Influence of nitrogen and spacing on growth and fodder yield of M P Chari (*Sorghum Bicolor* L.)

ABSTRACT

A field experiment was conducted during *Zaid* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) India. To study the Response of Nitrogen and spacing on growth and fodder yield of Sorghum (*Sorghum bicolor* L.). The treatments consist of Nitrogen 60,80,100 kg/ha and spacing of S_1- 35×15cm, S_2- 45×15cm, S_3- 55×15cm. There were 10 treatments each replicated thrice. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%) available N (163.42 kg/ha), available P (21.96 kg/ha) and available K (256.48 kg/ha). Results revealed that the higher plant height (186.96 cm), higher plant dry weight (52.78 g/plant), higher crop growth rate (55.0 g/m^2/day) and higher green fodder yield (28.36 and 22.43 t/ha) for 1^{st} and 2^{nd} cutting were significantly influenced with Nitrogen 100 kg/ha along with the spacing 55×15cm.

Keywords: *sorghum, nitrogen, spacing, growth parameters, and green fodder yield.*

INTRODUCTION

"Sorghum fodder is the most common feed for animals; however, it has a worse quality due to the presence of hydrocyanic acid (HCN). However, with a little protein supplement and adequately cured sorghum forage, cattle can be kept in good health throughout the winter with little or no grain supplement. Its fodder provides more than half of the elements that humans can digest, including 8% protein, 2.5% fat, and 45 % nitrogen-free extract (NFE). It has been stated that it has a feeding value comparable to corn, and animals enjoy it because of its palatability and succulence". (**Devi *et al.*, 2018**).

"At present, the country faces net deficit of 61.1 % green fodder and 21.9 % dry fodder. This situation indicates that the green forage supply has to be grown at 3.2 % to meet the deficit. To meet this challenge, concerted efforts are to be made for reducing the large gap between demand and supply of the fodder in the country. To meet the current level of livestock production and its annual growth in population, the deficit has to be met from either increasing productivity, increasing land area under fodder cultivation or through import. In animal feed supply, cereals have major role and four major cereals viz. maize, barley, sorghum and pearl millet account for about 44 per cent of the total cereals fodder production" **(Nabooji et al., 2018).** It's adaptability to grow under water stress areas makes it a better performance crop when we compare it to other cereal crops. Sorghum is a versatile crop that can grow in a variety of environments and offer green fodder from May to November. Sorghum is also a salt-tolerant crop to a degree (**Devi *et al.*, 2018**).

Protein supply is a crucial aspect that influences animal productivity in terms of yield and quality in order to create assets and boost livestock production. Protein feeding at high levels may help promote quick weight increase and milk output (**Hoffman et al., 2001**).

One of the key elements in crop establishment method that influences the crop stand and other yield metrics in various crops is row spacing. For farmers, maintaining the ideal planting density is a constant challenge. Lesser yields, ineffective radiation usage, and increased weed infestation are all effects of lower plant density. However, a dense plant population may result in lodging, inadequate light penetration in the canopy, a loss in photosynthesis because lower leaves are shaded, and a significant decrease in output **(Lemerle et al., 2006).**

MATERIALS AND METHODS

A field experiment was conducted during *zaid* season of 2022 at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology And Sciences, Prayagraj (U.P.) India. The soil of experimental plot was sandy loamy in texture, nearly neutral in soil reaction (pH 7.8), low in organic carbon (0.35%), The treatments consist of Nitrogen 60 kg/ha + Spacing 35x15cm, Nitrogen 60 kg/ha + Spacing 45x15cm, Nitrogen 60 kg/ha + Spacing 55x15cm, Nitrogen 80 kg/ha + Spacing 35x15cm, Nitrogen 80 kg/ha + Spacing 45x15cm, Nitrogen 80 kg/ha + Spacing 55x15cm, Nitrogen 100 kg/ha + Spacing 35x15cm, Nitrogen 100 kg/ha + Spacing 45x15cm, Nitrogen 100 kg/ha + Spacing 55x15cm and control plot. "The experiment was laid out in Randomized Block Design, with 10 treatments replicated thrice. The observations were recorded for plant height, plant dry weight, number of leaves/plant, Crop Growth Rate (g/ m^2/day), and green fodder yield (t/ha). The collected data was subjected to statistical analysis by analysis of variance method" **(Gomez and Gomez, 1976).**

RESULT AND DISCUSSION

GROWTH PARAMETERS

Plant height - At 60 DAS, the significantly higher plant height (186.96 cm) was observed in treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm) However, treatment-8 (Nitrogen 100 kg/ha + Spacing 45x15cm) was found to be statistically at par with treatment- 9 (Nitrogen 100 kg/ha + Spacing 55x15cm). The significantly higher plant height (186.96 cm) was observed with Nitrogen 100 kg/ha due to on higher levels of nitrogen was mainly attributed to more availability and uptake of nitrogen by crop which resulted in more vegetative growth and increase in protoplasmic constituent and acceleration in the process of cell division, expansion, and differentiation there by resulting in luxuriant growth. And Nitrogen promotes the vegetative growth thus, leading to increase in plant height. Similar findings conformity with **Agarwal *et al.* (2005)**. And also, with the reduced spacing, increases the competition in plants for light. So that plants stops grow in horizontal and grows in vertical. Early sown crop shown higher plant height than late sown crop. Similar results reveled with **Sandeep *et al.*, (2021).**

Plant dry weight - At 60 DAS, the significantly higher plant dry weight (52.78 gm) was observed in treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm) However, treatment-8 (Nitrogen 100 kg/ha + Spacing 45x15cm) was found to be statistically at par with treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm).The significantly higher plant dry weight (52.78 gm) was observed with the application of nitrogen 100 kg/ha. Nitrogen promotes the vegetative growth thus, leading to increase in dry weight. Might be with influenced root growth in a positive manner which could have helped better absorption and transformation of nutrients from source to sink capacity of plants. These similar results reported by **Ghosh *et al.* (2004).** Along, with that spacing also helps in improving the dry weight of the plant. The dry matter accumulation influence with the plant spacing higher as compare to lower plant spacing. The low plant densities to attain greater photosynthesis, assimilation of carbon dioxide due to more output per plant and greater dry matter production as reported in findings of **Williams *et al.*, (1968) and Sangoi *et al.*, (2002)**.

Crop Growth Rate - At 45-60 DAS, the significantly higher crop growth rate (55.0) was observed in treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm) However, treatment-8 (Nitrogen 100 kg/ha + Spacing 45x15cm) was found to be statistically at par with treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm).

YIELD ATTRIBUTE

Green fodder Yield (t/ha) - The significantly higher green fodder yield (28.36 t/ha) was observed in treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm) during 1st cutting. However, treatment-8 (Nitrogen 100 kg/ha + Spacing 45x15cm) was found to be statistically at par with treatment- 9 (Nitrogen 100 kg/ha + Spacing 55x15cm).

The significantly higher green fodder yield (22.43 t/ha) was observed in treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm) during 2nd cutting. However, treatment-8 (Nitrogen 100 kg/ha + Spacing 45x15cm) was found to be statistically at par with treatment-9 (Nitrogen 100 kg/ha + Spacing 55x15cm).

The significantly higher green fodder yield (28.36 t/ha) was observed with the application of nitrogen 100 kg/ha along with the spacing 55x15 cm, This might be due to with the nitrogen mainly attributed to improved growth and yield parameters, viz., plant height, leaf area, leaf stem ratio and the beneficial effects of nitrogen on cell division and elongation, formation of nucleotides and Co-enzymes which resulted in increased meristematic activity and photosynthetic area and hence more production and accumulation of photosynthates, yielding higher green fodder. These results are in conformity with the findings **of Ayub *et al.* (2002).** And along, with that Optimum planting pattern is that the necessity for proper utilization of growth resources and ultimately to use the potential productivity of any crop. The higher grain yield was recorded from the interaction impact of sowing dates and spacing. Similar findings were reported with **Manasa and Umesha c. (2022).**

CONCLUSION –

It was concluded that with the application of nitrogen 100 kg/ha and along with the spacing 55×15cm (Treatment-9), has performs positively and improves growth and yield parameters. Higher plant height, higher plant dry weight, maximum crop growth rate and maximum green fodder yield were also recorded with the application of nitrogen 100 kg/ha and along with the spacing 55×15cm (Treatment-9). These findings are based on one season therefore; further trials may be required for further confirmation.

REFERENCES

1. **Agarwal SB, Shukla VK, Sisodia HPS, Ranji Tomar, Arti Shrivastava (2005**). Effect of inoculation and nitrogen levels on growth, yield and quality of fodder sorghum [*Sorghum bicolor* (L.) Moench] varieties. *Forage Res*; **31**:106-108.
2. **Ayub M, Tanveer A, Ali S, Nadeem MA (2002)**. Effect of different nitrogen levels and seed rates on growth, yield and quality of sorghum (*Sorghum bicolor* L.) fodder. *Indian. J. Agric.Sci;* **72**(11):648-656.
3. **Devi, satpal, h. S. Talwar, ramprakash, v. Goyal, m. Goyal and n. Kumar (2018).** Physiological variability of sorghum [*sorghum bicolor* (l.) Moench] under salt stress. *Forage Res.,* **44** (2): pp. 101-104.
4. **Dontha Sandeep, Umesha C and SJV Surya Teja (2021).** Effect of sowing dates and spacing on growth and economics of sorghum (*Sorghum bicolor* L. Moench*)*. *International Journal of Chemical Studies*; **9**(1): 1685-1686.
5. **Ghosh, P. K., Bandyopadhyay, K. K., Manna, M. C., Mandal, K. G., Mishra, A. K. and Hati, K.M. (2004)**. Comparative effective effectiveness of cattle manure, poultry manure, phospho compost and fertilizer-NPK on three cropping system in vertisols of semi-arid tropics. II. Dry matter yield, nodulation, Chlorophyll content and enzyme activity. *Bioresource Technology* **95**:85-93.
6. **Gomez, K.A., Gomez, A. A., (1976)** Three or more factor experiment. (In*:) Statistical Procedure for Agricultural Research 2nd ed*., 1976, pp.139 -141.
7. **Hoffman, P.C., Esser, N. M., Bauman, L. M., Denzine, S. L., Engstrom, M. and Jonos, H. C. 2001.** Effect of dietary protein on growth and N balance of Holstein heifer. Journal of Dairy Science **84**: 843-847.
8. **Lemerle, D., Verbeek, B., and Diffy, S. (2006).** Influence of field pea (*Pisum sativum*) density on grain yield and competitiveness with annual rye grass (*Loliumrigidum*) in south-eastern Australia. *Australian Journal of Experimental Agriculture*, **46**, 1465-1472.
9. **Manasa A N, and C. Umesha , (2022).** Effect of Spacing and Plant Growth Regulators on Growth and Yield of Finger Millet (*Eleusine coracana* L.). International Journal of Plant & Soil Science **34**(13): 106-111.
10. **Nabooji A, Keshavaiah KV, Shirgapure KH and Shekara BG (2018)**, Effect of seed rates and nitrogen levels on growth and fodder yield of sweet sorghum. *Journal of Pharmacognosy and Phytochemistry* 2018; **7**(2): 1391-1394.

11. **Sangoi L, Gracieti MA, Rampazzo C & Bianchetti P (2002),** Response of Brazi1ia maize hybrids from different eras to changes in plant density, *Field Crops Research*, **79,** 39-51.

12. **Williams WA, Loomis RS, Duncan WG, Dorvrat A & Nunez AF, (1968).** Canopy architecture at various population densities and the growth and grain yield of corn, *Crop Science*, **8**, 303–308.

Table 1: Influence of nitrogen and spacing on Growth attributes of Sorghum.

S. No.	Treatment combinations	Plant height (cm)	Plant Dry weight (gm)	Crop growth rate (g/m^2/day)
1.	Nitrogen 60 kg/ha + Spacing 35x15cm	163.71	45.40	44.4
2.	Nitrogen 60 kg/ha + Spacing 45x15cm	170.53	46.51	46.4
3.	Nitrogen 60 kg/ha + Spacing 55x15cm	174.30	47.84	47.4
4.	Nitrogen 80 kg/ha + Spacing 35x15cm	172.94	47.18	48.2
5.	Nitrogen 80 kg/ha + Spacing 45x15cm	176.73	49.25	50.4
6.	Nitrogen 80 kg/ha + Spacing 55x15cm	179.72	50.82	51.7
7.	Nitrogen 100 kg/ha + Spacing 35x15cm	178.33	51.32	54.1
8.	Nitrogen 100 kg/ha + Spacing 45x15cm	183.32	51.74	53.3
9.	Nitrogen 100 kg/ha + Spacing 55x15cm	186.96	52.78	55.0
10.	Control	172.74	45.80	45.9
	F test	S	S	S
	S Em. (±)	1.85	0.72	1.68
	CD (P=0.05)	5.49	2.15	5.00

Table 2: Influence of nitrogen and spacing on green forage yield of Sorghum.

Treatment No.	Treatment combinations	Green fodder (t/ha) 1st cutting	Green fodder (t/ha) 2nd cutting
1.	Nitrogen 60 kg/ha + Spacing 35x15cm	22.68	18.17
2.	Nitrogen 60 kg/ha + Spacing 45x15cm	23.97	18.74
3.	Nitrogen 60 kg/ha + Spacing 55x15cm	25.09	19.31
4.	Nitrogen 80 kg/ha + Spacing 35x15cm	24.08	18.39
5.	Nitrogen 80 kg/ha + Spacing 45x15cm	25.19	19.52
6.	Nitrogen 80 kg/ha + Spacing 55x15cm	27.03	21.60
7.	Nitrogen 100 kg/ha + Spacing 35x15cm	26.41	20.08
8.	Nitrogen 100 kg/ha + Spacing 45x15cm	27.45	21.73
9.	Nitrogen 100 kg/ha + Spacing 55x15cm	28.36	22.43

10.	CONTROL	23.25	18.85
	F test	S	S
	SEm±	0.71	0.34
	CD (P=0.05)	2.10	1.02