

Influence of foliar nutrition on growth and yield of *rabi* sorghum (*Sorghum bicolor* L. Moench)

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ABSTRACT

A field experiment was carried out in clay soils during *rabi*, 2024-2025 at Agricultural College Farm, Bapatla to assess the response of *rabi* sorghum (*Sorghum bicolor* L. Moench) to foliar nutrition. The trial was laid out in a randomized block design with eight treatments and replicated thrice. The results of the investigation revealed that growth characters such as the plant height (168.2 cm), drymatter (13745 kg ha⁻¹), yield attributing characters such as earhead weight (64.5 g), grain yield (4414 kg ha⁻¹) and stover yield (7812 kg ha⁻¹) were significantly higher with the application of 100 % RDN (100 kg ha⁻¹) which was on par with the application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (159.3 cm, 13234 kg ha⁻¹, 61.5 g, 4215 kg ha⁻¹ and 7589 kg ha⁻¹, respectively), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40 DAS and 60 DAS (152.7 cm, 12720 kg ha⁻¹, 59.3 g, 4063 kg ha⁻¹ and 7482 kg ha⁻¹, respectively) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40 DAS and 60 DAS (145.0 cm, 12140 kg ha⁻¹, 57.2 g, 3871 kg ha⁻¹ and 7009 kg ha⁻¹, respectively).

Keywords: *Nano urea, Nano DAP, Sorghum, Seaweed extract and Urea*

Sorghum (*Sorghum bicolor* L. Moench) is an important grain and fodder crop in the world. It is ranked fifth among the most important grain crops in the world after wheat, rice, maize and barley (FAOSTAT, 2021). Sorghum crop is distinctive due to its drought tolerance capacity and it also has improved water and nutrient use efficiency. However, the average productivity of sorghum is less due to climate change, inadequate irrigation, limited access to modern technology and overuse of chemical fertilizers and pesticides. Sorghum is highly responding to foliar fertilization. Soil application of the nutrients is the most common practice, but it has many limitations with respect to availability of nutrients to the plants. Foliar application deliver nutrients directly to plants through their leaves, allowing for rapid absorption when root uptake is hindered, particularly during stress conditions like drought or cold weather. Foliar nutrition along with adequate amount of conventional fertilizers improves the efficiency of applied fertilizers apart from promoting the conversion of unavailable form of nutrients to available forms. Additionally, foliar application of primary nutrients has the potential to boost the crop productivity under moisture-stressed conditions. Nano fertilizers are the new generation of

synthetic fertilizers which contain readily available nutrients in the nano-scale range. Nano fertilizers provide nutrients throughout the crop growth period (Chandan *et al.*, 2023). Nano technology is characterized by its tiny size (1-100nm). A single nanoparticle of urea liquid at a concentration of 2-4ml/L during critical stages of crop is highly beneficial (Bhukya *et al.*, 2024). Nano-urea is the liquid version of solid urea. Seaweed sap contain essential trace elements and plant growth regulators such as auxins, gibberellins and cytokinins that speed up the metabolism of plants and boost crop yields. Several studies have shown that crops' responses to seaweed saps are as good as chemical fertilizers. Nearly 15 million tonnes of seaweed products are produced yearly worldwide, of which about one-third is used as nutritional supplements, biostimulants and biofertilizers for promoting plant growth and crop production. Recently, seaweed extract has gained popularity as a foliar spray due to their beneficial effects on various crops (Layek *et al.*, 2017).

MATERIAL AND METHODS

A field experiment was conducted at Agricultural college farm, Bapatla during *rabi*, 2023-

2024. The experiment was laid out in eight treatments. *Viz.*, T₁: 100 % RDN (100 kg ha⁻¹), T₂: 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40 DAS and 60 DAS, T₃: 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40 DAS and 60 DAS, T₄: 75 % RDN (75 kg ha⁻¹) + Foliar spray of KNO₃ @ 1 % at 40 DAS and 60 DAS, T₅: 75 % RDN (75 kg ha⁻¹) + Foliar spray of 19-19-19 @ 1 % at 40 DAS and 60 DAS, T₆: 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS, T₇: 75 % RDN (75 kg ha⁻¹) + Foliar spray of seaweed extract @ 2% at 40 DAS and 60 DAS and T₈: 75 % RDN (75 kg ha⁻¹) alone. Based on the soil analysis the results revealed that the soil of experimental site was clay in texture, pH is neutral in reaction (7.28), EC is non saline in nature (0.35 dS m⁻¹) and below the critical point, Soil is low in available nitrogen (231 kg ha⁻¹), medium in available P₂O₅ (42.8 kg ha⁻¹) and high in available K₂O (395 kg ha⁻¹) contents. Post harvest analysis of soil for chemical & physico-chemical properties were also done to determine the treatmental effects. The variety used in this study was NTJ-5. Nitrogen, phosphorus and potassium were supplied through urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. Nitrogen was applied in two equal split doses *viz.*, first dose was applied as basal and second

dose was applied at 30 DAS. Entire quantity of phosphorus and potassium were applied as basal as per the treatments. The data generated on various parameters during the course of investigation were statistically analyzed by applying the technique of analysis of variance contained in the procedures suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The table showed that plant height (cm) and drymatter production (kg ha⁻¹) at harvest was significantly influenced by the foliar nutrition. Significantly higher plant height at harvest was recorded with the application of 100 % RDN (100 kg ha⁻¹) (T₁) (168.2 cm) which was at par with the application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (T₆) (159.3cm), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40DAS and 60DAS (T₂) (152.7 cm) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40DAS and 60DAS (T₃) (145.0 cm). Foliar application of nitrogen promotes the growth by stimulating the cell division and enlargement which in turn increases the number and length of internodes that results in progressive plant height (Khokhar *et al.*, 2021) and also N fertilization helps in increasing

Table 1. Growth characters and yield attributes of sorghum as influenced by the foliar nutrition

Treatments	Plant height at harvest (cm)	Drymatter production at harvest (kg ha ⁻¹)	Earhead weight (g)	Grain Yield (kg ha ⁻¹)	Stover Yield (kg ha ⁻¹)	Harvest Index (%)
T ₁ - 100 % RDN (100 kg ha ⁻¹)	168.2	13745	64.5	4414	7812	36.1
T ₂ - 75 % RDN (75 kg ha ⁻¹) + Foliar spray of nano urea @ 4 ml L ⁻¹ at 40 DAS and 60 DAS	152.7	12720	59.3	4063	7482	35.1
T ₃ - 75 % RDN (75 kg ha ⁻¹) + Foliar spray of nano DAP @ 2.5 ml L ⁻¹ at 40 DAS and 60 DAS	145	12140	57.2	3871	7009	35.7
T ₄ - 75 % RDN (75 kg ha ⁻¹) + Foliar spray of KNO ₃ @ 1 % at 40 DAS and 60 DAS	135.3	11057	53.1	3550	6509	35.3
T ₅ - 75 % RDN (75 kg ha ⁻¹) + Foliar spray of 19-19-19 @ 1 % at 40 DAS and 60 DAS	138.5	11402	54.7	3652	6690	35.4
T ₆ - 75 % RDN (75 kg ha ⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS	159.3	13234	61.5	4215	7589	35.6
T ₇ - 75 % RDN (75 kg ha ⁻¹) + Foliar spray of seaweed extract @ 2% at 40 DAS and 60 DAS	141.2	11711	56.1	3750	6788	35.5
T ₈ - 75 % RDN (75 kg ha ⁻¹) alone	125.5	10826	51	3482	6315	35.6
SEm [±]	7.9	580	2.7	195	326	1.6
CD (p = 0.05)	24.1	1758	8.1	591	990	NS
CV (%)	9.4	8.3	8.1	8.7	8	7.9

the enzyme content, enzymatic activity and chlorophyll content of the leaves are expected to increase the photosynthetic activity that influences the growth and development (Nasar *et al.*, 2020).

Significantly higher drymatter production at harvest was recorded with the application of 100 % RDN (100 kg ha⁻¹) (T₁) (13745 kg ha⁻¹) which was at par with the application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (T₆) (13234 kg ha⁻¹), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40DAS and 60DAS (T₂) (12720 kg ha⁻¹) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40DAS and 60DAS (T₃) (12140 kg ha⁻¹). The observed increase in drymatter can be attributed to the elevated nitrogen levels resulting from the foliar application of urea, leading to a significant difference in total drymatter production. This effect may be linked to an elevated photosynthetic rate and increased leaf area (Rahman *et al.*, 2014). Improved crop growth and photosynthetic activity depends on efficient assimilating area and adequate nitrogen supply, which ensures proper production of photosynthates that leads to higher rate of drymatter accumulation (Kumar *et al.*, 2024).

Earhead weight (g), grain and stover yield (kg ha⁻¹) was significantly influenced by the foliar nutrition. Significantly higher earhead weight was recorded with the application of 100 % RDN (100 kg ha⁻¹) (T₁) (64.5 g) which was at par with the application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (T₆) (61.5 g), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40 DAS and 60 DAS (T₂) (59.3 g) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40DAS and 60DAS (T₃) (57.2 g).

Significantly higher grain yield was observed with the application of 100 % RDN (100 kg ha⁻¹) (T₁) (4414 kg ha⁻¹) which was at par with the application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (T₆) (4215 kg ha⁻¹), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40 DAS and 60 DAS (T₂) (4063 kg ha⁻¹) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40DAS and 60DAS (T₃) (3871 kg ha⁻¹). The increase in grain yield might be due to

increase in drymatter production, earhead weight and increase in translocation of assimilates from source to sink (Chavan *et al.*, 2023).

Significantly higher stover yield was recorded with the application of 100 % RDN (100 kg ha⁻¹) (T₁) (7812 kg ha⁻¹) which was at par with the application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (T₆) (7589 kg ha⁻¹), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40 DAS and 60 DAS (T₂) (7482 kg ha⁻¹) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40DAS and 60DAS (T₃) (7009 kg ha⁻¹). The increase in stover yield is mainly attributed to improved growth and yield parameters. This improvement is linked to the beneficial effects of nitrogen on cell division and elongation, as well as the synthesis of nucleotides and coenzymes which resulted in increased meristematic activity and photosynthetic area, ultimately leading to greater production and accumulation of photosynthates that resulted in higher yield (Somashekar *et al.*, 2015). Harvest index was found to be non-significant.

CONCLUSION

Based on the above findings it can be concluded that significant increase in plant height, drymatter production, earhead weight and yield was recorded with the application of 100 % RDN (100 kg ha⁻¹) (T₁) which was on par with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of urea @ 2% at 40 DAS and 60 DAS (T₆), application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano urea @ 4 ml L⁻¹ at 40 DAS and 60 DAS (T₂) and with application of 75 % RDN (75 kg ha⁻¹) + Foliar spray of nano DAP @ 2.5 ml L⁻¹ at 40 DAS and 60 DAS (T₃).

LITERATURE CITED

- Bhukya R, Raundal P, Rajendra N V, Pranay A, Sondawale and Ningfode M B 2024.** Effect of the application of nano-urea on growth and nutrient uptake of *rabi* maize (*Zea mays* L.). *International Journal of Advanced Biochemistry Research*. 8 (8): 1400-1403.
- Chandan B M, Sunil C, Girijesh G K, Thippeshappa G N and Millikarjuna H B 2023.** Effect of foliar application of nano and conventional urea on growth and yield attributes of ragi (*Eleusine Coracana* L.

- Gaertn). *International Journal of Environment and Climate Change*. 13 (11): 3578-3585.
- Chavan P M, Waghmare Y M, Maindale S D and Shinde L R 2023.** Studies on effect of foliar application of nano N fertilizer on growth and yield of sorghum (*Sorghum bicolor* L.). *The Pharma Innovation Journal*. 12 (3): 1501-1504.
- FAOSTAT 2021.** production volume of pulses worldwide from 2010 to 2019. (Accessed: 6/11/2021): <https://www.statista.com/statistics/721945/pulses-production-volume-worldwide/>.
- Gomez K A and Gomez A 1984.** *Statistical procedures for agricultural research*. 1st ed. John Wiley Sons, New York.
- Khokhar A, Bhat M A, Singh M J, Kaul A, Sandhu P S, Yousuf A, Dhillon B S and Chary G R 2021.** Effects of soil and foliar application of urea on growth, yield and economics of rainfed maize (*Zea mays* L.) in punjab. *Indian Journal of Dryland Agricultural Research and Development*. 36 (2): 27-32.
- Kumar S, Kumar N, Satpal PK, Kumar P, Kharor N and Dahiya P 2024.** Effect of nano urea on sustainable production of fodder sorghum. *Forage Research*. 50 (1): 70-76.
- Layek J, Das A, Ghosh A, Sarkar D, Idapuganti R G, Boragohain J, Yadav G S and Lal R 2017.** Foliar application of seaweed sap enhances growth, yield and quality of maize in eastern Himalayas. *Proceedings of the National Academy of Sciences. Biological Sciences*. 89: 221-229.
- Nasar J, Shao Z, Arshad A, Jones F G, Liu S, Li C, Khan M Z, Khan T, Banda J S K, Zhou X and Gao Q 2020.** The effect of maize-alfalfa intercropping on the physiological characteristics, nitrogen uptake and yield of maize. *Plant Biology*. 22 (6): 1140-1149.
- Rahman M Z, Islam M R, Karim M A and Islam M T 2014.** Response of wheat to foliar application of urea fertilizer. *Journal of the Sylhet Agricultural University*. 1 (1): 39-43.
- Somashekar K S, Shekara B G, Kalyanamurthy K N and Lohithaswa H C 2015.** Growth, yield and economics of multicut fodder sorghum (*Sorghum sudanense* L.) as influenced by different seed rates and nitrogen levels. *Forage Research*. 40 (4): 247-250.