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Research Article

Effect of nutrients (K and S) on growth, yield and economics of summer pearl millet [*Pennisetum glaucum* (L.)]

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ABSTRACT : The result of the study indicated that the growth and yield attributes increased by application of 120 kg K_2O/ha followed by 90 kg K_2O/ha. The maximum grain (3629 kg/ha) and fodder (6917 kg/ha) yields were recorded by application of 120 kg K_2O/ha followed by 90 kg K_2O/ha. The maximum grain (3619 kg/ha) and fodder (6875 kg/ha) yields were recorded by application of 40 kg S/ha followed by 30 kg S/ha. The maximum net realization of (Rs.22888/ha) along with BCR value of 2.36 was recorded by application of 120 kg K_2O/ha followed by 90 kg K_2O/ha with net realization of (Rs.21265/ha) and BCR (2.30). The highest value of net realization (Rs.24299/ha) with BCR (2.58) by 40 kg S/ha followed by 30 kg S/ha with net realization of (Rs. 22299/ha) and BCR (2.46).

KEY WORDS : Potassium, Net return, Pearl millet, Sulphur, Yield, Nutrients

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INTRODUCTION

Pearl millet is known as *bajara*. It is a major coarse grain crops. It is generally grown in summer season. India is the largest producer of pearl millet with an annual production of 3.984 lakh tonnes from an area of 1.752 lakh ha and productivity of 2274 kg/ha during summer and annual production of 62.054 lakh tonnes from an area of 87.412 lakh ha with productivity of 710 kg/ha during *Kharif* (AICPMIP-2011). Gujarat has an area of 1.742 lakh hectares producing 3.964 lakh tonnes with productivity of 2276 kg/ha during summer and area of 4.988 lakh hectares producing 4.324 lakh tonnes with productivity of 867 kg/ha during *Kharif* (AICPMIP-2011).

Potassium is major plant nutrients for the growth and development of growth in plants. Its major functions is to involve activity in photosynthesis, metabolism of carbohydrate and physiological processes such as root development, water uptake and utilization efficiency, synthesis of protein and amino acids, enzyme activation and also impart resistant against, drought, pest and disease. The potassium also increases crop quality and yield attributes in a number of crops. Sulphur plays vital functions in the plant. It is best known for its role in the synthesis of proteins, oils and vitamins. It is a constituent of three amino acids. Sulphur is known with the production of crops for superior nutritional and market quality produce.Keeping in view the above report, the present investigation was carried out to study the response

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of pearl millet to different doses of potassium and sulphur on growth and economics of summer pearl millet.

EXPERIMENTAL METHODS

Pearl millet hybrid "GHB-538" was planted at 60 cm x 10 cm spacing on 18th February, 2011 at Instructional Farm, College of Agriculture, Junagadh. The experiment consisting of sixteen treatments, in which four levels of potassium *viz.*, 0, 60, 90 and 120 kg/ha and four levels of sulphur *viz.*, 0, 20, 30 and 40 kg/ha were tried in Factorial Randomized Block Design with three replications. The experimental soil was medium black, clayey with moderate organic carbon (0.83 %), medium in available nitrogen (267 kg N/ha), medium in available phosphorus (38 kg P_2O_5/ha), rich in available potassium (232 kg K_2O/ha) and slightly alkaline in reaction (pH 8.0). The lines were drawn by marker in each plot keeping spacing of 60 cm in between two rows and furrows were opened by Kudali. Full dose of phosphorus (60 kg P_2O_5/ha) through single super phosphate and 50 per cent nitrogen (60 kg N/ha) from urea were applied in furrows before sowing. Remaining 50 per cent nitrogen (60 kg N/ha) was applied in the form of urea in two equal splits at an interval of 20-25 days during the experimentation. Entire quantity of potassium through muriate of potash and sulphur from gypsum were applied as per treatment at the time of sowing. Irrigation was based on the necessity and as per recommendations. Plant height was recorded at harvest, while tillers per plant, effective tillers per plant, earhead length, earhead thickness were recorded at harvest.

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Growth and yield attributes:

Data presented in Table 1 indicated that the maximum plant height (156.9 cm) recorded at harvesting time those plot which are treated with 120 kg K_2O/ha, but it remained at par with treatment 90 kg K_2O/ha. Thus, there is an increase in plant height with potassium application throughout the crop growth span. The probable reason might be positive effect of potassium on growth character due to augment of cell division and cell expansion. Number of total tillers per plant at harvest were also increased with an increase in potassium levels, wherein an application of potassium 120 kg K_2O/ha produced significantly more number of total tiller per plant (4.09) at harvest over control. It is due to potash, that enhances the development of strong cell walls and therefore stiffer straw which might be resulted into profuse tillering. These results are agreement with those reported by Kacha *et al*. (2011). Most of the yield attributes *viz*., number of effective tillers per plant, ear head length and girth and test weight were also improved due to potassium application wherein upper level of potassium (120 kg K_2O/ha) recorded significantly higher

Table 1: Effect of potassium and sulphur on growth and yield attributes and yields of pearl millet

Treatments	Plant height at harvest (cm)	Total tillers per plant	Effective tillers per plant	Ear head length (cm)	Ear head girth (cm)	Test weight (g)	Grain yield (kg ha^{-1})	Fodder yield (kg ha^{-1})	Grain : fodder ratio
Potassium level (K)									
Ko - Control	114.4	3.62	2.30	20.66	2.84	8.71	2669	5881	0.45
K_1- 60 kg/ha	130.4	3.87	2.52	22.88	3.06	9.23	3129	6528	0.48
K_2- 90 kg/ha	151.1	3.93	2.58	23.45	3.12	9.28	3428	6706	0.52
K_3 -120 kg/ha	156.9	4.09	2.74	25.03	3.28	9.45	3629	6917	0.54
S.E.±	4.09	0.08	0.07	0.48	0.07	0.14	103	213	0.02
C.D. at 5 %	11.80	0.23	0.20	1.38	0.20	0.41	298	616	0.05
Sulphur level (S)									
S_0 - Control	115.7	3.61	2.30	20.63	2.84	8.71	2696	5941	0.46
S_1 - 20 kg/ha	136.5	3.88	2.53	23.01	3.07	9.24	3122	6520	0.48
S_2 - 30 kg/ha	145. 7	3.93	2.58	23.44	3.12	9.28	3417	6696	0.52
S_3 - 40 kg/ha	154. 9	4.08	2.73	24.94	3.27	9.44	3619	6875	0.54
S.E.±	4.09	0.08	0.07	0.48	0.07	0.14	103	213	0.02
C.D. at 5 %	11.80	0.23	0.20	1.38	0.20	0.41	298	616	0.05
C.V. %	10.24	7.00	9.51	7.19	7.84	5.37	11.13	11.35	11.82
Interaction (K X S)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS= Non-significant

values of yield attributes over control. The probable reason for increase in test weight due to higher level of potassium might be attributed to the better filling of grains resulting into bold sized seeds and consequently higher test weight. Thus, all the yield attributes were remarkably improved and gave significant response of potassium application. The beneficial effect of potassium in growth and yield attributes were also reported by Heidari and Jamshid (2010).

An appraisal of data on growth parameters in Table 1 revealed that application of sulphur significantly increased plant height at harvest. Higher plant height (154.89 cm) at harvest was recorded with an application of 40 kg S/ha as compared to no sulphur application. The increase in plant height with an increase in sulphur level might be due to the beneficial effect of sulphur on the various metabolic activities and also because of its important role in cell division, photosynthetic process and formation of chlorophyll in the leaf. Therefore, an increase in plant height due to application of sulphur was also observed by Degra *et al*. (2008). Number of total tillers per plant (4.08) at harvest was significantly influenced due to sulphur fertilization (Table 1). Higher number of tillers per plant was observed under application of 40 kg S/ha as compaired to no sulphur application. These results are in conformity with the results observed by Dadhich and Gupta (2005).

Fertilizing the crop with sulphur significantly increased the yield attributes of pearl millet crop (Table 1) over no sulphur application. Application of 40 kg S/ha remarkably increased number of effective tillers per plant (2.73), earhead length (24.94 cm), earhead girth (3.27 cm) and test weight (9.44 g) as compared to control. Thus, an increase in different yield attributing characters might be due to sulphur application because sulphur is a part of amino acid (Cystine) which helps in chlorophyll formation, photosynthetic process, activation of enzymes and seed formation. Rise in different yield attributing characters like effective tillers per plant, earhead length, earhead girth and test weight were also recorded by Degra *et al*. (2008).

Grain and fodder yield

The grain and fodder yields (Table 1) of pearl millet also increased with the increase in potassium application wherein significantly higher grain yield (3629 kg/ha) was recorded with 120 kg K_2O/ha as compared to control. The higher grain yield could be due to the cumulative effect of improvement in yield attributes *viz*., number of effective tillers per plant, ear head length and thickness and test weight. Similarly, fodder yield (6917 kg/ha) was also significantly increased due to 120 kg K_2O/ha as compared to control. The improvement in fodder yield was mainly on account of increase in the growth parameters due to potassium applicatiion. These results are also in agreement with findings of Kacha *et al*. (2011)

Application of sulphur brought significant variation in grain and fodder yields of pearl millet (Table 1). The significant response in grain (3619 kg/ha) and fodder (6875 kg/ha) yields of pearl millet were obtained under application of 40 kg S/ha as compared to control. The higher yields with sulphur application could be ascribed to accelerated nutrients uptake which helped the plants to put optimum growth. As these growth and yield attributes as well as nutrients uptake showed significant increase in grain yield with sulphur fertilization. Likewise, fodder yield was also increased significantly due to significant response of plant growth parameters *viz.*, plant, height and number of tillers per plant. Similar results were reported by Yadav and Nand (2004).

Economics:

Data presented in Table 2 revealed that maximum net realization of Rs. 22888/ha) along with BCR value of 2.36 was recorded by application of 120 kg K_2O/ha followed by 90 kg K_2O/ha with net realization of (Rs. 21265/ha) and BCR (2.30).

Table 2: Economics of different treatments

Treatments	Grain yield (kg/ha)	Fodder yield (kg/ha)	Gross return (Rs./ha)	Cost of cultivation (Rs./ha)	Net return (Rs./ha)	Benefit cost ratio
Potassium level (K)						
Ko - Control	2669	5881	29628	14888	14740	1.99
K_1- 60 kg/ha	3129	6528	34552	15876	18676	2.18
K_2- 90 kg/ha	3428	6706	37635	16370	21265	2.30
K_3 -120 kg/ha	3629	6917	39752	16864	22888	2.36
Sulphur level (S)						
S_0 - Control	2696	5941	29932	14888	15044	2.01
S_1 - 20 kg/ha	3122	6520	34483	15110	19373	2.28
S_2 - 30 kg/ha	3417	6696	37520	15221	22299	2.46
S_3 - 40 kg/ha	3619	6875	39631	15332	24299	2.58

Selling price: Grain : 7 Rs./kg, Straw : 0.50 Rs./kg

The highest value of net realization (Rs. 24299/ha) with BCR (2.58) followed by 30 kg S/ha with net realization of (Rs. 22299/ ha) and BCR (2.46). This might be due to higher grain and fodder yields of pearl millet.

The data from present investigation as reported that the interaction effect of potassium and sulphur level was found non-significant for all these above parameters.

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