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Effect of Foliar Application of Nano Urea on Growth and Yield of Maize (*Zea mays* L.): A Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

maize requires large amounts of nutrients for appropriate growth, production and yield, it is regarded as a crop that is nutrient-exhaustive. The nutrient requirements of the maize crop can be maintained with the use of effective nutrient management techniques. Nanotechnology is gradually making its way from the experimental to the useful realms, like the development of slow-release

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fertilizers, conditional release of pesticides and herbicides, on the basis of nanotechnology has become critically important for promoting the development of environment friendly and sustainable agriculture. Traditional fertilisation techniques may undergo a revolution thanks to the inherent features of nanoparticles, which enable improved nutrient absorption, precision distribution and greater bioavailability. The results, as evidenced by multiple studies, indicate significant improvements in growth parameters, seed production, and overall plant health.

Keywords: Nano urea; sustainable agriculture; Environment; maize.

1. INTRODUCTION

"Maize is the third most essential cereal crop after rice and wheat, respectively. It serves as a staple food crop to people residing in rainfed areas" [1]. Maize is also known as "Queen of Cereals". Among the cereals, maize is the only cereal having the ability to attain highest yield potential [2]. The nutritional value of maize is high as it contains 72% starch, 10% protein, 8.5% fiber, 4.8% oil, 3.0% sugar and 1.7% ash.

"Nano Urea (Liquid) includes nanoscale nitrogen particles with 10,000 times the surface area and number of particles of 1 mm Urea prills (55,000 nitrogen particles over 1 mm Urea prill). When compared to urea, nano urea has an uptake efficiency of more than 80%. Stead of dumping granular urea into the soil, nano urea in liquid form can be sprayed directly on the leaves during two important growth stages of a crop. A 45 kg bag of urea can be replaced with a 500 ml vial of nano urea" [3]. "Nanotechnology comes into play and nano fertilizers can go a long way in ensuring sustainable soil health and crop production" [4]. "In recent years, researchers have tended to study several modern techniques in the agricultural field, particularly the possibility of using nanotechnology to improve fertilizer use efficiency towards the design and development of so-called nano fertilizers (NF)" [5]. "Nano fertilizers are important in modern agriculture having appropriate formulations and delivery mechanisms to ensure optimal uptake in plants" [6].

2. PLANT HEIGHT

The highest plant height recorded in 100% RDN + FSNU @ 4 ml/l at knee height and tasseling (234.1 cm) [1]. This result similar finding to Movahhedi [7] and Mohapatro *et al*. (2021). Application of nano urea (2-4 ml of Nano urea (4 % N) in one litre of water and sprayed on crop leaves at its active growth stages) increase plant height (42 cm) in blackgram as compare to control [8]. The maximum plant height (178.46 cm) recorded application of Nitrogen 100 kg/ha with the application of Zinc 30 kg/ha [9]. the experiment on *kharif* during maize. The treatment combination of Nano urea (50 %) along with urea (50%) recorded significantly higher plant height (195.80 cm) this experiment was conduct on *kharif* maize [10]. The experiment conduct on *kharif* maize the treatment combination of zinc (15 kg/ha) along with the application of nitrogen (200 kg/ha) recorded significantly higher plant height (232.6 cm) [11]. The experiment was done on *kharif* maize the treatment combination of Zinc (15 kg/ha) along with nitrogen (150 kg/ha) recorded significantly higher plant height (148.23 cm) [12]. The higher plant height (82.23 cm) was recorded with the application of Nitrogen (Nano urea) @ 3000 ppm and Boron @ 0.3 kg//ha (Sudhir et al. 2023). Foliar spray of Nano Urea at knee stage and tasselling stage could be an ideal technological alternative to achieve sustainability in irrigated maize (Samui et al. 2021) and significantly increased the plant height. Foliar nitrogen application through Nano-N resulted in notably greater plant heights in Oats [13].

3. PLANT DRY WEIGHT

The maximum Plant Dry weight was recorded (105.58 g) under Nitrogen 100 kg/ha with the application of Zinc 30 kg/ha [9]. Nitrogen increase more protein synthesis at higher nitrogen rate induced vegetative growth which resulted in increase photosynthesis surface that stimulated more leaf blade size [14]. The maximum plant dry weight (22.41 g) was recorded with the application of Nitrogen (Nano urea) @ 3000 ppm and Boron @ 0.3 kg//ha (Sudhir et al. 2023).

4. YIELD ATTRIBUTES

4.1 Number of Cob/Plants

The experiment conduct during *kharif* maize recorded highest number of cobs/plant (4.19) application of Zinc 30 kg/ha along with nitrogen 120 kg/ha [9]. The data recorded highest number of cobs/plant (2.47/plant) $ZnSO_4$ 30 kg/ha with the foliar application of Nano urea 3 ml/l [15].

4.2 Yield

The results indicated that application of 100% RDN+FSNU @ 4 ml/L at knee height and tasselling was significantly (6.84 t/ha) this result similarly finding were observed by Rathnayaka et al. [16], Alimohammadi et al. [17], Bhuiya et al. [18] and Mohanta et al. [19]. Significantly higher grain yield (8926 kg/ha) recorded in treatment Nano urea (50%) along with urea (50%) during *kharif* maize [10]. The experiment conduct on *kharif* maize the treatment combination of zinc (15 kg/ha) along with the application of nitrogen (200 kg/ha) recorded significantly higher grain yield (4564 kg/ha) (Iqbal *et al*. 2016). The highest seed yield per plant (14.34 g) recorded with foliar application of nitrogen (Nano urea) @ 300 ppm (Sudhir *et al.* 2023). Nano urea applied at tillering and pre-flowering stage was found superior in terms of growth, yield parameters and yield of finger millet [20].

4.3 Stover Yield

The experiment was done on *kharif* maize the treatment combination of Zinc (15 kg/ha) along with nitrogen (150 kg/ha) recorded significantly higher stover yield (11.20 t/ha) [12]. The experiment conduct during *kharif* maize recorded highest stover yield (54.8 q/ha) application of Zinc 30 kg/ha along with nitrogen 120 kg/ha [9, 21, 22].

5. CONCLUSION

It may be concluded that foliar application of Nano urea on Maize brought changes in growth, yield and yield attributes in vegetative and reproductive growth for higher production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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