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EFFECT OF SOWING METHODS ON PEARL MILLET [*Pennisetum glaucum (L.)*] IN RED SOIL OF VINDHYAN REGION

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Abstract: *A field experiment was conducted during kharif season of 2009-2010 at* Rajiv *Gandhi South Campus, B.H.U., Barkachha, Mirzapur to study the effect of sowing methods on growth, yield attributes, yield and nutrient uptake pearmillet [Pennisetum glaucum (L.)]. The experiment was laid out in Factorial Randomized Block Design having three replications with Bajra variety S.B.H. 7178 .Four* ***S****owing Methods ridge method, bed method, seed drill method and broadcast methods were adopted for experiments. Ridge method of sowing recorded significantly higher growth, yield, and nutrient uptake of pearlmillet than seed drill method, broadcast method of planting and, bed method. The maximum grain yield was recorded with ridge method of sowing.*
Key wards: *Ridge effect, Seed drill effect, Broadcast (direct) method, yield, pearl millet.*

Introduction: Peralmillet [*Pennisetum glaucum (L)*] commonly called as bajra, is an important dual purpose millet crop of grain and forage production. Peralmillet is a very important crop of rainfed area in India and India is the largest producer of bajra in the world. The production of bajra in India is 7.3 million tones and grown in 9.1 million hectare with productivity of 780 kg/ha. Among the different states the highest contribution in bajra is Rajasthan, followed by Gujarat, U.P and Haryana which are the important bajra growing states covering 87% of the total area and about 73% of the total production comes from these states.

In Uttar Pradesh, bajra occupies an area of about 7.0 lac hectares of which about 95% is under rainfed. The important bajra growing districts are Mathura, Agra, Bulandsahar, Aligarh and Farrukhabad. The productivity of bajra is very low due to imbalance application of fertilizer, problems of disease and pest uncertain and erratic rainfall distribution and problems of weeds. In U.P. the productivity of bajra is only 12.35 q/ha, with total production of 9.2 lac tones .the productivity may be raised up to 25-30 q/ha after proper management.

The problems of rainfed areas are manifold and complex in nature. However the main problem to which the other problems are associated in that of uncertainty of rainfall and its poor control and management in the field which leads to low and unstable agriculture production. Short span of rainy season and poor moisture retentively of soil due to topographical and textural problem further make the problem difficult. Excess loss of water through runoff lead to water stress at the critical stages of crop growth which affect the yield adversely. Minimizing the risk factor, in-*situ* moisture conservation and adoption of suitable crops and verities and agronomic practices are, therefore, vital for the success of dry land agriculture. In view of the fact that rainfed an area contributes about more than 98% of millets. Peralmillet has a higher level to heat tolerance than sorghum and maize. It thrives on light textured and well drained soils, but does not tolerate water logging like sorghum. Consequently, drought is the most important factor in limiting its production. It is very common practices adopted in rainfed area that the use of fertilizer in kharif crop rarely done by the farmers in moisture stress condition. However, the application of fertilizer affects the yield due to presence of balance nutrient and their better utilization under moisture condition. Besides other agronomic management practices, selection of suitable planting method are essential to make best use of limited available

water. Keeping in view the importance of sowing methods this study was designed to determine the best sowing method for ultimate Peralmillet production.

Materials and Methods

The experiment was conducted during *kharif* season of 2009 at Agriculture farm of Rajiv Gandhi South Campus, B.H.U., and Barkachha Mirzapur. In this regard land was given two ploughing followed by planking for the purpose of good seed bed preparation. The experiment was laid out in Factorial Randomized Block Design having three replications with net plot size of 5×13 m^2. Bajra variety S.B.H. 7178 was used in the experiment. Four **S**owing Methods ridge method, bed method, seed drill method and broadcast methods were adopted for experiments.

All the required agronomic practices were followed uniformity in all the plots throughout the growing period. 5 plants were selected randomly from each treatment and subjected for recording data using standard methods. Surface soil sample was also taken from each plot.

Following growth, yield and soil properties were recorded: Plant height, Dry weight, Plant biomass, Diameter, perimeter and length of ear, numbers of tillers per plant, Yield m^2, per ear, ear weight, 1000-grain weight, Economic grain and straw yield, pH, EC and organic carbon. All the collected data were subjected to analysis of variance test to discriminate the treatments mean.

Results and Discussion

Data pertaining to plant height and dry weight at different stages (30, 60, DAS and at harvest) are presented in the Table: 1. A critical examination of the data revealed that the sowing methods had significant effect on the plant height and dry weight which was measured at different stages of the crop. The plant height and dry weight of pearlmillet under different sowing methods at harvest stage ranged from 169.7 to 197.0 cm. and 71.3g to 158.6g respectively. The maximum plant height and dry weight was recorded in the treatment T_1 (ridge method) at 30, 60 DAS and at harvest stage of crop. The ridge method of sowing was remained statistically superior over the bed, seed drill and broadcast methods of sowing, is due to high moisture content and optimum plant population. Lowest plant height and dry weight was observed in broadcast method of sowing. It may be due to dense population of pearlmillet plants.

Table: 1 Effect of sowing methods on mean dry weight (g) & plant height (cm) of pearlmillet at 30 DAS, 60 DAS and at harvest

Treatment	30 DAS		60 DAS		At harvest	
	dry weight (g)	plant height cm)	dry weight (g)	plant height (cm)	dry weight (g)	plant height cm)
T_1	10.3	99.7	85.3	157.7	160.6	197.0
T_2	9.3	89.0	70.3	142.7	118.0	188.7
T_3	8.3	85.0	67.3	138.0	144.6	184.0
T_4	4.6	71.3	38.6	131.0	71.3	169.7
CD at 5%	**0.03**	**8.29**	**13.33**	**7.11**	**29.91**	**5.91**

Observed similarly result that plant height was significantly affected by different planting patterns [1]. Pearlmillet, dry matter/plant was influenced by different planting patterns [2] have also reported similar results [3, 4].

Scanning of data (Table: 2) related to the effect of different sowing methods on plant biomass and tillers per plant of pearlmillet crop (at 30, 60 DAS and at harvest) revealed that plant biomass and tillers per plant in different treatment was influenced by sowing methods. The plant biomass and tillers per plant under different sowing methods ranged from 147.6g to 307.6g and 1.87 to 4.0 tillers per plant, (at harvest stage) respectively. Though, the highest plant biomass and tillers per plant was found in the treatment of ridge method while the lowest plant biomass and tillers per plant was recorded in treatment of broadcast method. It showed that, increase in plant biomass and tillers per plant could be assigned due to higher moisture conservation under ridge method of sowing. There is direct relationship between the average plant biomass yields and tillers per plant which is governed by moisture availability in soil. The broadcast method of sowing had maximum plant density, there by the plant biomass and tillers per plant in broadcast method was lowest than other method of sowing (ridge, bed and seed drill methods). Pearlmillet, tillers/m row length, was influenced by different planting patterns [2].

Table: 2 Effect of sowing methods on mean tillers per plant, Plant biomass (g) of pearlmillet at 30DAS, 60 DAS and at harvest.

Treatment	30 DAS		60 DAS		At harvest	
	tillers per plant	Plant biomass(g)	tillers per plant	Plant biomass (g)	tillers per plant	Plant biomass(g)
T_1	2.8	74.6	3.5	173.0	4.04	307.6

T_2	2.6	69.6	2.9	141.6	3.33	241.0
T_3	2.4	69.0	2.4	127.6	2.64	194.3
T_4	1.5	34.0	1.6	93	1.87	147.6
CD at 5%	**0.05**	**7.2**	**0.15**	**6.9**	**0.34**	**34.7**

Data related to the effect of sowing methods on ear diameter, perimeter, ear length, ear weight and test weight of pearlmillet collected at full maturity of the crop, have been presented in Table: 3. The ear diameter, perimeter, ear length, ear weight and test weight collected at full maturity of the crop was significantly affected by the different sowing methods. The ear diameter, perimeter, ear length, ear weight and test weight under different sowing methods ranged from 2.24 to 3.13 inch, 6.6cm to 10.6, and 14.33 cm to 24.9cm, 16.16 to 36.7g, 6.3g to 7.1g respectively. The maximum ear diameter, perimeter, ear length, ear weight and test weight was obtained in the treatment T_1B_0 (ridge method). The maximum ear diameter, perimeter, ear length, ear weight and test weight in ridge method was due to better moisture, proper spacing and optimum number of plant, there by nutrient uptake more, better plant growth and ultimately maximum ear diameter. It indicates that the sowing methods have significant effect on ear diameter, perimeter, ear length, ear weight and test weight. The lowest value was recorded in treatment (T_4). The lowest ear diameter, perimeter, ear length, ear weight and test weight in broadcast method than other method (ridge, bed and seed drill methods) was due to high plant density; high nutrient competition and low moisture content there by poor growth of the plant and ultimately low in ear diameter, perimeter, ear length, ear weight and test weight.

However, sowing methods significantly differed from one another and significant effect on plant height [5]. This result supports the finding [6, 7].

Sowing methods significantly affected 1000-grain weight.1000-grain weight was also affected significantly by planting patterns. Significant effect on plant height and similarly results are findings of Malik *et al* (1990) who stated that planting patterns had a significant influence on 1000-grain weight [5].

Table: 3 Effect of sowing methods on mean diameter, perimeter, length, weight of ear and test weight of pearlmillet.

Treatment	Diameter (inch)	Perimeter (cm)	Length (cm)	Ear weight (g)	Test weight (g)
T_1	3.13	10.60	24.93	36.7	7.1
T_2	2.66	8.51	19.60	28.06	6.9
T_3	2.42	7.52	16.70	21.86	6.5
T_4	2.24	6.61	14.33	16.16	6.3
CD at 5%	**0.04**	**0.21**	**2.22**	**3.17**	**0.03**

The data pertaining to grain yield of pearl millet have been presented in Table: 4 A study of the data revealed that the maximum yield of pearl millet grain was recorded in ridge method of sowing. Increase in moisture control proved much instrumental in enhancing the production of pearl millet. The ridge method (T_1) of sowing which conserve more moisture than other method of sowing brought about significant improvement in grain yield of pearl millet over other method of sowing. The economic yield of different sowing methods ranged from 1312 to 2016kg ha^{-1}. The lowest yield of pearlmillet (1312 kg ha^{-1}) was recorded in broadcast method of sowing where no sufficient moisture was available. Highest pearlmillet yield (2016 kg ha^{-1}) was obtained with the ridge method of sowing which was higher in moisture control content than bed, seed drill and broadcast method of sowing. The economic yield in ridge method of sowing was 53.6% more than the broadcast method of sowing.

This could be attributed to better supply of moisture resulting in higher production tiller and grain number and there by higher yield. This improvement in grain yield could be assigned to higher moisture conservation under ridge method of sowing. There is direct relationship between the average ear diameter and nutrients uptake, which is governed by moisture availability in soil, there by healthy growth and ultimately higher yield. These results corroborate the finding [6, 7].

The data pertaining to straw yield of pearl millet have been presented in Table: 4. Study of the data revealed that the maximum straw yield of pearl millet was recorded in ridge method of sowing. The ridge method (T_1) of sowing which conserve more moisture than other method of sowing brought about significant improvement in straw yield of pearl millet over other method of sowing. The straw yield of different sowing methods ranged from 68.6 to 60.5 q ha^{-1}. The lowest straw yield of pearl millet (60.5 q ha^{-1}) was recorded in broadcast method

of sowing where no sufficient moisture was available. Highest straw yield of pearl millet (68.6 q ha^{-1}) was obtained with the ridge method of sowing (T_1) which was higher in moisture control content than bed, seed drill and broadcast method of sowing. The straw yield in ridge method of sowing was 13.3% more than the broadcast method of sowing. This could be attributed to better supply of moisture resulting in healthy growth more plant biomass there by more straw yield. This increase in straw yield could be assigned to higher moisture conservation under ridge method of sowing.

Similarly results that the entire yield attributes significantly due to planting patterns [8]. Modified planting patterns (Ridge and furrow, paired rows and paired rows + inter-crop system) brought about a significant improvement in grain and Stover yields of Pearl millet over uniform row system of planting. There is direct relationship between the healthy growth and nutrients uptake, which is governed by moisture availability in soil, there by healthy growth and ultimately higher straw yield [9].

The cost of cultivation (Rs ha^{-1}) under different sowing methods is given in Table 4. The cost of cultivation under different sowing methods ranged from 12900 to14600 was observed ridge method of sowing. The maximum cost of cultivation (14600) was observed in ridge method of sowing. Minimum cost of cultivation (12900) was observed in broadcast method. The gross returns (Rs ha^{-1}) ranged from 23690 to 33081 and the maximum (33081) was observed in broadcast method. The minimum gross returns (23690) were obtained in broadcast method of sowing. The net returns (Rs ha^{-1}) under different sowing methods ranged from 9090 to 20181. The maximum (20181) net returns was obtained in ridge method of sowing, where as minimum (9090) was in broadcast method of sowing. The benefit cost ratio (BC ratio) under different sowing methods ranged from 1.86 to 2.26. The benefit cost ratio (BC ratio) was obtained maximum (2.26) in ridge method of sowing, where as minimum (1.86) was in broadcast method of sowing. After studied the above information the ridge method was superior to other method of sowing and it is advised to farmers for adopting ridge method, because grain yield and net return is highest among all the methods of sowing.

Table: 4 Effect of sowing methods on grain& straw yield, cost of cultivation, net returns, gross returns and BC ratio of pearlmillet

Sowing methods	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net returns (Rs ha^{-1})	BC ratio
Ridge	18.43	50.4	14600	33081	20181	2.26
Seed bed	17.82	48.6	14300	31926	18026	2.23
Seed drill	16.44	40.8	13900	27844	13544	2.05
broadcast	15.06	32.8	12900	23690	9090	1.86
C.D. at 5%	0.62	2.85				
SE±	0.25	1.16				

Data related to pH, EC, Organic Carbon of soil under different sowing methods collected after pearlmillet harvesting has been presented in Table: 5. The pH values of soil samples under different sowing methods ranged from 5.0 to 5.4.The pH value were neither affected by the different sowing methods, nor by gypsum application. The maximum pH (5.4) was obtained in the soil sample which was taken from treatment of bed method. Generally all the soils from different plots of the treatments are moderate acidic in reaction.

Table: 5 chemical properties of soil under different sowing methods

Treatment	pH	EC (dSm^{-1})	Organic carbon (%)
T_1	5.1	0.38	0.49
T_2	5.4	0.32	0.43
T_3	5.3	0.26	0.57
T_4	5.1	0.28	0.39
CD at 5%	**NS**	**NS**	**NS**

It was clear that all the values of EC were (< 1dSm^{-1}) in the lower side of normal range. The EC of soil samples ranged from 0.26 to 0.50 dSm^{-1}. The maximum EC (0.50) was measured in broadcast method treatment. The EC value 0.25 (low) was safe for all crops and may be due to moderate leaching of soluble salts.

Perusal of the data revealed that the sowing methods had no significant effect on organic carbon content of soil sample (0-15 cm) collected after harvesting of pearl millet crop. The organic carbon content in the soil samples ranged from 0.38% to 0.57% (low to medium). Both of these sowing methods having 0.49% and 0.51% organic carbon content respectively, in soil thus, it was observed that no appreciable build-up of organic carbon in surface layer of plots treated with different sowing method .

In the light of aforementioned results it can be safely concluded that sowing method of ridge was found most suitable method of sowing, among all the methods of sowing under rainfed condition. And farmers of Eastern Uttar Pradesh were advised to adopt the ridge method of sowing for pearlmillet crop under rainfed condition for getting the maximum net returns.

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