.4 kg/ha). The experiment was laid out in Randomized Block Design (RBD) which consisted of 9 treatments and replicated thrice *viz.*, T₁: Nitrogen at 80 kg/ha and Zinc at 0.02%, T₂: Nitrogen at 80kg/ha and Zinc at 0.04%, T₃: Nitrogen at 80 kg/ha and Zinc at 0.06%, T₄: Nitrogen at 100kg/ha and Zinc at 0.02%, T₅: Nitrogen at 100kg/ha and Zinc at 0.04%, T₆: Nitrogen at 100kg/ha and Zinc at 0.06%, T₇: Nitrogen at 120kg/ha and Zinc at 0.02%, T₈: Nitrogen at 120kg/ha and Zinc at 0.04%, T₉: Nitrogen at

120kg/ha and Zinc at 0.06%. Nitrogen was applied in split dosage as half dose at the time of field preparation as basal dose and the remaining N was top dressed at CRI stage and jointing stages.

The whole dose of P_2O_5 and K_2O was applied at the rate of 60 kg/ha at the time of field preparation. Though the source of P_2O_5 and K_2O was single super phosphate (SSP) and muriate of potash (MOP), respectively. Zinc was used as a foliar application and was done twice viz., tillering and grain filling stages. The data collected were spikes/m², grains/spike, test weight (g), grain yield (t/ha), straw yield (t/ha) and harvest index. The yield attributes and yield were recorded at harvest. The economics of the treatments was computed based on cost of inputs applied in respective plots and value of produce obtained as per (grain and straw) prevailing price in the market. Statistical analysis was done and mean were compared at 5% probability level of significant results [9].

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

3.1.1 Number of spikes/m²

Number of spikes/m² showed significant difference among all treatments. Whereas, maximum number of spikes/m² (435.66) was observed in treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)]. However, treatment 6 [nitrogen at (100 kg/ha) and zinc at (0.06%)], treatment 7 [nitrogen at (120 kg/ha) and zinc at (0.02%)] and treatment 8 [nitrogen at (120 kg/ha) and zinc at (0.04%)] were found statistically at par with treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)] [Table-1]. The amount of N significantly affected the total number of spikes/m². Data showed that the genotypes exhibited significant differences regarding the total number of spikes/m² when the N level was increased. Similar result was reported by Mansour et al. [10]. The number of spikes/m² was affected by the application of Zn concentrations in leaves. Similarly, Seadh et al. [11] showed that “foliar Zn application provided 21% increase in the number of wheat spikes/m²”.

3.1.2 Number of grains/spikes

Number of grains/spike (56.53) was recorded significantly maximum in treatment 9 [nitrogen at

(120 kg/ha) and zinc at (0.06%)]. However, treatment 5 [nitrogen at (100 kg/ha) and zinc at (0.04%)], treatment 6 [nitrogen at (100 kg/ha) and zinc at (0.06%)], treatment 7 [nitrogen at (120 kg/ha) and zinc at (0.02%)] and treatment 8 [nitrogen at (120 kg/ha) and zinc at (0.04%)] were statistically at par with treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)] [Table-1]. Improvements in number of grains/spike are important aspects to achieve more grains/unit land area. It may be due to optimum amount of nitrogen and foliar application of zinc. These results are closely in conformity with findings of Firdous et al. [12] and Arif et al. [13].

3.1.3 Test weight

Significant & higher test weight (41.66 g) was recorded in treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)]. However, treatment 6 [nitrogen at (100 kg/ha) and zinc at (0.06%)], treatment 7 [nitrogen at (120 kg/ha) and zinc at (0.02%)] and treatment 8 [nitrogen at (120 kg/ha) and zinc at (0.04%)] were statistically at par with treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)] [Table-1]. This finding corroborates the finding of Firdous et al. [12] and Arif et al. [13].

3.2 Yield (t/ha)

3.2.1 Grain yield

Significantly higher grain yield (4.82 t/ha) of wheat was found in treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)]. However, treatment 6 [nitrogen at (100 kg/ha) and zinc at (0.06%)], treatment 7 [nitrogen at (120 kg/ha) and zinc at (0.02%)] and treatment 8 [nitrogen at (120 kg/ha) and zinc at (0.04%)] were statistically at par with treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)] [Table-1]. “The increase in yield of the varieties with increasing N rates up to adequate level might be due to the role of N in increasing the leaf area and promote photosynthesis efficiency which promote dry matter production and increase yield” [14]. “In line with this, improvements in wheat yield and its components under the acceptable increasing N rates were reported by Sticksel et al. [15]. The increase in the grain yield is attributable to the improved physiology of plants with the added Zn consequently correcting the efficiency of different enzymes, chlorophyll content, IAA hormone and improvement in nitrate conversion to ammonia in plant leading to higher yield” [16,17].

Table 1. Effect of nitrogen and zinc on yield attributes and yield of wheat

S. No.	Treatments	spikes/m ²	grains/ spike	Test weight (g)	Grain yield (t/ha)	Straw yield (t/ha)	Harvest index (%)
1.	Nitrogen at 80 kg/ha + Zinc at 0.02%	325.00	42.76	35.17	3.58	9.08	22.69
2.	Nitrogen at 80 kg/ha + Zinc at 0.04%	328.00	44.10	35.64	3.78	9.14	22.71
3.	Nitrogen at 80 kg/ha + Zinc at 0.06%	350.33	47.13	36.66	3.86	9.35	23.48
4.	Nitrogen at 100 kg/ha + Zinc at 0.02%	363.66	50.07	37.22	4.07	10.22	23.49
5.	Nitrogen at 100 kg/ha + Zinc at 0.04%	384.00	53.29	38.78	4.08	10.42	23.63
6.	Nitrogen at 100 kg/ha + Zinc at 0.06%	420.33	55.46	39.66	4.51	10.66	23.76
7.	Nitrogen at 120 kg/ha + Zinc at 0.02%	388.00	55.07	38.86	4.17	11.33	23.68
8.	Nitrogen at 120 kg/ha + Zinc at 0.04%	425.00	55.54	40.66	4.54	11.43	24.32
9.	Nitrogen at 120 kg/ha + Zinc at 0.06%	435.66	56.63	41.66	4.82	11.66	24.40
	F test	S	S	S	S	S	NS
	SEm_±	17.21	1.47	0.72	0.23	0.27	1.31
	CD (P= 0.05)	51.59	4.42	2.17	0.69	0.83	-

Table 2. Effect of biofertilizer and seaweed extract on economics of wheat

S. No.	Treatments	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio (B:C)
1.	Nitrogen at 80 kg/ha + Zinc at 0.02%	42154.30	99387.00	57232.70	1.36
2.	Nitrogen at 80 kg/ha + Zinc at 0.04%	42165.30	103540.00	61374.53	1.46
3.	Nitrogen at 80 kg/ha + Zinc at 0.06%	42176.30	105849.00	63672.70	1.51
4.	Nitrogen at 100 kg/ha + Zinc at 0.02%	42198.30	112623.00	70425.03	1.67
5.	Nitrogen at 100 kg/ha + Zinc at 0.04%	42209.30	113425.00	71215.53	1.69
6.	Nitrogen at 100 kg/ha + Zinc at 0.06%	42220.30	116160.00	73939.53	1.75
7.	Nitrogen at 120 kg/ha + Zinc at 0.02%	42440.30	125615.00	83175.03	1.96
8.	Nitrogen at 120 kg/ha + Zinc at 0.04%	42451.30	125234.00	82782.37	1.95
9.	Nitrogen at 120 kg/ha + Zinc at 0.06%	42462.30	132110.00	89650.70	2.11

3.2.2 Straw yield

Significantly higher straw yield (11.66 t/ha) was recorded in treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)]. However treatment 6 [nitrogen at (100 kg/ha) and zinc at (0.06%)] and treatment 8 [nitrogen at (120 kg/ha) and zinc at (0.04%)] were found to be statistically at par with treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)] [Table 1]. "Increase in straw yield of wheat with successive increase in N levels probably came through favourable influence of increasing N levels on growth parameters in terms of plant height, number of tillers, dry matter production" [18]. Corroborative findings have been reported by Behera and Rautaray [19], Patel et al. [20]. Straw yield of wheat, was significantly increased with the application of zinc. Similar results were reported by Keram et al. 2013.

3.2.3 Harvest index

Harvest index was found to be non-significant. However, highest harvest index (22.69 %) was recorded in treatment 9 [nitrogen at (120 kg/ha) and zinc at (0.06%)] as compared with other treatments [Table 1].

4. ECONOMICS

It is noticeable from data given in table-2 that the gross monetary return, net monetary return and B:C ratio varied due to application of nitrogen and zinc at different levels. In wheat the values of these parameter were less in plots receiving lower quantity of nitrogen and zinc but these indices fetched maximum gross monetary return, net monetary return and benefit cost ratio in plots receiving treatment 9 with application nitrogen at 120 kg/ha and zinc at 0.06% due to higher grain and straw yields.

5. CONCLUSION

Based on the above findings it can be concluded that application of nitrogen and zinc performs positively and improves yield attributes, yield and economics of wheat. The application of nitrogen 120 kg/ha along with zinc 0.06% resulted in achieving maximum grain yield and straw yield. These findings are based on one season therefore, further trail may be required to confirm the findings.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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