



ISSN Print: 2618-060X
 ISSN Online: 2618-0618
 NAAS Rating (2026): 5.20
 IJRA 2026; 9(9): 1248-1253
www.agronomyjournals.com
 Received: 01-07-2026
 Accepted: 04-08-2026
 Published: 28-09-2026

Manjanagouda

M.Sc. Scholar, Department of
 Agronomy, College of
 Agriculture, Raichur,
 University of Agricultural
 Sciences, Raichur, Karnataka,
 India

Ramesha Y. M

Associate Professor,
 Department of Agronomy,
 College of Agriculture, V. C.
 Farm, Mandya, University of
 Agricultural Sciences, Mandya,
 Karnataka, India

Kamble Anand Shankar

Professor, Department of
 Agronomy, Organic Farming
 Research Institute, Raichur,
 University of Agricultural
 Sciences, Raichur, Karnataka,
 India

Krishnamurthy D

Associate Professor,
 Department of Agronomy,
 Agricultural Research Station,
 Hagari, University of
 Agricultural Sciences, Raichur,
 Karnataka, India

Chandranaik M

Associate Professor,
 Department of Crop
 Physiology, Agricultural
 Research Station, Dhadesugur,
 University of Agricultural
 Sciences, Raichur, Karnataka,
 India

Vageesh M Patil

M.Sc. Scholar, Department of
 Agronomy, College of
 Agriculture, Raichur,
 University of Agricultural
 Sciences, Raichur, Karnataka,
 India

Corresponding Author: Manjanagouda

M.Sc. Scholar, Department
 of Agronomy, College of
 Agriculture, Raichur,
 University of Agricultural
 Sciences, Raichur,
 Karnataka, India

Effect of nano urea plus on nutrient uptake and economics of maize (*Zea mays* L.)

Manjanagouda¹, Ramesha Y. M², Kamble Anand Shankar³, Krishnamurthy D⁴,
 Chandranaik M⁵, Vageesh M Patil⁶

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i9q.6680>

ABSTRACT

A field experiment was conducted at the Agricultural Research Station, Dhadesugur, Karnataka, during kharif, 2025 to evaluate the effect of nano urea plus on nutrient uptake and economics of maize (*Zea mays* L.) under different spraying methods and nutrient management practices. The results revealed that application of nano urea plus through a power operated sprayer recorded higher nitrogen and phosphorus uptake, while potassium uptake showed a numerical improvement over the knapsack sprayer. Among the nutrient management practices, soil application of 100 % recommended dose of fertilizers (RDF) recorded the higher nitrogen uptake in grain (118.2 kg ha⁻¹), stover (70.7 kg ha⁻¹) and total (188.9 kg ha⁻¹), phosphorus uptake (34.8, 21.0 and 55.8 kg ha⁻¹) and potassium uptake (31.0, 102.3 and 133.3 kg ha⁻¹), respectively. The same treatment also recorded the higher gross returns (₹ 1,72,305 ha⁻¹), net returns (₹ 1,17,880 ha⁻¹) and benefit-cost ratio (3.17), remaining statistically on par with 75 % RDN supplemented with foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS. The absolute control recorded the lower nutrient uptake and economic returns. Thus, integrating reduced nitrogen fertilization with foliar nano urea plus offers a promising approach for sustaining nutrient uptake and economic returns in maize.

Keywords: Maize, Nano Urea Plus, Nutrient uptake, Nutrient management, Economics

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops globally and in India, where it ranks third among major cereals after rice and wheat. Popularly known as the “Queen of Cereals,” maize is cultivated throughout the year for multiple purposes, including human food, livestock feed, fodder, green cobs, baby corn, sweet corn and popcorn. Its versatility, nutritional value and adaptability make it an important crop for meeting the growing food and feed requirements. During 2024-25, maize occupied 12.09 million hectares in India, with a production of 43.41 million tonnes and productivity of 3.59 t ha⁻¹. Karnataka is one of the leading maize-producing states, contributing approximately 14.26 per cent to the national production, with an area of 1.91 million hectares, production of 6.19 million tonnes and productivity of 3.23 t ha⁻¹ during the same period (Anon., 2025) [1].

However, maize productivity is constrained by several biophysical and socioeconomic factors, including declining soil fertility, nutrient deficiencies, low nutrient use efficiency, increasing input costs, labour scarcity, restricted water availability and climate related challenges. Maize is an exhaustive and fertilizer responsive crop that requires adequate and balanced nutrient supply for achieving optimum growth and yield. Among the essential nutrients, nitrogen plays a central role in plant growth and development as a constituent of chlorophyll, amino acids, proteins, enzymes and other vital cellular compounds. Nevertheless, conventional nitrogen fertilization is associated with substantial nutrient losses through leaching and denitrification, which reduce nitrogen-use efficiency, increase production costs and contribute to environmental pollution (Nduwimana *et al.*, 2020; Meena *et al.*, 2021) [3, 2].

The continuous depletion of soil nutrients due to an imbalance between nutrient removal and replenishment has further aggravated the problem of declining soil fertility. Indian soils reportedly experience considerable annual nutrient depletion, while the fertilizer response of crops has declined over time (Bhattacharyya *et al.*, 2015) [4]. These challenges necessitate the development and adoption of efficient nutrient management technologies capable of improving fertilizer-use efficiency while sustaining crop productivity and soil health.

Nanotechnology has emerged as a promising approach for addressing nutrient management constraints in modern agriculture. Nano fertilizers are designed to enhance nutrient availability, improve nutrient absorption and reduce nutrient losses through their unique physicochemical properties. Their small particle size and large surface area facilitate efficient nutrient delivery and controlled release according to crop requirements, thereby improving nutrient-use efficiency and minimizing environmental losses (Baruah *et al.*, 2009; Cui *et al.*, 2010) [5, 6]. Foliar application of nano fertilizers offers an additional advantage by directly supplying nutrients to plant tissues during critical crop growth stages.

Nano urea plus is a liquid nitrogen fertilizer developed to supplement crop nitrogen requirements through efficient nutrient delivery. It contains 16 per cent nitrogen by weight and is intended to improve nitrogen absorption and utilization while reducing the dependence on conventional urea. Its potential benefits include improved crop growth and yield, reduced fertilizer losses, lower input costs and minimized soil and water pollution. Thus, evaluating Nano urea plus under specific agro climatic and crop production conditions is essential to establish its agronomic effectiveness, nutrient-use efficiency and economic viability in maize cultivation.

Material and Methods

The experiment was carried out at Agricultural Research Station, Dhadesugur, University of Agricultural Sciences, Raichur, Karnataka. The experimental site was geographically situated in Northern Dry Zone (Zone - III) of Karnataka at a Latitude of 15° 69' North, Longitude of 76° 89' East with an Altitude of 358 meters above mean sea level. The soil of the experimental site was medium black to deep black with clay loam texture. Regarding chemical properties, the soil was alkaline in reaction (pH-8.16), low in EC (0.29 dS.m⁻¹) and low in organic carbon content (0.50 %). The soil was low in available nitrogen (253.3 kg ha⁻¹), high in available phosphorus (37.8 kg ha⁻¹) and high in available potassium (326.5 kg ha⁻¹).

The experiment was laid out in a split plot design and replicated thrice. The experiment consisted of two spraying methods as main plot treatments viz., Knapsack sprayer (M₁) and Power operated sprayer (M₂) and six different nutrient management practices as sub plot treatments comprising recommended dose of fertilizers (N₁), 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS (N₂), 50 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 and 45 DAS (N₃), RDN through foliar application of nano urea plus @ 8 ml L⁻¹ at 30 and 45 DAS (N₄), absolute control (N₅) and nitrogen-free treatment (N₆) then totally twelve treatments. Observations were taken on growth, yield and yield attributes at 30, 60, 90 DAS and at harvest of the crop, analyzed the soil samples to know the nutrient status after the harvest of crop and calculated the economics of maize as influenced by the soil along with foliar application of nano urea plus.

The grain and fodder sample collected from each plot at harvest were dried in oven at 65 °C till a constant weight. These samples were grounded in laboratory mill, passed through 40 mm mesh sieve and used for estimating of N, P, K, Zn and Fe contents. Total nitrogen was determined by Kjeldahl's method, Phosphorus was estimated by Vanadomolybdate method, Potassium was estimated by Flame Photometer method, Zn and Fe content was estimated by using Atomic Absorption Spectrophotometer (AAS) with zinc and iron hollow cathode lamps as described by Jackson (1973) [7]. The economics was worked out based on the prevailing market price for the existing year. Data analysis and interpretation was done using Fisher's method of analysis of variance (ANOVA) technique as given by Panse *et al.* (1967) [8].

Results and Discussion

Nutrient uptake

Nitrogen (kg ha⁻¹)

The data on nitrogen uptake by maize at harvest differed significantly due to types of sprayers and nutrient management practices and are presented in Table 1. Results showed that application of nano urea plus through power operated sprayer recorded significantly higher nitrogen uptake in grain (86.9 kg ha⁻¹), stover (51.8 kg ha⁻¹) and total nitrogen uptake (138.7 kg ha⁻¹) compared to knapsack sprayer (80.0, 46.4 and 126.4 kg ha⁻¹, respectively).

Among the different nutrient management practices, soil application of recommended dose of fertilizers recorded significantly higher nitrogen uptake in grain (118.2 kg ha⁻¹), stover (70.7 kg ha⁻¹) and total nitrogen uptake (188.9 kg ha⁻¹) and which was on par with the soil

application of 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS (111.4, 65.8 and 177.2 kg ha⁻¹, respectively). The absolute control treatment recorded the least nitrogen uptake in grain (50.0 kg ha⁻¹), stover (23.1 kg ha⁻¹) and total nitrogen uptake (73.1 kg ha⁻¹). Furthermore, the interaction effect between types of sprayers and nutrient management practices on grain, stover and total nitrogen uptake was found non-significant.

The higher nitrogen uptake could be attributed to sustained N availability, which supported root proliferation, nitrate reduction and subsequent assimilation of nitrogen into plant tissues. Greater biomass and yield under adequate nutrition also increased crop N demand and its removal through grain and stover. Dhansil *et al.* (2018) [9] and Burhan *et al.* (2019) [10] reported similar improvements in nutrient uptake with balanced fertilization. The comparable response with the soil application of 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS may be associated with efficient foliar uptake and subsequent assimilation of nitrogen from the nano formulation, thereby supplementing soil derived N during active crop growth. Al-Juthery *et al.* (2020) [11] and Sharma *et al.* (2022) [12] also documented improved nutrient acquisition with nano-fertilizer application.

Phosphorus (kg ha⁻¹)

The data on phosphorus uptake by maize at harvest differed significantly due to types of sprayers and nutrient management practices and are presented in Table 1. Results indicated that application of nano urea plus through power operated sprayer recorded significantly higher phosphorus uptake in grain (26.9 kg ha⁻¹), stover (16.8 kg ha⁻¹) and total phosphorus uptake (43.7 kg ha⁻¹) compared to knapsack sprayer (25.1, 15.4 and 40.5 kg ha⁻¹, respectively).

Among the different nutrient management practices, soil application of recommended dose of fertilizers recorded significantly higher phosphorus uptake in grain (34.8 kg ha⁻¹), stover (21.0 kg ha⁻¹) and total phosphorus uptake (55.8 kg ha⁻¹) and which was on par with the soil application of 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS (33.6, 20.2 and 53.8 kg ha⁻¹, respectively). The absolute control treatment recorded the lower phosphorus uptake in grain (16.6 kg ha⁻¹), stover (9.8 kg ha⁻¹) and total phosphorus uptake (26.4 kg ha⁻¹). Moreover, the interaction effect between types of sprayers and nutrient management practices on grain, stover and total phosphorus uptake was found non-significant.

Improved phosphorus uptake with the application of balanced nutrition may be associated with adequate nutrient supply favoring root activity and effective acquisition of soil P and greater crop productivity also increased phosphorus removal through grain and stover. Sahu *et al.* (2022) [13] also reported a similar improvement in nutrient uptake under balanced fertilization. The comparable P uptake with the application of 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS may be related to improved plant N status, which supported root metabolic activity and P utilization despite reduced soil applied nitrogen. The absorbed phosphorus contributes to ATP formation, phosphorylation reactions, membrane functions and reproductive development, facilitating its utilization and translocation within the plant. Similar findings were reported by Pujari *et al.* (2026) [14].

Potassium (kg ha⁻¹)

The data on potassium uptake by maize at harvest differed significantly due to nutrient management practices and types of sprayer are presented in Table 1. Results showed that application of nano urea plus through power operated sprayer recorded numerically higher potassium uptake in grain (22.3 kg ha⁻¹), stover (85.6 kg ha⁻¹) and total potassium uptake (107.9 kg ha⁻¹) compared to knapsack sprayer (21.2, 84.3 and 105.6 kg ha⁻¹, respectively).

Nutrient management practices significantly influenced the potassium uptake in the treatment received RDF registered significantly higher potassium uptake in grain (31.0 kg ha⁻¹), stover (102.3 kg ha⁻¹) and total potassium uptake (133.3 kg ha⁻¹) and which was on par with the soil application of 75 % RDN + foliar application of nano urea plus

@ 4 ml L⁻¹ at 30 DAS (29.3, 99.3 and 128.6 kg ha⁻¹, respectively). The absolute control treatment recorded the lower potassium uptake in grain (11.4 kg ha⁻¹), stover (65.8 kg ha⁻¹) and total potassium uptake (77.2 kg ha⁻¹). Furthermore, the interaction effect between types of sprayers and nutrient management practices on grain, stover and total potassium uptake was found non-significant.

The greater potassium uptake was noticed in the treatment with the soil application of RDF may be explained by balanced nutrient supply favoring root activity and effective acquisition of soil K. Increased crop growth and dry matter production also created greater demand for K and its subsequent accumulation in grain and stover. Potassium plays a key physiological role in enzyme activation, osmotic regulation, stomatal functioning and phloem loading, thereby facilitating carbohydrate translocation and biomass formation. The similar response was observed in the treatment with the soil application of 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS could be associated with improved plant N status from foliar supplementation, which supported metabolic activity and indirectly favored K acquisition and utilization. These observations are consistent with the findings of Deo *et al.* (2022) [15] and Chinnappa *et al.* (2023) [16].

Economics

Cost of cultivation (₹ ha⁻¹)

The cost of cultivation varied among the nutrient management treatments due to differences in the quantity of fertilizers application and the number of foliar sprays employed (Graphically depicted in Fig. 1).

Between the sprayers, the power operated sprayer incurred a slightly higher cost of cultivation (₹ 53,468 ha⁻¹) than the knapsack sprayer (₹ 53,268 ha⁻¹), mainly because of its higher operational cost.

Among the different nutrient management practices, the higher cost of cultivation (₹ 57,295 ha⁻¹) was incurred in the treatment with the application of RDN through nano urea plus @ 8 ml L⁻¹ at 30 and 45 DAS, followed by 50 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 and 45 DAS (₹ 56,460 ha⁻¹). The lower cost of cultivation (₹ 45,095 ha⁻¹) was incurred under the absolute control.

Variation in cost of cultivation primarily reflected differences in fertilizer requirement, Nano urea plus application and spraying operations among the nutrient management practices. Treatments involving higher fertilizer inputs and repeated foliar sprays incurred greater expenditure due to additional input and application costs. In contrast, the absolute control registered the lowest cultivation cost owing to the exclusion of fertilizer and associated application expenses.

Gross returns (₹ ha⁻¹)

The data on gross returns of maize as influenced by the foliar application of nano urea plus are graphically depicted in Fig. 1.

Results revealed that application of nano urea plus through the power operated sprayer recorded numerically higher gross returns (₹ 1,41,309 ha⁻¹) than the knapsack sprayer (₹ 1,37,261 ha⁻¹).

Among the different nutrient management treatments, soil application of recommended dose of fertilizers noticed the highest gross returns (₹ 1,72,305 ha⁻¹), followed by 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS (₹ 168,347 ha⁻¹). Whereas, the absolute control treatment noticed the lower gross returns (₹ 103,139 ha⁻¹).

The higher gross returns obtained might be attributed to its superior grain and stover yields, resulting from balanced nutrient availability throughout the crop growth period. Adequate nutrient supply probably enhanced photosynthetic efficiency, dry matter accumulation and assimilate partitioning, thereby increasing marketable produce and total monetary returns. The comparatively higher gross returns recorded in the treatment with the soil application of 75 % RDN combined with foliar application of nano urea plus also indicate the beneficial role of foliar nitrogen in sustaining crop productivity.

Net returns (₹ ha⁻¹)

The data on net returns of maize differed significantly due to nutrient management practices and Types of sprayer are presented in Fig. 1.

Results demonstrated that application of nano urea plus through power operated sprayer recorded numerically higher net returns (₹ 87,841 ha⁻¹) than the knapsack sprayer (₹ 83,993 ha⁻¹). However, the differences between the sprayers were found to be non significant.

Soil application of recommended dose of fertilizers noticed significantly higher net returns (₹ 1,17,880 ha⁻¹) and which was on par in the treatment received 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS (₹ 1,13,307 ha⁻¹). The absolute control recorded the lowest net returns (₹ 58,044 ha⁻¹).

The higher net returns might be due to greater grain and stover yields, whose additional monetary returns outweighed the corresponding cost of fertilizer inputs. The comparable returns with 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS indicate that reduced soil-applied nitrogen supplemented through foliar nutrition could sustain economic productivity with only a marginal reduction in returns. The favourable balance between input expenditure and value of additional produce ultimately enhanced the monetary advantage of these treatments. Chavan *et al.* (2023) [17], Vasanth *et al.* (2025) [18] and Sahu *et al.* (2026) [19] also reported favourable economic responses under efficient nutrient management.

Benefit cost ratio (B:C)

The data on benefit cost ratio of maize differed significantly due to different nutrient management practices and Types of sprayer are graphically depicted in Fig. 1.

Results indicated that application of nano urea plus through power operated sprayer recorded a numerically higher benefit cost ratio (2.63) than the knapsack sprayer (2.57).

Among the different nutrient management treatments, soil application of recommended dose of fertilizers recorded the higher benefit cost ratio (3.17) and which was on par with the soil application of 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS (3.06). The lower benefit cost ratio (2.06) was observed with RDN through nano urea plus @ 8 ml L⁻¹ at 30 and 45 DAS. Furthermore, the interaction effect between types of sprayers and nutrient management practices on benefit cost ratio was found non-significant.

The higher benefit cost ratio could be ascribed to the greater value of produce realized relative to the expenditure incurred on cultivation, resulting in superior economic efficiency. Balanced fertilization ensured that the additional investment in nutrients was adequately compensated by increased marketable output. The comparable BC ratio with 75% RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS indicates the economic potential of integrating reduced soil-applied N with foliar nano nutrition while sustaining remunerative productivity. Kumari *et al.* (2024) [20], Vasanth *et al.* (2025) [18] and Sahu *et al.* (2026) [19] also documented favourable economic responses with efficient nutrient management.

Conclusion

Power operated sprayer recorded higher nitrogen and phosphorus uptake, while potassium uptake showed a numerical improvement over the knapsack sprayer. Among nutrient management practices, 100 % RDF recorded the higher N, P and K uptake, gross returns, net returns and BC ratio, remaining statistically on par with 75 % RDN supplemented with nano urea plus @ 4 ml L⁻¹ at 30 DAS. Thus, integrating reduced soil applied nitrogen with foliar nano urea plus offers a promising and economically viable nutrient management strategy for maize.

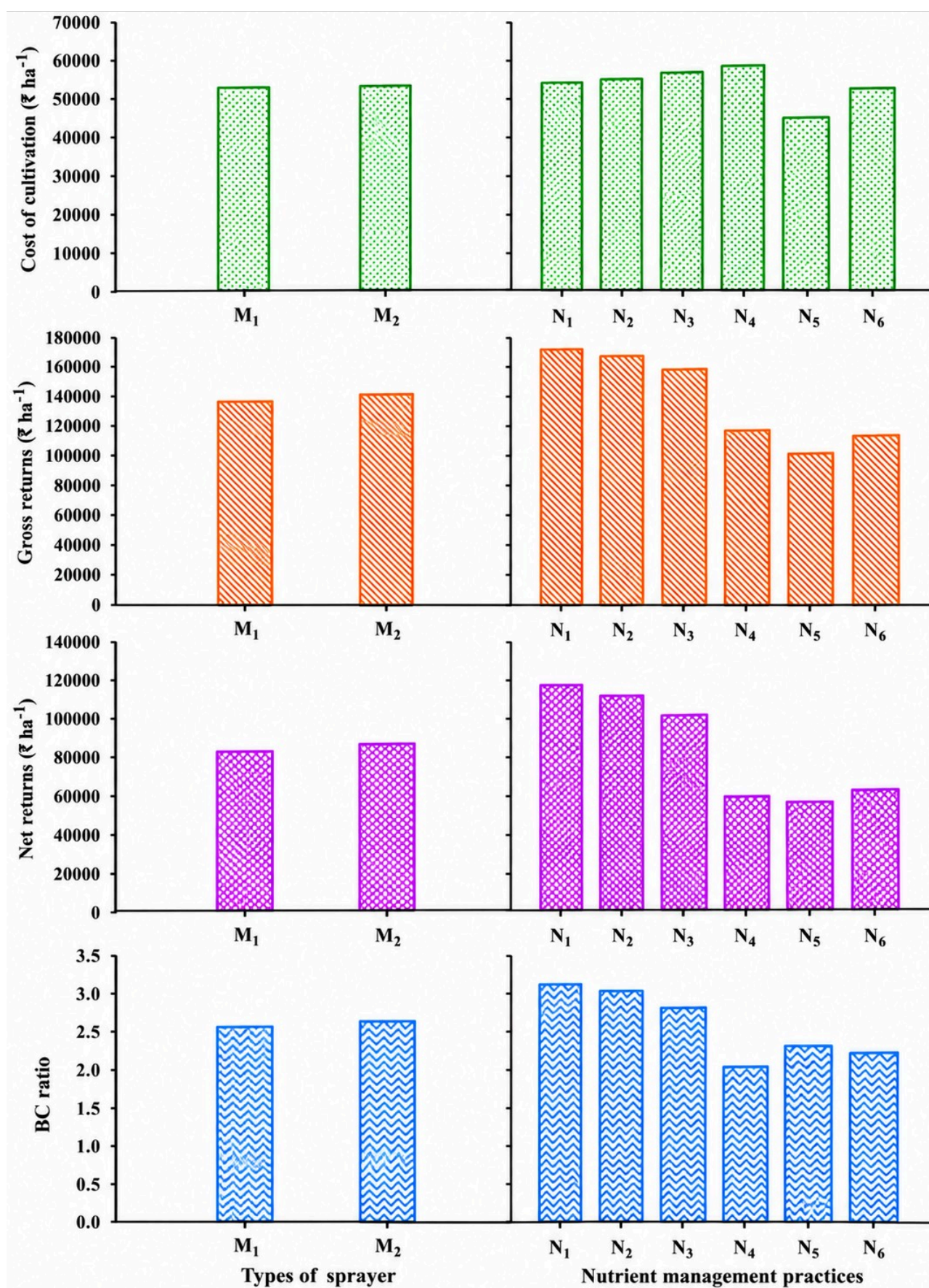


Figure 1. Economics of maize as influenced by the varying level of fertilizers and foliar application of nano urea plus

Note: M₁: Knapsack sprayer, M₂: Power operated sprayer; N₁: RDF (100 % Soil application), N₂: 75 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 DAS, N₃: 50 % RDN + Foliar application of nano urea plus @ 4 ml L⁻¹ at 30 and 45 DAS, N₄: RDN through foliar application of nano urea plus @ 8 ml L⁻¹ at 30 and 45 DAS, N₅: Absolute control, N₆: Nitrogen free

Table 1. Nitrogen, Phosphorus and Potassium uptake by maize as influenced by the varying level of fertilizers and foliar application of nano urea plus

Treatment	N uptake (kg ha ⁻¹)			P uptake (kg ha ⁻¹)			K uptake (kg ha ⁻¹)		
	Grain	Stover	Total	Grain	Stover	Total	Grain	Stover	Total
Main Plot: Types of sprayer (M)									
M ₁	80.0	46.4	126.4	25.1	15.4	40.5	21.2	84.3	105.6
M ₂	86.9	51.8	138.7	26.9	16.8	43.7	22.3	85.6	107.9
S.Em. ±	1.1	0.7	1.3	0.5	0.1	0.6	0.41	1.0	1.3
C.D. @ 5 %	3.1	2.2	3.9	1.6	0.3	1.7	1.22	3.1	3.8
Sub Plot: Nutrient management practices (N)									
N ₁	118.2	70.7	188.9	34.8	21.0	55.8	31.0	102.3	133.3
N ₂	111.4	65.8	177.2	33.6	20.2	53.8	29.3	99.3	128.6
N ₃	100.8	58.0	158.8	31.0	17.9	48.9	26.6	91.8	118.4
N ₄	67.2	46.7	113.9	21.8	15.5	37.3	18.3	75.9	94.2
N ₅	50.0	23.1	73.1	16.6	9.8	26.4	11.4	65.8	77.2
N ₆	53.2	30.1	83.2	18.0	12.2	30.2	13.9	74.9	88.8
S.Em. ±	2.9	1.3	3.4	0.7	0.4	0.9	0.6	1.8	1.7
C.D. @ 5 %	8.7	3.9	10.2	2.0	1.2	2.7	1.9	5.2	5.0
Interaction effect (M X N)									
M ₁ N ₁	112.8	67.4	180.2	33.5	20.2	53.7	30.8	101.5	132.3
M ₁ N ₂	106.1	62.5	168.6	32.5	19.2	51.7	29.2	98.3	127.5
M ₁ N ₃	97.6	55.7	153.2	30.0	17.5	47.5	26.5	92.1	118.6
M ₁ N ₄	64.9	43.8	108.7	21.8	14.7	36.5	17.6	74.0	91.6
M ₁ N ₅	48.1	21.3	69.4	16.0	9.3	25.3	10.5	65.4	75.9
M ₁ N ₆	50.6	27.5	78.1	16.8	11.5	28.3	12.9	74.5	87.4
M ₂ N ₁	123.6	73.9	197.5	36.1	21.8	57.9	31.2	103.0	134.2
M ₂ N ₂	116.6	69.2	185.8	34.8	21.1	55.9	29.4	100.3	129.6
M ₂ N ₃	104.0	60.4	164.4	32.1	18.4	50.4	26.8	91.5	118.2
M ₂ N ₄	69.4	49.6	119.0	21.9	16.4	38.2	19.1	77.8	96.9
M ₂ N ₅	52.0	24.9	76.9	17.3	10.4	27.6	12.2	66.1	78.4
M ₂ N ₆	55.7	32.6	88.3	19.3	13.0	32.3	14.8	75.2	90.0
S.Em. ±	4.2	1.9	4.9	1.0	0.6	1.3	0.9	2.5	2.4
C.D. @ 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: RDF: Recommended Dose of Fertilizer (150:75:37.5 of NPK Kg ha⁻¹); Recommended dose of phosphorus and potassium are common for all treatments except absolute control; NS: Non-Significant

Acknowledgement

This research was a part of M. Sc. thesis and the author greatly appreciate research facilities and support provided by Farm superintendent, ARS, Dhadesugur, UAS, Raichur.

References

- Anonymous. Directorate of Economics and Statistics (DES), Agricultural Statistics at a Glance 2024-25. Department of Agriculture and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, New Delhi. 2025.
- Meena RH, Jat G, Jain D. Impact of foliar application of different nano-fertilizers on soil microbial properties and yield of wheat. J. Environ. Biol. 2021;42(2):302-308.
- Nduwimana R, Kato J, Ezzat M. Impact of nutrient management on maize productivity. J. Agric. Sci. 2020;12(3):45-59.
- Bhattacharyya R, Ghosh BN, Mishra PK, Mandal B, Rao CS, Sarkar D, Das K, Anil KS, Lalitha M, Hati KM, Franzluebbers AJ. Soil degradation in India: Challenges and potential solutions. Sus. 2015;7(4):3528-3570.
- Baruah S, Dutta J. Nanotechnology applications in sensing and pollution degradation in agriculture. Env. Chem. Lett. J. 2009;7:191-204.
- Cui HX, Sun CJ, Liu Q, Jiang J, Gu W. Applications of nanotechnology in agrochemical formulation, perspectives, challenges and strategies. In international conference on Nanoagri, Sao pedro, Brazil. 2010:28-33.
- Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India, Pvt. Ltd. 1973:498.
- Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: ICAR, Publ. 1967;4(2):359.
- Dhansil A, Zalawadia NM, Prajapati BS, Yadav K. Effect of nano phosphatic fertilizer on nutrient content and uptake by pearl millet (*Pennisetum glaucum* L.) crop. Int. J. Curr. Microbiol. Appl. Sci. 2018;7(12):2327-2337.
- Burhan MG, Al-Hassan SA. Impact of nano NPK fertilizers to correlation between productivity, quality and flag leaf of some bread wheat varieties. Iraqi J. Agric. Sci. 2019;50:1-7.
- Al-Juthery HW, Ali EHAM, Al-Uburi RN, Al-Shami QNM, AL-Taey DK. Role of foliar application of nano npk, micro fertilizers and yeast extract on growth and yield of wheat. Int. J. Agric. Stat. Sci. 2020;16(1):1295-1300.
- Sharma SK, Sharma PK, Mandeewal RL, Sharma V, Chaudhary R, Pandey R, Gupta S. Effect of foliar application of nano-urea under different nitrogen levels on growth and nutrient content of pearl millet (*Pennisetum glaucum* L.). Int. J. Plant Soil Sci. 2022;34(20):149-155.

13. Sahu TK, Kumar M, Kumar N, Chandrakar T, Singh DP. Effect of nano urea application on growth and productivity of rice (*Oryza sativa* L.) under midland situation of Bastar region. J. Pharm. Innov. 2022;11(6):185-187.
14. Pujari SB, Gurubasavaswamy BM, Bhagyashree, Somashekar KS, Varsha C. Influence of nano urea and nano DAP on nutrient uptake in rabi maize (*Zea mays* L.) under irrigated conditions. Plant Arch. 2026;26(1):2881-2886.
15. Deo HR, Chandrakar T, Srivastava LK, Nag NK, Singh DP, Thakur A. Effect of nano DAP on yield, nutrient uptake and nutrient use efficiency by rice under Bastar plateau. Pharm. Innov. J. 2022;11(9):1463-1465.
16. Chinnappa SA, Krishnamurthy D, Ajayakumar MY, Ramesha YM, Ravi S. Effect of nano fertilizers on growth, yield, nutrient uptake and soil microbiology of *kharif* sorghum. Int. J. Environ. Clim. 2023;13(10):2339-2348.
17. Chavan PM, Waghmare YM, Maindale SD, Chaudhari BK. Studies on effect of foliar application of nano N fertilizer on yield and economics of sorghum (*Sorghum bicolor* L.). Pharma Innov. J. 2023;12(3):1498-1500.
18. Vasanth P, Sivakumar K, Jeyajothi R, Chandrasekaran P. Foliar spray of urea and nano-urea in yield and economics of maize (*Zea mays* L.). J. Appl. Nat. Sci. 2025;17(1):383-388.
19. Sahu TK, Chandrakar DK. Growth parameters, yield and economics of rice as influenced by application of different doses of nano urea. Int. J. Res. Agron. 2026;9(2):590-592.
20. Kumari JJR, Indu T, Singh R. Effect of nano urea and spacing on growth and yield of maize. Int. J. Res. Agron. 2024;7(5):278-281.

How to cite this article: Manjanagouda, Ramesha YM, Kamble AS, Krishnamurthy D, Chandranaik M, Patil VM. Effect of nano urea plus on nutrient uptake and economics of maize (*Zea mays* L.). *International Journal of Research in Agronomy*. 2026;9(9):1248-1253. doi: <https://www.doi.org/10.33545/2618060X.2026.v9.i9q.6680>