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# Response of nutrient content and quality of summer forage pearlmillet (*Pennisetum glaucum* L.) on sowing date and nitrogen level

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**Abstract**
A field experiment entitled "Effect of sowing date and nitrogen level on growth and yield of summer forage pearlmillet (*Pennisetum glaucum* L.)" was conducted on loamy sand soil at the Agronomy Instructional Farm, C. P. College of Agriculture, SDAU, Sardarkrushinagar during summer season of 2015. The experiment comprising sixteen treatment combinations were laid out in Split Plot Design and replicated three times. The treatment consisted combinations of four different date of sowing *viz*. 1st March ($D_1$), 15th March ($D_2$), 1st April ($D_3$) and 15th April ($D_4$) and four nitrogen levels *viz*. 80 kg/ha ($N_1$), 100 kg/ha ($N_2$), 120 kg/ha ($N_3$), 140 kg/ha ($N_4$). The recommended dose of phosphorus @ 40 kg $ha^{-1}$ was applied uniformly to all the treatment as basal. The results reported that the crude protein content, crude fibre content, nitrogen content by summer forage pearlmillet crop did not differ significantly due to different date of sowing. While, the nitrogen uptake was significantly higher in sowing on March 15th and it was followed by sowing on March 1st.

**Keywords:** Crude fibre content, Crude protein content, nutrient content and uptake and summer forage pearlmillet

## Introduction
Forage pearlmillet (*Pennisetum glaucum* L.) is good risk cover crop for sustained forage production under irrigated condition. The importance of cultivation of pearlmillet is being emphasized due to its profuse tillering habit, multicut nature, drought tolerance, resistance to insect pest and diseases, absence of poisonous prussic acid, good performance even in poor soil, leafiness and good for per day productivity. Forage pearlmillet is an excellent choice for warm season. Multicut nature of the crop ensured the forage supply over a long period of time. Forage pearlmillet is an important green fodder crop in the areas of light textured soils and give 2 to 3 cutting to meet the green fodder requirement of milch animals in summer season. Chemical fertilizer plays an important role in fodder crop production. Nitrogen is the most important nutrient for plant growth and is the most limiting nutrient in north Gujarat soil which is sandy to loamy sand soil having high infiltration and percolation rate. Nitrogen is an important constituent of protein and chlorophyll. It imparts dark green colour to plant, promote vegetative growth and helps in rapid growth. It improves the quality by increasing the protein content of fodder and governs to considerable degree the utilization of potassium, phosphorus and other elements. Nitrogen application increases the crude protein and metabolizes energy besides improving succulency and palatability of fodder crop. The information of date of sowing and nitrogen levels is lacking so that an experiment was planned at agronomy instructional farm S.D.A.U., Gujarat.

## Materials and Method
An experiment on effect of date of sowing and nitrogen levels on growth and forage yield of summer forage pearlmillet was carried out at Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar during summer season of 2015. The soil of experimental field was loamy sand in texture with low in organic carbon (0.18%) and available nitrogen (135 kg/ha), medium in available phosphorus (36.06 kg/ha) and high in potash (276.5 kg/ha) having pH value of 7.4. Total 16 treatment combinations comprising four level of date of sowing in main plot *viz*., 1st March (D1), 15th March (D2), 1st April (D3) and

15th April (D4) and four nitrogen levels in sub-plot *viz*., 80 kg N/ha (N1), 100 kg N/ha (N2), 120 kg N/ha (N3) and 140 kg N/ha (N4) laid out in split plot design with three replications. half dose of nitrogen in the form of urea and full dose of phosphorus in the form of Diammonium phosphate (DAP) were applied as basal dose in the previously opened furrow. After application of basal dose, the opened furrows were covered lightly with the soil. Remaining half dose of nitrogen was applied as top dressing in two equal split. The crop was kept weed free during the whole crop period and irrigation was applied as per crop requirements. Representative composite soil sample from 0-15 and 15-30 cm depth was collected initially from the entire experimental site and from each plot after the harvest of rice crop. For better representation, soil samples were prepared by mixing the soil collected from three spots from the plots randomly. The soil samples were air-dried and grounded to pass through 2 mm sieve. The soil samples were labelled and stored in polythene lined cotton bags for further analysis. The soil of the experimental field was loamy sand in texture. The soil samples were analysed for available nitrogen, phosphorus and potash as per the methods given in Table 1. The nitrogen content and uptake by summer forage pearlmillet was recorded after harvesting. The collected samples were washed with distilled water and dried in oven at 65±70 $^{o}$C till constant weight achieved and dry weight of each sample was done. Subsequently, the dried samples were powdered using willey mill and stored in clean polythene zip-bags for chemical analysis. All the data recorded during the study period were statistically analyzed by using standard methods as suggested by Panse and Sukhatme (1967) [11].

**Table 1:** Physicochemical properties of the soil of experimental plot

| Sr. No. | Properties | Soil depth (cm) | | Methods employed |
|---|---|---|---|---|
| | | 0-15 | 0-30 | |
| **[A]** | **Physical properties** | | | |
| (a) | Sand (%) | 84.89 | 84.97 | International Pipette Method (Piper, 1966). |
| (b) | Silt (%) | 7.35 | 7.28 | |
| (c) | Clay (%) | 7.28 | 7.45 | |
| (d) | Soil texture | Loamy sand | | |
| **[B]** | **Chemical properties** | | | |
| (a) | Soil pH (1: 2.5, Soil: Water ratio) | 7.58 | 7.38 | Potentiometric method (Jackson, 1973). |
| (b) | EC ($dSm^{-1}$ at 25ºC) | 0.11 | 0.15 | Schofield method (Jackson, 1973). |
| (c) | Organic carbon (%) | 0.19 | 0.17 | Walkley and Black's rapid titration method (Jackson, 1973). |
| (d) | Available N (kg/ha) | 141 | 129 | Alkaline Permanganate method (Jackson, 1973). |
| (e) | Available $P_2O_5$ (kg/ha) | 34.60 | 37.52 | Spectrophotometric method (Olsen's 1954). |
| (f) | Available $K_2O$ (kg/ha) | 282.5 | 270.5 | Flame photometer method (Jackson, 1973). |

## Results and Discussion

### Effect on available nitrogen, phosphorus and potash from soil

**Effect of date of sowing:** The effect of date of sowing on the available nitrogen, available phosphorous and available potash of the soil after harvesting of the summer forage pearlmillet crop did not show any nutrient mining effects (Table 2).

**Effect of nitrogen levels:** Available nitrogen status of the soil after harvest of the summer forage pearlmillet crop was found significant due to different levels of nitrogen. Application of 140 kg nitrogen per hectare recorded higher nitrogen status of soil after harvest of the summer forage pearlmillet crop being at par with the application of 120 kg nitrogen per hectare (Table 4). An application of 140 kg nitrogen per hectare recorded higher nitrogen status of the soil might be due to higher activity of microorganism leading to greater mineralization of applied and inherent nutrients and available nitrogen. The lowest amount of available nitrogen of the soil after harvest of summer forage pearlmillet crop was recorded by the application of 80 kg nitrogen per hectare, but available phosphorus and potash did not differ significantly by the application of different levels of nitrogen. These findings are in accordance with the finding of Bhoya *et al.* (2013) [2] and Reager *et al.* (2014) [13].

### Effect of different treatments on nitrogen content and uptake

**Effect of date of sowing:** Data presented in Table 2 revealed that the nitrogen content (%) was found non-significant due to different date of sowing of summer forage pearlmillet. However, 15$^{th}$ March sowing of the summer forage pearlmillet crop numerically increased the nitrogen content. While, significantly higher nitrogen uptake was recorded by 15$^{th}$ March sowing and which was to the magnitude of 68, 67, 64 and 56 per cent higher than that of 15$^{th}$ April sowing, respectively at all cuts (Table 2).

**Effect of nitrogen levels**

Significantly higher nitrogen content and uptake were recorded by the application of 140 kg nitrogen per hectare being at par with application of 120 kg nitrogen per hectare. The nitrogen content and uptake recorded by the application of 140 kg nitrogen per hectare was to the magnitude of 12, 11, 13, 10 and 24, 21, 24 and 30 per cent higher than that of 80 kg nitrogen per hectare, respectively at all cuts. The application of 120 kg nitrogen per hectare increased nitrogen content and uptake to the magnitude of 6, 5, 6, 5 and 16, 14, 17 and 15 per cent higher than that of 80 kg nitrogen per hectare, respectively at all cuts (Table 2). The higher uptake of nitrogen was due to higher dry fodder yield of summer forage pearlmillet crop as a resultant of higher growth and yield parameters. These results are in accordance with the findings of Buldak *et al.* (2010), Bhoya *et al.* (2013) [2] and Reager *et al.* (2014) [13]. Bhoya *et al.* (2013) [2] reported that the nitrogen content and nitrogen uptake of sorghum increased significantly with the increasing in the nitrogen levels from 40 to 120 kg per hectare.

**Table 2:** Available N, $P_2O_5$ and $K_2O$ in soil, nitrogen content and nitrogen uptake of summer forage pearlmillet crop as influenced by date of sowing and nitrogen levels

| Treatments | Available N (kg/ha) | Available $P_2O_5$ (kg/ha) | Available $K_2O$ (kg/ha) | Nitrogen content (%) | | | | Nitrogen uptake (kg/ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1st Cut (40 DAS) | 2nd Cut (70 DAS) | 3rd Cut (100 DAS) | 4th Cut (130 DAS) | 1st Cut (40 DAS) | 2nd Cut (70 DAS) | 3rd Cut (100 DAS) | 4th Cut (130 DAS) |
| **Main plot: Time of sowing (D)** | | | | | | | | | | | |
| $D_1$: 01st March | 167 | 31 | 271 | 0.88 | 0.89 | 0.86 | 0.83 | 116 | 87 | 50 | 23 |
| $D_2$: 15th March | 164 | 30 | 264 | 0.92 | 0.94 | 0.89 | 0.86 | 171 | 105 | 69 | 28 |
| $D_3$: 01st April | 160 | 30 | 261 | 0.85 | 0.87 | 0.82 | 0.79 | 92 | 81 | 46 | 22 |
| $D_4$: 15th April | 157 | 29 | 256 | 0.82 | 0.85 | 0.80 | 0.77 | 74 | 63 | 42 | 18 |
| S.Em.± | 2.5 | 0.8 | 3.8 | 0.02 | 0.02 | 0.02 | 0.02 | 6.46 | 4.77 | 2.13 | 1.14 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | 22.4 | 16.5 | 7.4 | 3.9 |
| C. V. (%) | 5.39 | 9.64 | 5.01 | 9.93 | 9.16 | 9.86 | 9.71 | 19.75 | 19.74 | 14.31 | 17.37 |
| **Sub plot: Nitrogen levels (kg/ha) (N)** | | | | | | | | | | | |
| $N_1$: 80 | 156 | 29 | 256 | 0.83 | 0.85 | 0.80 | 0.78 | 102 | 76 | 46 | 20 |
| $N_2$: 100 | 161 | 29 | 262 | 0.84 | 0.86 | 0.82 | 0.79 | 107 | 80 | 50 | 22 |
| $N_3$: 120 | 163 | 30 | 265 | 0.88 | 0.89 | 0.85 | 0.82 | 118 | 87 | 54 | 23 |
| $N_4$: 140 | 169 | 31 | 269 | 0.93 | 0.94 | 0.90 | 0.86 | 126 | 92 | 57 | 26 |
| S.Em.± | 2.4 | 0.6 | 3.4 | 0.02 | 0.02 | 0.02 | 0.02 | 5.40 | 2.48 | 2.05 | 0.91 |
| C.D. at 5% | 7.0 | NS | NS | 0.06 | 0.06 | 0.06 | 0.05 | 15.8 | 7.3 | 6.0 | 2.7 |
| C. V. (%) | 5.15 | 7.39 | 4.48 | 7.80 | 7.87 | 8.06 | 8.03 | 16.50 | 10.28 | 13.77 | 13.90 |
| D x N (Interaction) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

**Effect of different treatments on quality parameters**

**Effect of date of sowing**

The effect of different date of sowing on crude protein content (%) and crude fiber content (%) was found non significant. The protein content is the genetical character of the plants so that its values were varied non-significantly with the date of sowing. However, numerically higher crude protein content was noted by 15th March sowing. More or less same trend was observed in case of crude fiber content of summer forage pearlmillet crop. These results are in accordance with the findings of Yoon *et al.* (1994) and Verma *et al.* (2012) [15]. The result of Verma *et al.* (2012) [15] revealed that early sowing of maize (*i.e.*, 25th October) significantly influenced crude protein content and fibre content as compared to late sowing (*i.e.*, 5th November).

**Effect of nitrogen levels**

Crude protein content (%) is the resultant of the nitrogen content of the crop (Table 3). Crude protein content (%) was significantly affected by the application of nitrogen. Significantly higher crude protein content was recorded by the application of 140 kg nitrogen per hectare which was to the tune of 13, 13, 13 and 14 per cent higher than that of 80 kg nitrogen per hectare, respectively at all cuts. This might be due to that nitrogen being as essential constituent of chlorophyll, protoplasm, protein and nucleic acids. These results are in accordance with the findings of the Katoria *et al.* (1981) [9], Devi and Padmaja (2007) [5, 6] and Golada *et al.* (2012) [7]. The result of Devi and Padmaja (2007) [5, 6] revealed that the crude protein content of pearlmillet increased significantly with the increasing in the nitrogen levels from 30 to 90 kg per hectare.

Significantly higher crude fiber content was recorded by the application of 140 kg nitrogen per hectare being at par with application of 120 kg nitrogen per hectare (Table 3). The application of 140 kg nitrogen per hectare increased the fibre content to the tune of 16, 14, 14 and 14 per cent higher than that of 80 kg nitrogen per hectare, respectively all cuts. The higher crude fiber content might be due to more synthesis of fibre by the plant tissue. This could also be explained on the basis of better availability of desired and required nutrient in crop root zone and enhanced photosynthetic and metabolic activity resulting in better partitioning of photosynthates to sinks, which ultimately reflected in quality enhancement in terms of crude fibre content. The present findings are in accordance with the findings of Jakhar *et al.* (2003) [8], Ayub *et al.* (2011) [1] and Bhoya *et al.* (2013) [2].

**Table 3:** Crude protein content and crude fibre content of summer forage pearlmillet crop as influenced by date of sowing and nitrogen levels

| Treatments | Crude protein content (%) | | | | Crude fibre content (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | 1st Cut (40 DAS) | 2nd Cut (70 DAS) | 3rd Cut (100 DAS) | 4th Cut (130 DAS) | 1st Cut (40 DAS) | 2nd Cut (70 DAS) | 3rd Cut (100 DAS) | 4th Cut (130 DAS) |
| **Main plot: Time of sowing (D)** | | | | | | | | |
| $D_1$: 01st March | 5.52 | 5.59 | 5.36 | 5.18 | 27.75 | 28.69 | 30.58 | 31.25 |
| $D_2$: 15th March | 5.75 | 5.86 | 5.58 | 5.34 | 28.02 | 28.97 | 30.85 | 31.52 |
| $D_3$: 01st April | 5.32 | 5.41 | 5.15 | 4.95 | 27.53 | 28.47 | 30.35 | 31.03 |
| $D_4$: 15th April | 5.13 | 5.28 | 4.98 | 4.79 | 27.31 | 28.25 | 30.13 | 30.81 |
| S.Em.± | 0.16 | 0.15 | 0.15 | 0.14 | 0.66 | 0.66 | 0.66 | 0.66 |
| C.D. at 5% | NS | NS | NS | NS | NS | NS | NS | NS |
| C. V. (%) | 9.97 | 9.19 | 9.98 | 9.75 | 8.23 | 7.98 | 7.49 | 7.33 |
| **Sub plot: Nitrogen levels (kg/ha) (N)** | | | | | | | | |
| $N_1$: 80 | 5.15 | 5.26 | 4.99 | 4.79 | 25.46 | 26.68 | 28.74 | 29.14 |
| $N_2$: 100 | 5.26 | 5.36 | 5.10 | 4.89 | 26.55 | 27.48 | 29.24 | 30.28 |
| $N_3$: 120 | 5.48 | 5.59 | 5.32 | 5.12 | 28.95 | 29.84 | 31.18 | 32.08 |
| $N_4$: 140 | 5.82 | 5.93 | 5.66 | 5.46 | 29.64 | 30.38 | 32.75 | 33.10 |
| S.Em.± | 0.14 | 0.14 | 0.14 | 0.14 | 0.48 | 0.48 | 0.47 | 0.48 |
| C.D. at 5% | 0.40 | 0.40 | 0.40 | 0.39 | 1.39 | 1.39 | 1.39 | 1.39 |
| C. V. (%) | 8.67 | 8.51 | 8.92 | 9.25 | 5.95 | 5.75 | 5.40 | 5.28 |
| D x N (Interaction) | NS | NS | NS | NS | NS | NS | NS | NS |

**Table 4:** Economics of the different treatments on summer forage pearlmillet crop as influenced by date of sowing and nitrogen levels

| Treatments | Green forage yield (q/ha) | Gross realization (/ha) | Total cost of cultivation (/ha) | Net realization (/ha) | Benefit: Cost ratio |
|---|---|---|---|---|---|
| **Main plot: Time of Sowing (D)** | | | | | |
| $D_1$: 01st March | 2048 | 307200 | 69111 | 238089 | 4.44 |
| $D_2$: 15th March | 2425 | 363750 | 69111 | 294639 | 5.26 |
| $D_3$: 01st April | 1960 | 294000 | 69111 | 224889 | 4.25 |
| $D_4$: 15th April | 1567 | 235050 | 69111 | 165939 | 3.40 |
| **Sub plot: Nitrogen levels (kg/ha) (N)** | | | | | |
| N1: 80 | 1580 | 237000 | 68703 | 168297 | 3.44 |
| N2: 100 | 1879 | 281850 | 68975 | 212875 | 4.08 |
| N3: 120 | 2104 | 315600 | 69246 | 246354 | 4.55 |
| N4: 140 | 2438 | 365700 | 69518 | 296182 | 5.26 |

**Effect of different treatments on economics**

**Effect of date of sowing**

Sowing of summer forage pearlmillet crop on 15th March recorded maximum net realization (₹2,94,639 per hectare) and benefit cost ratio (5.26) (Table 4). Minimum net realization (₹1,65,939 per hectare) and benefit cost ratio (3.40) was observed by 15th April sowing. The higher net realization and benefit cost might be due to higher green forage yield recorded by 15th March sowing. These findings are in conformity with those reported by Patel *et al*. (1987) [12] and Luikham *et al*. (2012) [10].

**Effect of nitrogen levels**

An application of 140 kg nitrogen per hectare recorded maximum net realization (₹2,96,182 per hectare) and benefit cost ratio (5.26) and it was followed by the application of 120 kg nitrogen per hectare (Table 4). This can be attributed due to higher green forage yield recorded with the application of 140 kg nitrogen per hectare. These findings are in conformity with those reported by Chaudhary *et al*. (2014) [4] and Reager *et al*. (2014) [13].

**Conclusion**

On the basis of one year experimentation, it can be concluded that higher nutrient and quality content, net realization and benefit cost ratio can be achieved by growing of summer forage pearlmillet crop (Gujarat Fodder Bajra 1) on 15th March and fertilizing with 140 kg nitrogen per hectare.

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