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Effect of different planting methods and nutrient levels on growth, yield and economy of pearl millet (*Pennisetum glaucum* L.) cv. MRB 2210

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Abstract
A field experiment was conducted during *kharif* season 2012 at Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (U.P.). The soil was sandy loam, pH of soil was 7.4 with 0.39% organic C, having available N, P, K, 185.5, 36 and 98 kg ha^{-1} respectively. The experiment involving hybrid 'MRB 2210' was laid out in factorial randomized block design with nine treatments replicated thrice, comprising 3 planting patterns *viz*., uniform row system (URS) at 50 cm; paired row system (PRS) at 30/70 cm; and ridge and furrow (R&F) system at 50 cm) and 3 nutrients levels [F_1= Without fertilizer; F_2 (N = 120kg ha^{-1}, P = 80kg ha^{-1}, K = 60kg ha^{-1}) and F_3 (N = 100kg ha^{-1}, P = 60kg ha^{-1}, K = 40kg ha^{-1})]. Paired Row System of planting with nutrient levels of F_2 (N = 120 kg, P = 80 kg and K = 60 kg) were significantly increased the grain yield (3 t ha^{-1}), stover yield (171.18 t ha^{-1}), test weight (8.83 gm), net return (21590.48 ha^{-1}) and benefit cost ratio (1.98) as compared with Ridge & Furrow (R&F) and Uniform Row System (URS) of planting.

Keywords: Planting methods, Nutrient levels, Growth, Yield, Pearl millet

Introduction
Pearl millet (*Pennisetum glaucum* L.) popularly known as *Bajra*, cattle millet, bulrush millet belongs to the grass family or gramineae. In the world, it's rank sixth followed by rice, wheat, corn, barley and sorghum (Anonymous, 2013). However, in India, it is fourth most important cereal crop after rice, wheat and sorghum. India is the largest producer of Pearl millet in the world. In India major producing state are Rajasthan (46%), Maharashtra (19%), Gujarat (11%), Uttar Pradesh (8%) and Haryana (6%), (Sonawane *et al*., 2010).
Pearl millet is an important coarse grain cereal generally grown as rainfed crop on marginal lands under low input management conditions. It is adapted to drought and poor soil fertility, but responds well to good management and higher fertility levels. It is generally cultivated in area with rainfall ranging from 150 to 600 mm. It is a dual purpose crop, its grain is used for human consumption and its fodder as cattle feed. Pearl millet is a small seeded caryopsis. Ensuring balanced quantity of nutrients in a given soil for good plant growth is the greatest challenge of the day as yield potentials vary among soils. For maintaining sustained crop production, balanced manuring is essential to build up soil health. Wide use of suitable planting method (Kaushik and Gautam, 1992) and nutrient management comprising INM approach (Bellaki *et al*., 1999) are essential to make best use of limited available water.

Materials and Methods
The experiment was carried out during *kharif* season 2012 at Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (U.P.), which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna by the side of Allahabad Rewa Road about 5 km away from Allahabad city. The soil of experimental field was sandy loam, pH of soil was 7.4 with 0.39% organic C, having available N, P, k, 185.5, 36 and 98 kg h^{-1} respectively. The experiment involving hybrid 'MRB 2210' was laid out in factorial randomized block design with nine treatments replicated thrice, comprising 3 planting methods uniform row system(URS) at 50 cm; paired row system(PRS) at 30/70 cm; and ridge and furrow system(R&F) at 50 cm and 3 nutrients levels (F_1, Without fertilizer; F_2, N = 120kg ha^{-1}, P = 80kg ha^{-1}, K = 60kg ha^{-1}; and F_3, N = 100kg ha^{-1}, P = 60kg ha^{-1}, K = 40kg ha^{-1}). Seasonal consumptive use of water by the crop for the entire growing season was estimated from total soil-moisture depletion by soil moisture determination (Dastne, 1974).

Results and Discussion

Growth characters: Growth parameters of pearl millet, *viz.* plant height, dry weight, were influenced by different planting methods and nutrient levels. Paired row system with F_2 (N = 120kg ha^{-1}, P = 80kg ha^{-1}, K = 60kg ha^{-1}) recorded maximum improvement in growth parameters, which were significantly superior to UR and R&F system of planting. The plant height of pearl millet was showed significant difference and highest under T_5 [Paired row spacing (PRS) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})] in later stages i.e., at 60 DAS. The plant dry weight of pearl millet was showed non-significant difference and highest was recorded under T_5 [Paired row spacing (PRS) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})] at75 DAS. Different planting methods and nutrient levels did not affect the plant height and dry weight at early stages of growth. This may have been due to the slower rate of mineralization of nutrients, but in T_5 at later stages the growth increase was may be due to the more mineralization and availability of nutrients. Similar reports have been reported by Rathore *et al.,* (2006); Tetarwal and Rana (2007); Bantiono *et al.,* (1990); Jadhav *et al*., (1996).

Productivity: Grain yield, stover yield, test weight of pearl millet increased significantly due to modified planting methods and different nutrient levels. Paired row system with F_2 (N = 120kg ha^{-1}, P = 80kg ha^{-1}, K = 60kg ha^{-1}) recorded maximum yield, stover yield, test weight, of pearl millet, which were significantly superior to UR and R&F system of planting. Grain yield, and test weight of pearl millet was showed significant difference and highest under T_5 [Paired row spacing (PRS) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})]. In different planting methods and nutrient levels grain yield test weight and stover yield, best in T_5 because at later stages the growth increase was may be due to the more mineralization and availability of nutrients. Similar reports have been reported by Potts *et al.* (1991); Aune *et al* (1992b); Bantiono *et al.,* (1990); Kumar *et al.,* (1995); Jadhav *et al*., (1996).

Economics: Among different planting methods and nutrient levels in pearl millet the highest total cost of cultivation (20559 ₹ ha^{-1}) was obtained in treatments T2 [Uniform row spacing (URS) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})], T_5 [Paired row spacing (PRS) + F_2($N_{120}P_{80}K_{60}$ kg ha^{-1})], T_8 [Ridge & Furrow (R&F) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})] respectively while lowest cost of cultivation (15380 ₹ha^{-1}) was observed in treatmentT_1 [Uniform row spacing (URS) +F_1 ($N_0P_0K_0$ kg ha^{-1})], T_4 [Paired row spacing (PRS) + F_1 ($N_0P_0K_0$ kg ha^{-1})], T_7 (Ridge & Furrow (R&F) + F_1[$N_0P_0K_0$ kg ha^{-1}]) respectively. Total cost of cultivation are equal in (T_1, T_4, and T_7), (T_2, T_5, and T_8) and (T_3, T_6, and T_9) because variable and fixed cost were same respectively.

Among different planting methods and nutrient levels in pearl millet the highest gross return (43604.48 ₹ha^{-1}) was obtained in treatments T_5 [Paired row spacing (PRS) + F_2($N_{120}P_{80}K_{60}$ kg ha^{-1})], while lowest gross return (19748.34 ₹ha^{-1}) was observed in treatment T_1 [Uniform row spacing (URS) +F_1($N_0P_0K_0$ kg ha^{-1})]. The highest net return (21590.48 ₹ha^{-1}) was recorded in treatment T_5 [Paired row spacing (PRS) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})], while lowest net return (4368.34 ₹ha^{-1}) was obtained in treatment T_1 [Uniform row spacing (URS) + F_1 ($N_0P_0K_0$ kg ha^{-1})]. The highest B:C ratio (1.98) was recorded in treatments T_5 [Paired row spacing (PRS) + F_2 ($N_{120}P_{80}K_{60}$ kg ha^{-1})], while lowest B:C ratio (1.28) was obtained in treatment T_1 [Uniform row spacing (URS) + F_1 ($N_0P_0K_0$ kg ha^{-1})].

Conclusion

It is concluded that Paired row spacing (PRS) + F_2 ($N_{120}P_{80}K_{60}$ kgha^{-1}) was best for obtaining highest net returns (21590.48 ₹ha^{-1}) and B:C ratio (1.98) in pearl millet under different planting patterns and nutrient levels. Since the findings are based on the research done in one season it may be repeated for further confirmation.

Table 1: Effect of different planting methods and nutrient levels on plant height, dry weight, grain yield, stover yield, test weight, total cost of cultivation, gross return, net return and benefit cost ratio

Treatment	Plant height (cm)	Dry weight (gm)	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Test weight (gm)	Total cost of cultivation (₹/ ha)	Gross return (₹/ ha)	Net return (₹/ha)	Benefit cost ratio
T_1 : Uniform row spacing (URS) +F_1	131.73	62.85	1.40	122.07	5.40	15380	19748	4368	1.28
T_2 : Uniform row spacing (URS) + F_2	191.88	84.00	2.29	166.06	7.93	22014	34778	12764	1.57
T_3 : Uniform row spacing (URS) + F_3	185.14	82.94	1.93	156.97	7.36	20559	30210	9651	1.46
T_4 : Paired row spacing (PRS) + F_1	134.58	64.05	1.49	114.39	5.46	15380	21564	6184	1.40
T_5 : Paired row spacing (PRS) + F_2	193.54	84.54	3.00	171.18	8.83	22014	43604	21590	1.98
T_6 : Paired row spacing (PRS) + F_3	189.36	82.90	2.70	160.74	7.43	20559	39984	19425	1.94
T_7 : Ridge & Furrow (R&F) + F_1	133.34	63.36	1.45	115.92	5.33	15380	21212	5832	1.37
T_8 : Ridge & Furrow (R&F) + F_2	192.34	84.12	2.64	168.72	8.36	22014	39669	17655	1.80
T_9 : Ridge & Furrow (R&F) + F_3	186.23	83.14	2.27	158.26	7.33	20559	35336	14777	1.71
F - test	NS	NS	S	S	S				
S. Ed. (±)	2.6766	0.4566	2.4580	2.6127	0.160				
C. D. at 5%	-	-	5.211	5.539	0.0756				

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