Andhra Pradesh J Agril. Sci : 11(1): 1-6, 2025

EFFECT OF FOLIAR APPLICATION OF NANO UREA ON GROWTH AND YIELD OF FODDER MAIZE

G. GEERVANI*, V. CHANDRIKA, S. TIRUMALA REDDY AND M. MADHAN MOHAN

Department of Agronomy, S.V. Agricultural College, ANGRAU, Tirupati-517 502.

Date of Receipt: 22-01-2025 Date of Acceptance: 03-02-2025

ABSTRACT

A field experiment entitled "Effect of foliar application of nano urea on growth and yield of fodder maize" was conducted at Dryland Farm, S.V. Agricultural College, Tirupati campus of Acharya N.G. Ranga Agricultural University, Andhra Pradesh, India during *rabi,* 2023-24. The experiment was laid down in the randomized block design and replicated thrice. Significantly higher values of plant height, leaf area index, green and dry fodder yields were recorded with application of 100% of RDN @120 kg N ha^{-1} + two sprays of nano urea @ 4 ml l^{-1} at knee high and tasselling stages, which was found to be on par with 100 % RDN through urea in three splits (33 % basal + 33 % KH + 33 % TS). Significantly lower values were realized with control.

KEYWORDS: Green fodder yield, Dry fodder yield, Knee high stage, Tasselling stage, Recommended dose of nitrogen.

INTRODUCTION

India feeds about 20 per cent of the world's livestock which means that a significant portion of the global livestock population relies on food resources from India's agricultural activities. The livestock population in India is increasing at a rate of 0.66 per cent per year. Additional pressure is put on the supply of fodder resources by this growth rate. Only 4 per cent of India's total arable land is currently dedicated to the production of fodder. Due to the insufficient amount of land set aside for the production of fodder, there may not be enough resources to support the increasing number of animals. The quantity and quality of the fodder that animals are fed have a significant impact on their health and production. In India, there is now a major shortage of feed supplies. There is 35.6 per cent scarcity of green fodder, 10.5 per cent shortfall of dry fodder and 44 per cent shortage of concentrate feed ingredients across the nation. This shortage shows that there is a gap between the supply and demand for fodder, which is problematic for livestock farmers. While there is a need to close the supply gap for fodder, the prospect of increasing the amount of land available for fodder cultivation is given weight.

Among the cultivated forage crops, maize (*Zea mays* L.), produces rich and nutritious green fodder which is a good source of carbohydrates. The green fodder is particularly suitable for silage making. Apart from having higher fodder yield, it is also tolerant to a wide range of climatic conditions. Maize crop is succulent, widely adaptable and fodder is highly palatable without any antinutritional factors throughout the growth period of the crop (Kashyap *et al*., 2023). As maize is an exhaustive crop, the nutritional requirement is very high. Due to continuous use of conventional urea, the quality of fodder is said to reduce in due course of time. Use of nanotechnology in fodder crops helps to increase the hay and silage quality thereby increasing the milk production in cattle.

Nanotechnology is the manipulation of matter on a near atomic scale to produce new structures, materials and devices. Conventional fertilizers when applied to crop will be subjected to different types of losses like photolysis, hydrolysis, leaching and degradation thereby reducing the availability of fertilizer (Ajithkumar *et al*., 2021). But use of nano fertilizers reduces the losses as they are very minute in size and can be made easily available at target sites. The present study was planned to investigate the effect of nano urea on growth and yield of fodder maize.

MATERIAL AND METHODS

A field experiment was conducted at Dryland farm, S.V. Agricultural College, Tirupati during *rabi,* 2023-24 on sandy loam soils. The soil was neutral in reaction, low in available nitrogen, high in available phosphorus and medium in available potassium status. The variety of fodder maize used in the experiment was African Tall. The present experiment was laid out in a randomized block design with nine treatments and replicated thrice. The treatments consisted of control (no application of N) (T_1), application of nano urea alone twice at KH and TS

*Corresponding author, E-mail: gopireddygeervani@gmail.com

(T_2), 100 % RDN through urea in three splits (33 % basal + 33 % KH + 33 % TS) (T_3), RDN only basal (33 %) + two sprays of nano urea at KH and TS (T_4), RDN only basal (50 %) + two sprays of nano urea at KH and TS (T_5), 75 % of RDN (33 % basal + 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS (T_6), 75 % of RDN (66 % basal + 17 % KH + 17 % TS) + two sprays of nano urea at KH and TS (T_7), 50 % of RDN (33 % basal + 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS (T_8) and 100 % of RDN (33 % basal+ 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS (T_9). Recommended dose of fertilizer used in the experiment was 120-50-40 N, P_2O_5 and K_2O kg ha^{-1}. Recommended dose of phosphorus and potassium were applied as basal to all the treatments. Nano urea was sprayed @ 4 ml l^{-1} during knee high and tasselling stages.

Plant height was recorded from five randomly tagged plants at different intervals *viz*., 20, 40, 60 DAS and at harvest. It was measured from the base of the plant to the tip of the longest leaf up to tasselling stage and later on it was measured from the base of the plant to the tip of the tassel and mean was expressed in cm. Five plants were selected outside the net plot area, leaving the extreme border row, for destructive sampling to generate data on leaf area at different stages of crop growth. Leaf area of five destructively sampled plants from border rows was measured at 20, 40, 60 DAS and at harvest by using LI-COR model, LT-300 leaf area meter with transparent conveyor belt and electronic digital display. After computing the leaf area (cm^2), leaf area index was calculated by using the following formula as suggested by Watson (1952).

$$LAI = \frac{\text{Leaf area (cm}^2\text{)}}{\text{Unitl and area (cm}^2\text{)}}$$

Crop was harvested at milky dough stage. Green fodder yield of fodder maize from the net plot area was harvested separately by leaving 5 cm stubbles from ground surface and expressed in t ha^{-1}. After harvesting, heaps were left in the field for one week for sun drying. Then dry fodder yield of maize from net plot area was weighed and total dry fodder yield was expressed in t ha^{-1}.

RESULTS AND DISCUSSION

Data pertaining to the plant height, leaf area index and yield as influenced by varied levels of nitrogen and foliar application of nano urea was discussed in different sections.

Plant height

Plant height of fodder maize recorded highest values with 75 % of RDN (66 % basal + 17 % KH + 17 % TS) + two sprays of nano urea at KH and TS (T_7) at 20 DAS. Whereas, taller plants at all the growth stages of observations *viz*., 40, 60 DAS and at harvest, were recorded with 100 % of RDN (33 % basal+ 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS (T_9) but it was found to be on par with 100 % RDN through urea in three splits (33 % basal + 33 % KH + 33 % TS) (T_3). The shorter plants of fodder maize were associated with control (T_1). This might be due to greater availability of nitrogen at higher fertilizer doses *i.e*., 100 % RDN (T_9 and T_3) which might have improved protein synthesis and photosynthesis leading to rapid cell division and enlargement, which ultimately resulted in vigorous plant growth. Nano urea has been suggested to enhance various physiological processes in plants, such as photosynthesis, nutrient uptake and enzymatic activities. These improvements in plant physiology can contribute to better growth and development, potentially leading to increased plant height. The obtained results were in conformity with the findings of Lahari *et al*. (2021) and Navya *et al*. (2022).

Leaf area index

Leaf area index of fodder maize recorded highest values with 75 % of RDN (66% basal + 17% KH + 17% TS) + two sprays of nano urea at KH and TS (T_7) at 20 DAS. Higher leaf area index of fodder maize at 40, 60 DAS and at harvest was found with 100 % of RDN (33 % basal+ 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS (T_9) which was on par with 100 % RDN through urea in three splits (33 % basal + 33 % KH + 33 % TS) (T_3). While the minimum leaf area index was associated with control (T_1). Application of 100 % recommended dose of N along with two foliar sprays of nano urea was found beneficial in increasing the leaf area of fodder maize at harvest compared to other treatments. This might be due to the fact that maize thrives on readily available nitrogen. Applying nitrogen through both soil and foliar methods creates a dynamic system. Soil application provides a base supply, while foliar sprays act like booster shots. This targeted approach ensures that nitrogen is available when it is most crucial for cell division and elongation in leaves. This results

Table 1. Plant height (cm) of fodder maize at different growth stages as influenced by varied levels of nitrogen and foliar application of nano urea

Treatments	20 DAS	40 DAS	60 DAS	At harvest
T_1 : Control (no application of N)	24.3	49.8	89	128
T_2 : Application of nano urea alone twice at KH and TS	25.6	55.8	112	150
T_3 : 100% RDN through urea in three splits (33% basal + 33% KH + 33% TS)	32.4	80.5	177	216
T_4 : RDN only basal (33%) + two sprays of nano urea at KH and TS	32.0	71.5	135	168
T_5 : RDN only basal (50%) + two sprays of nano urea at KH and TS	34.6	72.1	141	175
T_6 : 75% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	31.5	76.0	158	196
T_7 : 75% of RDN (66% basal + 17% KH + 17% TS) + two sprays of nano urea at KH and TS	35.2	76.7	162	199
T_8 : 50% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	28.3	72.4	145	178
T_9 : 100% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	32.7	81.1	181	220
SEm±	0.61	1.14	4.1	5.0
CD (P = 0.05)	1.8	3.4	12	15

Table 2. Leaf area index of fodder maize at different growth stages as influenced by varied levels of nitrogen and foliar application of nano urea

Treatments	20 DAS	40 DAS	60 DAS	At harvest
T_1 : Control (no application of N)	0.12	0.80	1.34	1.62
T_2 : Application of nano urea alone twice at KH and TS	0.12	0.94	1.83	2.13
T_3 : 100% RDN through urea in three splits (33% basal + 33% KH + 33% TS)	0.21	1.40	3.23	4.13
T_4 : RDN only basal (33%) + two sprays of nano urea at KH and TS	0.21	1.09	2.32	2.69
T_5 : RDN only basal (50%) + two sprays of nano urea at KH and TS	0.28	1.11	2.39	2.81
T_6 : 75% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	0.20	1.26	2.82	3.44
T_7 : 75% of RDN (66% basal + 17% KH + 17% TS) + two sprays of nano urea at KH and TS	0.30	1.27	2.85	3.55
T_8 : 50% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	0.16	1.13	2.48	2.91
T_9 : 100% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	0.22	1.41	3.25	4.20
SEm±	0.010	0.038	0.104	0.154
CD ($P = 0.05$)	0.03	0.12	0.31	0.46

Table 2. Green and dry fodder yields (t ha^{-1}) of fodder maize as influenced by varied levels of nitrogen and foliar application of nano urea

Treatments	Green fodder yield	Dry fodder yield
T_1 : Control (no application of N)	14.27	2.46
T_2 : Application of nano urea alone twice at KH and TS	20.14	3.84
T_3 : 100% RDN through urea in three splits (33% basal + 33% KH + 33% TS)	28.68	6.63
T_4 : RDN only basal (33%) + two sprays of nano urea at KH and TS	22.13	4.56
T_5 : RDN only basal (50%) + two sprays of nano urea at KH and TS	23.09	4.80
T_6 : 75% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	25.55	5.67
T_7 : 75% of RDN (66% basal + 17% KH + 17% TS) + two sprays of nano urea at KH and TS	26.94	6.02
T_8 : 50% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	23.50	4.96
T_9 : 100% of RDN (33% basal + 33% KH + 33% TS) + two sprays of nano urea at KH and TS	29.77	6.94
SEm±	0.654	0.150
CD (P = 0.05)	1.96	0.45

in significant increase in leaf area and overall vegetative growth. These results are in conformity with the findings of Rani *et al*. (2019) and Ajithkumar *et al*. (2021).

Green and dry fodder yields

Higher green and dry fodder yields of fodder maize were recorded with 100 % of RDN (33 % basal+ 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS (T_9) which was on par with 100 % RDN through urea in three splits (33 % basal + 33 % KH + 33 % TS) (T_3). Significantly lower green fodder yield of fodder maize was recorded with control (T_1). The treatments with 100 % RDN (T_9 and T_3) recorded higher dry fodder yield. This was mainly because of superior performance in vegetative growth with respect to plant height, leaf area and leaf: stem ratio which ultimately resulted in higher dry matter accumulation. In the other treatments, substitution of conventional N with nano-urea (T_2, T_4, T_5, T_6, T_7 and T_8) might have significantly decreased the uptake of N by the plant. As fodder maize is an exhaustive crop, decreased uptake of nutrients by plant, affects cell division and elongation, formation of nucleotides and coenzymes, which led to decreased meristematic activity and photosynthetic area and in turn less production and accumulation of photosynthates yielding lower green and dry fodder. This corresponds to the results of Kumar (2023).

In conclusion, the present study revealed that application of 100 % of RDN (33 % basal+ 33 % KH + 33 % TS) + two sprays of nano urea at KH and TS is the most efficient nutrient management practice to obtain better growth and higher fodder yield in fodder maize.

LITERATURE CITED

Ajithkumar, K., Kumar, Y., Savitha, A.S., Ajayakumar, M.Y., Narayanaswamy, C., Raliya, R., Krupashankar, M.R and Bhat, S.N. 2021. Effect of IFFCO nanofertilizer on growth, grain yield and managing turcicum leaf blight disease in maize. *International Journal of Plant and Soil Science*. 33(16): 19-28.

Kashyap, S., Kumar, R., Ram, H., Kumar, A., Basak, N., Sheoran, P., Bhatacharjee, S., Biswal, B., Ali, G., Kumar, B and Bhakuni, K. 2023. Quantitative and qualitative response of fodder maize to use of bulk and nano-fertilizers in North Western Plains of India. *Agronomy*. *13*(7): 1889.

Kumar, A.M.R. 2023. Foliar application of nano urea for enhancing productivity and quality of fodder maize (Zea mays L.). *M.Sc. (Agri.) Thesis*. University of Agricultural Sciences, Bangalore, Karnataka, India.

Lahari, S., Hussain, S.A., Parameswari, Y.S and Sharma, S.H.K. 2021. Grain yield and nutrient uptake of rice as influenced by the nano forms of nitrogen and zinc. *International Journal of Environment and Climate Change*. 11(7): 1-6.

Navya, K., Kumar, S.R., Chaitanya, K.A and Sampath, O. 2022. Effect of nano nitrogen in conjunction with urea on growth and yield of mustard (*Brassica juncea* L.) in Northern Telangana Zone. *Biological Forum: An International Journal*. 14(3): 95-99.

Rani, B., Nirali, B., Zalawadia, N.M and Rushang, K. 2019. Effect of different levels of chemical and nano nitrogenous fertilizers on yield and yield attributes of sorghum crop (*Sorghum bicolor* L.). *International Journal of Current Microbiology and Applied Sciences*. 8(8): 2878- 2884.

Watson, D.J. 1952. The physiological basis of variation in yield. *Advances in Agronomy*. 6: 103-109.