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Effects of Conventional Urea and Nano Urea Application on Growth and Yield of Maize (*Zea mays* L.)

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ABSTRACT

Maize (*Zea mays*) is one of the most significant staple food crops in the world, it is a monocotyledonous plant that is a member of the Poaceae family. It is crucial to close the maize yield gap in order to fulfil the demand pressure brought on by a fast-expanding population for food. One of the best methods to bridge the gap between actual and prospective production was to provide an adequate quantity of nutrients at the appropriate time and through the appropriate source.The trial was accomplished during the Kharif season in the year 2022-2023 on the PMH13 Variety of Maize. In this study, eight treatments were used to study their influence on Maize growth and yield. The experimental design followed was a Randomized block design which consists of 8 treatment combinations and was replicated three times. The study revealed that the maize has shown a significant response to nano urea with regard to growth and yield attributes. It had observed that the growth and yield parameters of the maize have shown an increasing trend in all the parameters. The maximum plant height was observed at 197.80 cm in T5 (75% RDN+Nano urea @ 4 ml/l) and the minimum was recorded as 156.67 cm in T1 (Absolute control) respectively. Whereas, maximumgrain yield was recorded as 65.23 q/ha in T5 (75% RDN+Nano urea @ 4 ml/l) followed by 63.57q/ha in T4 (75% RDN+Nano urea @ 2 ml/l) and the minimum was obtained as 27.63 q/ha in T1 (Absolute control). This study concluded that the nano urea can be used as a sustainable Agri-input and increased yield.

Key words : *Maize, Urea, Nano urea, Growth, Yield, Recommended dose nitrogen.*

Introduction

Maize (*Zea mays*) is one of theOne of the most significant staple food crops in the world, it is a monocotyledonous plant that is a member of the Poaceae family. It comes in third place in terms of output and acreage after rice and wheat (Maitra *et al*., 2019, 2020). It had higher yield compared to other cereals. The third-most significant cereal crop is maize, behind rice and wheat. With an average yield of 3057 kg/ha, maize accounts for 30.16 million tonnes of production in India from an area of 9.87 million hectares (FAOSTAT, 2020). It is cultivated on nearly 150 m ha in about 160 countries. It is crucial to close the maize yield gap in order to fulfil the demand pressure brought on by a fast-expanding population for food (Maitra *et al*., 2019). One of the best methods to bridge the gap between actual and prospective production was to provide an adequate quantity of nutrients at the appropriate time and through the appropriate source.

Fertilization is a fundamental cultural activity in agricultural systems across the world, and it has a significant impact on crop output. Mineral fertiliser

application is a major management method that plays a vital role in increasing crop production and, as a result, sustaining sufficient food and feed supplies across the world (Chaudhary *et al.,* 2017). Considering nitrogen has such a strong impact on a plant's vegetative development, its accessibility and affordability are factors in greater acceptance and indiscriminate use, respectively (Li *et al.,* 2017). Yet, in spite of the abundant supply of nitrogen, its availability was extremely low because of its increased vulnerability to losses, including leaching, volatilization, and denitrification (Nduwimana *et al.,* 2020; Meena *et al*., 2021). In the long term, using nitrogen-based fertilisers less effectively might degrade maize quality and harm the ecosystem. To achieve agricultural sustainability, it is now imperative to embrace slow-release nitrogen fertilisers that are comparably more effective.

Nano sized fertilizers are important for nanotechnology for a sustainable agriculture. An appropriate substitution for nitrogen fertilisers at the macro scale would be the use of nanotechnology as a source of nitrogen (Madzokere *et al*., 2021). The greater surface to volume ratio caused by the nano size optimises the need for fertiliser, in comparison. Data on the relative effectiveness of nano urea compared to urea on maize, however, were limited.In comparison to conventional urea, liquid urea application of Nano Urea at plant's need for nitrogen is efficiently used during the crop growth phases. crop growth stages of a plant effectively use its nitrogen requirement and increases crop productivity and quality. The current experiment's goal is to assess the results of spraying nano-urea at two distinct phases of urea at growth-knee height and tasselling, respectively over urea at various amounts of nitrogen.

Materials and Methods

The present study was conductedat the research farm of the Department of Agronomy, Lovely Professional University, Phagwara, Kapurthala district, which is located in the sub-tropical region of the central plains of Punjab, a research trial was carried out in the Kharif season of 2022–2023. The farm, which is 252 meters above mean sea level and 20 km from Jalandhar city in Punjab, is precisely situated between geographical coordinates of 31.24 North latitude and 75.6909 East latitude. The area has sandy loamy to clay-textured soil with a pH range of 7.8 to 8.5. The current site falls under the classification of the Trans-Gangetic Agro-climatic zone. It receives 527.1 mm of rainfall on average each year.

To meet the appropriate tilth requirement of the maize crop, the soil in the study area was ploughed once with a tractor with cultivator followed by two turnings with a rotavator. The maize hybrid 'PMH13' seeds were sown on 22 June 2022 with a seed rate of 10kg/acreby using flat bed method at 60 cm × 20 cm spacing. The dimensions of each plot were taken as 5m × 4m. The crop was harvested on 30September 2022. The fertilizers were applied considering 110:150:20 kg/acre of N: P_2O_5: K_2O as recommended dose. Half dose of N and full dose of P_2O_5 and K_2O were applied at the time of sowing and the remaining half of nitrogen was applied astop dressing at knee high stage. Apart from the treatments, all other agronomic management practices were performed as per the package of practice recommended to this region.

The experiment was set out in randomized block design with 8 treatments and three replications. The treatments under this research were namely T1: (control), T2: (100% RDN) (recommended dose of nitrogen), T3: (75% RDN+Nano urea spray@ 1 ml/l water), T4:(75% RDN+ Nano urea spray@ 2ml/L water), T5:(75% RDN+ Nano urea spray@ 4 ml/l water), T6: (50% RDN+ Nano urea spray@1ml/L water), T7: (50% RDN+Nano urea spray@ 2 ml/l water), T8: (50%RDN+Nano urea spray@ 4ml/l water). The nano-urea manufactured by Indian Farmers Fertilizer Cooperative Limited (IFFCO) was used in this trial.

The data related to plant height (cm), number of leaves, was recorded at 30 days, 60 days and at the time of harvest respectively. And grain yield (q/ha), stover yield (q/ha), biological yield (q/ha) were recorded at harvest. The analysis of the variance of the data was done statistically in OPSTAT.

Results and Discussion

Growth parameters

The growth parameter, plant height (cm) was analysed statistically and presented in Table 1 and graphically represented in Fig. 1. The results indicated that the plant height evaluated in this study were significantly influenced by all the treatments over T1 control (no nitrogen application). The maximum plant height was recorded with T5(75%

RDN+Nano urea @ 4 ml/l), which was statistically at par with T8(50% RDN+ Nano urea@ 4 ml/l) applied at knee height and tasselling, respectively as shown in Table 1 and Fig. 1. However, T5(75% RDN+Nano urea @ 4 ml/l) was statistically at par with T2 (100% RDN) without foliar spray of nano-urea and T2 (100% RDN) was statistically at par with T6 (50% RDN+ Nano urea@1 ml/l) and T1 (control). And minimum plant height was recorded

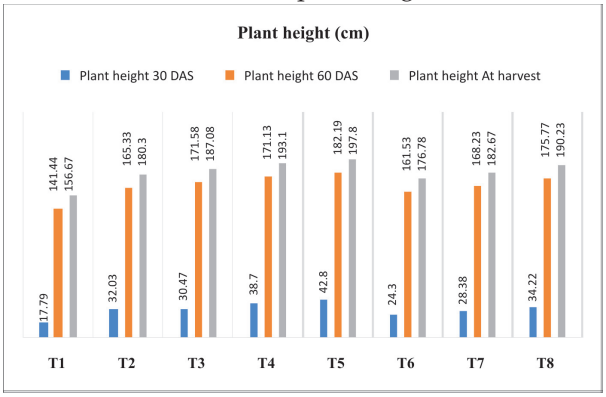

Fig. 1. Effects of Nano urea application on plant height at 30, 60 DAS and at harvest.

with T1(control). This might be attributed due to increase in cell growth as influenced by the nitrogen availability and these results were in agreement with the findings of (Movahhedi, 2015) and (Mohapatro *et al*., 2021).

The number of leaves per plant was found highest in T5 (75% RDN+Nano urea @ 4 ml/l) and lowest in T1 (control) with 8 leaves per plant and 3.67 leaves per plant respectively at 30 days, and at 60 days 15.33 leaves per plant and 7.33 leaves per plant respectively and 16 leaves per plant and 8.67 leaves per plant respectively at 90 days as shown in Table 1.

Yield Parameters

The results obtained from grain yield, stover yield and biological yield have been represented in Table 2. Nano urea applied treatments showed much influence on the grain yield of kharif maize. The data of grain yield revealed that the treatment T5 (75% RDN+Nano urea @ 4 ml/ l) produced the highest yield of (65.23 q/ha). The treatments with T4 (75% RDN+ Nano urea spray@ 2ml/l water) and T8 (50%

Table 1. Growth parameters plant height(cm) and no. of leaves.

Treatment	Plant height (cm)			No. of leaves		
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T1 Control	17.79	141.44	156.67	3.67	7.33	8.67
T2 100% RDN	32.03	165.33	180.3	5.67	11	12
T3 75%RDN+Nano urea @1 ml/l	30.47	171.58	187.08	6.33	12.67	13.33
T4 75%RDN+Nano urea @2 ml/l	38.7	177.13	193.1	7.67	14.33	15
T5 75%RDN+Nano urea @4 ml/l	42.8	182.19	197.8	8	15.33	16
T6 50%RDN+Nano urea @1 ml/l	24.3	161.53	176.78	5.33	10	10.67
T7 50%RDN+Nano urea @2 ml/l	28.38	168.23	182.67	6	11.67	12.33
T8 50%RDN+Nano urea @4 ml/l	34.22	175.77	190.29	6.67	13.67	14.33
SE (m)	0.387	0.378	0.394	0.285	0.37	0.256
CD (P= 0.05%)	1.184	1.157	1.206	0.874	1.133	0.784

Table 2. Yield parameters grain yield, stover yield, biological yield.

Treatment	Grain yield (q/ha)	Stover yield (q/ha)	Biological yield q/ha)
T1 Control	27.63	58.43	81.67
T2 100% RDN	57.20	90.73	146.73
T3 75%RDN+Nano urea @1 ml/l	60.07	98.53	160.50
T4 75%RDN+Nano urea @2 ml/l	63.57	108.53	172.57
T5 75%RDN+Nano urea @4 ml/l	65.23	114.70	179.20
T6 50%RDN+Nano urea @1 ml/l	54.07	86.37	140.77
T7 50%RDN+Nano urea @2 ml/l	58.13	94.57	154.23
T8 50%RDN+Nano urea @4 ml/l	61.70	103.57	166.30
SE (m)	0.235	0.539	0.337
CD (P= 0.05%)	0.720	1.649	1.033

RDN+ Nano urea @ 4 ml/l) also produced statistically at par yields of (63.57 q/ha), (61.70) respectively. However, the treatment T1(control) produced the least yield (27.63 q/ha) because of insufficient nitrogen, probably due to lack of nutrients. Fig. 2 represents the yield of grain data graphically. The acquired results also agree with preliminary findings made by Biradar *et al.* (2012) and Jat *et al.* (2013).

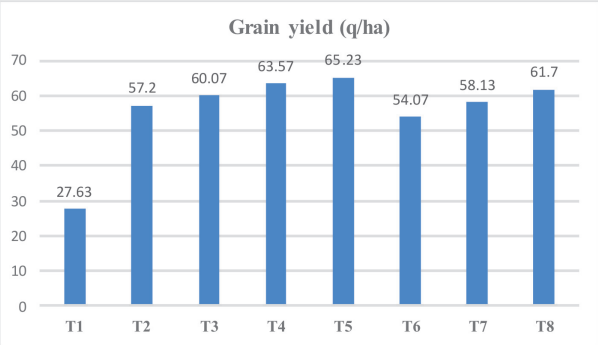

Fig. 2. Effects of Nano urea application on grain yield (q/ha).

The stover yield (q/ha) and biological yield (q/ha) was found to be maximum in T5 (75% RDN+Nano urea @ 4 ml/l) (114.70q/ha) and (179.20q/ha) respectively. And it was closely followed by treatment T4 (75% RDN+ Nano urea spray@ 2 ml/l water) (108.53q/ha) and (172.57q/ha) respectively and treatment T8 (50% RDN+ Nano urea @ 4 ml/l) (103.57q/ha) and (166.30). And the lowest yield was found in treatment T1 (control) with (58.43q/ha) and (81.67q/ha) respectively as shown in Table 2. A similar observation of the effect of different nitrogen management levels on maize yields was observed by Biradar *et al.* (2012), Selassie (2011).

Conclusion

The experiment findings suggest that the application of Nano urea had a significant impact on the growth and yield characteristics of maize. The investigation revealed that the T5 (75% RDN+Nano urea @ 4ml/l) treatment was the most effective in attaining higher growth and yield attributes of maize. treatment T4 (75% RDN+ Nano urea spray@ 2 ml/l water) was found to be comparable to treatment T5 (75% RDN+Nano urea @ 4 ml/l) in all growth and yield attributes. This indicates that applying 4ml Nano urea in litre watercombined with 75% RDN was preferred to all other treatments. The absolute control treatment (T1), which did not use either fertilizers or nutrients had the lowest growth and yield attributes of any treatment. The adoption of 75%RDN + foliar spray of nano-urea @ 4 ml/l at knee stage and tasselling stage, however, might be an appropriate technical solution to achieve sustainability in irrigated maize.

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