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Nano Nitrogen for Increasingyield of Maize (*Zea mays* L.)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Nitrogen fertilizers play an important role in the cultivation of crops, excessive and improper usage of fertilizers cause severe issues with respect to human and environment. It is essential to go for alternative sources of nitrogen like nano nitrogen with slow and controlled release of nitrogen.An experiment was conducted at Agriculture Research Farm, Lovely Professional University, Phagwara, during *kharif* 2022 by using the nano source of nitrogen in maize crop.The experiment was laid out in the randomized block design with eight treatments replicated thrice.Among the different combinations of recommended dose of fertilizers along with nano urea the treatment applied with 100% N+Nano N applied twice at 30 and 60 days after sowing(T6) was thebest treatmentin terms of growth and yield (7.2 t/ha).

Keywords: Environment; fertilizers; maize; nanonitrogen; recommended dose.

1. INTRODUCTION

Maize (*Zea mays* L) is the third-largest cereal crop in the world after wheat and rice and it grows worldwide in both irrigated and rain-fed regions [1]. India produces 21.81 (MT) of maize in an area of 8.69million hectares [2]. Maize is cultivated on around 150 million hectares

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across 160 nations with a diverse range of soil types, climates, biodiversity, and management techniques, contributing 36% (782 MT) to the world's grain supply. The world's greatest producer of maize, the United States of America (USA), accounts for about 35% of global production [3]. Maize required a lot of nutrients for their growth and development because of the exhaustible nature of the crop. The crop's productivity depends upon the nutrient management system. When fertilizers are applied directly to the soil, nutrients are lost through a wide variety of processes including photolysis, hydrolysis, leaching, and degradation. Therefore, the fertilizer provided may not be able to reach the desired locations in the plant's system and may not be able to promote the best possible development and productivity of crops. Consequently, an effort was under taken to minimize nutrient loss and improve nutrient utilization by implementing strategies that optimize nutrient retention and uptake by foliar spray of nano nitrogen [4]. Compared to traditional fertilizers, nano fertilizers are being studied as a strategy to improve plant nutrition and boost nutrient use efficiency. It is a new agricultural input intended for gradually and carefully releasing nutrients into the soil, preventing environmental harm and enhancing crop development and yield [5]. Volatilization is reduced by directly applying nano urea to the plant. It enables the nutrient to be readily absorbed by the tissues of the plant. The plant components store the leftover nutrients, which could then be progressively used when necessary. Combining nano fertilizers with conventional fertilizers increases the effectiveness of nutrient absorption [6]. Significant increase in plant height, chlorophyll, number of grains per cob and yield of maize was observed when the plots are treated with 75% RDF + foliar application of nano urea @ 4ml/L [7]. Ghobashy et al., [8] reported that maize hybrids had a significant effect on growth and yield attributes of maize. 75% mineral N along with 25% nano N application increased growth, yield and yield components of maize in both seasons. Al-Saray and Al-Rubaee [9] reported that a significant difference was observed among the different fertilization treatments. Application of nano fertilizer resulted in the highest yield and yield attributes during both spring and autumn seasons.

2. MATERIALS AND METHODS

The experiment was conducted at the Research Farm of School of Agriculture, Lovely Professional University, Phagwara, Punjab in 2022. The study area is in Chaheru village of Kapurthala district, which lies in the northern plain zone between 31.26° N, 75.70°E. The experiment was planned and laid out using randomised block design, with 8 treatments T1:Control, T2: Recommended NPK, T3: Recommended NPK +1 foliar spray of nano urea at knee height stage, T4: 50% N + Full dose of PK+1 foliar spray nano of urea at knee height stage, T5: 25% N + Full dose of PK+1 foliar spray nano of urea at knee height stage, T6:Recommended NPK +2 foliar spray of nano urea at knee height stage and silking stage, T7: 50% N + Full dose of PK+2 foliar spray of nano urea at knee height stage and silking stage, T8: 25% N + Full dose of PK+2 foliar spray of nano urea at knee height stage and silking stage, replicated thrice. Hybrid maize TA 5084 was sown on 18thMay, 2022at seed rate of 25 kg per hectare, with spacing (plant to plant X row to row) 60 X 20 cm. The application of nutrients was done as per the package and practices of PAU. Nano nitrogen @ 2ml / litre at knee height and tasselling stages of crop. Five irrigations were applied at four-leaf stage, knee height stage, tasselling stage, skilling stage and dough stage. Observations on various growth parameters like height of the plant were recorded using scale, chlorophyll content were recorded using SPAD meter, at 30-day intervals. Based on the visual inspections, the crop was harvested after 110 daysat the appropriate stage of maturity. Cobs and stover were weighed by using a weighing machine separately for their fresh & dry weights and the data was statistically analysed.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The effect of different treatments on growth parameters were significant in nano urea application treatments.

3.2 Plant Height (cm)

It is evident from Fig. 1 that in terms of plant height, the tallest plants (218.7cm) were observed under T6 (Recommended NPK +2 foliar spray nano urea at knee height stage and silking stage) and was at par with T7 and T3.The shortest plant height (168 cm) was observed in T1. Radwan et al., 2017 found that highest value (193.73) of maize plant height was obtained when foliar applications of nano-fertilizers and soil application of conventional fertilizers.

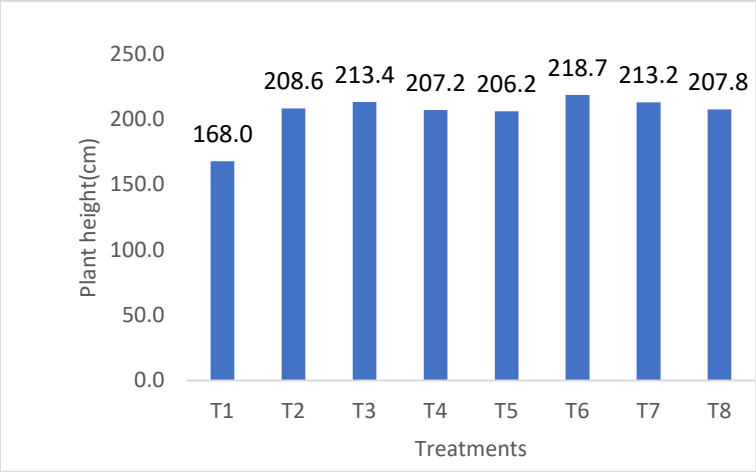

Fig. 1. Effect of plant height under various treatments

3.3 Chlorophyll Content

In terms of chlorophyll content (Fig. 2) the highest values (44.5) were recorded by application of T6 (Recommended NPK +2 foliar spray nano urea at knee height stage and silking stage) followed byT3 (43.8) while the lowest value (38.5) were observed in T1. The highest chlorophyll content was recorded in treatments that received nano urea, indicating that nano urea can improve the photosynthetic efficiency of plants, leading to higher chlorophyll content [10]. The reason that nano-fertilizers have a higher surface and reactive area is more because they contain very small or tiny particles, which provide them more sites to promote various metabolic processes in the plant system, leading to increased photosynthetic production and ultimately increasing the growth and yield of maize (Dwivedi et al., 2018).

3.4 Yield Attributes

For yield parameters as presented in Figs. 3 & 4, the highest test weight (35.7 g) and number of grains per row (25.3) was recorded in T6i.e.Recommended NPK +2 foliar spray nano urea at knee height stage andsilking stage, followed by T3 (Recommended NPK +1 foliar spray nano urea at knee height stage) and while the lowest test weight (22.7 g) and number of grains (17.3) was observed in control [11]. Kumar et al.,(2021) observed that application of nano nitrogen increases productivity and grain output by enhancing photosynthesis and nutrient translocation. The above results are supported by Alzreejawi et al., [12]. The highest values were recorded in treatments that received multiple applications ofnano urea (T6), indicating that sustained application of nano urea may provide better results than a single or reduced nitrogen application.

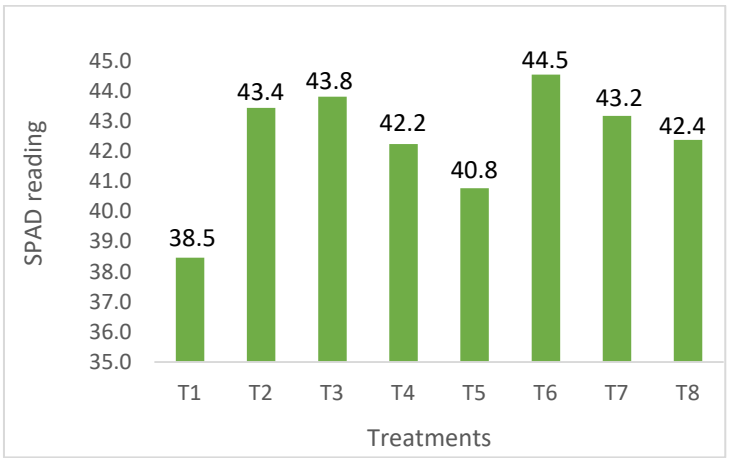

Fig. 2. Effect of nano nitrogen on chlorophyll content

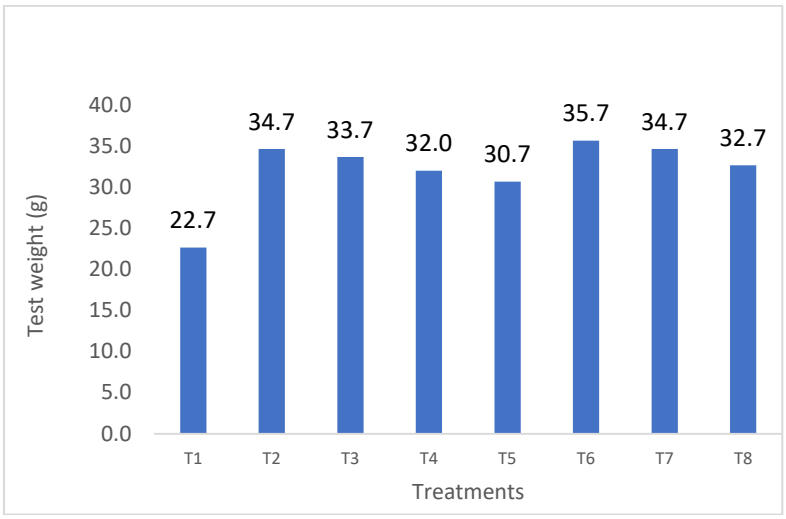

Fig. 3. Effect of nano nitrogen on test weight

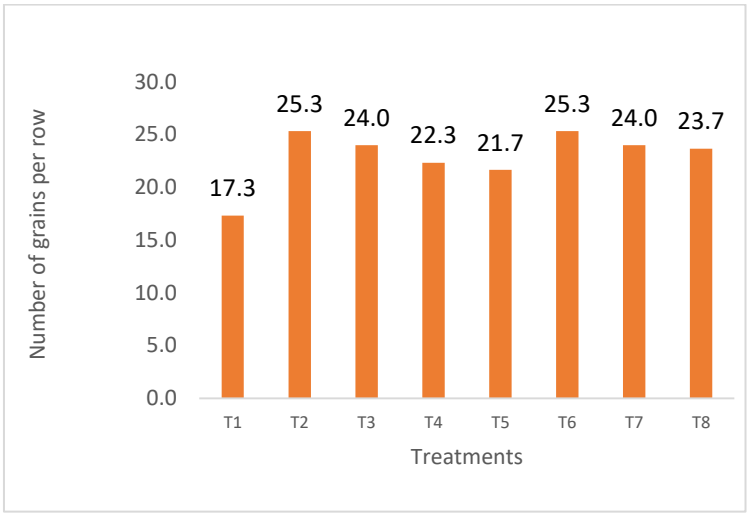

Fig. 4. Effect of nano nitrogen on number of grains per row

4. CONCLUSION

Based on the research conducted on the effects of nano nitrogen on the growth and yield of maize, it can be concluded that the use of nano nitrogen can positively impact the growth and yield of maize. The application of recommended NPK +2 foliar spray nano of urea at knee height stage and silking stage (T6) has been shown to increase plant height (218.7 cm), chlorophyll content (44.5), test weight (35.7 g) which ultimately resulted in increase in yield(72.6 q/ha).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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