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To assess the foliar application of nutrients on growth and yield of wheat

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Abstract
The present research experiment entitled "To assess the foliar application of nutrients on growth and yield of wheat (*Triticum aestivum* L.)" was carried out during Rabi season of 2024 at Rama University Mandhana, Kanpur, Uttar Pradesh focused on the wheat variety Golden Halna. The experiment consisted ofeight treatments were tested in Randomized Block Design with four replication T_1:RDF (120:60:40 NPK), T_2: RDF +FYM (@0.96q/h), T_3: RDF + Urea (@2.0%), T_4: RDF + $ZnSO_4$ (@0.5%), T_5: RDF + Borex (@0.2%), T_6: RDF + Urea (@2.0%) + ZnSO4 (@0.5%), T_7: RDF + $ZnSO_4$ (@0.5%) + Borex (@0.2%), T_8: RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%). The soil of field was sandy loam. The pH of soil was 7.8. The wheat variety Golden Halna was sown on 2 December, 2024 at row spacing of 20 cm with seed rate of 100 kg/ha. Full dose of phosphorus and potash was applied as basal dose at the time of sowing and the nitrogen was applied as per treatment. The source of nitrogen, phosphorus and potash was organic and inorganic respectively. Result showed that the treatment T8 RDF + Urea (@2.0%) + $ZnSO_4$ (@0.5%) + Borex (@0.2%) found superior in terms of maximum root and shoot growth, yield attributes and yield. The maximum grain yield (41.210 q/h), straw yield (127.120 q/h), gross income (Rs 140412.00) and net income (Rs 71199.00) recorded under RDF + Urea (@2.0%) + $ZnSO_4$ (@0.5%) + Borex (@0.2%) treatment. The increment in the grain yield, gross income and net income evaluated 21.31%, 15.49% and 22.92% respectively under T_8, RDF + Urea (@2.0%)+ $ZnSO_4$ (@0.5%) + Borex (@0.2%) treatment compare to control treatment.

Keywords: N:P:K, Urea, ZnSO4, Borex, FYM

Introduction
Wheat, a globally important cereal grain, is cultivated primarily for its seed, which serves as a staple food in many parts of the world. This crop belongs to the genus *Triticum*, with *Triticum aestivum* being the most commonly cultivated species. Botanically, its kernel is classified as a caryopsis, a type of dry fruit. The USDA statistical data shows that China, India and Russia dominate wheat production, accounting for 46% of world production. China holds high position as a result of good crop yield of 5.5 t/ha last year, with a total of 132 m/t harvested by agri producers. India ranks second owing to its significant areas 102 M t of wheat were harvested on 30 M ha. In Russia, 27 M ha were allocated for wheat and 74 M t of grain were harvested**.** Uttar Pradesh has registered the highest wheat producer with 35.4 MT productions. Cultivated as a rabi crop, wheat is U.P's main agriculture produce And the state contributes around 31.92% of the country's total wheat production. FYM is primarily made from cow dung, cow urine, waste grass and other dairy waste. FYM is nutrient rich. A small portion of N is available directly to the plants, while great portion is made available when FYM decomposes. FYM implementation increases soil fertility. Urea serves as a concentrated source of nitrogen and supports vital plant functions. Nitrogen from urea contributes to the synthesis of amino acids and proteins, fundamental components of plant cell structures and metabolic enzymes. It also plays a role in ATP formation, a compound critical for energy transfer in plant cells (Mathews *et al*., 2000) [17]. Boron is indispensable for several physiological processes including cell division, membrane stability, sugar transport, and the development of floral structures. Its deficiency can hinder pollen formation and carbohydrate utilization, ultimately reducing grain quality and fertility (Gupta and Solanki, 2013 [13]; Da Rocha Pinho *et al*., 2015 [8].

Zinc is essential for the synthesis of plant growth regulator calledauxin (AA); such compound regulates the growth and development of plants. Zinc uptake is promoted by liberal use of foliar spray of nitrogen and potassium. That is the reason due to which fertilizer, enriched with zinc is preferable for intensive farming system. Zinc is necessary component of several enzymes participating in the synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids As well as in the metabolism of other micronutrients and plays an import role in the production of biomass (Cakmak 2008) [5].

Materials and Methods

Experimental site

The present investigation was conducted in field No. 35 at Students Instructional Farm (SIF) at Rama University, Mandhana, Kanpur (U.P.) during Rabi season of 2024-25. The experimental farm falls under the Indo - gangetic alluvial tract of Central Uttar Pradesh. The farm is well levelled and irrigated by tube well. Geographically, Kanpur is situated in the central part of U.P. and subtropical tract of North India between latitude ranging from 25° 56 to 28" 58 North and longitude 79° 31' to 80° 34' East and located on an elevation of about 125.9 meter above mean sea level in gangetic plain. The seasonal rainfall of about 816 mm received mostly from IInd Fortnight of June or first Fortnight of July to mid October with a few showers in winter season. The maximum and minimum temperature in the Rabi season usually occurs 35 °C and 15 °C, respectively.

Experimental protocol

Crop was fertilized uniformly at a rate of 120 kg N + 60 kg P2O5 + 40 kg K2O. Half amount of Nitrogen together with full amount of Phosphorous, and Potash were applied as basal at the time of sowing. Remaining half dose of nitrogen was top dressed into two split doses at 32 (first irrigation) and 56 days after sowing (DAS). The nitrogen, phosphorous, potassium were supplied through urea, DAP and muriate of potash respectively. Foundation seed of wheat variety Golden Halna (K-0424) was used @ 100 kg/ha. Seed of wheat variety Golden Halna (K-0424) was sown at row spacing 20.0 cm apart. Sowing of wheat was done by country plough treatment wise and after sowing planking was done. First irrigation was applied at CRI stage after 21 days and after that 3 additional irrigation were given to fulfilment of crop after 20-25 days interval. Two hands weeding by Khurpie were done in each plot as per requirement of crop to remove the weeds and break the upper soil layer to check evaporation. The details of the various culture operations followed from time to time duration the course of experimentation for clean cultivation of crop after 30-35 and 50-55 days after sowing of crop. The crop was harvested manually on 3 April 2020 first of all plot borders were harvested from all sides of plot separately and then crop of net plot were harvested. The harvesting is done manually with the help of sickle.

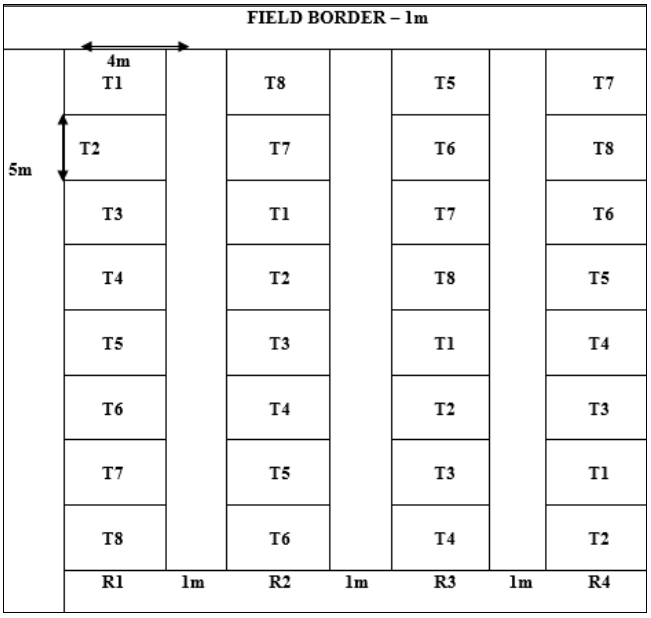

Fig 1: Layout plan of Experiment

Statistical analysis

For determining the significance of difference caused by different treatments data were subject to statistical analysis and significant response of 5% level have been computed whereas necessary. Critical difference has been worked out for comparison of mean values for various treatments and their effects.

Results and Discussion

Effect of treatment on shoot growth of wheat

It is obvious from the findings of the result that integrated doses of RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) treatments recorded significantly superior result in the treatments of shoot growth of wheat compared to individual doses of nutrients, FYM along with RDF in different treatment and control also. The superior imposed nutritional level RDF + Urea (@2.0%) + $ZnSO_4$ (@0.5%) + Borex (@0.2%) recorded maximum plant height i.e. 14.690, 81.620, 83,600 and 84.550 at 30 DAS, 60 DAS, 90 DAS and at harvesting stage. Respectively, fresh weight of is 15.740 g, 151.710 g, 102.960 g and 24,700 g at 30 DAS, 60 DAS, 90 DAS and at harvesting stage, respectively, the dry weight of shoot 2.440 g, 8.950 g, 20.620 g and 22.860 g at 30 DAS, 60 DAS, 90 DAS and at harvesting stage, respectively, number of tillers 2.500, 5.080, 5.310 and 5.430 at 30 DAS, 60 DAS, 90 DAS and at harvesting stage, respectively, leaf area 0.590 cm^2, 5.200 cm^2 and 4.600

cm² at 30 DAS, 60 DAS and 90 DAS respectively. The improvement in above growth characters under integrated doses of treatment may Be due to balance nutrition provided throughout treatment.

Effect of treatment on root growth

Balance nutrition provided through RDF + Urea (@2.0%) + $ZnSO_4$ (@0.5%) + Borex (@0.2%) treatments significantly improve the fresh weight of root, dry weight of root and root length recorded at different intervals compared to control treatment. The maximum fresh weight of root 6,780 g. 10.780g. 11.450 g and 10.25 g at 30 DAS. 60 DAS. 90 DAS and at harvesting stage, respectively. Dry weight of root 1.120 g, 1.780 g, 1.890 g and 1.930 g at 30 DAS, 60 DAS, 90 DAS and at harvesting stage, respectively and root length 4.150 cm, 10.500 cm, 11.130 cm and 11.180 cm at 30 DAS, 60 DAS, 90 DAS and at harvesting stage. Respectively recorded under RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) treatments. The improvement in root dynamics may be due to balance nutrition provided through the integrated dose treatment.

Yield attributes

The integration of RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) doses increased the yield attributes *viz*. Ear length, number of ear per plant, number of grain per ear and number of spikelet per ear compared to control treatment. The RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) treatment recorded maximum ear length is 10.710 cm, number of ear per plant is 5.220, number of grain per ear 47.450 and number of spikelet per ear 21.980 at Harvesting stage.

Effect of treatment on yield

The biological yield of wheat increased significantly under different treatment to the tune of 6.67% to 14.59% compared to lowest treatment i.e. RDF control treatment. The minimum increment 6.67% recorded under RDF+ FYM (@0.96 g/h) and maximum increment 14.59% recorded under RDF + Urea (2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) when compared to RDF control only treatment. Similarly grain yield of wheat increases to tune of 2.20% to 21.31% under different treatment the maximum value of grain yield recorded 41.210 q/ha, 21.31% under RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) treatment. Similarly straw yield of wheat increases tune of 7.72% to 12.57% when compared to lowest treatment i.e. RDF control only. The minimum increment 7.72% recorded under RDF + Urea (@2.0%) and maximum increment 12.57% under RDF + Urea (@2.0%) + $ZnSO_4$ (@0.5%) + Borex (@0.2%) when compared to RDF control treatment.

Effect of treatment on economics

The gross income evaluated on the basis of Grain and straw yield and price of produce shown significant increment in gross income under different treatment. The gross income increased to the tune of Rs 5976 and 4.91% to Rs 18835 and 15.49% compared to RDF control treatment. The minimum gross income Rs 5976 and 4.91% is under RDF + FYM (@0.96 g/h) and maximum gross income Rs 18835 and 15.49% is under RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) treatment. The net profit varies to the tune of 6.44% to 22.92% under 47 Different treatment. RDF + ZnSO4 (@0.5%) + Borex (@0.2%) and RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) registered net income of 10.41% and 22.92% respectively. The minimum beneficial Cost ratio is 0.55 recorded under RDF + Urea (@2.0%) + ZnSO4 (@0.5%) and maximum B:C ratio is 13.84 recorded under RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) treatment.

Conclusion

The plant population per m² (cm) measured at 30 DAS stage of crop growth was significantly higher with combine application of treatment RDF + FYM (@0.96q/h) over remaining treatments. The plant height (cm) measured at 30 DAS stage of crop growth was significantly higher with combine application of treatment RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) over remaining treatments. The plant height (cm) measured at 60 DAS stage of crop growth was significantly higher with combine application of treatment RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) over remaining treatments. The leaf area index (cm²) was recorded at 30, 60 and 90 DAS was significantly higher with combine application of treatment RDF Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) over remaining treatments. The number of ear per plant was significantly higher with combine application of treatment RDF+ Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) over remaining treatments. The number of grain per ear was significantly higher with combine application of treatment RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) over remaining treatments. The test weight was significantly higher with combine application of treatment RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) over remaining treatments. The biological yield (q/ha) of wheat was significantly affected by combine application of treatment RDF + Urea (@2.0%) + ZnSO4 (@0.5%) + Borex (@0.2%) with a mean value of 168.330 q/ha over remaining treatments. The grain yield (q/ha) of wheat was significantly affected by combine application of treatment RDF + Urea (@2.0%) + ZnSO4 (@0.5%) - Borex (@0.2%) with a mean value of 41.210 q/ha over remaining treatments.

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