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Spatial arrangement of pearl millet (*Pennisetum glaucum*) under different plant densities in arid zone of Rajasthan*

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Under frequent drought situation in arid region, despite other factors, a low plant density and their arrangement may stabilize the yield of pearl millet [*Pennisetum glaucum* (L.) R.Br. emend. Stuntz]. Several workers (Gautam 1970, Umrani *et al.* 1983, Pandey *et al.* 1988) reported that a row spacing of 45–50 cm for a plant density of 150 000 – 200 000 plants/ha is sufficient for pearl millet under semi-arid conditions. Garg *et al.* (1993) found that wider spacing (> 60 cm) did not increase the yield of pearl millet in dry year in arid zone. A low plant density of 100 000–133 000 plants/ha is optimum for the arid zone of Rajasthan (ARS, Mandor 1991). However, scientific study on proper crop structure for such a low plant density under different rainfall situations in arid zone is lacking. Therefore the present investigation was undertaken.

The field study was conducted at Mandor during the rainy season of 1991 and 1992. The soil was alkaline (*p*H 8.2), poor in organic matter (0.173–0.194% organic C), medium in available P (8.7–9.6 kg) and high in available K (235–250 kg/ha). It included 12 treatments, viz T_1, 30 cm x 15 cm, farmers' practice (222 000 plants); T_2, 45 cm x 17 cm (133 000 plants); T_3, 45 cm x 22 cm (100 000 plants); T_4, 60 cm x 12.5 cm (133 000 plants); T_5, 60 cm x 16.5 cm (100 000 plants); T_6, 60 cm x 22 cm (75 000 plants); T_7, 75 cm x 10 cm (133 000 plants); T_8, 75 cm x 13 cm (100 000 plants); T_9, 75 cm x 17.5 cm (75 000 plants); T_{10}, 90 cm x 8.5 cm (133 000 plants); T_{11}, 90 cm x 11 cm (100 000 plants); and T_{12}, 90 cm x 15 cm (75 000 plants/ha). The experiment was laid out in randomized block design with 3 replications. A fertilizer dose of 40 kg N/ha and 8.7 kg P/ha was uniformly applied. Whole quantity of P and half the N were drilled at the sowing time and the remaining half N was top-dressed at 25–35 days after sowing, depending on the availability of moisture in the soil. A hybrid 'MH 179' was sown on 19 July 1991 and 25 July 1992. Total rainfall during the season (July–October) in 1991 was 221.2 mm compared with the average 360 mm of the region, and the crop observed moisture stress in 2 prolonged dry spells during 10–26 days after sowing and again from 42 days to maturity. In contrast, during 1992 the rainfall was not only well distributed but also higher (446.6 mm) than in the previous year. The rainfall-use efficiency (RUE) was calculated as:

$$\text{RUE} = \frac{\text{Grain yield (kg/ha)}}{\text{Seasonal rainfall (Jul–Oct)}}$$

The planting structure affected the effective tillers/plant (Table 1). All the treatments produced significantly higher effective tillers compared with the planting structure of 30 cm x 15 cm (222 000 plants/ha). Maximum tillers were produced in planting structure of 60 cm x 22 cm (75 000 plants), which was comparable to that of other crop structures except to 75 cm x 10 cm, 90 cm x 8.5 cm and 90 cm x 11 cm. This might be because of less intra-row spacing left in the treatments. Ear length was not affected by the different crop structures and plant densities. Grain weight/plant was significantly higher in all the treatments compared with that of 30 cm x 15 cm (222 000 plants/ha). Planting structure of 60 cm x 16.5 cm (100 000 plants) produced the maximum and significantly higher grain weight/plant compared with the wider row spacings of 75 and 90 cm with plant densities of 133 000 and 100 000 plants/ha because of less intra-row spacing available in these treatments, producing less effective tillers and consequently reducing the grain weight/plant. Garg *et al.* (1993) did not observe significant effect of wider spacing of > 60 cm on grain weight/plant under erratic rainfall condition.

Planting structure of 60 cm x 12.5 cm (133 000 plants) produced the maximum and significantly higher grain yield compared with the treatment of highest (222 000 plants) and lowest (75 000 plants) plant densities. It indicates that too low or too high plant density was of less use in erratic rainfall condition of arid zone of Rajasthan. Dry-matter production per unit area decreased with reduction in plant density. Maximum and significantly higher dry matter was produced at 30 cm x 15 cm (222 000 plants) compared with that at lowest planting density (75 000 plants). Thus improvement in the performance of individual plant (higher effective tillers and grain weight/plant) brought about by decrease in plant density below 100 000 plants/ha could not fully compensate the

* Short note

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Table 1 Effect of plant structure on yield attributes, grain yield of pearl millet and rainfall-use efficiency

Treatment	Effective tillers/ plant	Ear length (cm)	Grain weight (g/plant)	Grain yield (tonnes/ha)	Dry-matter yield (tonnes/ha)	Rainfall-use efficiency (kg/ha/mm)
T_1	0.61	23.9	6.5	0.851	2.67	2.22
T_2	1.21	24.9	13.9	1.370	2.40	3.77
T_3	1.26	24.3	13.9	1.279	2.39	3.43
T_4	1.26	24.8	14.3	1.413	2.50	3.93
T_5	1.33	25.5	14.6	1.282	2.43	3.53
T_6	1.41	26.3	14.4	0.888	2.05	2.48
T_7	1.19	25.2	11.8	1.214	2.40	3.36
T_8	1.24	26.6	12.4	1.184	2.25	3.27
T_9	1.31	27.6	14.1	0.866	2.05	2.48
T_{10}	0.97	25.0	12.8	1.213	2.42	3.39
T_{11}	1.12	25.3	12.6	1.044	2.29	2.39
T_{12}	1.23	26.3	14.2	0.793	2.00	2.26
SEm +	0.88	0.82	0.31	0.099	0.095	
CD ($P = 0.05$)	0.260	NS	0.9	0.292	0.28	

T_1, 30 cm x 15 cm, 222 000 plants/ha; T_2, 45 cm x 17 cm, 133 000 plants/ha; T_3, 45 cm x 22 cm, 100 000 plants/ha; T_4, 40 cm x 12.5 cm, 133 000 plants/ha; T_5, 60 cm x 12.5 cm, 100 000 plants/ha; T_6, 60 cm x 22 cm, 75 000 plants/ha; T_7, 75 cm x 10 cm, 133 000 plants/ha; T_8, 75 cm x 13 cm, 100 000 plants/ha; T_9, 75 cm x 17.5 cm, 75 000 plants/ha; T_{10}, 90 cm x 8.5 cm, 133 000 plants/ha; T_{11}, 90 cm x 11 cm, 100 000 plants/ha; and T_{12}, 90 cm x 10 cm, 75 000 plants/ha.

yield loss per hectare. Our study supports that of Stewart and Steiner (1990), who advocated moderate plant population with moderate row width for crops grown under dryland condition. Maximum rainfall-use efficiency was obtained in the plant structure of 60 cm x 12.5 cm, followed by 45 cm x 17 cm and 60 cm x 16.5 cm. The lowest rainfall-use efficiency was observed in plant structure of 30 cm x 15 cm.

It was concluded that crop structure of 60 cm x 12.5 cm that can adjust a plant density of 133 000 plants/ha was more practical and appropriate for erratic rainfall condition of arid zone of Rajasthan.

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