Original Research Article

Effect of Spacing and Potassium Levels on Yield and Economics of Foxtail Capital M millet (*Setaria italica L.*)

ABSTRACT

A field experiment was conducted to determine the influence of spacing and potassium on foxtail millet (*Setaria italica* L.) var. during the summer season (*Zaid*) of 2022 with 9 treatments (*viz*. spacing at 25 x 10 cm, 30 x 10 cm, 35 x 10 cm respectively and K at 10, 20 and 30 kg/ha respectively) at Crop Research Farm, Department of Agronomy, Faculty of Agriculture, SHUATS, Prayagraj (U.P). Application of Spacing 30×10cm+ 30 kg/ha Potassium recorded highest grain yield (2.11 t/ha), stover yield (3.95 t/ha). higher net return (84,587.00₹/ha), gross return (57,552.00₹/ha) and benefit: cost ratio (2.13).

Key words: Economics, Foxtail millet, Potassium, Spacing, Yield.

INTRODUCTION

Foxtail millet (*Setaria italica* L.) is one of the oldest cultivated millets and most economically important species of the genus Setaria. Foxtail millet commonly known as Navane in Karnataka. It has been popular for its wider adaptability, low input requirement and it has good nutritive value as it is rich in proteins (12.3 g), carbohydrates (60.9 g), fat (4.3 g), crude fibre (8.0 g), calcium (3.1g), vitamins and thiamin (590 mg) per 100 g. It can be grown on marginal lands even under aberrant weather condition when the major crops cannot be grown successfully. It is also called as famine reserve and is extensively grown under low rainfall area. Small millets in India occupied on area of 9.17 lakh hectare area, with a production of 4.60 lakh tonnes and productivity of 501 kg ha-^{1} (Anon., 2014). In Karnataka it is cultivated in an area of 0.36 lakh hectare and producing 0.29 lakh tonnes with a productivity of 835 kg ha-^{1}.

Variation in the plant population causes changes due to light intensity, humidity and temperature within canopy. Under wider spacing, plants tend to put forth a vigorous vegetative growth, while closer spacing tend to restrict the same. Optimum population level is the one, which provides the plant with the best environment to express its full capacity under the given conditions.

Nutritional demand of crop can be determined by measuring nutrient uptake which may change with changing nitrogen rates and plant population. Potassium is an important ion in maintaining physiological plant water relations and is an essential macronutrient required for proper development of plants, in addition to activation of numerous enzymes. Potassium plays an important role in the maintenance of electrical potential gradient across cell membrane, generation of turgor and is the major cat ion in the maintenance of anion balance. It improves drought, disease or pest tolerance in crop besides improving quality of the produce. It is a soil aggregating agent which is known to have positive effect on soil physical properties and subsequently crop yields. Recent studies showed declining status of potassium in Indian soils in most of the states from high to medium or medium to

low status. It was considered that Indian soils are rich in K and seldom recommended K fertilizers to crops. High crop K removal than K addition by farmers and imbalanced use of NPK fertilizers are contributing to large scale K mining leading to emergence of K deficiency in soils and crops. Red, lateritic and shallow black soils have under gone K fertility depletion. K recommendation needs revalidation across the agro climatic zone considering the variation in the soil type and crop potential. Further, fertilizer recommendations are being made based on available K status, but significant proportion of plant need is met from nonexchangeable fraction of K. Therefore, there is a need to consider both the fractions of K in soils for potassium fertilizer recommendation to crops and awareness on K use by farmers in K deficient regions needs more emphasis.

MATERIALS AND METHODS

A field experiment was conducted during *Kharif* season of 2022, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). To assess the effect of spacing and potassium on growth and yield of Foxtail millet (*Setaria italica* L.). The experiment was laid out in Randomized Block Design comprising of 10 treatments which are replicated thrice. Each treatment net plot size is 3m × 3m. The treatment are categorized as with 3 levels of plant geometry and 3 levels of potassium when applied in combinations as follows, (T_1) 25x10cm + 10kg/ha potassium ,(T_2) 25x10cm + 20kg/ha potassium, (T_3) 25x10cm + 30kg/ha potassium , (T_4) 30x10cm + 10kg/ha potassium ,(T_5) 30x10cm + 20kg/ha potassium,(T_6) 30x10cm + 30kg/ha potassium, (T_7) 35x10cm + 10kg/ha potassium, (T_8) 35x10cm + 20kg/ha potassium, (T_9) 35x10cm + 30kg/ha potassium, . The field pea crop was harvested treatment wise at harvesting maturity stage. Growth parameters viz. plant height (cm), dry matter accumulation (g plant^{-1}) were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, seeds were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and grain yield per ha was computed and expressed in kgs per hectare. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in tonnes per hectare. The data was computed and analysed by following statistical method of Gomez and Gomez (1984). The benefit: cost ratio was worked out after price value of seed with stover, and total cost included in crop cultivation.

RESULTS AND DISSCUSION

Effect of Spacing and potassium on Yield and Yield Attributes: Length of ear (cm)

Significant effect was observed by the statistical analysis of length of ear Treatment Spacing35×10cm+ 30 kg/ha Potassium resulted in significantly highest ear head length (18.90 cm). However, Spacing30×10cm+ 30 kg/ha Potassium, Spacing35×10cm+ 20 kg/ha Potassium were found to be statistically on par with Spacing35×10cm+ 30 kg/ha Potassium. Sufficient interception of sunlight promotes efficient photosynthesis activities and ultimately greater accumulation of

photosynthates under wider spacing. Narrow spacing with dense plant population resulted in the lower values of yield attributes. Potassium is involved in number of physiological processes, protein synthesis and activation of enzymes. Recent studies showed declining status of K in Indian soils in most of the states from high to medium or medium to low status (Brar *et al*., 2011). In the present investigation, the crop responded up to 35 kg K2O ha-1. Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields. Similar results reported by Sujith Reddy and Shikha Singh (2021) , Srinivasa *et al* (2019)

Number of grains/ear

Significant effect was observed by the statistical analysis of number of grains/ear. Treatment (6) Spacing30×10cm+ 30 kg/ha Potassium recorded significant and highest number of grains/ear head (1452). However, Spacing35×10cm+ 10 kg/ha Potassium, Spacing35×10cm+ 30 kg/ha Potassium recorded statistical parity with Spacing30×10cm+ 30 kg/ha.The yield attributes of foxtail millet increased significantly due to spacing and potassium. It may be due to less competition exerted for light, moisture and nutrients. Sufficient interception of sunlight promotes efficient photosynthesis activities and ultimately greater accumulation of photosynthates under wider spacing. Narrow spacing with dense plant population resulted in the lower values of yield attributes. Potassium is involved in number of physiological processes, protein synthesis and activation of enzymes. Recent studies showed declining status of K in Indian soils in most of the states from high to medium or medium to low status (Brar *et al*., 2011). In the present investigation, the crop responded up to 35 kg K2O ha-1. Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields. Similar results reported by Sujith Reddy and Shikha Singh (2021) , Srinivasa *et al* (2019).

Grain yield (t/ha)

The grain yield showed increasing trend with the application of spacing and potassium in foxtail millet. The highest grain yield was obtained with the treatment Spacing30×10cm+ 30 kg/ha Potassium (2.11 t/ha), however Spacing35×10cm+ 30 kg/ha Potassium treatment were found to be statistically on par with Spacing30×10cm+ 30 kg/ha Potassium. The grain yield of foxtail millet increased significantly due to spacing and potassium. It may be due to less competition exerted for

light, moisture and nutrients. Sufficient interception of sunlight promotes efficient photosynthesis activities and ultimately greater accumulation of photosynthates under wider spacing. Narrow spacing with dense plant population resulted in the lower values of yield attributes. Potassium is involved in number of physiological processes, protein synthesis and activation of enzymes. Recent studies showed declining status of K in Indian soils in most of the states from high to medium or medium to low status (Brar *et al*., 2011). In the present investigation, the crop responded up to 35 kg K2O ha-1. Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields. Similar results reported by Mownika *et al*. (2021), Sujith Reddy and Shikha Singh (2021).

Stover yield (t/ha)

The stover yield of foxtail millet was also influenced by the application of spacing and potassium. Highest stover yield (3.95 t/ha) was recorded Spacing30×10cm+ 30 kg/ha Potassium, however Spacing35×10cm+ 30 kg/ha Potassium, Spacing35×10cm+ 20 kg/ha Potassium treatment were found to be statistically on par with Spacing30×10cm+ 30 kg/ha Potassium. The stover yields of foxtail millet increased significantly due to spacing and potassium. It may be due to less competition exerted for light, moisture and nutrients. Sufficient interception of sunlight promotes efficient photosynthesis activities and ultimately greater accumulation of photosynthates under wider spacing. Narrow spacing with dense plant population resulted in the lower values of yield attributes. Potassium is involved in number of physiological processes, protein synthesis and activation of enzymes. Recent studies showed declining status of K in Indian soils in most of the states from high to medium or medium to low status (Brar *et al*., 2011). In the present investigation, the crop responded up to 35 kg K2O ha-1. Potassium aggregating agent which is known to have positive effect on soil physical properties such as plant height, healthy growth etc and subsequently crop yields.

Similar results reported by Mownika *et al*. (2021), Sujith Reddy and Shikha Singh (2021).

CONCLUSION

The results revealed that application of Spacing 30×10cm+ 30 kg/ha Potassium recorded Maximum length of ear (18.90 cm), grain yield (2.11 t/ha). higher net return (84,587.00₹/ha), gross return (57,552.00₹/ha) and benefit: cost ratio (2.13). and hence, can be recommended to the farmers.

REFERENCES

Attar, A. V., Patil, B. T., Bhalekhar, M. N. and Shinde, K. G., 2013, Effect of spacing and fertilizer levels on growth, yield and quality of garden pea (*Pisum sativum* L.) CV. Phule priya. Bioinofolet, **10**(4B): 1240-1242.

Avasthe, R.K., Verma, S., Ashok Kumar and Rahman, H., 2012, Performance of rice (Oryza sativa) varieties at different spacing under system of rice intensification (SRI) in mid hill acid soils of Sikkim Himalayas. *Ind. J. Agr*., **57**(1): 32-37.

Basavarajappa, R., Prabhakar, A. S. and Halikatti, S. I., 2002, Effect of tillage practices, organics, nitrogen levels and their interactions on yield and economics of foxtail millet during kharif. Karnataka J. Agric. Sci., 15 (3): 485- 490.

Brar, M. S., Bijya, S. K. and Shrinivasa Rao, C. H., 2011, Role of potassium nutrition in nitrogen use efficiency in cereals. *Int. Pot. Inst., Indian*. **3**: 221 – 223.

Charate, S., Thimmegowda, M. N., Rao, G. E., Ramachandrappa, B. K. and Sathish, A. (2018). Effect of nitrogen and potassium levels on growth and yield of little millet (*Panicum sumatrense* L.) under dryland alfisols of southern Karnataka. *International Journal of Pure & Applied Bioscience*, **6** (6), 918- 923.

Gabatshele, M. L., Thembinkosi, M., Phizana M., Christopher M., and Witness M., 2014, Growth and effect of two pearl millet land races as affected by the intra-row spacing. *Int. J. curr. Microbio. Apllied sci*., 3: 505-515.

Jadhav, S. G., Chavan, D. A. and Waghmare, Y. M., 2015, Effect of plant spacing, growth regulator and nutrient management on yield, quality and economics of bt cotton. *J. Cotton Res. Dev.* **29**(1): 48-52.

Kamal, I. A., Siddig, A. M. A., Ali, H. B. and Thabit, A. H., 2013, Effect of plant spacing and variety on performance of rain-fed pearl millet (*Pennisetum glaucum* L.) grown on two soil types at zalingei area, *Sudan. J. Sci. Technol*., **3**(5).

Maitra, S., Ghosh, D.C., Sounda, G. and Jana, P.K. 2001. Performance of intercropping legumes in finger millet (*Eleusine coracana*) at varying fertility levels. *Indian Journal of Agronomy*, **46**(1): 38-44.

Mownika R, Sanbagavalli S, Thavaprakaash N, Kalarani MK and Renukadevi K. (2021). Studies on crop geometry and potassium on growth and yield of foxtail millet (*Setaria italica* L.) under irrigated condition. *The Pharma Innovation Journal*; **10**(10): 1256-1260.

Nagappa Govinakoppa, Deepak Kamatar, Anil Kumar H and T Sudha (2021). Impact of fertilizer, spacing and genotypes on yield, income and related traits in little millet. *The Pharma Innovation Journal*; SP-**10**(10): 132-138

Rashid Khan, M., Murshedulalam and Rezaulkarim, 2006, Integrated nutrient approach to increase the yield in rice cv. BRRI dhan44, *Life Sci. J.,* **10**(4): 172-181.

Sangeeta, Surakod, V. S., Patil, M. B., Ashwathama, V. H. And Patil, P.V., 2014, Effect of crop geometry on pearl millet (*pennisetum glaucum* (l.) r. br.) under dryland conditions. M.Sc. Thesis*, UAS Dharwad*, 21- 22.

Srinivasa DK, Chikkaramappa T, Basavaraja PK, Sukanya TS, Murali K and Chamegowda TC (2019). Status of different forms of potassium under foxtail millet crop as influenced by graded levels of potassium in Alfisols of Chikkaballapura region, Karnataka. *International Journal of Chemical Studies*; **7**(3): 3435-3441

Shankar Charate, Thimmegowda, M. N., Gangadhar Eswar Rao, Ramachandrappa, B. K. and Sathish, A. Effect of Nitrogen and Potassium Levels on Growth and Yield of Little Millet (*Panicum sumatrense*) under Dryland Alfisols of southern Karnataka. *Int. J. Pure App. Biosci.* **6** (6): 918-923

Shafi Nazir, M., Hafiz M. Shafiq, Saeed, M. and Jabbar, J., 1997, Integrated nitrogen management with planting geometry for multicut hybrid sorghum. *Pak. J. Agri. Sci*., **34**(1): 1-4.

Shinggu, C. P. and Gani, M., 2012, Effects of planting methods, sowing dates and spacing on weed and the productivity of finger millet (*Eleusine corocana* L.) in the northern guinea savanna of nigeria. *Global J. Bio-Sci. Biotech*., **1**(2): 160-162.

Soomro, H. and Alam, M. S., 2009, Effect of plant geometry and nitrogen rates on quality traits and yield of wheat. *J. Environ. Sci. Natural Res*., **4**(1): 172-176.

Sujith Reddy and Shikha Singh (2021). Effect of spacing and potassium levels on growth and yield of finger millet (*Eleusine coracana* L.) *Asian Jr. of Microbiol. Biotech. Env. Sc.* Vol. **23** (2): 158-162

Tetarwal, J.P. and Nanwal, R.K. 2002. Productivity of pearl millet (*Pennisetum glaucum*) as influenced by cropping systems and fertilization under rainfed conditions. *Agronomy Digest*, 2: 8-11.

Thavaprakaash, N., Velayudham, K. and Muthukumar, V. M., 2008, Response of crop geometry, intercropping system and INM practices on yield and fodder quality of baby corn. *Asian J. Scientific Res*., **1**(2): 153-159.

Vasuki, S. B., Yogananda, D. C., Preetu, K. S. and Jayaprakash, S. M., 2009, Impact of longterm fertilizer application on soil quality, crop productivity and sustainability. Department of Soil science and Agricultural chemistry, *Uni. Agric. Sci*., pp: 22.

Yayeh Bitew and Fekremariam Asargew, 2014, Determination of seed rate and inter row spacing for finger millet production (*Eleusine coracana* L.) in north western Ethiopia. *Int. J. Res. Rev*., **1**(4)

Table 1. Effect of spacing and potassium on growth attributes of foxtail millet.

Treatment No.	Treatment combinations	Yield Attributes			
		Length of ear	No.of grains/ear	Grain Yield	Straw yield
1.	Spacing25×10cm+ 10 kg/ha Potassium	15.80	1150	1.51	3.72
2.	Spacing25×10cm+ 20 kg/ha Potassium	16.63	1196	1.64	3.75
3.	Spacing25×10cm+ 30 kg/ha Potassium	17.47	1250	1.69	3.82
4.	Spacing30×10cm+ 10 kg/ha Potassium	16.97	1272	1.61	3.74
5.	Spacing30×10cm+ 20 kg/ha Potassium	17.90	1297	1.79	3.75
6.	Spacing30×10cm+ 30 kg/ha Potassium	18.20	1452	2.11	3.95
7.	Spacing35×10cm+ 10 kg/ha Potassium	17.60	1397	1.90	3.77
8.	Spacing35×10cm+ 20 kg/ha Potassium	18.53	1365	1.82	3.85
9.	Spacing35×10cm+ 30 kg/ha Potassium	18.90	1415	2.04	3.90
	F test	S 0.08	S 0.31	S 18.61	S 0.03
	SEm±				
	CD (P=0.05)	0.25	0.91	55.28	0.08

Table 2. Effect of spacing and potassium on economics of production of foxtail millet

Treatment	Cost of No.	Treatment combinations	cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	Benefit:Cost ratio
1.		Spacing25×10cm+ 10 kg/ha Potassium	26,701.00	60,400.00	33,699.00	1.26
2.		Spacing25×10cm+ 20 kg/ha Potassium	26,868.00	65,413.00	38,545.00	1.43
3.		Spacing25×10cm+ 30 kg/ha Potassium	27,035.00	67,747.00	40,712.00	1.51
4.		Spacing30×10cm+ 10 kg/ha Potassium	26,701.00	64,533.00	37,832.00	1.42
5.		Spacing30×10cm+ 20 kg/ha Potassium	26,868.00	71,507.00	44,639.00	1.66
6.		Spacing30×10cm+ 30 kg/ha Potassium	27,035.00	84,587.00	57,552.00	2.13
7.		Spacing35×10cm+ 10 kg/ha Potassium	26,701.00	75,840.00	49,139.00	1.84
8.		Spacing35×10cm+ 20 kg/ha Potassium	26,868.00	72,760.00	45,892.00	1.71
9.		Spacing35×10cm+ 30 kg/ha Potassium	27,035.00	81,587.00	54,552.00	2.02