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Effect of Crop Geometry and Fertilizer Levels on the Grain Yield of Little Millet (*Panicum sumatrense* L.) in Rainfed Vertisols

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ABSTRACT: Little millet crop is emerging as important crop under climate resilient agriculture and for developing functional foods for the expanding diabetic and obese population. But, the productivity of the crop is low due to its cultivation in marginal and sub marginal lands without application of fertilizers and improper crop geometry. By keeping this in view, a field study was conducted at Agricultural Research Station, Podalakur, SPSR Nellore District during *rabi* season 2019-20 to find out the effect of crop geometry and fertilizer levels on growth and yield of little millet. An experiment was laid out in Factorial RBD with four crop geometries (S_1: 20cm × 10 cm; S_2: 25cm × 10 cm; S_3: 30cm × 10 cm S_4: Broadcasting) as one factor and three fertilizer levels (F_1: Control; F_2:20-20-0 kg N, P_2O_5 and K_2O /ha; F_3: 40-20-10 kg N, P_2O_5 and K_2O/ha) as another factor with three replications. The results revealed that among the four crop geometries the highest grain yield (1511 kg /ha) was recorded at crop geometry of 25 cm × 10 cm and the highest stover yield (2514 kg/ha) was recorded in broadcasting. Among the fertilizer levels application of 40-20-10 kg N, P_2O_5 and K_2O /ha registered significantly higher grain (1485 kg/ ha) and stover yield (2679kg/ha). Little millet grain yield was significantly influenced by crop geometry and fertilizer levels interaction. Significantly the highest grain yield (1833 kg ha^{-1}) was recorded at crop geometry of 25 cm × 10 cm with application of 40-20-10 kg N, P_2O_5 and K_2O/ha.

Keywords: Little millet, Crop geometry, Fertilizer levels.

INTRODUCTION

Little millet (*Panicum sumatrense* L.) is most important minor millet, which belongs to Poaceae family. The crop is generally grown in areas where climatic conditions viz., rainfall, temperature and soil fertility are too harsh to grow. It is also resistance to adverse agro-climatic conditions of high drought as well as water logging because of its earliness in maturity. The crop spread is in all over India and is majorly covering the states of Karnataka and Andhra Pradesh. It will yield some grain and useful fodder even under very poor conditions. The crop is a balanced and staple food of tribal and economically poor section of the population. It provides low priced proteins, minerals and vitamins in the form of sustainable food. The stover is a good fodder for cattle. Presently, little millet crop is emerging as an important crop for developing functional foods for the expanding diabetic and obese population in urban people.

But, productivity of the crop is low due to its cultivation in marginal and sub-marginal lands with imbalanced fertilizer application and ignorance in cultivation practices. Nitrogen is major nutrient which playing important role in the physiology and in the process of photosynthesis. Phosphorus (P) is most useful nutrient in the plant growth and its presence in every living plant cell and its takes parts indifferent key plant functions, including energy transfer, photosynthesis, transformation of sugars and starches, nutrient movement within the plant. Potassium is involved in many metabolic activities and translocation of photosynthates and confer drought tolerance and quality improvement. Crop geometry as an key factor for maximum utilization of moisture and nutrients from the soil and above ground growth by harvesting highest possible solar radiation (Uphoff *et al.,* 2011). The optimum plant population exerts near maximum pressure to exploit environmental resources to the fullest extent and there by leading to higher yield of crop. But limited research work was done for optimum crop geometry and fertilizer doses it is in the millet. Hence the present investigation was undertaken to find out the response of little millet to crop geometry and fertilizers.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* season, 2019 -20 under rainfed conditions at Agricultural Research Station, Podalakur (14°22°N latitude, 79°44°E longitude and 43 m altitude), Sri Potti Sriramulu Nellore district, Andhra Pradesh. The climatic condition of the Sri Potti Sriramulu Nellore district is sub-tropical influenced by north-east monsoon. The soils are clay loam in texture, porous and grayish black having pH of 8.45, EC of 0.229 dSm^{-1}, organic carbon 0.32%, available nitrogen, available phosphorus and available potassium are 208, 48 and 225 kg /ha respectively. The field experiment was laid out in Factorial RBD with four crop geometries (S_1: 20cm × 10 cm; S_2: 25cm × 10 cm; S_3: 30cm × 10 cm; S_4: Broad casting) as one factor and three fertilizer levels (F_1: Control; F_2: 20-20-0 kg nitrogen, phosphorus and potash per hectare; F_3: 40-20-10 kg nitrogen, phosphorus and potash per hectare) as another factor with three replications. The little millet variety OLM 203 seeds were sown in nursery beds of 1 m × 2 m size in lines of 7.5 cm apart with seed rate of 8kg ha^{-1}. Twenty one days old seedlings were transplanted in the main field as per the treatments. In broad casting treatment seed was broad casted in the main field on the same date of nursery sowing. Fertilizers were applied as per the treatments. Nitrogen, phosphorus and potash were applied in the form of Urea, Single Super Phosphate and Muriate of Potash, respectively. The full dose of phosphorus and potassium as well as 50% of nitrogen was applied as basal dose and remaining 50 per cent nitrogen was top dressed 20 days after sowing. All agronomic practices are followed as per package of practices of ANGRAU, Guntur. During the crop period 449.7mm of the total rainfall of was received in 26 rainy days. The experimental data was analyzed by using Fischer's method of Analysis of variance (ANOVA) as outlined by Gomez and Gomez (1984) and the results are presented and discussed at 0.05 per cent probability.

RESULTS AND DISCUSSION

Effect of crop geometry on growth, yield parameters and yield. Plant height was significantly differed with different crop geometries. The higher plant height (119.4 cm) was recorded in broadcasting (Table 1), but which was on par with crop planted at 20 cm × 10 cm and 25 cm × 10 cm. This might be due to more competition for sunlight in narrow spaced plants. Similar observations were reported by Hugar *et al*. (2001). Panicle length, number of grains per panicle and test weight was significantly influenced due to different crop geometries. Crop geometry of 30 cm × 10 cm was recorded significantly higher panicle length, number of grains per panicle and test weight, but test weight was on par with crop geometry of 25 cm × 10 cm. This might be due to wider spacing reduces the competition between plants, increases the interception of solar radiation which in turn enhanced the photosynthesis. These results are corroborating with the findings of Kalaraju *et al*. (2011); Vijay *et al.* (2019).

Grain and stover yields were significantly influenced by different crop geometries. Significantly the highest grain yield (1511kg/ha) was recorded with crop geometry of 25 cm × 10 cm. The higher grain yield may be due to adoption of crop geometry with optimum plant population. The highest stover yield (2514 kg /ha) was recorded in broad casting. This might be due to taller plants and higher crop density.

Effect of fertilizer levels on growth, yield parameters and yield. Application of 40-20-10 kg N, P_2O_5 and K_2O /ha recorded significantly taller plants, but which was on par with application of 20-20-0 kg N, P_2O_5 and K_2O/ha. This may be due to provision of sufficient nutrients to plants which leads to anatomical changes for taller plants. Similar results were also reported by Pradhan *et al*. (2011); Raundal and Patilvidya (2017). The panicle length was influenced significantly due to different fertilizer levels. Application of 40-20-10 kg N, P_2O_5 and K_2O per hectare recorded significantly higher panicle length. This might be due to availability of nitrogen, phosphorus and potassium to plants resulted in higher accumulation of photosynthates might be responsible for higher panicle length. The test weight of little millet was differed significantly due to different fertilizer levels. Application of 40-20-10 kg N, P_2O_5 and K_2O per hectare recorded higher test weight, but which was on par with the application of 20-20-0 kg N, P_2O_5 and K_2O /ha and significantly superior over non application of fertilizers. Higher source to sink relationship by application of fertilizers leads to higher values of test weight. Results are in corroboration with those obtained by Ramamoorthy and Lourduraj (2002); Pradhan *et al.* (2011). The grain yield of little millet was influenced significantly due to different fertilizer levels. Application of 40-20-10 kg N, P_2O_5 and K_2O per hectare recorded significantly higher grain yield (1485 kg/ha). This might be due to more number of grains per panicle and test weight. These results are in accordance with Bhomte *et al.* (2013); Raundal and Patilvidya (2017); Shankar *et al.* (2018).

Stover yield of little millet was significantly influenced by different fertilizer levels. Application of 40-20-10 kg N, P_2O_5 and K_2O per hectare significantly recorded the highest stover yield (2679kg /ha). This might be due to higher growth parameters. These results are in congruence with the findings of Deshmukh (2007); Pradhan *et al*. (2011); Raundal and Patilvidya (2017).

Interaction effect of crop geometry and fertilizer levels on growth, yield parameters and yield. Interaction failed to influence significantly on growth and yield parameters but, it has significant influence on grain yield of little millet. Significantly the highest grain yield (1833 kg /ha) was recorded at crop geometry of 25 cm × 10 cm with application of 40-20-10 kg N, P_2O_5 and K_2O per hectare.

Table 1: Growth and yield parameters as well as grain and stover yield (kg/ha) of little millet as influenced by crop geometry and fertilizer levels.

Treatment	Plant height(cm) at harvest	Length of panicle (cm)	Number of grains/ panicle	Test wt. (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Crop geometry						
20 cm × 10 cm	116.2	20.23	375	2.34	1278	2398
25 cm × 10 cm	115.7	21.03	391	2.39	1511	2327
30 cm × 10 cm	104.8	22.01	409	2.40	1242	2325
Broadcasting	119.4	19.91	351	2.22	1081	2514
S.E (m) +/-	1.42	0.16	5.65	0.017	26.95	29.01
CD (0.05)	4.18	0.47	16.7	0.05	79.6	85.6
Fertilizer levels						
Control	102.2	19.67	345	2.24	1019	2050
20-20-0 kg N, P_2O_5 and K_2O ha^{-1}	117.3	21.02	386	2.35	1331	2444
40-20-10 kg N, P_2O_5 and K_2O ha^{-1}	122.5	21.69	415	2.37	1485	2679
S.E (m) +/-	1.23	0.14	4.89	0.015	23.34	25.12
CD (0.05)	3.62	0.40	14.4	0.04	68.91	74.2
Interaction						
S.E (m) +/-	2.45	0.274	N.S.	0.030	46.7	50.25
CD (0.05)	N.S.	N.S.	N.S.	N.S.	137.8	N.S.

Table 2: Interaction effect of crop geometry and fertilizer levels on the grain yield (kg ha^{-1}) of little millet.

	F_1	F_2	F_3	Mean
S_1	993	1372	1468	1278
S_2	1140	1562	1833	1511
S_3	1021	1296	1410	1242
S_4	921	1094	1228	1081
Mean	1019	1331	1485	

CONCLUSION

The present investigation revealed that, crop geometry of 25 cm × 10 cm and application of 40-20-10 kg N, P_2O_5 and K_2O/ ha was found to be optimum for realizing higher grain yield in rainfed vertisols of Southern agro climatic zone of Andhra Pradesh.

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Conflict of Interest. None.

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