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Effect of Foliar Application of Nano Urea on Yield Attributes and Yield of Wheat (*Triticum durum* Desf.) in Malwa Region of Madhya Pradesh

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ABSTRACT: The present experiment entitled "Effect of foliar application of nano urea on yield attributes and yield of wheat (*Triticum durum* Desf.) in Malwa region of Madhya Pradesh." was conducted during *rabi* season in year 2022-23 at Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, College of Agriculture, Indore (M.P.). The experiment was laid out in RBD (Randomized Block Design) with 8 treatments and three replications. The treatment consists of T_1 (Control (only P_2O_5 and K_2O applied)), T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)), T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea rest N top-dressed) with P_2O_5 and K_2O), T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU), T_5 (Only P_2O_5 and K_2O applied as basal + 60 kg/ha N top dressed + 2- spray of 4% NU), T_6 (2-spray of 4% NU with P_2O_5 and K_2O), T_7 (2-spray of 4% NU without P_2O_5 and K_2O) and T_8 (High organic N (Neem cake) with 2-spray of 4% NU (no P_2O_5 and K_2O)). The results showed that the Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea rest N top-dressed) with P_2O_5 and K_2O treatment (T_3) performed the best in terms of number of effective tillers/plant, length of ear head (cm), test weight (g), grain yield (kg/ha), straw yield (kg/ha), biological yield (kg/ha) and harvest index (%). This was followed closely by the treatment involving sequential application of Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O) (T_2) and Basal 60 kg/ha N with P and K + 2-spray of 4% NU (T_4). The Control (only P_2O_5 and K_2O applied) treatment (T_1) consistently gave the lowest values for all the parameters measured. Overall, the findings suggest potential benefits of foliar nano urea application on wheat productivity in the study region.

Keywords: Nano Urea, Foliar Application, Wheat, Yield Attributes, Recommended NPK Dose, Basal NPK Application, Top Dressing, Malwa Region, Madhya Pradesh.

INTRODUCTION

Wheat (*Triticum durum* L.) is the most important staple food crop and it consumed about 36% of the world population and improvement in its productivity has played a key role in making the country self-sufficient in food grains (Tiwari *et al.*, 2017). Wheat is an annual grass that belongs to the Poaceae family. The crop is typically planted in the fall and harvested in the summer, although the exact timing may vary depending on the climate and growing conditions. Wheat is one of the chief sources of diet by providing half of the dietary protein and more than half of the calories to the rising population of India. As a consequence, Scientists are always focusing to produce higher yields to feed the nation (Khan *et al.*, 2015).

Triticum durum commonly known as durum wheat, is an important wheat species cultivated globally for the production of semolina flour used in making pasta, couscous and some types of bread (Feillet and Dexter 1996). T. durum is a tetraploid species (genome AABB, 2n = 4x = 28) that originated from the Fertile Crescent around 8,000–10,000 years ago through the hybridization of wild diploid species *T. urartu* (genome AA) and an unknown Aegilops species with a BB genome (McFadden and Sears 1946).

The nutritive value of wheat is fairly high as compared to other cereals. It contains protein (11.80%), fat (1.50%), carbohydrates (71.20%), mineral matter (1.50%), calcium (0.50%) and phosphorus (0.32%) (Swaminathan *et al.*, 1981). Wheat protein is known as gluten which provides the structural framework for the spongy, cellular texture of bread and bakery products. Apart from food purposes, wheat grains have also industrial importance for manufacturing paste, alcohol,

gluten etc. Residues obtained after milling *i.e*. bran used as cattle feed. Wheat straw is utilized as a fodder for livestock feeding the and also useful in manufacturing mattresses, straw hats, paper and articles of art purposes. Wheat straw is also a good source of bedding material for livestock.

Wheat is cultivated in at least 63 countries of the world. The leading countries in wheat cultivation are China, India, Russia, U.S.A and Canada (IWPS, 2022). Total world production of wheat was 772 million tons an on area of 218 million hectares with a productivity of 2960 kg ha^{-1} (IWPS, 2022). Wheat is the second important cereal crop after rice in India. It is cultivated in 31.61 million ha area with an annual production of about 109.52 million tonnes and average productivity of 3464 kg/ha (GOI, 2021).

MATERIAL AND METHOD

The field experiment was carried out during the *rabi* season of 2022-23 at the Agricultural Research Farm of Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya located in Indore, Madhya Pradesh, India. A randomized block design with 8 treatments and three replications was used for conducting the experiment. The total number of plots was 24 (8 treatments x 3 replications). The individual plot size was 5m × 3m. Wheat variety ' HI 8759 ' was used for sowing. Observations on various yield attributes like number of effective tillers/plant, ear head length, test weight, grain yield, straw yield, biological yield and harvest index were recorded.

Number of effective tillers/plant. Number of tillers per plant was counted five tagged wheat plant in each plot and finally total number of tillers was expressed in average number of effective tillers per plant.

Length of ear head (cm). Length of ear head (cm) were sampled from the tagged plants in each plot. The length was measured in cm which help of scale. The mean length of ear head was computed and expressed in cm.

Test weight (g). After threshing and weighing, a random sample of grains was drawn from grain yield of each plot. From this sample, 1000 grain was counted and their weight (g) was recorded.

Grain yield (kg/ha). After taking the weight of total biomass, the produce of each net plot was threshed, clean grains were separated sun dried to maintain 12-14% moisture. The grain yield was recorded in kg $plot^{-1}$ and finally the values were converted into kg/ha.

Straw yield (kg/ha). All the above ground biomass of experimental crop of every plot was harvested than sun dried and weighed in kg/plot and finally converted in to kg/ha.

Biological yield (kg/ha). All above the ground plant parts of the net plot were dried and weighed in kg per plot to represent the biological yield and finally converted in to kg ha^{-1}.

Harvest index (%). Harvest index is the ratio of the economic yield to biological yield which was calculated. It was expressed in percentage.

$$\text{HI}(\%) = \frac{\text{Grain yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \times 100$$

RESULT

The data regarding effect of foliar application of nano urea on yield attributes of wheat (*Triticum durum* Desf.) in Malwa region of Madhya Pradesh has been presented in Table 1.

Number of effective tillers/plant. The significantly maximum (189.27) no. of effective tillers/meter row length were found in the treatment T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top-dressed) with P_2O_5 and K_2O), which was at par with the treatment, T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)) (185.60) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU) (179.49). Significantly minimum no. of effective tillers/meter row length (156.18) was observed in treatment T_1 (Control (only P_2O_5 and K_2O applied)). Also, similar results were reported by Anonymous (2021).

Length of ear head (cm). The significantly maximum (8.13 cm) length of ear head (cm) was found in treatment T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top-dressed) with P_2O_5 and K_2O), which was at par with the treatment, T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)) (7.93 cm) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU) (7.79 cm). Significantly minimum length of ear head (cm) (5.09 cm) was observed in treatment T_1 (Control (only P_2O_5 and K_2O applied)). Also, similar results were reported by Anonymous (2021).

Test weight (g). The significantly maximum (49.29 g) test weight (g) was found in treatment T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top-dressed) with P_2O_5 and K_2O), which was at par with the treatment, T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P2O5 and K2O)) (48.79 g) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU) (47.93 g). Significantly minimum test weight (g) (36.25 g) was observed in treatment T_1 (Control (only P_2O_5 and K_2O applied)). Also, similar results were reported by Anonymous (2021).

Grain yield (kg/ha). The significantly maximum grain yield (3810.22 kg/ha) was obtained in the treatment T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top-dressed) with P_2O_5 and K_2O), which was at par with the treatment, T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)) (3759.72 kg/ha) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU) (3452.86 kg/ha). Significantly minimum grain yield (1800.18

kg/ha) was observed in the treatment T_1 (Control (only P_2O_5 and K_2O applied)). These outcomes are consistent with findings of Islam *et al.* (2023).

Straw yield (kg/ha). The significantly maximum straw yield (4720.22 kg/ha) was recorded in the treatment T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top-dressed) with P_2O_5 and K_2O), which was at par with the treatment, T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)) (4559.72 kg/ha) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU) (4252.86 kg/ha). Significantly minimum straw yield (2680.18 kg/ha) was observed in treatment T_1 (Control (only P_2O_5 and K_2O applied)). Similar study were also observed by Ojha *et al.* (2023); Mehta and Bharat (2019).

Biological yield (kg/ha). Among the data significantly maximum (8530.44 kg/ha) biological yield (kg/ha) was found in treatment T_3 (Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top-dressed) with P_2O_5 and K_2O), which was at par with the treatment, T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)) (8319.44 kg/ha) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU) (7705.72 kg/ha). Significantly minimum biological yield (kg/ha) (4480.36 kg/ha) was observed in treatment T_1 (Control (only P_2O_5 and K_2O applied)). Similar result was also found by Al-Juthrey *et al.* (2019).

Harvest index (%). Among the data significantly maximum (45.17 %) harvest index (%) was found in treatment T_2 (Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)) (8319.44 kg/ha), which was at par with the treatment, T_6 (2-spray of 4% NU with P_2O_5 and K_2O (44.87 %) and T_4 (Basal 60 kg/ha N with P and K + 2-spray of 4% NU)), Significantly minimum harvest index (%) (40.17 %) was observed in treatment T_1 (Control (only P_2O_5 and K_2O applied)). The results obtained in the present study are supported by the works of Gangwar *et al.* (2022); Mehta and Bharat (2019).

Table 1: Effect of foliar application of nano urea on number of effective tillers/meter row length, length of ear head (cm), test weight (g), grain yield (kg/ha), straw yield (kg/ha), biological yield (kg/ha) and harvest index (%).

Tr. No.	Treatment Details	No. of effective tillers/meter row length	Length of ear head (cm)	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T_1	Control (only P_2O_5 and K_2O applied)	156.18	5.09	36.25	1800.18	2680.18	4480.36	40.17
T_2	Recommended dose of fertilizers (120-60-40 kg/ha of N, P_2O_5 and K_2O)	185.60	7.93	48.79	3759.72	4559.72	8319.44	45.17
T_3	Recommended dose of N fertilizers (Basal 60 kg/ha N + 2-spray of 2% Urea + rest N top dressed) with P_2O_5 and K_2O	189.27	8.13	49.22	3810.22	4720.22	8530.44	44.66
T_4	Basal 60 kg/ha N with P and K + 2-spray of 4% NU	179.49	7.79	47.93	3452.86	4252.86	7705.72	44.79
T_5	Only P_2O_5 and K_2O applied as basal + 60 kg/ha N top dressed + 2-spray of 4% NU	173.46	7.46	46.60	3242.53	4042.53	7285.06	44.51
T_6	2-spray of 4% NU with P_2O_5 and K_2O	168.11	6.84	44.71	3033.64	3733.64	6767.28	44.87
T_7	2-spray of 4% NU without	159.25	6.34	40.59	2442.52	3142.52	5585.04	43.63
T_8	High organic N (Neem cake) with 2-spray of 4% NU (no P_2O_5 and K_2O)	163.26	6.59	42.83	2830.76	3530.76	6361.52	44.56
	SEm±	**4.09**	**0.28**	**4.69**	**108.91**	**120.58**	**215.21**	**0.65**
	CD (0.05)	**12.42**	**0.88**	**NS**	**330.35**	**365.75**	**652.77**	**1.97**

CONCLUSIONS

Based on the results, foliar application of nano urea was found to improve yield attributes of wheat. Treatment T_3, which received the recommended dose of nitrogen fertilizer along with foliar sprays of nano urea, recorded the highest number of effective tillers, ear head length, test weight, grain yield, straw yield and biological yield. However, these parameters were also improved under T_2 and T_4 treatments involving recommended NPK dose and basal nitrogen with nano urea sprays, respectively. In contrast, the control treatment T_1 showed the lowest values. Therefore, the study concluded that foliar application of nano urea has the potential to enhance wheat productivity and yields in the study region.

FUTURE SCOPE

The promising results of this study indicate that foliar application of nano urea can significantly influence yield attributes and grain yield of wheat under the agro-climatic conditions of the Malwa region. However, further studies are recommended to evaluate the long-term effects of nano urea on soil health and crop quality. Additionally, the integration of nano urea with precision nutrient management practices and its impact on different wheat varieties across diverse agro-ecological zones could provide deeper insights and support its large-scale adoption among farmers. Exploring its environmental implications and cost-effectiveness at the farm level will also be crucial for sustainable agricultural practices.

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