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Effect of nitrogen levels and harvesting time on growth, yield and economics of fodder sorghum (*Sorghum bicolor* L.)

Sandeep Kumar, Ravinder Nath and Kartikeya Choudhary

Abstract
In Himachal Pradesh, farmers typically possess small land holdings where fodder cultivation has remained almost neglected. In Himachal Pradesh grasslands/pastures produce far below their potential and their carrying capacity is only 1.05 ACU (adult cattle unit with average body weight of 350 kg). Regarding nitrogen, it facilitates more vegetative growth by enhancing the photosynthetic rate. The higher the nitrogen content, the greater the vegetative growth potential. Therefore, present investigation titled "Effect of Nitrogen Levels and Harvesting Time on Growth, Yield and Economics of Fodder Sorghum (*Sorghum bicolor* L.)" was conducted during *kharif* season of 2022 at Chameli Agriculture Farm, MS Swaminathan School of Agriculture, Shoolini University of Biotechnology and Management Sciences, Solan, Himachal Pradesh. The soil of the experimental site was sandy loam in texture, slightly alkaline in reaction with EC in safer range, medium in organic carbon, available nitrogen, potassium and high in available phosphorus. The field experiment was laid out in factorial randomized block design comprising twelve treatments with three replications. The experiment consists of four levels of nitrogen i.e., (N_0) Control, (N_1) 50 kg N ha^{-1}, (N_2) 100 kg N ha^{-1} and (N_3) 150 kg N ha^{-1} as first factor and three harvesting times i.e., (H_1) 45 DAS, (H_2) 60 DAS and (H_3) 75 DAS as second factor. Recommended dose of phosphorous and potassium (50:50 kg ha^{-1}) was applied through SSP and MOP at the time of sowing. However, nitrogen was applied through urea 1/3 at the time of sowing and remaining two equal splits at 20 and 40 DAS. JS-263 variety of sorghum was used for sowing. Other crop management practices were followed as per the recommendation of the area. Results indicated that among the nitrogen levels, application of 150 kg N ha^{-1} recorded significantly higher growth character and green fodder yield of fodder sorghum over rest of the nitrogen levels. In case of harvesting time, harvesting at (H_3) 75 DAS recorded significantly higher growth character and green fodder yield. Economically, application of 150 kg N ha^{-1} along with harvesting at 75 DAS resulted in higher gross returns, net returns and B:C ratio.

Keywords: Fodder sorghum, nitrogen, sowing methods

Introduction
Forages are the mainstay of animal wealth and their production is the backbone of livestock industry. The scarcity of green forages and grazing resources in India has made the livestock to suffer continuously with malnutrition resulting in their production potentiality at sub-optimum level as compared to many developed nations. India accounts for 15 per cent of the total livestock population of the world with only 3 per cent of the world's geographical area (Ammaji and Suryanarayana, 2003) [1]. Though, India accounts for high cattle population, the productivity of cattle is the lowest mainly because of their poor feeding. The total estimated fodder availability of the country's livestock population is projected at 395.3 m t green and 452.7 m t dry forages as against the requirement of 1957 m t green and 588.2 m t dry forage, respectively. India is the second- largest grower of sorghum, right behind the United States. Sorghum production in India is about 525.5 and 453.2 million tons green and dry fodder, respectively (Forage Crop Research - Indian Institute of Millets Research, 2020) [13]. At the present level of forage resource utilization, production of an additional 661.8 m t of green and 135.5 m t of dry forages are needed to cope up with the feeding requirement of animals (Bhag *et al*., 2006) [6]. Further, the increasing competition between human and livestock population for required nutrition is of great concern owing to land and input constraints (Kumar, 2006) [15]. Fodder sorghum productivity in India is low because of insufficient supply or sub optimal use of nutrients, nitrogen in particular. Nutrient rich fodder sorghum is more advantageous in many ways such as high yield in shorter period and continuous supply of green fodder for a longer period (Shinde *et al*., 2009) [19] Nitrogen, being one of the most important nutrients,

play a vital role in growth, development and fodder quality improvement as it is the principal constituent of protein.

Materials and Methods

The present research work titled "Effect of Nitrogen Levels and Harvesting Time on Growth, Yield and Economics of Fodder Sorghum (*Sorghum bicolor* L.)" was conducted during June to August month of 2022 at Chameli Agriculture Farm, MS Swaminathan School of Agriculture, Shoolini University of Biotechnology and Management Sciences, Solan. Geographically, Chameli Agriculture Farm is situated 30 km away from Solan city at an elevation of 1,270 meters above mean sea level lying between latitude 30º 85'67.30 N and longitude 77º 13'20.38 E. It falls under the mid-hill zone of Himachal Pradesh. The field of the experimental site represented ideal spatial unit in respect of texture, make up and fertility status. The climate of this region is generally characterized as sub-humid, sub temperate with cool winters. Generally, December and January months are the coldest while, May and June are the hottest months. The average annual rainfall of this is 1262 mm and is mostly received during the month of June to August. The soil of the experimental site was homogeneous in fertility status with uniform textural make up. The soils of this region were medium to high in availability of nitrogen, phosphorous and potassium. The experiment was laid out in a Factorial Randomized Block Design comprising of twelve treatment combinations with three replications. The experiment included four levels of nitrogen i.e., (N_0) Control, (N_1) 50 kg N ha^{-1}, (N_2) 100 kg N ha^{-1} and (N_3) 150 kg N ha^{-1} as first factor and three harvesting times i.e., (H_1) 45 DAS, (H_2) 60 DAS and (H_3) 75 DAS as second factor. The variety, JS-263 was used in the sowing at a rate of 150 kg ha^{-1}. Nitrogen was applied through urea; 50 kg P ha^{-1} was applied through single super phosphate and 50 kg K ha^{-1} was applied through MOP evenly to the crop. Data recorded on various parameters of the experiment was subjected to analysis by using Fisher's method of analysis of variance (ANOVA) and interpreted as outlined by Gomez and Gomez (1984) [11]. The levels of significance used in 'F' and 't' test was p= 0.05. Critical difference values were calculated where F test was found significant.

Results and Discussions

Growth parameters

Growth parameters of fodder sorghum were recorded in terms of number of leaves plant^{-1}, number of tillers plant^{-1} at 40 DAS and dry matter accumulation (kg m^{-2}) at 45 DAS (Table 1). The data revealed that among the nitrogen levels, significantly higher number of tillers plant^{-1} (3.08), number of leaves plant^{-1} (16.36) and dry matter accumulation (1.56 kg ha^{-1}) were recorded with application of (N_3) 150 kg N ha^{-1} over rest of the nitrogen levels. This might be due to higher level of nitrogen might have brought about a significant increase number of tillers plant^{-1} and the increase in taller plants, higher number of leaves plant^{-1} with increase in nitrogen levels provided larger photosynthetic surface area to intercept more radiant energy which might have resulted in more dry matter accumulation. These results are in conformity with the results of Gupta *et al.* (2008) [12]; Jung *et al*. (2009) [14] and Azam *et al*. (2010) [4].

However, among the harvesting time significantly higher number of tillers plant^{-1} (2.78), number of leaves plant^{-1} (14.64), and dry matter accumulation (1.44 kg m^{-2}) was recorded when the harvesting was done at (H_3) 75 DAS. The significant increases in all growth characters due to delay in harvesting time and also due the faster growth accelerated by cell division and cell enlargement in specialized meristematic tissue, this finding is supported by Gardner *et al.* (2006) [10] who reported that delay the harvesting, resulting in increased height or length. There was an increase in growth characters with delayed harvesting has also been reported by Ayub *et al*. (2002) [2]; Bukhari (2009) [9] and Muhammad and Shehzad (2013) [16].

Yield

Among the levels of nitrogen, significantly higher green fodder yield (51.69 t ha^{-1}) was observed with application of (N_3) 150 kg N ha^{-1}. Nitrogen is essential for carbohydrates used within the plants and stimulates the growth and development as well as uptake of other nutrients. This element encourages above ground vegetative growth and this favourable impact resulted in taller plants, a greater number of leaves, higher total chlorophyll content, more tillers and higher dry matter accumulation might have reflected in terms of higher green fodder yields. Similar reports were given by Bhilare *et al*. (2002) [7]; Bishanoi *et al*. (2005) [8]; Ayub *et al*. (2007) [3] and Sharma and Verma (2009) [18].

A close perusal of the data (Table 2) among the harvesting time, significantly higher green fodder yield (47.91 t ha^{-1}) was observed when harvesting was done at (H_3) 75 DAS. Increase in fodder yield with delayed harvesting could be mainly attributed to longer duration which increased the growth parameters due to more resources available for the synthesis of metabolites which results in taller plants and thicker stems. This is in accordance with the results reported by Ramamurthy and Shankar (2005) [17], Balasubramanian and Ramamoorthy (2007) [2].

Economics

Economics of fodder sorghum varied according to different treatments. Data (Table 3) revealed that higher gross returns (103378 ₹ ha^{-1}), net returns (79272 ₹ ha^{-1}) and B: C ratio (3.28) ratio was recorded with application of (N_3) 150 kg N ha^{-1}. Among the harvesting time, highest gross returns (95828 ₹ ha^{-1}), net returns (71650 ₹ ha^{-1}) and B: C ratio (2.95) was observed when crop was harvesting at (H_3) 75 DAS.

Table 1: Effect of nitrogen levels and harvesting times on growth parameters of fodder sorghum

Treatments	No. of tillers plant^{-1} at 40 DAS	No. of leaves plant^{-1} at 40 DAS	Dry matter accumulation (kg ha^{-1}) at 45 DAS
Factor- A (Nitrogen levels)			
N_0: 0 kg ha^{-1} (Control)	2.24	11.68	1.00
N_1: 50 kg ha^{-1}	2.48	12.54	1.16
N_2: 100 kg ha^{-1}	2.77	14.37	1.28
N_3: 150 kg ha^{-1}	3.08	16.36	1.56
SEm±	0.08	0.29	0.04
LSD (p=0.05)	0.23	0.85	0.11
Factor-B (Time of Harvesting)			
H_1: 45 DAS	2.52	13.24	1.05
H_2: 60 DAS	2.63	13.33	1.27
H_3: 75 DAS	2.78	14.64	1.44
S.Em±	0.07	0.25	0.03
LSD (p=0.05)	0.20	0.74	0.09
Interaction (N*H)	NS	NS	NS

Table 2: Effect of nitrogen levels and harvesting times on green fodder yield (t ha^{-1}) of sorghum fodder

Treatments	Green fodder yield (t ha^{-1})
Factor- A (Nitrogen levels)	
N_0: 0 kg ha^{-1} (Control)	34.24
N_1: 50 kg ha^{-1}	39.20
N_2: 100 kg ha^{-1}	44.75
N_3: 150 kg ha^{-1}	51.69
S.Em±	1.07
LSD (p=0.05)	3.15
Factor-B (Time of Harvesting)	
H_1: 45 DAS	36.81
H_2: 60 DAS	42.69
H_3: 75 DAS	47.91
S.Em±	0.93
LSD (p=0.05)	2.73
Interaction (N*H)	NS

Table 3: Effect of nitrogen levels and harvesting times on economics (₹ ha^{-1}) of fodder sorghum

Treatments	Economics (₹ ha^{-1})			B:C ratio
	Cost of cultivation	Gross returns	Net returns	
Factor- A (Nitrogen levels)				
N_0: 0 kg ha^{-1} (Control)	22150	68489	46339	2.08
N_1: 50 kg ha^{-1}	23358	78405	55603	2.43
N_2: 100 kg ha^{-1}	24106	89505	66051	2.81
N_3: 150 kg ha^{-1}	24232	103378	79272	3.28
Factor-B (Time of Harvesting)				
H_1: 45 DAS	22078	73617	51539	2.32
H_2: 60 DAS	23545	85388	62260	2.68
H_3: 75 DAS	24761	95828	71650	2.95

Conclusion

Among the nitrogen levels, (N_3) 150 kg N ha^{-1} recorded significantly higher growth characters and green fodder yield of fodder sorghum, during course of study. In case of harvesting time, harvesting at (H_3) 75 DAS recorded significantly higher growth characters and green fodder yield. Economically, nitrogen levels (N_3) 150 kg N ha^{-1} along with harvesting (H_3) 75 DAS resulted in higher gross returns, net returns and B:C ratio.

References

1. Ammaji P, Suryanarayana K. Influence of different levels of nitrogen on yield and nutritive parameters of cereal fodder varieties. J Res, Acharya N G Ranga Agric Univ. 2003;30(4):11-16.
2. Ayub M, Muhammad AN, Asif T, Azhar H. Effect of different levels of nitrogen and harvesting times on the growth, yield, and quality of sorghum fodder. Asian J Plant Sci. 2002;1(4):304-307.
3. Ayub M, Nadeem MA, Tanveer A, Tahir M, Khan RMA. Interactive effect of different nitrogen levels and seeding rate on fodder yield and quality of pearl millet. Pak J Agric Sci. 2007;44(1):592-596.
4. Azam M, Waraich EA, Pervaiz A, Nawaz F. Response of a newly developed fodder sorghum (*Sorghum bicolor* L. Moench) variety (F-9917) to NPK application. Pak J Life Social Sci. 2010;8(2):117-120.
5. Balasubramanian A, Ramamoorthy K. Effect of plant geometry, nitrogen levels, and time of harvest on the productivity of sweet sorghum. Madras Agric J. 2007;83:462-463.
6. Bhag M, Pathak PS, Upadhyaya US, Gupta JNS, Suresh G. Soil fertility, fertilizers, and integrated nutrients use. In: Handbook of Agriculture. ICAR Publications. 2006:1128-1130.
7. Bhilare RL, Patil VS, Hiray. Effect of N levels and time of nitrogen application on forage yield of sorghum. Forage Res. 2002;28(1):32-34.
8. Bishanoi N, Mali AL, Sumeriya HK. Fodder quality of dual-purpose sorghum genotypes as influenced by varying plant population and nitrogen levels. Forage Res. 2005;30(4):229-230.
9. Bukhari MA. Effect of different harvesting intervals on growth, forage yield, and quality of pearl millet (*Pennisetum americanum* L.) cultivars. M.Sc., Thesis, University of Agriculture, Faisalabad, Pakistan. 2009;7(5).
10. Gardner FP, Brent PR, Mitchell RL. Physiology of crop plants. Scientific Publishers, Jodhpur. 2006:1-302.
11. Gomez KA, Gomez AA. Statistical procedures for agricultural research. IRRI. A Wiley Pub., New York. 1984:199-201.
12. Gupta VK, Meena RK, Rana DS. Effect of nitrogen levels and cutting management on growth and yield of multicut forage sorghum. Hind-Res J. 2008;3(2):1-6.

13. IIMR, Indian Institute of Millets Research. Annual Report. Rajendranagar, Hyderabad 500 030, India; 2020. p.152.
14. Jung GA, Kocher RE, Glica A. Minimum-tillage forage turnip and rape production hill land as influenced by sod suppression and fertilizer. Agron J. 2009;76:404-408.
15. Kumar NS. Yield, quality, and cut-frequency of multicut fodder sorghum [*Sorghum bicolor* (L) Moench] as affected by nitrogen management. M.Sc. (Ag.) Thesis, ANGRAU, Hyderabad. 2006;33(2):123-112.
16. Muhammad M, Shehzad A. Optimizing nitrogen input and harvest time to maximize the maize fodder yield in Punjab, Pakistan. Pak J Agric Sci. 2013;50(1):75-81.
17. Ramamurthy V, Shankar V. Response of Pennisetum tri-specific hybrid to nitrogen and harvesting dates. Indian J Agron. 2005;43(3):533-536.
18. Sharma KC, Verma RS. Range Management and Agro-forestry. 2009;25:57-60.
19. Shinde VS, Raikhelkar SV, Shelke VB, Bainade SS. Performance of multicut forage sorghum varieties under different nitrogen levels. J Maharashtra Agric Univ. 2009;12(1):22-25.