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EFFECT OF LEVELS OF POTASSIUM AND BIOFERTILIZERS ON GROWTH, YIELD OF PEARLMILLET (*PENNISETUM GLAUCUM* L.)

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***Key words**: Pearl millet, Potassium, Biofertilizers, Growth and yield.*

Abstract– A field experiment was conducted during *kharif* 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The treatments which are T_1: 10 kg/ha potassium + VAM, T_2: 20 kg/ha potassium + VAM, T_3: 20 kg/ha potassium + VAM, T_4: 10 kg/ha potassium + PSB, T_5: 20 kg/ha potassium + PSB, T_6: 30 kg/ha potassium + PSB, T_7: 10 kg/ha potassium + Azotobacter, T_8: 20 kg/ha potassium + Azotobacter, T_9: 30 kg/ha potassium + Azotobacter used. The experiment was laid out in Randomized Block Design with nine treatments each replicated thrice. The results showed that viz: plant height (186.12 cm) and maximum dry weight (47.12 g) were significantly recorded with the application of 30 kg/ha potassium + Azotobacter. Maximum effective tillers (3.33), ear head length (28.93 cm), number of grains/ear head (1609.46), test weight (8.94 g) and higher grain yield (3.91 t/ha), stover yield (7.23 t/ha) were significantly recorded with the application of 30 kg/ha potassium + azotobacter compared to all other treatments. However, the maximum gross returns (84115.17 INR/ha), net returns (50004.17 INR/ha) and B:C ratio (1.46) was significantly recorded significantly with the application of 30 kg/ha potassium + azotobacter as compared to all other treatments.

INTRODUCTION

Pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] is one of the important cereal crops of hot and dry areas of arid and semi-arid climatic conditions. It has been estimated that pearlmillet embodies a tremendous productivity potential particularly in areas encountering extreme environmental stress conditions on account of drought. It grows on poor sandy soils as well its drought escaping character has made it a popular crop of drought prone areas. Pearlmillet provides staple food for the poor's in a short period in relatively dry tracts of the country. It is nutritionally better than many cereals as it is a good source of protein having higher digestibility (12.1%), fats (5.0%), carbohydrates (69.4%) and minerals (2.3%). Grains constitute an important cattle or poultry feed. Green fodder is used either as such or is preserved as hay or silage which has proved extremely useful in dry regions (Anonymous, 2011).

Potassium (K) is substantially an important nutrient for plant growth, and has the capability to maximize plant growth and it influences soil-plant interactions as well. As, for acting as an essential nutrient for crop production and its development; it acts as a co-factor for more than 40 enzymes that are involved in metabolic pathways directly. Its application effects on turgor potential, opening and closing of stomata, relative water contents, photosynthetic rate, leaf water potential, grain weight, transpiration rate, grain yield, biological yield of crops and disturbed consumption mechanism of fixed Biofertilizers play an important role in increasing the availability of native and applied nutrients and productivity in sustainable manner. *Azotobacter* is a free-living nitrogen fixing bacteria. It has been reported to fix about 20 kg N ha^{-1} per year in a field of non-legume crop and also secretes some growth promoting substances (Subba Rao, 1982). Phosphate solubilizing microorganism, particularly the soil bacteria belonging to the genera *Pseudomonas* and

Bacillus and fungi belonging to the genera *Penicillium* and *Aspergillus* possess the capability to transform insoluble phosphates into soluble forms (Alexander, 1977)

MATERIALS AND METHODS

A field experiment was conducted during Kharif season 2020 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P) which is located at 25 degree 39′ 42′′N latitude, 81 degree 67′56′′E longitude and 98 m altitude above the mean sea level, during Kharif season 2020 on sandy loamy in texture nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 Kg/ha), available P (15.2 Kg/ha), and available K (232.5 Kg/ha). The treatment consisted 3 levels of potassium and bio-fertilizers T_1: 10 kg/ha potassium + VAM, T_2: 20 kg/ha potassium + VAM, T_3: 20 kg/ha potassium + VAM, T_4: 10 kg/ha potassium + PSB, T_5: 20 kg/ha potassium + PSB, T_6: 30 kg/ha potassium + PSB, T_7: 10 kg/ha potassium + Azotobacter, T_8: 20 kg/ha potassium + Azotobacter, T_9: 30 kg/ha potassium + Azotobacter used. The Experiment was laid out in Randomized Block Design, with nine treatments which are replicated thrice. The recommended dose of fertilizer is 20:50:40 Kg/ha NPK and applied at the time of sowing in the Urea, DAP and MOP. Collected soil samples were analysed for organic carbon by rapid titration method (Sparks, 1996), Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956), available phosphorus by Olsen's method as outlined by Jackson (1967), available potassium was determined by extracting with neutral normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined by Jackson (1973) and available S was estimated by turbid metric method as described by sparks (1996). Experimental data collected was subjected to statistical analysis by adopting fisher's method of analysis of variance (ANOVA) as outlined by Gomez and Gomez (2010). Critical Difference(CD) values were calculated the 'F' test was found significant at 5% level.

RESULTS

Plant height

Observation regarding the plant height of pearl millet are given in Table 1 and there was an increasing trend of the values at successive stages. The analysis of plant height was significantly higher in all different growth intervals. At harvest, the highest significant plant height (186.12 cm) was recorded with application of 30 kg/ha K + Azotobacter which was significantly superior over rest of all the treatments.

Plant dry weight

Observation regarding the plant dry weight of pearl millet is given in Table 2 and there was an increasing trend of the values at successive stages. The analysis of plant dry weight was significantly higher in all different growth intervals. At harvest, the highest significant plant dry weight (47.12) was recorded with application of 30 kg/ha K + Azotobacter which was statistically on par with application of 30 kg/ ha K + *VAM*, 20 kg/ ha K + *PSB* and 30 kg/ ha K + *PSB.*

Yield attributes and yield

Application of 30 kg/ha K + *Azotobacter*. Whereas, dry weight (47.12 g), effective tillers/plant (3.33), ear head length (28.93 cm), Number of grains per ear head (1444.82) and test weight (8.94 g) was recorded significantly higher with the application of

Table 1. Effect of Potassium and Biofertilizers levels on plant height of Pearl millet

Treatment combinations	20 DAS	40 DAS	60 DAS	80 DAS
10 kg/ ha K + VAM	8.23	53.67	165.40	173.53
20 kg /ha K + VAM	14.78	55.88	167.87	177.64
30 kg/ ha K + VAM	10.45	57.97	173.34	181.60
10 kg /ha K + PSB	9.85	57.30	166.95	175.57
20 kg/ ha K + PSB	10.34	57.73	170.45	179.65
30 kg/ ha K + PSB	10.22	58.56	175.62	182.99
10 kg /ha K + Azotobacter	9.91	55.76	168.68	177.33
20 kg/ ha K + Azotobacter	11.06	57.31	171.76	180.52
30 kg /ha K + Azotobacter	9.10	60.23	176.17	186.12
SEm(±)	1.27	0.25	0.74	0.87
CD (P=0.05)	-	0.76	2.22	2.63

application of 30 kg/ha K + *Azotobacter*. Whereas, grain yield (39.12 q/ha) and stover yield (72.31 q/ha) was recorded significantly higher with the application of 30 kg/ha K + *Azotobacter*.

Economics

Experimental results revealed that application of 30 kg/ha K + Azotobacter recorded higher gross returns (84115.17INR) net returns (50004.17INR) and benefit: cost ratio (1.47 INR) and minimum gross returns (58616.17INR), minimum net returns (24745.17INR) and minimum benefit: cost ratio (0.73) were recorded with the treatment of 10 kg N/ ha plus Rhizobium.

DISCUSSION

Increasing level of potassium resulted in the higher plant height, similar results were observed by Rajput (2006). Seed inoculation with *Azotobacter*

Table 2. Effect of Potassium and Biofertilizers on Plant dry weight of Pearl millet

Treatment combinations	20 DAS	40 DAS	60 DAS	80 DAS
10 kg/ ha K + VAM	2.42	8.13	30.69	41.89
20 kg /ha K + VAM	0.96	9.78	30.90	44.72
30 kg/ ha K + VAM	1.04	12.39	33.34	45.35
10 kg /ha K+ PSB	1.28	9.46	29.82	42.19
20 kg/ ha K+ PSB	1.35	11.04	31.63	45.46
30 kg/ ha K+ PSB	1.20	12.50	33.83	45.74
10 kg /ha K + Azotobacter	0.97	8.66	30.40	41.68
20 kg/ ha K+ Azotobacter	1.53	11.57	32.81	43.54
30 kg /ha K + Azotobacter	2.00	13.18	35.73	47.12
Sem(±)	0.52	0.57	0.66	0.77
CD (P=0.05)	-	1.73	1.99	2.31

Table 3. Effect of Potassium and Biofertilizers on Yield and yield attributes of Pearl millet

Treatment Combination	Effective Tillers/ plant	Earhead length (cm)	No. of grains/ Head	Test Weight (g)	Grain yield (q/ha)	Stover Yield (q/ha)
10 kg/ ha K + VAM	2.11	22.66	1080.00	8.15	27.26	57.08
20 kg /haK + VAM	2.11	24.89	1091.45	8.37	32.23	61.61
30 kg/ haK + VAM	2.89	27.31	1166.09	8.83	32.94	70.55
10 kg /ha K+ PSB	2.78	23.68	1117.21	8.38	32.69	60.33
20 kg/ ha K+ PSB	2.67	26.31	1609.46	8.32	34.79	69.06
30 kg/ ha K+ PSB	3.22	27.16	1343.38	8.71	37.96	71.53
10 kg /ha K + Azotobacter	2.22	23.88	1076.73	8.54	30.25	65.15
20 kg/ ha K+ Azotobacter	2.89	27.43	1237.81	8.31	35.36	70.55
SEm (±)	0.13	0.26	80.70	0.10	1.68	2.60
CD (P=0.05)	0.39	0.79	-	0.30	5.01	7.72

Table 4. Effect of Potassium and Biofertilizers levels on Economics of Pearl millet

Treatment combinations	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
10 kg/ha K + VAM	33871	58616.17	24745.17	1.73
20 kg/haK + VAM	33991	69301.67	35310.67	2.04
30 kg/haK + VAM	34111	70828.17	36717.17	2.08
10 kg/ha K+ PSB	33871	70276.33	36405.33	2.07
20 kg/ha K+ PSB	33991	74798.50	40807.50	2.20
30 kg/ha K+ PSB	34111	81606.83	47495.83	2.39
10 kg/ha K + Azotobacter	33871	65044.67	31173.67	1.92
20 kg/ha K+ Azotobacter	33991	76016.83	42025.83	2.24
30 kg/ha K + Azotobacter	34111	84115.17	50004.17	2.47

resulted in Nitrogen fixation in plants and significantly increased the plant height, dry matter accumulation Singh (2000). Increasing levels of potassium resulted in increase of plant dry weight, application of potassium up to 80 kh ha significantly increased growth attributes like plant height, number of leaves per plant and plant dry weight similar results were obtained by Sofi *et al*. (2005**)** Singh and Saxena (1997) reported that inoculation of nitrogen fixing and phosphate Solubilizing bacteria and micro-organisms alone or in combination increased number of tillers of pearl millet. This could mainly be ascribed to the increased availability of the nitrogen to the plants through biological nitrogen fixation in rhizosphere by Azotobacter that caused better root development reported by Husain *et al*., (2013). Application of potassium improved the number of grains per head which might be due to the favourable effects of potassium on nutrient uptake, photosynthetic activity, improving its mobilization reported by Yadav *et al*. (2011). Experimental finding showed that application of biofertilizers resulted in taller plants and more tillers/plant and 1000 grains weight which in turn in higher grain yield and stover yield (Kumawat and Jat, 2007). The synergistic effect of integration of inorganic sources along with biofertilizers resulted in better nutrient uptake, which accelerated the photosynthetic rate, adequate biomass production that reflected on grain yield. The results are in accordance with Reddy *et al*. (2016) and Sakarvadia *et al*. (2012). An increase in uptake of plant nutrients empowered the plant to manufacture more quantity of photosynthates resulting in more stover yield. Results were reported by Thumar *et al*. (2016).

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