

# Exploring the impact of varying nitrogen levels and cutting management on fodder yield and nutritional quality in fodder pearl millet (*Pennisetum glaucum* L.)

Formatted: Font: Italic

## ABSTRACT

A field experiment was conducted at AICRP What's the meaning? on Forage Crops and Utilization, ARI, Rajendranagar, Hyderabad CITY?? COUNTRY?? during kharif??? 2021. The treatments consisted of four fodder pearl millet varieties (TSFB 15-4, TSFB 15-8, Moti bajra and Moti bajra), two nitrogen levels (80 and 120 kg N ha<sup>-1</sup>) and two cutting management practices (C<sub>1</sub>: Two cuts: 1<sup>st</sup> at 60 DAS, 2<sup>nd</sup> cut at 50% flowering) (C<sub>2</sub>: Three cuts: 1<sup>st</sup> at 50 DAS, 2<sup>nd</sup> cut at 35 days after 1<sup>st</sup> cut and 3<sup>rd</sup> cut at 50% flowering) laid out in randomized block design with factorial concept, with Factor (A) as varieties, Factor (B) as nitrogen levels and Factor (C) as cutting management with three replications. The soil was sandy loam in texture with pH of 7.0 low in available nitrogen, medium in available phosphorus and available potassium. The results revealed that TSFB 15-8 recorded significantly higher green fodder (769.8 q ha<sup>-1</sup>) and dry fodder (191.7 q ha<sup>-1</sup>) yields. The variety TSFB 15-8 was also shown highest crude protein content (6.0%), crude protein yield (13.8 q ha<sup>-1</sup>) and higher nitrogen uptake (190.2 kg ha<sup>-1</sup>). Application of nitrogen 120 kg N ha<sup>-1</sup> significantly recorded maximum green fodder yield (716.1 q ha<sup>-1</sup>), dry fodder yield, crude protein content (6.1%), crude protein yield (14.7 q ha<sup>-1</sup>) and nitrogen uptake (207.1 kg ha<sup>-1</sup>). But as the nitrogen application increases the ADF and NDF contents decrease. The higher ADF and NDF contents recorded highest at 80 kg N ha<sup>-1</sup> and lowest at 120 kg N ha<sup>-1</sup>. Three cuts for green fodder recorded highest crude protein content (6.5%), crude protein yield (13.9 q ha<sup>-1</sup>) and nitrogen uptake (228.0 kg ha<sup>-1</sup>) over two cuts for green fodder. Variety TSFB 15-8 with nitrogen level of 120 kg N ha<sup>-1</sup> at C<sub>2</sub> found suitable and economical for cultivation in southern Telangana zone.

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

**Keywords:** Varieties, nitrogen levels and cutting management

**Comment [SPCA1]:** These words are in the title, search for different keywords. Minimum 5 must be entered.

## 1. INTRODUCTION

**Comment [SPCA2]:** Improve the introduction

In India, the requirement of green fodder was 611.99 Mt against the availability of only 224.08 Mt (Anonymous, 2006). The availability of fodder resources is approximately 60% of the requirement, and the area under fodder crops in India is approximately 8.6 M ha. To meet the fodder shortage for the growing animal population, the fodder growing area should ideally be around 20 M ha by 2020, but this appears to be rather difficult to achieve Hazra and Tripathi [4]. The only way to increase productivity per unit area under irrigated or rainfed conditions is through balanced nutrition to fodder crops. Pearl millet (*Pennisetum glaucum* L.) is one of the most widely adapted cereal forage crops under rainfed conditions, and it is gaining popularity in Maharashtra (India) due to its rapid growth, high quality forage, and improved palatability. Nitrogen is a necessary primary element. Although optimising nitrogen levels is an important aspect of cost-effective N fertilizer management, excessive nitrogen use degrades soil health and

**Comment [SPCA3]:** [1]

Formatted: Highlight

**Comment [SPCA4]:** If you put the reference in parentheses, it is not necessary to repeat it again. Apply in all document.

**Comment [SPCA5]:** Where are 1, 2 and 3?

Formatted: Highlight

Formatted: Font: Italic

**Comment [SPCA6]:** Ref???

leads to nitrate-N accumulation in fodder, which is toxic to animals. The ruminant toxic effects of nitrate are well known Bradley et al. [2]. Nitrate is converted to highly toxic nitrite in the rumen by bacterial nitrate reductase Lewis et al. [14]. Ruminants are primarily exposed to nitrates through the plants they consume Wright and Davison [17]. Nitrogen is an essential nutrient for fodder crop vegetative growth and plays a critical role in increasing fodder productivity and quality. Therefore, the development of quality fodder cultivars and management to meet out the fodder requirements forever increasing livestock population is imperative, as the quality of fodder is very important issue with respect to livestock health status as well as to maximize the animal production. Many new improved genotypes of pearl millet are being developed as forage varieties, and it is necessary to standardize the nitrogen dose for improved forage yield and quality with nontoxic accumulation of nitrate-N. As a result, the current investigation was launched.

Comment [SPCA7]: Ref???

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Comment [SPCA8]: Ref?

Formatted: Highlight

Formatted: Highlight

Comment [SPCA9]: Objective??

Comment [SPCA10]: Where is the statistical analysis?

Comment [SPCA11]: edaphoclimatic characteristics, altitude, location of the study with georeferenced location?

Comment [SPCA12]: Country? It is an international paper

Comment [SPCA13]: this should go in the introduction

Comment [SPCA14]: ???

## 2. MATERIALS AND METHODS

A field experiment was conducted during *kharif* season of 2021 at AICRP on Forage Crops and Utilization, ARI, PJTSAU, Rajendranagar, Hyderabad. The present research work is framed with an objective to identify high green fodder and nutritious fodder pearl millet varieties influenced by nitrogen levels and cutting management. The experiment was laid out with randomized block design with factorial concept. The soil was sandy loam in texture with pH of 7.0 low in available nitrogen, medium in available phosphorus and available potassium. The experiment consisted of 16 treatment combinations viz., four varieties (TSFB 15-4, TSFB 15-8, Moti bajra and BAIF bajra), two nitrogen levels (80 and 120 kg N ha<sup>-1</sup>) and two cutting management practices (C<sub>1</sub>: Two cuts: 1<sup>st</sup> at 60 DAS, 2<sup>nd</sup> cut at 50% flowering) (C<sub>2</sub>: Three cuts: 1<sup>st</sup> at 50 DAS, 2<sup>nd</sup> cut at 35 days after 1<sup>st</sup> cut and 3<sup>rd</sup> cut at 50% flowering) with three replications. The phosphorus (40 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>) and potassium (20 kg K<sub>2</sub>O ha<sup>-1</sup>) were applied through Di-ammonium phosphate and Murate of potash respectively. Nitrogen was given in split dose, half as basal and other half dose was given after 30 DAS and after each cut as top dressing. Crop was sown at a row distance of 30 cm. The crop was sown during 2<sup>nd</sup> week of July and harvested when crop attained 50% flowering. Five plants were randomly selected in each net plot area for taking observations on growth and yield attributing parameters. The crude protein content of forage was worked out by multiplying the nitrogen percentage with factor 6.25 (Doubetz and Wells, 1968). The crude protein yield was calculated by multiplying crude protein percentage with dry matter yield and expressed in quintal ha<sup>-1</sup>. Data obtained were statistically analyzed as mentioned by Gomez and Gomez, 1984.

Comment [SPCA15]: what is your variable? Only nitrogen? Or protein?

Comment [SPCA16]: Which method do you use to quantify protein?

Comment [SPCA17]: A very old reference

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Comment [SPCA18]: idem

## 3. RESULTS AND DISCUSSION

### 3.1 Growth parameters

### 3.1.1 Varieties

The growth and fodder yield of pearl millet significantly varied among varieties (Table 1). The pearl millet variety TSFB 15-8 recorded significantly higher plant height (105.0 cm) over other varieties and also the maximum number of tillers was found in TSFB 15-8(4.0) and was at par with Motibajra-. The TSFB 15-8 recorded highest green fodder yield of 769.8 q ha<sup>-1</sup> which was followed by TSFB 15-4 (704.3 q ha<sup>-1</sup>) and the same variety recorded higher dry matter yield of 191.7 q ha<sup>-1</sup> followed by variety Moti bajra (182.1 q ha<sup>-1</sup>). This was due to the superiority of the genotype to produce more values of growth characters like plant height and number of tillers.

### 3.1.2 Nitrogen levels

Application of nitrogen 120 kg N ha<sup>-1</sup> recorded significantly higher green fodder yield (716.1 q ha<sup>-1</sup>) and dry matter yield (182.7q ha<sup>-1</sup>). Increase in green bio-mass yield was due to increased plant height (102.6 cm). Nitrogen is directly involved in cell division, cell elongation, formation of nucleotides and co-enzymes that increased meristematic activity, since nitrogen is an integral part of chlorophyll, plays an important role in photosynthesis and produce more of photosynthates, which helped in accumulation more dry matter yield. This is in conformity with the findings of Goladaet al. [6] and Damameet al. [4].

Comment [SPCA19]: ref???

Comment [SPCA20]: what did they find??

### 3.1.3 Cutting management

Results with cutting management indicated that the increased plant height (96.0 cm) was reported with two cuts (C1) and number of tillers m<sup>-2</sup> (4.6) was recorded with three cuts. Significantly higher green fodder yield (764.7 q ha<sup>-1</sup>) and dry matter yield (188.2 q ha<sup>-1</sup>) were recorded in three cuts (C2) as compared to two cuts of green fodder yield (615.0 q ha<sup>-1</sup>) and dry matter yield (161.2 q ha<sup>-1</sup>). This might be due to high production potential of all the varieties and higher number of tillers m<sup>-2</sup> as evident from data (Table 1).

### 3.1.4 Interaction effect

The interaction between different varieties and nitrogen levels was found to be significant, while for dry matter yield the interaction effects were non- significant.

Comment [SPCA21]: Where is the results of statistical analysis?

## 1.1 Quality parameters

### 1.1.1 Varieties

TSFB 15-4 and TSFB 15-8 recorded at par significantly higher crude protein content (5.84% and 5.65 respectively) and crude protein yield (13.8% and 13.6 q ha<sup>-1</sup>) as compared to Moti bajra (5.22% and 11.4

q ha<sup>-1</sup>) and BAIF bajra (4.93% and 9.8 q ha<sup>-1</sup>) Table-2. The increase may be due to increased nutrient uptake, assimilation and translocation to the biomass. Similar results has reported by Rana et al. [15]. The higher crude protein content and crude protein yield is due to higher dry matter yield of variety TSFB 15-8 as compared to other varieties. The highest nitrogen uptake has recorded in TSFB 15-4 (221.1kg ha<sup>-1</sup>) at par with TSFB 15-8 (218.8 kg ha<sup>-1</sup>). This might be due to the fact that the pearl millet cultivar TSFB 15-4 and TSFB 15-8 had higher nitrogen uptake due to better adaptability in low soil fertility condition areas. Higher nitrogen uptake leads to higher crude protein percentage in leaves and stem of fodder pearl millet, which ultimately increased crude protein yield. The differential behavior of these varieties could also be explained solely by the variation in their genetic constituent. The genotype variation in behavior viz., growth parameters and yields were also reported by other researcher in pearl millet.

### 1.1.2 Nitrogen levels (kg ha<sup>-1</sup>)

Application of nitrogen 120 kg N ha<sup>-1</sup> recorded significantly higher crude protein content and crude protein yield (5.6% and 13.2 q ha<sup>-1</sup>) compared to nitrogen 80 kg N ha<sup>-1</sup> (5.2% and 11.2 q ha<sup>-1</sup>) Table-2. This might be due to the application of nitrogen resulted in increased availability of nitrogen status in the soil, which in turn leads to significant improvement in nitrogen content in fodder and ultimately the crude protein content also increased. Crude protein yield may be due to increased crude protein and dry matter yield. The results were in cognizance with the findings of Damameet al. [3] and Meena and Jain (2013). The nitrogen application increased the uptake of nitrogen which is the constituent of amino acids and protein (Randhawa et al. [16] and decreased the pectin, cellulose and hemicellulose content which are major constituents of fiber Babu et al.

Comment [SPCA22]: ???

### 1.1.3 Cutting management

Three cuts for green fodder had recorded significantly higher crude protein content and crude protein yield (6.15% and 12.6 q ha<sup>-1</sup>) as compared to two cuts for green fodder (4.67% and 11.7 q ha<sup>-1</sup>) Table-2. This was attributed due to higher crude protein and dry matter yield finally resulted in higher crude protein yield. Higher nitrogen uptake (202.7 kg ha<sup>-1</sup>) were also recorded with three cuts for green fodder, which was possibly due to more time period available for sufficient vegetative growth resulting higher fodder yield.

### 1.1.4 Interaction effect

The interaction effects were found to be non-significant.

Comment [SPCA23]: ???

## 4. CONCLUSION

Based on the research results it can be inferred that forage pearl millet variety TSFB 15-8 with nitrogen level of 120 kg N ha<sup>-1</sup> at C<sub>2</sub>(Three cuts) found suitable and economical for cultivation in Southern Telangana Zone. These results are in conformity with findings of Shekaraet al. [16] and Shekara et al. [17].

Comment [SPCA24]: this is not a conclusion

Table-1a: Effect of Nitrogen and Cutting management on performance of Forage Pearl Millet varieties (Kharif, 2021)

Treatment	Plant height (cm)	Number of shoots/tillers Per plant	GFY (q ha <sup>-1</sup> )	DMY (q ha <sup>-1</sup> )
V <sub>1</sub> : TSFB15-4	86.1	3.6	704.3	182.1
V <sub>2</sub> : TSFB15-8	105.0	4.0	769.8	191.7
V <sub>3</sub> : Moti Bajra	88.0	4.0	665.5	172.2
V <sub>4</sub> : BAIFBajra-1	95.5	3.7	619.9	152.8
S.Em±	2.9	0.1	19.39	6.8
C.D. at 5%	8.4	0.3	57.5	19.8
N <sub>1</sub> : 80 Kg ha <sup>-1</sup>	84.7	3.9	663.6	166.7
N <sub>2</sub> : 120 Kg ha <sup>-1</sup>	102.6	3.8	716.1	182.7
S.Em±	2.0	0.7	14.0	4.8
C.D. at 5%	5.9	NS	40.7	14
C <sub>1</sub> : Two Cuts	96.0	3.1	615.0	161.2
C <sub>2</sub> : Three Cuts	91.4	4.6	764.7	188.2
S.Em±	2.0	0.08	14.0	4.8
C.D. at 5%	NS	0.22	40.7	14.0
Interactions				
V × N : S.Em±	4.1	0.16	28.1	9.6
C.D. at 5%	NS	0.46	81.4	NS
V × C: S.Em±	4.1	0.15	28.1	9.6
C.D. at 5%	11.9	NS	NS	NS
N × C: S.Em±	2.9	0.10	19.9	6.8
C.D. at 5%	NS	NS	NS	NS
V × N × C: S.Em±	5.8	0.22	39.8	13.7
C.D. at 5%	16.9	0.64	NS	NS

Comment [SPCA28]: ???

Comment [SPCA25]: what is the meaning?

Comment [SPCA26]: ?? idem

Comment [SPCA27]: This table is in different font



**Table-2: Effect of Nitrogen and Cutting management on performance of Forage Pearl Millet varieties (Kharif, 2021)**

Treatment	Crude Protein Content (%)	Crude Protein Yield (g ha <sup>-1</sup> )	N Uptake Kg ha <sup>-1</sup>
V <sub>1</sub> : TSFB15-4	5.84	13.8	221.1
V <sub>2</sub> : TSFB15-8	5.65	13.6	218.8
V <sub>3</sub> : Moti Bajra	5.22	11.4	183.1
V <sub>4</sub> : BAIFBajra-1	4.93	9.8	156.6
S.Em±	0.06	0.52	8.4
C.D. at 5%	0.16	1.5	24.3
N <sub>1</sub> : 80 Kg ha <sup>-1</sup>	5.23	11.17	178.8
N <sub>2</sub> : 120 Kg ha <sup>-1</sup>	5.59	13.18	211.0
S.Em±	0.04	0.38	5.9
C.D. at 5%	0.12	1.1	17.2
C <sub>1</sub> : Two Cuts	4.67	11.7	187.1
C <sub>2</sub> : Three Cuts	6.15	12.6	202.7
S.Em±	0.04	0.3	5.9
C.D. at 5%	0.12	NS	NS
Interactions			
V × N : S.Em±	0.08	0.7	11.9
C.D. at 5%	NS	NS	NS
V × C: S.Em±	0.08	0.7	11.9
C.D. at 5%	NS	NS	NS
N × C: S.Em±	0.05	0.5	8.4
C.D. at 5%	NS	NS	NS
V × N × C: S.Em±	0.11	1.0	16.8
C.D. at 5%	NS	NS	NS

## 5. REFERENCE

1. Anonymous, 2006. Hand book of Agriculture, ICAR, New Delhi. pp. 1353-1355
2. Bradley WB, Eppson HF, Beath OA. Univ. Wyoming Agric. Exp. Sta. Bull. 1940;241:3-20.
3. Damame SV, Bhingarde RN, Pathan SH. Effect of different nitrogen levels on nutritional quality and nitrate nitrogen accumulation in forage pearl millet genotypes grown under rainfed conditions. Forage Research. 2013;39(2): 93-95.
4. Hazra CR, Tripathi SB. Fert. News. 1998;43:77-89.
5. Lewis D. Biochem. Journal. 1951;48:175-179
6. Rana DS, Bhagatsingh, Joshi UN. Response of oat genotypes to nitrogen levels. Forage research. 2009;35(3):184-85.
7. Randhawa NS, Singh J, Sindhu MS. Forage research. 1989;15:128-131.

**Comment [SPCA29]:** very few references for an international article.

**Comment [SPCA30]:** ??? I couldn't find it

**Comment [SPCA31]:** Review the guide for authors

**Formatted:** Highlight

8.Wright MJ, Davison KL. Adv. Agron. 1964;16:197-247.

9.Shekara BG, Lohithaswa HC. Fodder and seed yield of forage pearl millet genotypes as influenced by different levels of nitrogen. Forage Research. 2009;35(1): 45-47.

10..Shekara BG, Mahadevu P, Chikkarugi NM, Manasa N. Response of pearl millet (*Pennisetum glaucum* L.) varieties to nitrogen levels for higher green forage yield and quality in southern dry zone of Karnataka. Forage Research. 2019;45(3): 232-234.

UNDER PEER REVIEW