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Effect of Fertility on Growth, Yield and Yield Attributes of Pearl Millet (*Penisetum glaucum L.*) under Rainfed Condition

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ABSTRACT: *A field experiment was conducted at the student instructional farm of Department of Soil conservation and water management, C.S. Azad University of Agriculture & Technology, Kanpur (U.P.)-India during 2008. To evaluate the effect of fertility management on growth, yield and yield attributes of pearl millet under rain fed condition. A significant enhancement with the application of 40 kg N+ 20 kg P2O5+20 Kg K2O+ 20 Kg Com. Zno + 20 Kg Gypsum (S) was recorded in plant height, number of tillers, number of leaves, days to 50 % flowering days to maturity, number of ear bearing, length of ear, girth of ear, weight of ear, grain weight per ear, test weight, biological yield. Fertility management significantly influenced grain yield. Treatment T_6 produced maximum (20.08 q ha^{-1}) grain yield followed byT_4, T_5 and T_3. However, the lowest grain production was reported in treatment T_0 (9.47) followed by T_1.*

INTRODUCTION

About 40% of the land in the world is under arid and semi-arid climatic conditions (Gamo, 1999). Efficient use of rainwater and optimization of crop water productivity (WP) are important in such conditions. An FAO analysis (FAO, 2003) of 93 developing countries expects increase of agricultural production over the period 1998–2030 by 49% in rain fed and by 81% in irrigated regions. Pearl millet (*Pennisetum glaucum* (L.) R. Br.), the world's hardiest warm season cereal crop (Reddy *et al.,* 2013). Globally it ranks sixth after rice, wheat, maize, barley and sorghum in terms of area (Khairwal *et al.,* 2007) and share 42% of total world production (*Ramesh et al.,* 2006). Pearl millet is an indispensable arid and semi arid crop of India (Ramesh *et al.,* 2006) cultivated as dual purpose (food and feed) crop in over 8.3 m ha ranking fourth among total cereals (Yadav *et al.,* 2011). The recent spurt in prices of wheat, rice and maize and growing demand for non-food uses (cattle and poultry feed, alcohol and starch industries) pearl millet become cheaper alternative sources (Reddy *et al.,* 2013). Further, the nutritional value of these crops offers much scope to development of value added products in new health conscious consumer segments (Yadav *et al.,* 2011) as it contains more fibre and is good for diabetic and heart patients. Pearl millet is the richest sources of nutrition, especially iron, calcium and zinc among cereals and hence can provide all the nutrients at the least cost compared to wheat and rice (Parthasarathy *et al.,* 2006). The productivity of the crop is very low (25-26 q ha^{-1}) due to imbalances application of fertilizers, disease insect-pest, weed infestation and uncertain and erratic distribution of rainfall. Pearl millet is efficient in its utilization of moisture and has a higher level to that than jowar and maize. Water stress decreased water potential, transpiration efficiency, rate of stomatal conductance, photosynthesis efficiency of flag leaves. The application of balance nutrients and their better utilization under moisture condition for enhancing growth, yield and yield attributing parameters of crops is important factor under rainfed condition. Fertilization of crop enhance water use efficiency, controlling soil erosion by promoting rapid and vigorous growth of crop to check runoff and increases the water holding capacity of soil. Application of nitrogen helps in better vegetative growth of plants, phosphorous for better proliferation which extracts moisture from deeps layer of the soil particularly

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during moisture stress condition. Potassium increase the potential and improving the quality of grains. Sulphur is a constituent of amino acids especially for methionine, cystine, cysteine, biotin and thiamine. Zinc influences the formation of some hormones, auxin metabolism like tryptophan, synthatase, triptomine and reproduction of certain plants. Keeping in this view an experiment was conducted to assess the effect of fertility on growth, yield and yield attributes of Pearl millet (*Penisetum glaucum L.*) under rainfed condition

METHODS AND MATERIAL

A field experiment was conducted at the student instructional farm of Department of Soil conservation and water management, C.S. Azad University of Agriculture & Technology, Kanpur (U.P.)-India during 2008. There are six treatments along with control and one genotype (ICMV-221) of Pearl millet were taken in consideration are as follows.

T_0: Control

T_1: 40 Kg N

T_2: 40 kg N+ 20 kg P2O5

T3: 40 kg N+ 20 kg P2O5+20 Kg K2O

T_4: 40 kg N+ 20 kg P2O5+20 Kg K2O+ 20 Kg com. Zno

T_5: 40 kg N+ 20 kg P2O5+20 Kg K2O+ 20 Kg Gypsum

T_6: 40 kg N+ 20 kg P2O5+20 Kg K2O+ 20 Kg Com. Zno + 20 Kg Gypsum (S)

The seeds of Pearl millet were collected from seed centre of C.S. Azad university of Agriculture & technology, Kanpur. 21 experimental plots were prepared. The experiment was conducted in Randomized Block Design with seven treatments including control and three replications. Recommended agronomic practices were made as per recommendation. Irrigation was made on the requirement of the crops. Plant height was measured in centimeter with the help of meter scale from the soil level to the aerial top leaf of the stem. Number of tillers, number of leaves were counted , Days to 50 % flowering, number of ear, length of ear, girth of ear , weight of ear, per grain weight per ear, test weight, biomass yield , grain yield, stover yield was recorded at harvesting stage. Harvest index percent can be calculated by formula suggested by Donald (1962) as follow:

$$Harvest\ index\ (\%) \frac{Economic\ yield}{Biological\ yield} \times 100$$

The average values of all parameters were statistically analyzed to find out the level of significance using MSTAT-C Package programme developed by Russel (1986). The means differences were compared by Dancan's New Multiple Range Test (DMRT) at 5% level of significance.

RESULT AND DISCUSSION

A significant enhancement was noted in all the growth factors by the adequate application of fertilizers under rainfed condition (Table 1). Significant enhancement was noted in plant height at various stages of growth by fertility management. The tallest plants were reported in treatments (T_6) followed by T_4, T_5. However, minimum plant height was noted in T_0 at all the stages of growth. The fertility had a significant effect on tillers production per plant at 30, 60 and 90 DAS. Maximum number of tillers per plant was recorded in the treatment T_6, while lowest tillers production was recorded in treatment combination T_0. A significant result was reported in number of leaves per plants up to harvest by through maintaining the fertility. Treatment T_6 showed better performance compared to other treatment combinations. Fertility management affect the plant population due to increasing levels of fertilizer. This might be due to better uptake of plant nutrients in condition of proper moisture throughout the crop period. Similar finding were also reported by Kaushik *et al.,* (1982). Nitrogen is the main component of the protoplasm involves in various metabolic processes *viz.* photosynthesis (Corsi, 1995), stimulation of cell division and elongation (Ali, 2010). These leads to increase in dry matter accumulation, greater plant height and tillers per plant (Ayub *et al.,* 2009). Phosphorous enhances the root development and strength of the plant. This result was in conformity with the findings of Shahin *et al*. (2013). There was progressive increase in plant height, number of tillers and dry matter accumulation with zinc fertilizer. Zinc involves in the moisture stress and biosynthesis of indole acetic acid (IAA) which helps in better development of growth attributes (Ganapathy and Savalgi, 2006). Potassium increases the potential capacity of the plant against the diseases and insect pest. Sulphur increase nutritive value of grain and grain population.

Yield and yield attributing factor increased by the application of fertilizers in a proper dose at a proper time (Table 2). The management of fertility had a significant effect on days to 50 percent flowering and days to maturity. Treatment T_0 (49.66) showed early flowering, while treatment T_6 (60.33) produced late flowering and late maturity. Significant results were

Table 1
Effect of Fertility on Growth Attributes of Bajra (*Penisetum glaucum L*) under Rainfed Condition

Treatments	*Plant height*			*Number of Tillers/Plant*			*Number of leaves/ Plant*		
	30 DAS	*60DAS*	*At harvest*	*30 DAS*	*60DAS*	*At harvest*	*30 DAS*	*60DAS*	*At harvest*
T_0	31.52	129.39	134.64	1.1	1.08	1.22	5.20	6.42	3.00
T_1	34.95	151.81	165.38	1.25	1.12	1.45	6.33	7.82	4.
T_2	42.45	164.22	170.32	1.45	1.88	1.70	6.61	8.43	4.30
T_3	44.50	165.66	17.92	1.72	2.43	2.20	6.92	8.55	4.60
T_4	49.93	187.83	20.42	2.15	3.02	3.00	7.82	9.43	4.90
T_5	48.51	172.49	181.11	1.85	2.66	2.55	7.42	9.08	4.75
T_6	51.44	190.58	25.1	2.43	3.25	3.42	7.95	9.76	5.00
S.E. (Diff.)±	1.32	1.388	2.890	0.0489	0.208	0.0294	0.187	0.237	0.116
CD at 5 %	2.877	3.024	6.297	0.1065	0.453	0.064	0.407	0.516	0.252

Table 2
Effect of Fertility on Yield and Yield Attributes of Bajra (*Penisetum glaucum L*) under Rainfed Condition

Treatments	*Days to 50% flowering*	*Days to maturity*	*Number of ear bearing/plant*	*Length of ear (cm)*	*Girth of ear (cm)*	*Weight of ear (g)*	*Grain weight/ ear (g)*	*Test weight (g)*	*Biomass yield (q ha^{-1})*	*Grain yield (q ha^{-1})*	*Stover yield (q ha^{-1})*
T_0	49.66	87.1	1.15	19.33	6.12	14.50	10.91	6.25	51.14	9.47	41.67
T_1	54.00	91.26	1.35	23.17	7.25	16.83	12.88	7.38	69.61	12.62	56.99
T_2	55.66	94.1	1.66	24.70	7.75	19.96	15.47	8.50	82.94	15.54	67.40
T_3	56.33	95.33	1.87	26.44	8.03	20.03	15.96	8.62	87.31	16.40	70.91
T_4	58.33	97.1	2.25	30.27	9.86	22.61	17.65	10.15	95.52	18.35	77.17
T_5	57.66	96.20	2.12	29.35	8.43	21.87	17.12	9.65	92.19	17.56	74.63
T_6	60.33	98.00	2.45	31.36	1.14	24.12	19.20	10.48	104.77	20.08	84.69
S.E. (Diff.)±	1.000	1.349	0.07	1.984	0.146	0.498	0.312	0.209	1.145	0.768	1.305
CD at 5 %	2.179	2.939	0.153	4.323	0.319	1.085	0.680	0.455	2.494	1.673	2.840

reported for ear bearing tillers per plant. The maximum number of ear bearing tillers was recorded under treatment T_6. The lowest ear bearing in treatment in T_0. Length of ear and girth of ear was significantly influenced by the fertility management. Treatment T_6 had longest ear, girth, while treatment T_0 produced shortest ear and girth. A significant enhancement was noted in weight of ear, grain weight of ear and test weight. Treatment T_6 produced better performance in this regard, while treatment T_0 showed poor results. The fertility had a significant effect on biomass and stover production per hectares. The highest biomass and stover production per hectares was noted under treatment T_6 while, lowest yield in control (T_0). Fertility management significantly influenced grain yield on grain yield. Treatment T_6 produced maximum (20.08 q ha^{-1}) grain yield followed byT_4, T_5 and T_3. However, the lowest grain production was reported in treatment T_0 (9.47) followed by T_1.

The yield and yield attributes significantly increased with fertility management. This may be attributed to adequacy of moisture utilization of fertilizer properly which might be suitable condition for plant growth and development. Application of nitrogen induced vigorous growth of the plant; phosphorous enhances the root development and strength of the plant as well as formation of bold and viable seed in the ear which ultimately increase the ratio of grain and straw. Potassium increases the potential capacity of the plant against the diseases and insect pest. Sulphur increase nutritive value of grain and grain population, Zinc enhance the moisture stress and metabolic activities of plant which enhances the growth and development of plant. The improvement of yield attributes with progressive increase of nitrogen levels was also reported by Ali (2010). Zinc improved the yield attributes by improving the source and sink relationship due to increased translocation of photosynthates towards reproductive system (Sammauria and Yadav (2010). zinc involve in many metallic enzyme system, regulatory functions and auxin production (Muthukumararaja and Sriramachandrasekharan (2012). Nitrogen nutrition of plants appears to be synergistic with zinc, which may leads to increase in many physiological and molecular activities which in turn improve yield attributing characters (Cakmak *et al*., 2010). Similar results were also reported by other workers Bhargava *et al*., (1991) and Limon *et al*., (1998). Experimental findings indicate that application of nitrogen and zinc fertilizers bring significant change

in crop growth (plant height, number of tillers, dry matter accumulation), yield attributes (number of panicle/plant, length of panicle, girth of panicle, number of grain/panicle, grain weight/panicle, test weight) and yield of pearl millet. Yield attributes of pearl millet, *viz*., number of grain/panicle, grain weight and test weight, were significantly influenced with variable levels of nitrogen and zinc fertilization.

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