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## Performance of multicut fodder sorghum to integrated nitrogen management practices

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### Abstract

A field experiment on “Effect of integrated nitrogen management on yield and quality of *rabi* fodder sorghum” was conducted during *rabi* 2025-26 at Agricultural Research Institute, Rajendranagar, to evaluate the influence of integrated nitrogen management practices on growth and yield of fodder sorghum. The experiment was laid out in a Randomized Block Design with eleven treatments replicated thrice. The results indicated that integrated nitrogen management significantly influenced growth and yield parameters at the first cut (60 DAS).

Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded significantly higher values of plant height (197.11 cm), number of nodes plant<sup>-1</sup> (13.16), internodal length (15.13 cm), leaf area (4813.60 cm<sup>2</sup> plant<sup>-1</sup>), green fodder yield (197.98 q ha<sup>-1</sup>) and dry fodder yield (75.82 q ha<sup>-1</sup>) at first cut (60 DAS). This treatment was statistically on par with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>). The lowest values for all growth and yield parameters were observed under the control treatment (T<sub>11</sub>).

**Keywords:** Fodder sorghum, fodder yield, integrated nitrogen management, organic manures, biofertilizers

### 1. Introduction

Livestock is an integral component of Indian agriculture, contributing 5.50% to the total Gross Value Added (GVA) during 2022-23. India ranks first globally in milk production, contributing 24.76% of world milk production, with output increasing from 146.31 to 247.87 million tonnes during 2024-25 (DAHD and Fisheries, 2025) [5]. Despite having the world's largest livestock population, productivity remains low mainly due to inadequate supply of quality fodder. India currently faces a deficit of 35.6% green fodder, 10.95% dry fodder and 44% concentrate feed and future projections indicate continued shortages unless fodder production increases by 1.69% annually (IGFRI Vision, 2050) [8].

Sorghum is an important fodder crop grown during both *kharif* and *rabi* seasons because of its high biomass production and adaptability to diverse agro-climatic conditions (Ritu *et al.*, 2024). Being a nutrient exhaustive crop, sorghum requires adequate nitrogen management for higher productivity. However, continuous use of chemical fertilizers alone may adversely affect soil health and increase cultivation costs. Integrated Nitrogen Management (INM), involving inorganic fertilizers, organic nutrient sources and biofertilizers, offers a sustainable approach to improve soil fertility, fodder yield and quality (Raj *et al.*, 2024) [7]. Therefore, the present study was undertaken to evaluate the effect of INM on yield and quality of *rabi* fodder sorghum.

### 2. Materials and Methods

The experiment was conducted at Agricultural Research Institute, Rajendranagar, during *rabi* 2025-26 in sandy clay loam soil to study the “Effect of integrated nitrogen management on yield and quality of *rabi* fodder sorghum”. The experiment was laid in a randomized block design with eleven treatments and three replications. The treatments consist of (T<sub>1</sub>) 100% RDN, (T<sub>2</sub>) 100% RDN+AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>3</sub>) 75% RDN, (T<sub>4</sub>) 75% RDN + AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>5</sub>) 75% RDN +25% N- FYM & AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>6</sub>) 75% RDN + 25% N-vermicompost & AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>7</sub>) 75% RDN + 25% N-poultry manure & AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>8</sub>) 75% RDN + 25% N- sheep manure& AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>9</sub>) 75% RDN + 25% N- neem

cake & AZB+PSB @ 5 kg ha<sup>-1</sup>, (T<sub>10</sub>) 75% RDN + 25% N- biogas slurry & AZB+PSB @ 5 kg ha<sup>-1</sup> and (T<sub>11</sub>) control- no nitrogen application, periodical observations were recorded. The data obtained were subjected to statistical analysis as per the standard procedures given by Gomez and Gomez (1984).

### 3. Results and Discussion

#### 3.1 Growth Parameters

##### 3.1.1 Plant height (cm)

The data presented in Table 1 indicated that plant height was significantly influenced by integrated nitrogen management practices at first cut (60 DAS). Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded the maximum plant height (197.11cm) at first cut (60 DAS) and remained statistically on par with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>), which recorded (195.14 cm) at first cut. This was followed by T<sub>6</sub> (75% RDN + 25% N through vermicompost + AZB + PSB @ 5 kg ha<sup>-1</sup>) with plant heights of (173.83 cm). Whereas the lowest values were recorded under T<sub>11</sub> (control) (103.89 cm).

The superior plant height observed under T<sub>2</sub> and T<sub>7</sub> treatments could be attributed to the sustained availability of nitrogen, which enhanced chlorophyll synthesis, cell division and overall vegetative growth. In addition, combined application of organic sources with biofertilizers improved soil microbial activity and nutrient availability, resulting in better nutrient uptake and improved crop growth over the control. Similar findings were also

reported by Jadav *et al.* (2018) [2] under integrated nutrient management practices involving recommended fertilizer dose with biofertilizers.

##### 3.1.2 Number of nodes plant<sup>-1</sup>

The data presented in Table 1 revealed that the number of nodes per plant, an important growth parameter, was significantly influenced by integrated nitrogen management practices. Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded the highest number of nodes plant<sup>-1</sup> (13.16) at first cut and was statistically comparable with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>), which recorded (12.13). This was followed by T<sub>6</sub> (75% RDN + 25% N through vermicompost + AZB + PSB @ 5 kg ha<sup>-1</sup>) with values of (9.90), whereas the lowest number of nodes was recorded under T<sub>11</sub> (control) with (5.83) at first cut.

The improved nodal development observed in T<sub>2</sub> and T<sub>7</sub> may be attributed to continuous and balanced nutrient availability, particularly nitrogen, which enhanced stem growth and cellular activity. The integrated application of organic manures along with biofertilizers further improved soil microbial activity and nutrient availability, resulting in better vegetative growth compared to the control treatment. Similar observations were reported by Ismaeil *et al.* (2012) [3], who found that poultry manure application in fodder sorghum significantly increased the number of nodes per plant over untreated control.

**Table 1:** Growth of fodder sorghum as influenced by integrated nitrogen management at first cut (60 DAS)

| Treatments      | Plant height (cm) | Number of nodes plant <sup>-1</sup> | Internodal length (cm) | Leaf area (cm <sup>2</sup> plant <sup>-1</sup> ) |
|-----------------|-------------------|-------------------------------------|------------------------|--------------------------------------------------|
| T <sub>1</sub>  | 161.87            | 8.20                                | 11.14                  | 3541.30                                          |
| T <sub>2</sub>  | 197.11            | 13.16                               | 15.13                  | 4813.60                                          |
| T <sub>3</sub>  | 153.80            | 7.20                                | 10.26                  | 3262.30                                          |
| T <sub>4</sub>  | 158.87            | 7.53                                | 10.92                  | 3434.57                                          |
| T <sub>5</sub>  | 164.87            | 8.60                                | 11.25                  | 3582.50                                          |
| T <sub>6</sub>  | 173.83            | 9.90                                | 13.10                  | 4000.30                                          |
| T <sub>7</sub>  | 195.14            | 12.13                               | 14.55                  | 4528.90                                          |
| T <sub>8</sub>  | 167.86            | 8.93                                | 11.98                  | 3624.37                                          |
| T <sub>9</sub>  | 171.90            | 9.70                                | 12.52                  | 3854.87                                          |
| T <sub>10</sub> | 169.60            | 9.47                                | 12.01                  | 3705.17                                          |
| T <sub>11</sub> | 103.89            | 5.83                                | 8.60                   | 2012.20                                          |
| S. Em. ±        | 7.70              | 0.47                                | 0.58                   | 180.18                                           |
| CD (P=0.05)     | 22.72             | 1.40                                | 1.72                   | 531.54                                           |

##### 3.1.3 Internodal length (cm)

The data presented in Table 1 indicated that internodal length was significantly influenced by integrated nitrogen management practices. Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded the highest internodal length (15.13 cm) and was found statistically on par with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>), which recorded (14.55 cm). This was followed by T<sub>6</sub> (75% RDN + 25% N through vermicompost + AZB + PSB @ 5 kg ha<sup>-1</sup>) with values of (13.10 cm) while the lowest internodal length was observed under T<sub>11</sub> (control) with (8.60 cm) at first cut.

The greater internodal length observed under T<sub>2</sub> and T<sub>7</sub> treatments may be attributed to adequate nitrogen supply, which promoted active cell elongation and stem growth. Further, the integrated use of organic nutrient sources along with biofertilizers enhanced nutrient availability and improved soil biological activity, resulting in better crop growth compared to the control treatment. Similar findings were reported by Jadav *et al.* (2018) [2], who observed maximum internodal length with the combined application of recommended fertilizer dose along with

*Azotobacter* and Phosphate Solubilizing Bacteria.

##### 3.1.4 Leaf area (cm<sup>2</sup> plant<sup>-1</sup>)

The data presented in Table 1 revealed that leaf area, an important parameter influencing crop growth and fodder productivity, was significantly influenced by integrated nitrogen management practices. Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded the maximum leaf area (4813.60 cm<sup>2</sup> plant<sup>-1</sup>) at first cut (60 DAS) and remained statistically on par with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>), which recorded (4528.90 cm<sup>2</sup> plant<sup>-1</sup>). This was followed by T<sub>6</sub> (75% RDN + 25% N through vermicompost + AZB + PSB @ 5 kg ha<sup>-1</sup>) with values of (4000.30 cm<sup>2</sup> plant<sup>-1</sup>), while the lowest leaf area was observed under T<sub>11</sub> (control) with (2012.20 cm<sup>2</sup> plant<sup>-1</sup>).

The higher leaf area recorded under T<sub>2</sub> and T<sub>7</sub> treatments may be attributed to improved nutrient availability, which enhanced overall vegetative growth, including stem elongation and better leaf development. The combined application of inorganic fertilizers, organic nutrient sources and biofertilizers likely

improved nutrient uptake and promoted vigorous crop growth. Similar findings were reported by Bama *et al.* (2013) <sup>[4]</sup>, who observed maximum leaf area in fodder sorghum with the application of poultry manure in combination with biofertilizers.

### 3.2 Yield

#### 3.2.1 Green fodder yield (q ha<sup>-1</sup>)

The data presented in Table 2 indicated that integrated nitrogen management significantly influenced the green fodder yield of fodder sorghum. Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded the highest green fodder yield (197.98 q ha<sup>-1</sup>) at first cut (60DAS). However, it was found statistically on par with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>), which produced (190.24 q ha<sup>-1</sup>). This was followed by T<sub>6</sub> (75% RDN + 25% N through vermicompost + AZB + PSB @ 5 kg ha<sup>-1</sup>), recording green fodder yield of (173.84 q ha<sup>-1</sup>) at first cut. In contrast, T<sub>11</sub>- control resulted in lowest green fodder yield, recording (95.82 q ha<sup>-1</sup>).

Higher green fodder yield under T<sub>2</sub> (100% RDN + AZB + PSB) and its parity with T<sub>7</sub> (75% RDN + 25% N poultry manure + AZB + PSB) may be attributed to balanced nutrient supply, enhanced nutrient uptake and improved soil microbial activity, which promoted greater biomass production. The present findings are in agreement with the results of Bama *et al.* (2013) <sup>[4]</sup>, who reported in fodder sorghum that the application of poultry manure along with biofertilizers resulted in the highest green fodder yield.

**Table 2:** Yield of fodder sorghum as influenced by integrated nitrogen management at first cut (60 DAS)

| Treatments      | Green fodder yield (q ha <sup>-1</sup> ) | Dry fodder yield (q ha <sup>-1</sup> ) |
|-----------------|------------------------------------------|----------------------------------------|
| T <sub>1</sub>  | 157.83                                   | 49.56                                  |
| T <sub>2</sub>  | 197.98                                   | 75.82                                  |
| T <sub>3</sub>  | 147.32                                   | 42.30                                  |
| T <sub>4</sub>  | 150.31                                   | 43.86                                  |
| T <sub>5</sub>  | 161.29                                   | 51.53                                  |
| T <sub>6</sub>  | 173.84                                   | 65.68                                  |
| T <sub>7</sub>  | 190.24                                   | 73.49                                  |
| T <sub>8</sub>  | 163.51                                   | 53.96                                  |
| T <sub>9</sub>  | 171.01                                   | 62.20                                  |
| T <sub>10</sub> | 168.24                                   | 59.17                                  |
| T <sub>11</sub> | 95.82                                    | 26.52                                  |
| S. Em. ±        | 7.64                                     | 2.71                                   |
| CD (P=0.05)     | 22.54                                    | 8.01                                   |

#### 3.2.2 Dry fodder yield (q ha<sup>-1</sup>)

The results presented in Table 2 showed that dry fodder yield was significantly influenced by integrated nitrogen management practices. Among the treatments, T<sub>2</sub> (100% RDN + AZB + PSB @ 5 kg ha<sup>-1</sup>) recorded the highest dry fodder yield (75.82 q ha<sup>-1</sup>) and remained statistically on par with T<sub>7</sub> (75% RDN + 25% N through poultry manure + AZB + PSB @ 5 kg ha<sup>-1</sup>), which recorded (73.49 q ha<sup>-1</sup>). This was followed by T<sub>6</sub> (75% RDN + 25% N through vermicompost + AZB + PSB @ 5 kg ha<sup>-1</sup>) with dry fodder yields of (65.68 q ha<sup>-1</sup>), while the lowest dry fodder yield was recorded under T<sub>11</sub> (control) with (26.52 q ha<sup>-1</sup>).

The higher dry fodder yield observed under T<sub>2</sub> and its statistical parity with T<sub>7</sub> may be attributed to balanced nutrient supply, improved nutrient uptake and enhanced photosynthetic efficiency, which ultimately resulted in greater dry matter accumulation. Similar findings were reported by Bama *et al.* (2013) <sup>[4]</sup> and Sathiyabama *et al.* (2024) <sup>[1]</sup>, who observed higher dry fodder yield with the combined application of poultry manure and biofertilizers.

### 4. Conclusion

The study revealed that application of 100% RDN+ AZB + PSB @ 5 kg ha<sup>-1</sup> significantly improved growth and yield of multicut fodder sorghum. However, it was found on par with application of 75% RDN + 25% N supplied through poultry manure along with AZB + PSB @ 5 kg ha<sup>-1</sup>, indicating that poultry manure can effectively substitute a part of inorganic nitrogen while sustaining crop productivity and improving soil health.

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