Original Research Article

Influence of nitrogen and zinc on yield attribute, yield and economics of wheat (*Triticum aestivum* L.)

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 consisting of 9 treatments viz., T_1 nitrogen at 80 kg/ha and zinc at 0.02 %, T_2 nitrogen at 80 kg/ha and zinc at 0.04 %, T_3 nitrogen at 80 kg/ha and zinc at 0.06 %, T_4 nitrogen at 100 kg/ha and zinc at 0.02 %, T_5 nitrogen at 100 kg/ha and zinc at 0.04 %, T_6 nitrogen at 100 kg/ha and zinc at 0.06 %, T_7 nitrogen at 120 kg/ha and zinc at 0.02 %, T_8 nitrogen at 120 kg/ha and zinc at 0.04 %, T_9 nitrogen at 120 kg/ha and zinc at 0.06 % , where laid out in Randomized Block Design with 3 replications. The results showed that T_9 [nitrogen at (120kg/ha) + zinc at (0.06%)], found more productive as it attained the superior values of yield attributing trails 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).

Key words: Wheat, nitrogen, zinc, yield attributes, yield and economics

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 (Gupta *et al.*, 2019). Wheat is also a good source of essential dietary substances like carotenoids, flavonoids and phenolic compounds. The massive importance of wheat can be understood with the figures of grown area of 215.48 m ha with annual production of 731.46 mt and productivity of 33.9 q/ha during 2018-19 worldwide (USDA 2020). 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 (Balaganesh *et al*., 2019). 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.

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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.,* (2011). Consequently to get more crop production, nitrogen application is essential in the form of chemical fertilizer Ali *et. al.,* (2000). Yield and yield components of high yielding varieties generally increase with increasing levels of nitrogen Bahera *et. al.,*.

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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 (Coleman 1998; Ranja and Das 2003). 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 ab sorption (Brown et al. 1993).

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.

Material and method-

During *Rabi* season of 2021-22, a field experiment was conducted out a the Crop Research Farm of the Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (Allahabad) U.P. in alluvial soil, which is located at 25o 39' 42" N latitude, 81o 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*., T_1: Nitrogen at 80 kg/ha and Zinc at 0.02%, T_2: Nitrogen at 80kg/ha and Zinc at 0.04%, T_3: Nitrogen at 80 kg/ha and Zinc at 0.06%, T_4: Nitrogen at 100kg/ha and Zinc at 0.02%, T_5: Nitrogen at 100kg/ha and Zinc at 0.04%, T_6: Nitrogen at 100kg/ha and Zinc at 0.06%, T_7: Nitrogen at 120kg/ha and Zinc at 0.02%, T_8:

Nitrogen at 120kg/ha and Zinc at 0.04%, T_9: 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. (Gomez & Gomez, 1976)

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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	-

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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

Results and discussion

Yield attributes

Number of spikes/m²- Number of spikes/m^2 showed significant difference among all treatments. Whereas, maximum number of spikes/m^2 (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.*, *(2017)*. The number of spikes/m² was affected by the application of Zn concentrations in leaves. Similarly, Seadh et al. (2009) showed that foliar Zn application provided 21% increase in the number of wheat spikes/m².

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Number of grains/spike - 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. (2018) and Arif et al. (2019).

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*. (2018) and Arif *et al*. (2019).

Yield (t/ha)

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 Belete *et. al.*, (2018). In line with this, improvements in wheat yield and its components under the acceptable increasing N rates were reported by Sticksel *et al.* 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 (Hacisalihoglu *et al.*, 2003; Abbas *et al.*, 2010).

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 (Patra and Ray 2018). Corroborative findings have been reported by (Baheraa and Rautaray 2010), Patel *et. al.*, (2012). Straw yield of wheat, was significantly increased with the application of zinc. Similar results were reported by Keram *et. al.*

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].

Economics

It is noticeable from data given in table-2 that the gross monitory return, net monitory return and B:C ratio varied due to application of nitrogen and zinc at different levels. In wheat the values of these parameter where less in plots receiving lower quantity of nitrogen and zinc but these indices fetched maximum gross monitory return, net monitory 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.

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.

References

1. Halepyati, A.S. (2001). Influence of irrigation and nitrogen levels on growth and yieldn of wheat. *Karnataka. J. Agric.* Sci., **14**(2): 449-450. (CAB. Absts. 2002-2003).
2. Das, A., Sarkar, M. and Islam, N. (2019). Evaluation of different levels of nitrogen, zinc and their combined effect on yield and yield contributing traits of wheat. *Progressive Agriculture* **30**(3): 288-297.
3. Martin-Ortiz, D., L.H. Ndez-Apaolaza and A. Ga-Rate, (2010). Wheat (Triticum aestivum L.) Response to a zinc fertilizer applied as zinc lignosulfonate adhered to a NPK fertilizer. *Journal of Agriculture and Food Chemistry*, **58**: 7886-7892.
4. Grant, C.A. and L.D. Bailey, (1989). Nitrogen, phosphorus and zinc management effects on grain yield and cadmium concentration in two cultivars of durum wheat. *Canadian Journal of Plant Science*, **1**: 63-70.
5. Zia, M.M. Sharif, A.M. Aslam, M.B. Baig and A. Ali, (2000). Fertility issues and fertilizer management in rice wheat system. *Quarterly Sciences and Veterinary*, **5**(4): 59-73.

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6. Asif, M., Ali, A., Safdar, M. E., Maqsood, M., Hussain, S., & Arif, M. (2009). Growth and yield of wheat as influenced by different levels of irrigation and nitrogen. *International Journal of Agriculture and Applied Sciences*, **1**(1), 25-28.
7. Gupta, J. P., Kumar, R and Kumar, V. (2019). Effect of nitrogen management and plant growth regulators on yield and yield attributes of wheat (Triticum aestivam L.) 3rd National Conference On promoting & reinvigorating agri-horti, technological innovations [PRAGATI-2019]. *International Journal of Chemical Studies*. **6**: 272-274.
8. Kwanchai A. Gomez & Arturo A. Gomez. *Statistical Procedures for Agricultural Research.*
9. Balaganesh, G., Makarabbi, G., and Sendhil, R. (2019). Tracking the performance of wheat production in Uttar Pradesh. *Indian Journal of Economics and Development*, **15**(2): 216-224. DOI:10.5958/2322-0430.2019.00026.X
10. U.B. Kutman, B. Yildiz, L. Cakmak, (2011). Effect of nitrogen on uptake, remobilization and partitioning of zinc and iron throughout the development of durum wheat. Plant and Soil. V. 342, n. 1-2, p. 149-164.
11. A. Ali, M.A. Choudhry, M.A. Malik, R. Ahmad and Saifullah (2000). Effect of various doses of nitrogen on the growth and yield of two wheat cultivar. *Pak. J. Biol. Sci.* **3**(6): 1004-1005
12. U.K. Behera, B.A. Chougule, R.S. Thakur, KN. Ruwali. R.C Bhawsar and H.N. Pandey (2000). Influence of planting dates and nitrogen levels on yield and quality of durum wheat (Triticum durum). *Indian J. Agric. Sci*.**70**: 434-6.
13. Coleman, J.E. (1998). Zinc enzymes. Current Opinion in Chemical Biology **2:**222–234.
14. Ranja, G., Das,P. (2003).Effect of metal toxicity on plant growth and metabolism: I. Zinc. Agronomy **23**:3–11.
15. Brown, P.H., Cakmak, I., Zhang, Q. (1993). Form and function of zinc in plants. Chap. 7. In: Robson, A.D. (ed.), Zinc in Soils and Plants, Kluwer Academic Publishers, Dordrecht,The Netherlands, pp. **90**–106.
16. E. Mansour, A. M. A. Merward, M. A. T.Yasin, M. I. E. Abdul- Hamid, E.E.A. EL-Sobky and H.F. Oraby (2017), *The Journal Of Agriculture Science* 155, 1407-1423
17. Seadh, S.E. et al. Influence of micronutrients foliar application and nitrogen fertilization on wheat yield and quality of grain seed. *Journal of Biological Sciences*, v.9, n.8, p.851-858, (2009).

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18. S Firdous, BK Agarwal and V Chhabra (2018), *Journal of Pharmacognosy and Phytochemistry*
19. Mohd Arif, L N Dashora, J Choudhary, S.S. Kadam, and Mohammed Mohsin (2019). *Indian Journal Of Agricultural Science* **89**(10): 1664-8
20. Fresew Belete, Nigussie Dechassa, Adamu Molla and Tamado Tana (2019). Agriculture and Food Security.
21. Sticksel E, Maid! F-X, Retzer F, Dennert J, Fischbeck G. Efficiency of grain Production of winter wheat as affected by N fertilisation under particular consideration of single culm sink size. Eur J Agron. (2000); **13**:287-94. 26.
22. Hacisalihoglu G, Hart JJ, Wang YH, Cakmak I, Kochian. LV. Zinc efficiency is correlated with enhanced expression and activity of zinc-requiring enzymes in wheat. Plant Physiology. (2003); **131**:595-602.
23. Abbas G, Hassan G, Ali MUA, Aslam M, Abbas Z. Response of wheat to different doses of ZnSO4 under Thal desert environment. Pak. J Bot. (2010); **42**(6):4079.
24. Bishnupriya Patra and Pratik Kumar Ray (2018). *Journal of Experimental Agriculture International* **21**(1): 1-5
25. Beheraa UK, Rautaray SK Effect of biofertilizers and chemical fertilizers on productivity and quality parameters of durum wheat (Triticum turgidum) on a Vertisol of Central India. Arch. Agron, Soil Sci. (2010). **5**6(1):65-72.
26. Patel CB, Singh RS. Yadav MK, Singh SK, Singh MK, Singh KK, Mall RK. Response of different wheat (Triticum aestivum L. Emend Fiori & Paol.) genotypes to various nitrogen levels under late sown conditions of Eastern Uttar Pradesh. Env. & Ecology. (2012). **30**(3C):1 1192-1196.
27. Keram KS, Sharma BL, Sharma GD, Thakur RKD. Impact of zinc application on its translocation into various plant parts of wheat and its effect on chemical composition and quality of grain. Scientific Research and Essays. (2013). **8**(45):2218-2226.