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Dokhe PK
M.Sc. (Agri) Student, Department of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Wadile SC
Associate Professor of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Shant PU
M.Sc. (Agri) Student, Department of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Jagtap PM
M.Sc. (Agri) Student, Department of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Sonawane PD
Professor of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Kathepuri JV
Subject Matter Specialist, KVK, College of Agriculture, Dhule, Maharashtra, India

Corresponding Author:
Dokhe PK
M.Sc. (Agri) Student, Department of Agronomy, College of Agriculture, Dhule, Maharashtra, India

Effect of nano-urea application on growth and yield of *kharif* Maize (*Zea Mays* L.)

Dokhe PK, Wadile SC, Shant PU, Jagtap PM, Sonawane PD and Kathepuri JV

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Abstract
An experiment on "Effect of nano-urea application on growth and yield of *kharif* Maize (*Zea mays* L.)" was conducted during *kharif* 2023 at Post Graduate research Farm, Agronomy Section, College of Agriculture, Dhule (Maharashtra). The experiment had three replications with eleven treatments was set up in a randomized block design. In general, the growth attributes like plant height (190.36 cm), number of functional leaves plant^{-1} (8.82) and dry matter accumulation plant^{-1} (203.63 g) were found to be superior with application of 100% N through urea (T_3) which was statistically at par with application of 75% N through urea+ 25% N through three foliar sprays of nano urea at 20, 40 and 60 DAS (T_5) and application of 75% N through urea + 25% N through two foliar sprays of nano urea at 20 and 40 DAS (T_4). The yield attributing characters such as number of cobs plant^{-1} (1.33),length of cob without husk (21.28 cm), girth of cob without husk (15.04 cm), cob weight with husk (131.62 g), cob weight without husk (119.53 g), number of grains rows cob^{-1}(14.87), number of grains cob^{-1} (512.40), grain weight cob^{-1} (149.91 g) and seed index (100 grain weight) (29.09 g) were significantly maximum under the application of application of 100% N through urea (T_3) which was statistically at par with application of 75% N through urea+ 25% N through three foliar sprays of nano urea at 20, 40 and 60 DAS (T_5) and application of 75% N through urea + 25% N through two foliar sprays of nano urea at 20 and 40 DAS (T_4). The grain yield (66.74 q ha^{-1}) and stover yield (86.76 q ha^{-1}) were significantly more in application of 100% N through urea (T_3) which was statistically at par with application of 75% N through urea+ 25% N through three foliar sprays of nano urea at 20, 40 and 60 DAS (T_5) and application of 75% N through urea + 25% N through two foliar sprays of nano urea at 20 and 40 DAS (T_4).
Among the different nutrient management treatments application of 100% N through urea with 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O or 75% N through urea+ 25% N through three foliar sprays of nano urea at 20, 40 and 60 DAS 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O or 75% N through urea + 25% N through two foliar sprays of nano urea at 20 and 40 DAS 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O to maize crop exhibited higher plant height (cm), number of functional leaves plant^{-1}, dry matter plant^{-1} (g), number of cobs plant^{-1}, length of cob (cm), girth of cob (cm), cob weight with husk (g), cob weight without husk(g), number of grains cob^{-1}, number of grains rows cob^{-1}, grain weight cob^{-1} (g), test weight (100 grain weight) (g), grain yield (q ha^{-1}), stover yield (q ha^{-1}) than rest of treatments.

Keywords: Nano-urea, Maize, Foliar spray, DAS

Introduction
Maize scientifically known as *Zea mays* L., belongs to the Gramineae family (2n=20) and the tribe maydeae, maize is often referred to as a "miracle crop" and the "queen of grains" due to its remarkable productivity holds third position among cereals in India, following wheat and rice. The term "corn" signifies its role in sustaining life, providing essential nutrients for both humans and animals globally. Maize cultivation occurs year-round in all seasons and is practiced worldwide. Its nutritional composition is notable, with approximately 72% starch, 10% protein, 8.5% fiber, 4.8% oil, 3.0% sugar, and 1.7% ash (Elamin and Elagib, 2001) [4]. Maize is an exhaustible crop that demands high nutrition for their growth and development. The productivity of crop depends on nutrient management system. Inorganic fertilizers are most widely used all over world as it gives higher yield and end result is also much appreciable. Efficient use of nitrogen is important for maize production as it increases yield and maximizes economic return and minimizes NO_3 leaching to ground.

Nitrogen (N) occupies a conspicuous place in plant metabolic system. Nitrogen being a major part of plants, and it is an essential constituent of protein and chlorophyll present in many major portions of the plant body.Urea is the most extensively used commercial nitrogen fertilizer for enhancing crop output. Urea accounts for around 82% of overall fertilizer usage in India and approximately 55% of total nitrogen fertilizer consumption worldwide. Plants use around 30- 40% of the nitrogen from urea. The remainder is lost owing to rapid chemical alteration as a result of leaching, volatilization, denitrification, and run off, resulting in low usage efficiency and also adding to environmental degradation and entering aquatic systems and leading to eutrophication (Navya *et al.*, 2022) [10].

Whereas nano urea has high nitrogen use efficiency and also it is environment friendly. This fertilizer is popularly known as "smart fertilizer" because it cuts down the emission of nitrous oxide which is the prime pollutant of soil and air and also helps in reduction of global warming. These properties make it a promising alternative over conventional urea. (Kannoj *et al.*, 2022) [5]. What makes nano urea effective is its tiny size that provides greater surface to mass ratio and hence helps in its targeted delivery of nutrients.

In order to improve the nitrogen-use efficiency by crops, several strategies have been suggested in the past few decades. Nanotechnology denotes to study of particles on the atomic scale for their use and control (Khaveh *et al.*, 2015) [6]. Nanotechnology focuses on creating new compounds by modifying the material. These "nano fertilizers" have high surface area, sorption capacity, and controlled-release kinetics to targeted sites making them an efficient distribution system (Kumar *et al.*, 2021[a]) [7].

The greatest alternative to urea fertilizer presently is liquid nano urea. One bottle of nano urea (500 ml) equals one bag of urea (45 kg), which is about 10% less expensive than a bag of regular urea. It has the potential to reduce urea fertilizer imports. One liquid nano urea particle is 30 nanometer in diameter and has 10,000 times the surface area to volume size of regular granular urea (Sahu *et al*., 2022) [12]. Urea raises soil pH by hydrolysis, resulting in large ammonia volatilization losses. Many fertilizer companies in India developed nanotechnology-based Nano Urea (Liquid) fertilizer to address the imbalanced and excessive use of conventional pilled urea (Arya *et al*., 2022) [1]. Present day's nano fertilizers are emerging as an alternative to conventional fertilizers (Veronica *et al.*, 2014) [15].

Nanotechnology is one possibility for reaching these aims in a long-term and precise manner, and scientists are now researching nano particles for use in plant science and agriculture. In various plants, a range of inorganic, organic, and composite nano materials have been researched to identify their potential effect on plant growth, development, and production.The effect of nano particles on plants is highly reliant on both their intrinsic properties (size, shape, surface area, surface charge, and so on) and their extrinsic nano bio-interactions. (Kumar *et al.*, 2021[b]) [8]. In order to solve higher fertilizer requirement during crop growth, and to address environmental issues and also taking economic aspects under consideration, the use of nitrogen nano fertilizer is essential (Sharma *et al.*, 2022) [14].

Materials and Methods

The field experiment was conducted during the *Kharif* season of 2023 at the Agronomic Farm, Agronomy Section, College of Agriculture, Dhule, M.S. (India) during *Kharif* 2023. The Post Graduate Research Farm is located in Northern Maharashtra's Agro-climatic Zone-6, often known as the scarcity zone. It is located at 20.4 ºN latitude and 74 ºE longitude. The elevation is 258 meters above mean sea level. Climatologically, this area falls in the sub-tropical region at the North. The rainfall is mostly received in 34 to 40 rainy days in a year. The total rainfall of 1041.8 mm was received in 47 days during the experimentation, which was 87.25 per cent of annual rainfall. The experiment had eleven treatment and three replications was set up in a randomized block design. The Eleven treatments included T_1-Absolute control (no fertilizer), T_2-Water spray at 20,40 and 60 DAS,T_3-100% N through urea,T_4-75% N through urea + 25% N through two foliar sprays of nano urea at 20 and 40 DAS,T_5-75% N through urea+ 25% N through three foliar sprays of nano urea at 20, 40 and 60 DAS,T_6-50% N through urea+ 50% N through two foliar sprays of nano urea at 20 and 40 DAS,T_7-50% N through urea+ 50% N through three foliar sprays of nano urea at 20,40 and 60 DAS,T_8-75% N through urea+ 25% N through three foliar sprays of 2% urea at 20,40 and 60 DAS, T_9-50% N through urea+ 50% N through three foliar sprays of 2% urea at 20,40 and 60 DAS,T_{10}-75% N through urea+ 25% N through three foliar sprays of 2 ml/ L nano urea at 20,40 and 60 DAS,T_{11}-50% N through urea+ 50% N through three foliar sprays of 4 ml/ L nano urea at 20,40 and 60 DAS. Whereas recommended dose of Phosphorous and Potassium is common to all treatment except T_1. The recommended dose of fertilizer in the form of urea, SSP and MOP were applied as per treatment with recommended of fertilizer dose of 120:60:40 N: P_2O_5: K_2O kg ha^{-1}. The IFFCO nano urea (4% W/V) liquid was used for foliar spray. The crop of hybrid variety NK-6045 was sown at spacing 75 cm x 20 cm.

Table 1: Treatment details

Tr. No.	Treatment Details
T_1	Absolute Control. (No Fertilizer)
T_2	Water spray at 20, 40 and 60 DAS.
T_3	100% N through urea.
T_4	75% N through urea + 25% N through two foliar sprays of nano urea at 20 and 40 DAS.
T_5	75% N through urea+ 25% N through three foliar sprays of nano urea at 20, 40 and 60 DAS.
T_6	50% N through urea+ 50% N through two foliar sprays of nano urea at 20 and 40 DAS.
T_7	50% N through urea+ 50% N through three foliar sprays of nano urea at 20, 40 and 60 DAS.
T_8	75% N through urea+ 25% N through three foliar sprays of 2% urea at 20, 40 and 60 DAS.
T_9	50% N through urea+ 50% N through three foliar sprays of 2% urea at 20, 40 and 60 DAS.
T_{10}	75% N through urea+ 25% N through three foliar sprays of 2 ml/ L nano urea at 20, 40 and 60 DAS.
T_{11}	50% N through urea+ 50% N through three foliar sprays of 4 ml/ L nano urea at 20, 40 and 60 DAS.

Note:

1. 500 ml bottle of liquid nano urea is equivalent to 50 kg urea bag.
2. For T_2 no top dressing with urea is done.
3. 10 tonne ha^{-1} FYM is common to T_2 to T_{11}.

The topography of the experimental field was uniformly levelled and well drained. The soil of experimental field was clayey in nature. Composite soil sample was collected and analysed for physical and chemical properties. The data of soil analysis revealed that the soil was clay in texture, low in available nitrogen, medium in available phosphorus and very high in available potassium content and moderately alkaline in reaction. The soil was free from any kind of salinity or sodicity hazards.

Growth parameters like plant height (cm), number of functional leaves plant^{-1}, dry matter plant^{-1} (g), is recorded at 30 DAS, 45 DAS, 60 DAS, 75 DAS and at harvest from five selected plants from each net plot. Days to 50 per cent tasselling, days to 50 per cent silking, days to physiological maturity is recorded from net plot at tasselling, at silking, at physiological maturity, respectively in each plot. The number of cobs per plant^{-1}, length of cob without husk (cm), girth of cob without husk (cm), cob weight with husk (g), cob weight without husk (g), number of grains cob^{-1}, number of grains rows cob^{-1}, grain weight cob^{-1} (g) and seed index (100 grain weight) (g) observational plant was counted and mean was worked out by using five plants from each net plot. For grain yield (q ha^{-1}), after harvest cobs were sun dried, and grains removed with the help of hand maize sheller. Grain weight per net plot was recorded and calculated as grain yield per hectare. For stover yield (q ha^{-1}) harvested plant ware sun dried till they showed constant weight. The weight of stover per net plot was recorded and calculated as stover yield per hectare.

The data collected and analysis of data was carried out by "Analysis of Variance method" by Panse and Sukhatme, 1967[11]. When the treatment differences were significant standard error (S.E.±) and critical difference (C.D.) were calculated at 5% probability level and when the treatment differences were not significant, only standard error was worked out.

Results and Discussion

Growth Studies

Data in a respect of plant height (cm), number of functional leaves plant^{-1}, dry matter plant $^{-1}$ (g) of maize as influenced by various treatments at different growth stages were analyzed statistically and presented in Table 2. The results indicated that growth attributes evaluated in study were significantly influenced by all the treatments over control (no fertilizer). The higher plant height (cm), number of functional leaves plant^{-1}, dry matter plant $^{-1}$ (g) of maize was significantly influenced due to different treatment and various growth stages of crop, except 30 DAS.

The observations regarding the growth *viz*., plant height (cm), number of functional leaves plant^{-1}, dry matter plant $^{-1}$ (g) were significantly influenced by different nano-urea application treatments and days to 50 per cent tasselling, days to 50 per cent silking and days to physiological maturity shows non-significant results. The growth of maize crop in terms of growth attributes *viz*., plant height, number of functional leaves plant^{-1}, and total dry matter plant^{-1} was maximum with treatment application of 100% nitrogen (N) through urea (T_3) with the corresponding values were 190.36 cm, 8.82 and 203.63 g at harvest but it was at par with treatment application of 75% N through urea + 25% N through three foliar sprays of nano urea at 20,40 and 60 DAS (T_5) with corresponding values 177.25 cm, 8.25, 199.80 g, respectively and treatment 75% N through urea + 25% N through two foliar spray of nano urea at 20 and 40 DAS (T_4) with corresponding values 175.85 cm, 7.95, 194.71 g, respectively. However, substantial reduction in growth characters was observed in treatment absolute control (no fertilizers) (T_1).

The maximum plant height in treatment T_3 may be due to balanced supply of NPK which help in various nutrients and translocation of better and more availability of more nitrogen for early establishment of photosynthetic apparatus such as enzymes, pigments and other compounds needed for photosynthesis and other beneficial effects of nitrogen in cell elongation and cell division in meristematic activity as well as internodal expansion. Nano-fertilizers are very effective tool for precise nutrient management in precision agriculture with matching the crop growth stage for nutrient and may provide nutrient throughout the crop growth stage period. Nano urea increases the efficiency of nutrient uptake and utilization and releases nitrogen in a regulated way, minimizing losses from volatilization and leaching. Nano-urea can improve a number of physiological functions in plants, including enzyme activity, photosynthesis, and nutrient uptake. The findings were analogous to those obtained by Chavan *et al.*, (2023) [3], Meena *et al.*, (2023) [9], Bhukya *et al.*, (2024) [2].

Table 2: Plant height (cm), Number of functional leaves plant^{-1} of maize as influenced periodically due to different treatments

Tr. No.	Plant height(cm)					Number of functional leaves plant^{-1}				
	30 DAS	45 DAS	60 DAS	75 DAS	At harvest	30 DAS	45 DAS	60 DAS	75 DAS	At harvest
T_1	28.44	50.62	101.16	148.87	150.44	6.82	6.96	8.96	9.56	6.21
T_2	36.79	54.18	106.67	156.20	157.77	7.12	8.12	9.12	10.42	6.32
T_3	44.44	74.59	140.58	188.79	190.36	8.71	9.86	13.16	13.56	8.82
T_4	38.37	67.15	133.12	173.95	175.85	8.57	9.76	12.87	12.79	7.95
T_5	42.64	69.45	136.49	175.68	177.25	8.62	9.81	12.92	13.12	8.25
T_6	32.33	60.27	121.46	163.94	165.51	8.24	9.24	11.94	11.87	6.73
T_7	31.31	61.78	123.65	165.49	167.06	8.32	9.41	12.32	12.14	6.82
T_8	41.68	63.98	126.22	170.61	172.18	8.43	9.54	12.61	12.45	7.43
T_9	41.45	58.14	118.94	163.31	164.88	7.95	8.95	10.95	11.14	6.45
T_{10}	39.72	65.86	132.06	171.59	173.16	8.49	9.66	12.75	12.58	7.75
T_{11}	30.49	59.14	119.25	162.81	164.38	8.17	9.17	11.77	11.59	6.66
GM	37.06	62.29	123.60	167.38	168.99	8.13	9.13	11.76	11.93	7.22
SE(m)±	3.96	3.25	2.96	5.13	5.12	0.54	0.11	0.18	0.30	0.31
CD (at 5%)	NS	9.60	8.74	15.14	15.11	NS	0.31	0.54	0.88	0.93

Maximum number of functional leaves occurred at 75 DAS crop and thereafter decreased with increase in plant height and enlargement of individual leaf size, which created adverse shading effect over the lower leaves. These might have added to the natural death and senescence of older leaves. Application of 100% N through urea improve the physio-chemical properties of soil and enhanced the supply of essential nutrients for better plant growth and development. The findings were analogous to those obtained by Chavan *et al.*, (2023) [3], Meena *et al.*, (2023) [9], Bhukya *et al.*, (2024) [2]. Nano urea can enhance the uptake and utilization of nutrients, including nitrogen, by plants. Improved nutrient availability and utilization can lead to increased biomass and ultimately contribute to higher plant dry weight. Nano urea has been reported to positively influence various physiological processes in plants, such as photosynthesis, enzymatic activities, and nutrient metabolism. These enhancements can promote plant growth and biomass accumulation, resulting in increased plant dry weight. The findings were analogous to those obtained by Chavan *et al.*, (2023) [3], Meena *et al.*, (2023) [9], Bhukya *et al.*, (2024) [2].

Table 3: Dry matter plant $^{-1}$ (g) of maize as influenced periodically due to different treatments

Tr. No.	Dry matter plant $^{-1}$(g)					Days to		
	30 DAS	45 DAS	60 DAS	75 DAS	At harvest	50% tasselling	50% silking	Physiological maturity
T_1	8.16	14.19	49.32	94.44	113.72	55.67	61.67	105.00
T_2	10.44	19.56	58.15	109.58	125.86	56.00	62.00	105.33
T_3	13.93	38.26	96.95	181.77	203.63	58.00	64.00	107.00
T_4	11.95	32.78	89.82	173.52	194.71	57.33	63.33	106.33
T_5	12.48	35.91	94.24	177.27	199.80	57.67	63.67	106.67
T_6	10.87	28.46	68.43	141.96	156.32	56.67	62.67	105.67
T_7	13.54	29.17	71.15	151.85	170.87	57.00	63.00	106.00
T_8	11.48	31.55	82.18	167.69	177.62	57.00	63.00	106.00
T_9	10.38	25.19	63.83	118.53	137.47	56.00	62.00	105.00
T_{10}	11.64	32.56	83.51	171.19	184.55	57.00	63.00	106.00
T_{11}	10.53	26.37	64.34	129.17	148.44	56.00	62.00	105.00
GM	11.40	28.54	74.72	147.00	164.82	56.76	62.76	105.82
SE(m)±	1.10	2.25	5.00	2.89	6.08	0.61	0.63	0.62
CD (at 5%)	NS	6.65	14.74	8.54	17.94	NS	NS	NS

Yield attributes and Yield

The yield attributes *viz*., number of cobs plant^{-1}, cob length without husk, cob girth without husk, grain weight cob^{-1}, number of grains cob-^{1}, cob weight with husk (g), cob weight without husk (g), number of grain rows cob^{-1}, seed index (100 grain weight) (g), grain yield (q ha^{-1}) and stover yield (q ha^{-1}) were differed significantly due to different treatments. The values of these yield attributes were maximum with application of 100% nitrogen (N) through urea (T_3). The corresponding values were number of cobs plant^{-1}(1.33), cob length without husk (21.28 cm), cob girth without husk (15.04 cm), grain weight cob^{-1} (149.61 g), number of grains cob^{-1} (512.40), cob weight with husk (131.62 g), cob weight without husk (11`9.53 g), number of grain rows cob^{-1} (14.87) and seed index (29.09 g) but it was at par with treatment application of 75% N through urea + 25% N through three foliar sprays of nano urea at 20,40 and 60 DAS (T_5) with corresponding values were number of cobs plant^{-1} (1.20), cob length without husk (21.15 cm), cob girth without husk (14.78 cm), grain weight cob^{-1} (142.24 g), number of grains cob^{-1} (497.40), cob weight with husk (127.98 g), cob weight without husk (115.84 g), number of grain rows cob^{-1} (14.20) and seed index (28.66 g) and treatment application of 75% N through urea + 25% N through two foliar spray of nano urea at 20 and 40 DAS (T_4) with corresponding values number of cobs plant^{-1}(1.20), cob length without husk (19.79 cm), cob girth without husk (14.44 cm), grain weight cob^{-1} (140.04 g), number of grains cob^{-1} (492.20), cob weight with husk (125.91 g), cob weight without husk (113.35 g), number of grain rows cob^{-1} (14.20) and seed index (28.42 g). However, substantial reduction in yield attributing characters was observed in treatment absolute control (no fertilizers) (T_1).

Table 4: Number of cobs plant^{-1}, cob weight with husk(g), cob weight without husk (g), length of cob without husk (cm), girth of cob without husk (cm), number of grain rows cob^{-1}, number of grains cob^{-1}, grain weight cob^{-1}(g), seed index (100 grain weight) (g), Grain yield (q ha^{-1}) and stover yield (q ha^{-1}) of maize as influenced due to different treatments

Tr. No.	Cobs plant^{-1}	Cob weight (g)		without husk (cm)		Number of grain rows cob^{-1}	Number of grains cob^{-1}	Grain weight cob^{-1} (g)	Seed index (g)	Yield (q ha^{-1})	
		With Husk	Without husk	Length of cob	Girth of cob					Grain	Stover
T_1	1.00	76.35	70.99	16.12	13.02	11.93	304.73	69.27	22.70	30.56	39.72
T_2	1.00	93.27	81.11	17.10	13.13	12.40	406.53	95.03	23.33	42.40	55.12
T_3	1.33	131.62	119.53	21.28	15.04	14.87	512.40	149.91	29.09	66.74	86.76
T_4	1.20	125.91	113.55	19.79	14.44	14.00	492.20	140.04	28.42	63.13	82.06
T_5	1.20	127.98	115.84	21.15	14.78	14.20	497.40	142.24	28.66	64.18	83.43
T_6	1.07	108.42	96.97	17.80	13.53	13.33	452.20	114.37	25.31	57.22	74.38
T_7	1.13	111.51	99.68	18.52	13.68	13.63	467.33	118.77	25.34	59.56	77.42
T_8	1.13	116.59	104.82	19.33	13.93	13.93	468.57	126.44	27.02	60.74	78.96
T_9	1.07	102.44	90.94	17.25	13.21	13.00	440.53	106.34	24.18	56.16	73.00
T_{10}	1.13	122.43	110.60	19.61	14.33	13.87	484.13	126.24	27.02	61.82	80.36
T_{11}	1.07	107.52	96.29	17.47	13.30	13.20	450.40	113.33	25.25	58.20	75.66
GM	1.12	111.28	100.03	18.67	13.85	13.49	452.40	118.36	26.03	56.43	73.35
SE(m)±	0.05	2.79	2.85	0.63	0.23	0.30	8.99	6.76	0.60	1.36	1.77
CD (at 5%)	0.15	8.22	8.40	1.85	0.69	0.89	26.51	19.94	1.77	4.01	5.21

Further, it was observed that the expression of these yield attributes ultimately reflected on higher grain yield (66.70 q ha^{-1}) and stover yield (86.76 q ha^{-1}) where application of 100% nitrogen (N) through urea (T_3) was done to maize crop which was at par with treatment application of 75% N through urea + 25% N through three foliar sprays of nano urea at 20,40 and 60 DAS (T_5) with grain yield (64.18 q ha^{-1}) and stover yield (83.43 q ha^{-1}) and treatment 75% N through urea + 25% N through two foliar spray of nano urea at 20 and 40 DAS (T_4) grain yield (63.13 q ha^{-1}) and stover yield (82.76 q ha^{-1}). The lowest grain yield (30.56 q ha^{-1}) and stover yield (39.72 q ha^{-1}) were observed in treatment absolute control (no fertilizers) (T_1). These are in accordance with those reported by Chavan *et al.*, (2023) [3], Meena *et al.*, (2023) [9], Bhukya *et al.*, (2024) [2].

Nano urea enhance their solubility and improve nutrient availability. This increased nutrient uptake nitrogen, can contribute to improved plant growth, development and ultimately, higher maize yield. Nano urea has been reported to particularly enhance plant growth. Nutrient supply by the treatments and demand by the crop for nutrient wherever is balanced their source is well developed with proper increased photosynthesis that led to accumulation of carbohydrates and proteins in the sink (Samui *et al.*, 2022) [13].

Increase in stover yield with higher dose of fertilization may be due to vigorous and luxuriant growth of maize. An improvement in stover yield with higher levels of nitrogen obtained may be attributed to higher meristematic activity and thus better growth of the plants, resulting ultimately in higher stover yield. The higher accumulation dry matter in plants might have improved the values of yield attributes at higher levels of nitrogen which resulted in higher stover yield. Increased stover yield was attributed due to enhanced morphological characters (Samui *et al.*, 2022) [13].

Conclusion

Application of 100 per cent N through urea with 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O or application of 75% N through urea + 25% N through three foliar sprays of nano urea at 20,40 and 60 DAS with 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O or application of 75% N through urea + 25% N through two foliar spray of nano urea at 20 and 40 DAS with 60 kg ha^{-1} P_2O_5 and 40 kg ha^{-1} K_2O recorded higher values and found beneficial in terms of growth, yield contributing characters, yield in maize crop.

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