TITLE

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

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ABSTRACT

A field experiment was conducted to determine the influence of spacing and potassium levels on foxtail millet (*Setaria italica* L.) var.during the (*Zaid*) 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) .The soil experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.28%), available N (225kg/ha), available P (19.50kg/ha) and K (92kg/ha) at Crop Research Farm, Department of Agronomy, Faculty of Agriculture, SHUATS, Prayagraj (U.P). Spacing of 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 INR/ha), gross return (57,552.00INR/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 thiamine (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 macro nutrient 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 cation 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 carried out in the Zaid season of 2022 at the Department of Agronomy's crop research farm at Sam Higginbottom University of Agriculture, Technology, and Sciences, Prayagraj, which is situated at 25^0 24' 42" N latitude, $81^0$50' 56" E longitude and 98 m altitude above mean sea level (MSL). To evaluate how spacing and potassium affect the growth and yield of Foxtail millet (Setaria italica L.). The experiment was set up using a RandomizedBock Design with nine treatments that were replicated three times. The size of each treatment net plot is 3m x 3m. When used in combinations, the treatments were divided into 3 levels of plant geometry and 3 levels of potassium. (T1) 25x10cm + 10 kg/ha Potassium; (T2) 25x10cm + 20 kg/ha Potassium; (T3) 25x10cm + 30 kg/ha Potassium; (T4) 30x10 cm + 10 kg/ha Potassium; (T5) 30 x 10 cm + 20 kg/ha Potassium; (T6) 30 x 10 cm + 30 kg/ha Potassium; (T7) 35 x 10 cm + 10 kg/ha Potassium; (T8) 35 x 10 cm + 20 kg/ha Potassium; and (T9) 35 x 10 cm + 30 kg/ha Potassium. At the point of harvesting maturity, the foxtail millet crop was harvested carefully. After harvesting, seeds were collected from each net plot and dried for five days in the sun using five randomly chosen representative plants from each plot of each replication. Growth characteristics, such as plant height (cm) and dry weight (g), were manually recorded on these representative plants. Afterwards, the grain yield per acre was calculated, cleaned, and expressed in kilogrammes per hectare. Stover yield from each net plot was recorded and expressed in tonnes per hectare after complete drying under the sun for 10 days. The information was calculated and examined by following statistical method of 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)

With a spacing of 35x10cm + 30 kg/ha of Potassium, the largest ear head length was considerably obtained (18.90cm). However, spacing 30x10cm + 30 kg/haPotassium and 35x10cm + 20 kg/haPotassium were found statistically at par with spacing of 35x10cm + 30kg/ha Potassium. Effective photosynthesis is encouraged by sufficient sunlight absorption, which leads to larger accumulation of photosynthetic over wider areas. The lower values of the yield attributes were caused by the tight spacing and dense plant population. Many physiological activities, including protein synthesis and enzyme activation, include potassium. most states, the status of K in Indian soils has decreased from high to medium or medium to low, according to recent studies (Brar et al., 2011). The crop responded to the investigation up to 35 kg K_2O/ha. Aggregating potassium is known to improve soil physical attributes like plant height, healthy growth, etc., which in turn improves agricultural yields. Sujith Reddy and Shikha Singh (2021), Srinivasa et al., and others have observed similar findings (2019)

Number of grains/ear

The statistical analysis of number of grains/ear found a significant influence. Treatment (6) 30x10cm + 30 kg/ha of separation Potassium had the greatest and most significant amount of grains/ear heads (1452). Spacing 35 cm x 10 cm + 10 kg/ha for Potassium and 35 cm x 10 cm + 30 kg/ha for Potassium. Statistics showed that potassium and Spacing30 cm x 10cm+30 kg/ha were equal. Due to spacing and potassium, foxtail millet's yield characteristics considerably improved. It might be because there is less competition for nutrients, moisture, and light. A sufficient amount of sunlight absorption encourages effective photosynthesis processes, which leads to a bigger accumulation of photosynthates over a wider area. The lower yield attribute values were a result of the tight spacing and dense plant population. Many physiological activities, including protein synthesis and enzyme activation, include potassium. Recent research revealed that K levels were falling in most Indian soils a very low status (Brar et al., 2011). The crop responded to the investigation up to 35 kg K_2O/ha. Aggregating potassium is known to improve soil physical attributes like plant height, healthy growth, etc., which in turn improves agricultural yields. Similar findings were reported by Srinivasa et al., Sujith Reddy and Shikha Singh (2021), and others (2019)

Grain yield (t/ha)

With the application of spacing and potassium in foxtail millet, the grain production trended upward. The treatment Spacing30 x 10cm + 30 kg/ha Potassium (2.11 t/ha) produced the maximum grain yield, while Spacing35 x 10cm + 30 kg/ha Potassium was shown to be statistically equivalent to Spacing 30 x 10 cm +

30 kg/ha Potassium. Due to spacing and potassium, foxtail millet's grain output greatly increased. It might be because there is less competition for nutrients, moisture, and light. A sufficient amount of sunlight absorption encourages effective photosynthesis processes, which leads to a bigger accumulation of photosynthates over a wider area. The lower values of the yield attributes were caused by the tight spacing and dense plant population. Potassium plays a role in several enzyme activation, protein synthesis, and physiological activities. The crop responded to the investigation up to 35 kg K_2O ha1. Aggregating potassium is known to improve soil physical attributes like plant height, healthy growth, etc., which in turn improves agricultural yields. Sujith Reddy, Shikha Singh, and Mownika et al. (2021) all reported results that were similar (2021).

Stover yield (t/ha)

The use of spacing and potassium had an impact on the stover production of foxtail millet as well. The treatment that produced the highest yield of stover (3.95 t/ha) was spacing 30 cm + 30 kg/ha of Potassium, although spacing 35x10cm + 30 kg/ha of Potassium and spacing 35x10cm + 20 kg/ha of Potassium were shown to be statistically equivalent to spacing 30x10 cm + 30 kg/ha of Potassium. Due to spacing and potassium, foxtail millet's stover yield greatly increased. It might be because there is less competition for nutrients,moistureand light. A sufficient amount of sunlight absorption encourages effective photosynthesis processes, which leads to a bigger accumulation of photosynthates over a wider area. The lower values of the yield attributes were caused by the tight spacing and dense plant population. Many physiological activities, including protein synthesis and enzyme activation, include potassium. The crop responded to the investigation up to 35 kg K_2O/ha. Aggregating potassium is known to improve soil physical attributes like plant height, healthy growth, etc., which in turn improves agricultural yields. Mownika et al. (2021), Sujith Reddy and Shikha Singh (2021) all reported similar findings.

CONCLUSION

The application of spacing 30 x 10cm + 30 kg/ha Potassium yielded maximum length of ear (18.90 cm), grain production (2.11 t/ha), higher net return (84,587.00 INR/ha), gross return (57,552.00 INR/ha), and benefit:cost ratio, according to the findings (2.13). and can therefore be suggested to farmers.

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Table 1. Effect of crop spacing and potassium levels on yield attributes and yield of foxtail millet.

		Yield Attributes			
S. No.	**Treatment Combination**	**Length of ear (cm)**	**No. of grains earhead^{-1}**	**Grain Yield (t/ha)**	**Straw Yield (t/ha)**
1.	25×10cm+ 10 kg/ha K	15.80	1150	1.51	3.72
2.	25×10cm+ 20 kg/ha K	16.63	1196	1.64	3.75
3.	25×10cm+ 30 kg/ha K	17.47	1250	1.69	3.82
4.	30×10 cm +10kg/ha K	16.97	1272	1.61	3.74
5.	30×10cm+ 20 kg/ha K	17.90	1297	1.79	3.75
6.	30×10cm+ 30 kg/ha K	18.20	1452	2.11	3.95
7.	35×10cm+ 10 kg/ha K	17.60	1397	1.90	3.77
8.	35×10cm+ 20 kg/ha K	18.53	1365	1.82	3.85
9.	35×10cm+ 30 kg/ha K	18.90	1415	2.04	3.90
	F test	S	S	S	S
	SEm±	0.08	0.31	18.61	0.03
	CD (P=0.05)	0.25	0.91	55.28	0.08

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

S. No.	Treatment combinations	Cost of Cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	Benefit:Cost ratio
1.	25×10cm+ 10 kg/ha K	26,701.00	60,400.00	33,699.00	1.26
2.	25×10cm+ 20 kg/ha K	26,868.00	65,413.00	38,545.00	1.43
3.	25×10cm+ 30 kg/ha K	27,035.00	67,747.00	40,712.00	1.51
4.	30×10cm+ 10 kg/ha K	26,701.00	64,533.00	37,832.00	1.42
5.	30×10cm+ 20 kg/ha K	26,868.00	71,507.00	44,639.00	1.66
6.	30×10cm+ 30 kg/ha K	27,035.00	84,587.00	57,552.00	2.13
7.	35×10cm+ 10 kg/ha K	26,701.00	75,840.00	49,139.00	1.84
8.	35×10cm+ 20 kg/ha K	26,868.00	72,760.00	45,892.00	1.71
9.	35×10cm+ 30 kg/ha K	27,035.00	81,587.00	54,552.00	2.02