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Evaluation of Fodder bajra (*Pennisetum glaucum* L.) performance to the Foliar Application of Nano Urea liquid on Yield attributes and Economics

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ABSTRACT: Optimum nutrient management for good yields with reducing cost of cultivation is desirable for cultivation of fodder crops. In order to evaluate the best practice for nitrogen management in fodder bajra with urea and nano urea applications, the present investigation was carried out during *rabi* 2021 with 6 treatments and 4 replications in randomised block design at College farm, College of Agriculture, Rajendranagar, Hyd-30, Telangana, in sandy loam soils. The study disclosed that urea application @27 kg N/ha each at basal, 20 & 40 DAS (T_2) recorded significantly at par with basal urea application @27 kg N/ha + foliar spray of nano urea liquid @2.5 ml/l each at 20 & 40 DAS with respect to fodder bajra growth and yield. 100 % RDN application through urea recorded higher results w.r.t economics over other treatment applications. Hence, N management through urea and also urea + nano urea liquid foliar spray @2.5 ml/l might be the best combination among other foliar spray rates for obtaining best use efficiency and sustainability.

Keywords: Nitrogen, nano urea liquid, leaf to stem ratio, urea, foliar spray, fodder bajra.

INTRODUCTION

Livestock is the backbone of India's economy in terms of Income, Employment, food, social security, Equity, and Sustainability. It plays a crucial role in the rural economy of India by providing employment and uniform income throughout the year. Adequate supply of quality fodder is essential for sustainable livestock production and productivity. Total area under fodder crops on individual crop basis in India is 9.58 m. ha (Indiastat, 2020). Which is only 4.2 to 4.4% of the total cultivated area and present a net deficiency of 44% concentrate feed materials, 35.6% green fodder and 10.95% dry fodder in the country (IGFRI Vision, 2050). There is hardly any scope of expansion due to increasing pressure on cultivable land for food crops and cash crops. The solution, therefore, lies in increasing quality fodder production on limited space and time with greater emphasis on nutrient management.

Pearlmillet (*Pennisetum glaucum*. L) is an important minor millet and better alternative because it is a quick-growing and short-duration crop, cultivated as dual purpose crop mostly under rainfed conditions due to its high tillering ability, dry matter production, protein content, palatability, higher nutritive value and excellent growth habit (Rana and Bana 2012). Even some of the varieties are grown exclusively for fodder production. It has no anti-nutritional factors such as prussic acid, withstands multiple cuttings, perform better under marginal and low fertile soils but responds well to good management and higher fertility levels. Application of nitrogen to fodder crops is the most important way to increase forage production. Although the optimization of nitrogen fertilization is an important aspect in making pearl millet fodder production cost effective, use of N in excess leads to soil health deterioration and accumulation of nitrate-N in fodder which is harmful to animals. We can also use nano fertilizers over traditional fertilizers for foliar application. Nano fertilizers are synthesized or modified form of traditional fertilizers with the help of nanotechnology used to improve nutrient availability in soil. Nano urea liquid is a source of nitrogen, crucial towards proper

crop growth and development. Foliar application of Nano urea liquid at critical crop growth stages effectively fulfills the N requirement and reflects higher crop productivity and quality in comparison to conventional urea. The present study was therefore, designed to investigate the response of fodder bajra to urea and liquid nano urea on growth, yield and economics.

MATERIALS AND METHODS

The present field investigation was carried out during rabi 2021 at College Farm, College of Agriculture, Rajendranagar, Hyd-30, PJTSAU, Telangana which is geographically located at 78°24' - 39.2" E longitude and 17°19' - 19.2" N Latitude and at an altitude of 542.3 m above MSL. Experimental location falls under Southern Telangana Agro Climatic Zone. The soil having pH 7.5 was sandy loam in texture, EC (0.67 dS m^{-1}) and organic carbon (0.44 %) with available NPK 187, 64 and 334 kg ha^{-1} respectively. During crop growth period the average of weekly mean $RH_{(morning)}$, $RH_{(evening)}$, T_{max}, T_{min} and evaporation recorded were 89.63 %, 52.87 %, 28.87 °C, 16.07 °C and 3.11 mm respectively. The total amount of rainfall received during the crop growth period was 26.2 mm in 3 rainy days. The experiment was laid out in a RBD using six treatment combinations with four replications. In this experiment, Nitrogen was applied in three split doses with both forms of urea and nano urea liquid with different doses through soil and foliar application methods. P_2O_5 & K_2O were applied basally through SSP and MOP sources respectively. The standard RDF (100%) dose is 80:40:30 NPK Kg ha^{-1}. These six treatment combinations were laid out with four replications, among nutrients 1/3rd dose of nitrogen (Urea), full dose of P_2O_5 & K_2O were applied at the time of sowing. Remaining, half dose of nitrogen (urea application and foliar spary of nano urea liquid) were applied each at 20 and 40 DAS respectively.

The other agronomic practices like irrigation and weed control measures were done as per recommended practices of PJTSAU, Rajendranagar. All growth and yield parameters of fodder bajra were recorded periodically on randomly selected and tagged plants. The plant samples were collected at crop harvest and analyzed for quality parameters following by standard procedure.

The cost of cultivation and the gross returns were calculated using the green fodder yield of fodder bajra and the market price of the produce at the time of marketing. The net returns per hectare were calculated by deducting the cost of cultivation per hectare from the gross returns per hectare.

Net monetary returns = Gross monetary returns - Total cost of cultivation

Benefit cost ratio was worked out for each treatment by using the formula given by Subba Reddy and Raghuram (1996).

$$\text{B: C} = \frac{\text{Gross returns (₹ /ha)}}{\text{Cost of cultivation (₹ /ha)}}$$

The data acquired from various parameters under investigation were analysed by the method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984). The level of significance (LoS) used in the "F" test was given at 5%.

RESULTS AND DISCUSSION

A. Growth Parameters

The data regarding growth parameters *viz.*, plant height, stem diameter and number of leaves $plant^{-1}$ are presented in (Table 1). Highest number of tillers m^{-2} and plant height (84.52 and 165 cm respectively) were recorded with urea application @27 kg N/ha each at basal, 20 & 40 DAS (T_2) which is statistically at par with basal urea application @27 kg N/ha + foliar spray of nano urea liquid @2.5 ml/l each at 20 & 40 DAS (T_4) (77.84 and 153 cm respectively). T_4 recorded at par with basal urea application @27 kg N/ha + foliar spray of nano urea liquid @3 ml/l each at 20 & 40 DAS (T_5) (72.72 and 149 cm respectively). While lowest growth parameters are recorded with no N application (103 cm and 52.78 respectively). Growth parameters increased by 16-33% and 12-32% respectively with influence of nano urea foliar spray in combination with urea application over control.

Results disclosed that application of nitrogen through both sources (Urea and nano urea liquid) either individual or in combination significantly increased growth parameters over control. Analagous results were reported by Srivani *et al*. (2022), Navya *et al*. (2022), Sumanta *et al*. (2022), and Parizad *et al*. (2017). The increase was might be due to more accumulation of nutrient during respective stages of crop growth. The beneficial effect of nitrogen with higher photosynthetic activity and protein synthesis may promote cell division and cell elongation which accelerate the vegetative growth. The middle nano urea liquid foliar spray rates were in close agreement with the findings of Abdel-Salam *et al.* (2018) in lettuce.

Leaf to stem ratio. Leaf to stem ratio of fodder bajra as influenced by urea and liquid nano urea applications were presented in table 1 revealed that the plants raised with the combined application of basal urea @27 kg N/ha + foliar spray of nano urea liquid @2.5, 3, 3.5 and 2 ml/l concentration recorded statistically similar leaf: stem ratio with each other (0.42, 0.41, 0.40 and 0.39 respectively). It ranged from 0.25 to 0.42. Leaf to stem ratio (0.34) recorded with 100 % urea application. Significantly lowest leaf to stem ratio (0.25) was registered with absolute control (T_1). Lowest leaf to stem ratio registered with advancing in stage of the crop

might be due to weight of stems enhanced more comparatively to weight of leaves. In comparison with urea to that of liquid nano urea foliar sprays, maximum weight of stems were registered in plants fertilized with 100% RDN application with urea (T_2) which resulted in L: S ratio. Similar findings were reported by Srivani *et al*. (2022) and Tiwana *et al*. (2005).

B. Yield

On scrutiny of yield data presented in (Table 1) disclosed that green fodder yield and dry fodder yield of bajra were significantly influenced by urea and liquid nano urea applications. Urea application @27 kg N/ha each at basal, 20 & 40 DAS (T_2) recorded significantly highest yield (292 and 72.36 q/ha respectively) and at par with basal urea application @27 kg N/ha + foliar spray of nano urea liquid @2.5 ml/l each at 20 & 40 DAS (T_4) (271 and 65.36 q ha^{-1} respectively). (T_4) recorded on par yield with basal urea application @27 kg N/ha + foliar spray of nano urea liquid @3 ml/l each at 20 & 40 DAS (T_5) (263 and 59.86 q ha^{-1} respectively). While significantly lowest yield was recorded with no nitrogen (181 and 24.22 q ha^{-1} respectively). Yield *viz*., green and dry fodder yield increased by 16-33% and 44-63% with influence of urea in combination with nano urea foliar sprays over absolute control respectively. This may be attributed that nitrogen is an essential constituent of plant tissue and is involved in cell division and cell elongation which reflected its beneficial effect on the growth characters *viz*., plant height, number of tillers per m^2 and yielding higher green and dry fodder. Almost similar findings were reported by Jagriti *et al*. (2023), Srivani *et al*. (2022), Navya *et al*. (2022) and Rajesh *et al*. (2021). The middle nano urea foliar spray rates were in close agreement with the findings of Abdel-Salam *et al.* (2018) in lettuce.

Table 1. Influence of nitrogen with urea and nano urea liquid forms on yield attributes and yield of fodder bajra.

Treatments	Height of the plant (cm)	No. of tillers m^{-2}	Leaf: stem ratio	Green fodder yield (q ha^{-1})	Dry fodder yield (q ha^{-1})
T_1- Control	103	52.78	0.25	181	24.22
T_2- Urea application @ 27 kg N/ha each at basal, 20 and 40 DAS.	165	84.52	0.34	292	72.36
T_3- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 2 ml/l each at 20 and 40 DAS.	122	60.12	0.39	216	43.45
T_4- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 2.5 ml/l each at 20 and 40 DAS.	153	77.84	0.42	271	65.36
T_5- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 3 ml/l each at 20 and 40 DAS.	149	72.72	0.41	263	59.86
T_6- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 3.5 ml/l each at 20 and 40 DAS.	138	67.44	0.40	243	52.74
SEm±	4.21	2.22	0.01	7.48	2.39
CD (P=0.05)	12.68	6.71	0.04	22.56	7.21

C. Economics

On persual of data (Table 2) economic retuns as influenced by urea and nano urea liquid applications on fodder bajra revealed that higher relative economics were obtained with 100% RDN application through urea application @ 27 kg N/ha each at basal, 20 and 40 DAS (T_2) (58300 and 18000 ₹/ha respectively). The next best alternative was T_4 (Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 2.5 ml/l each at 20 and 40 DAS) and the lowest were obtained with T_1 (control) (36100 and 100 ₹/ha respectively). Economic returns of fodder bajra enhanced by (16-33 and 94-99%) with application of urea in combination with foliar spray of liquid nano urea over control respectively. Higher level of N application which might be owing to better NUE increased yield of fodder bajra resulting in the higher economic returns. Similar findings were also reported by researchers (Srivani *et al*. (2022), Goud *et al*., 2022 and Yogendra Kumar *et al*., 2020).

The data on benefit cost ratio as influenced by urea and nano urea liquid applications in fodder bajra were presented in (Table 2) revealed that highest B: C ratio was recorded with urea application @27 kg N/ha each at basal, 20 and 40 DAS (T_2) (1.45), followed by T_4 (basal urea application @27 kg N/ha + foliar spray of liquid nano urea @2.5 ml/l each at 20 and 40 DAS) (1.29) and the lowest benefit cost ratio was realized with control (T_1) (1.00). Benefit cost ratio enhanced by 4-22 percent with urea application in combination with foliar spray of nano urea liquid over control. Higher green fodder yield and net returns obtained with T_2 might be responsible for higher B: C ratio. The present

findings confirms with that of others (Srivani *et al*., 2022, Goud *et al.*, 2022 and Ajithkumar *et al*., 2021).

Table 2: Influence of nitrogen with urea and nano urea liquid forms on economics of fodder bajra.

Treatments	Cost of cultivation (₹/ ha)	Gross returns (₹/ ha)	Net returns (₹/ ha)	Benefit cost ratio
T_1- Control	36000	36100	100	1.00
T_2- Urea application @ 27 kg N/ha each at basal, 20 and 40 DAS.	40300	58300	18000	1.45
T_3- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 2 ml/l each at 20 and 40 DAS.	41400	43200	1800	1.04
T_4- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 2.5 ml/l each at 20 and 40 DAS.	41800	54100	12300	1.29
T_5- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 3 ml/l each at 20 and 40 DAS.	42300	52500	10200	1.24
T_6- Basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 3.5 ml/l each at 20 and 40 DAS.	42700	48500	5800	1.14

Note: Selling price of green fodder bajra @ 2 ₹/ kg.

CONCLUSION

Based on the present analysis, it can be concluded that basal urea application @ 27 kg N/ha & foliar spray of liquid nano urea @ 2.5 ml/l each at 20 and 40 DAS could be the best nitrogen management practice. However, urea application @ 27 kg N/ha each at basal, 20 and 40 DAS as 100% RDN application through urea recorded statistically on par with urea & liquid nano urea foliar sprays @2.5 ml/l each at 20 and 40 DAS w.r.t yield attributes and yield of fodder bajra. 100% RDN application through urea recorded higher returns and B: C ratio over other treatment applications.

FUTURE SCOPE

Study on effect of nano urea on multicut varieties of fodder bajra and perennial fodders.
Study of liquid nano urea in combination with nano DAP and nano zinc need to be focussed.

Conflict Of Interests. Authors have declared that no conflict of interests exist.

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