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Production Potential of Improved pearlmillet (*Pennisetum glaucum L.*) Cultivars under Staggered Sowing in Raifed Areas of Western India

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Abstract

Performance of 8 pearlmillet (*Pennisetum glaucum* L.) cultivars, viz. (6 hybrids, ('MH 2114', 'MH 2106', 'MH 2107', 'MH 2155', 'MPMH 17' and 'KBH 108') and 2 varieties, viz.('MP 570' and 'Pusa 383') was evaluated under 3 sowing dates (10-15 July, 25-30 July and 10-15 August) at the Pearlmillet Research Station, Jamnagar, Gujarat, India during kharif season of 2017, to find out the production potential of pearlmillet cultivars under staggered sowing in raifed area of Western India. The growth and yield attributes in 10-15 July sown crop recorded higher values than late sowings. The crop sown on 10-15 July gave significantly higher grain yield (3069 kg/ha) and stover (6696 kg/ha) yields, net returns (36591 Rs/ha), benefit: cost ratio (2.80) and economic efficiency (412 Rs/ha/day) than that sown on 25-30 July and 10-15 August sowing. Pearlmillet hybrids gave 21.9% higher grain yield than varieties. Among the hybrids, 'MH 2155' recorded significantly higher grain yield (3291 kg/ha), profits (41042 Rs/ha) with the maximum benefit : cost ratio (3.14) and economic efficiency followed by 'KBH 108'; and among the varieties 'MP 570' was found promising.

Keywords: Cultivar; Economic Efficiency; Economics; Grain Yield; Hybrid; Pearlmillet

Introduction

Pearlmillet (*Pennisetum glaucum* L.) is the major staple food of millions of rural poor in arid and semi-arid regions of the world. It is one of the important cereal crops globally after rice, wheat and maize. In India, pearlmillet occupies an area of 7.32 million hectares producing 9.18 million tones with productivity of 1255 kg/ha. In Gujarat, it is cultivated over an area of 0.46 million hectares with a production and productivity of 0.77 million tones and 1677 kg/ha respectively (DES, 2016). Being a C4 crop, it utilizes high temperature and solar radiation more efficiently. Under changing climate scenario, pearlmillet being a drought-hardy crop will play an important role in food, feed and fodder security of the Indian population. Sowing time is one of the major inputs affecting growth and crop yield. It affects duration of vegetative, reproductive and maturity period of crop. Optimum planting time for pearlmillet may vary from one variety to another and from a region to another because of variation of agro-ecological conditions. Sowing date ensure complete harmony between vegetative and reproductive phase, on one hand, and climatic rhythm, on the other, and helps in realizing potential yield. Pearlmillet development begins at a base temperature around 12ºC, an optimum temperature between 30-35 ºC and a lethal temperature around 45 ºC. The effect of temperature on the length of plant growth cycle, especially the grain filling phase is the most important factor in explaining the reduced yields at warmer temperatures [1]. Plants have a definite temperature requirement before they attain certain phenological stages. Hence, it becomes imperative to have knowledge of exact duration of phenological stages in a particular crop-growing environment and their impact on yield of crop. Growing of suitable variety at an appropriate time is essential for ensuring optimum productivity. Therefore, an experiment was planned to determine the production potential of different pearlmillet varieties under staggered sowing in raifed areas of Western India.

Materials and Methods

A field experiment was conducted at Pearlmillet Research Station, Junagadh Agricultural University, Jamnagar (22º47' N, 70º07' E, 18.00 m above the mean sea level), Gujarat, India, during the kharif season of 2017, to find out the production potential of pearlmillet varieties with staggered sowing in Western India. The site is situated in the North Saurashtra agro-climatic region of Gujarat under Gujarat plains and hills zone of India. The rainy season commences in the second fortnight of June and ends in September, with an average annual rainfall of

500 mm. July and August are the peak months of rainfall. During the crop season the minimum temperature ranged from 23.1 to 28.0ºC and the maximum temperature ranged from 28.7 to 37.0ºC. The weather parameters, viz. mean relative humidity, wind velocity and sunshine hours were normal during the experiment period. In general, the weather conditions were congenial during crop season. The experimental soil was clay loam in texture and slightly alkaline in reaction with pH 7.7 and EC 0.36 dS/m. It was moderately fertile being low in organic carbon (4.9 g/kg), medium in available nitrogen (231 kg/ha) and phosphorus (11.9 kg/ha) and high in available potassium (326.7 kg/ha). Treatments consisting of 3 sowing dates (10-15 July, 25-30 July and 10-15 August) in main plot and 8 pearlmillet cultivars including 6 hybrids ('MH 2114', 'MH 2106', 'MH 2107', 'MH 2155', 'MPMH 17' and 'KBH 108') and 2 varieties ('MP 570' and 'Pusa 383') in subplot were replicated thrice in a split plot design. The sowing was done manually in rows at 60 cm spacing with 4-6 cm depth. The excess plants were thinned out at 20 days after sowing (DAS) keeping within row distance at 10 cm maintaining uniform plant stand. To control initial flushes of weeds, atrazine 0.5 kg/ha was applied as pre-emergence with 600 l/ha water with the help of knap-sack sprayer fitted with flat-fan nozzle. Hand-hoeing was done at 25 DAS and intra-row weeds were removed by hand-weeding. The gross and net plot size was 5.0 x 3.6 m and 4.0 x 2.4 m respectively. Pearlmillet crop was fertilized with 80 kg N and 40 kg P/ha through urea and single super phosphate. At sowing 50% N along with full dose of P were applied and remaining 50% N was applied at 30 DAS. Crop protection measures were taken up against pests and disease infestation. Irrigations were scheduled as and when required. Days to 50% flowering was recorded with 50% plants were found by manual counting of plant row by row at flowering stage. The yield attributes, viz. effective tillers/plant, earhead length and test weight was recorded at the time of harvesting. The crop was harvested manually with the help of sickle when earhead almost matured. The ear head were threshed and winnowed and grain so obtained was weighed and data on grain and stover yields were recorded. Weather data were collected from the Agro-meteorological Observatory of department of agronomy, Pearlmillet research station, Junagadh Agricultural University, Jamnagar. Gross returns were calculated on the basis of prevailing market price of the produce. Net income was calculated as difference between gross returns and total cost of cultivation. Data were analyzed with analysis of variance (ANOVA) as suggested by Gomez and Gomez (1984). Treatments were compared by computing the F-test. The significant differences between treatments were compared pare wise by critical difference at the 5 per cent level of probability.

Results and Discussion

Growth and Yield Attributes

Different growth attributes, viz. plant height, total tillers/plant and yield attributes, viz. effective tillers/plant, earhead length and 1000-grain weight were significantly influenced by sowing dates and varieties (Table 1). Significantly the highest plant height, total tillers/plant, effective tillers/plant, earhead length and 1000-grain weight were recorded with 10-15 July sown pearlmillet crop than that of later sowing. The higher value of yield attributing parameters in case of early sowing over delayed ones could be attributed to availability of optimum environmental conditions for growth and development of crop which might enhance accumulation of photosynthates from source to sink. Lower values of growth attributes of late sown crop may be attributed to inhibited vegetative growth of crop due to higher temperature in comparison to early sown crop. Andhale et al. [2] reported significant reduction in plant height, earhead length and girth and 1000-grain weight with delay in sowing during summer in pearlmillet. Growth and yield attributes were significantly affected due to different cultivars. Plant height, earhead length and 1000-grain weight were significantly the maximum with 'MH 2155', however plant height and earhead length were statistically on par with 'KBH 108', while the maximum total and effective tillers/plant was recorded with MPMH17 followed by MH 2106 [3,4].

Table 1: Effect of sowing time and cultivars on phenology and growth and yield attributes of pearlmillet.

Treatment	Phenology		Growth Attributes		Yield Attributes		
	Days to 50% Flowering	Days to Maturity	Plant Height (cm)	Total Tillers/ Plant	Effective tillers/ Plant	Earhead Length (cm)	1000-Grain Weight
Sowing Dates							
10-15 July	52.75	88.73	206.23	4.11	3.25	24.32	9.95
25-30 July	50.96	85.21	198.79	3.75	2.81	23.01	9.46
10-15 August	49.13	83.89	189.12	3.45	2.48	21.34	9.1
SEm ±	0.15	0.31	0.54	0.04	0.04	0.19	0.06
CD (P=0.05)	0.57	1.22	2.13	0.17	0.16	0.75	0.25
Cultivars							
MH 2114	50	84.32	183.6	4.2	3.02	23.71	8.7
MH 2106	52.44	85.67	195.16	4.56	3.36	23.98	10.15

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MH 2107	52.78	86.54	208.13	3.89	3.02	23.05	7.74
MH 2155	55.67	88.04	214	3.62	3.24	24.89	11.94
MPMH 17	44.89	81.35	160	4.62	3.58	21.98	8.2
KBH 108	56.22	89.45	213.02	4	3.07	24.25	11.15
MP 570	48.22	83.43	199.62	2.66	1.76	23.34	8.87
Pusa 383	47.33	82.56	210.84	2.6	1.71	21.77	9.24
SEm ±	0.21	0.41	0.82	0.07	0.06	0.27	0.05
CD (P=0.05)	0.59	1.17	2.35	0.19	0.18	0.77	0.14

Phenology

Sowing dates and different varieties had significant differences in days to 50% flowering and maturity (Table 2). The crop sown on 10-15 July took significantly higher number of days to 50% flowering and maturity than that of 25-30 July and 10-15 August dates of sowing. The flowering and maturity days on 10-15 July sown crop increased by 3.62 and 4.84 days respectively over 10-15 August Sowing. The late sown crop completed its life cycle at an accelerated pace, leading to shortening of days taken to flowering and maturity. The reproductive period was also shortened due to late sowing. In different cultivars, 'MH 2155' and 'KBH 108' being statistically at par took significantly more number of days to 50% flowering and maturity over other cultivars while, significantly the minimum 50% flowering and maturity days was noted with 'MPMH 17'. The variation in phenology of sorghum cultivars was also reported by Mishra et al. [5].

Table 2: Effect of sowing time and cultivars on yield and economics of pearlmillet.

Treatment	Yield (kg/ha)		Economics			
	Grain Yield	Stover Yield	Gross Returns (Rs/ha)	Net Returns (Rs/ha)	Benefit : Cost Ratio	Economic Efficiency (Rs/ha/day)
Sowing Dates						
10-15 July	3069	6696	49662	36591	2.8	412
25-30 July	2723	6172	44294	31223	2.39	366
10-15 August	2256	5671	37255	24184	1.85	288
SEm ±	68	80	1001	926	0.09	11
CD (P=0.05)	269	312	3933	3639	0.35	43
Cultivars						
MH 2114	2793	5356	44458	31387	2.4	372
MH 2106	2963	6066	47548	34477	2.64	402
MH 2107	2501	6273	41287	28216	2.16	326
MH 2155	3291	8039	54113	41042	3.14	466
MPMH 17	2224	5000	36136	23065	1.76	284
KBH 108	3081	7847	50981	37910	2.9	424
MP 570	2697	4856	42614	29543	2.26	354
Pusa 383	1912	6000	32768	19697	1.51	239
SEm ±	77	92	1176	1023	0.11	16
CD (P=0.05)	220	264	3352	2916	0.31	46

Yield

Pearlmillet grain and stover yields were significantly impressed due to different sowing time and varieties. Significantly the highest grain and stover yields were recorded with 10-15 July sowing over 25-30 July and 10-15 August sown crop (Table 2). The increase in pearlmillet grain yield with earlier sowing over 25-30 July and 10-15 August sown crop was 12.71 and 36.04% respectively. Higher grain and stover yields under 10-15 July sowing date can be ascribed to favourable environmental conditions at all pheno-phases, which resulted in better development of yield attributing traits such as effective tillers, earhead length and 1000-grain weight, than later sowing dates (Table 1). Gouri et al. [6] found that delayed sowing hastened the crop phonological development, thereby causing significant reduction in crop yields. Prakash et al. [7] and Gupta et al. [8] also reported the similar observation under delayed sowing.

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The hybrid 'MH 2155' recorded the highest grain (3291 kg/ha) and stover (8039 kg/ha) yields which was statistically on par with 'KBH 108' but was significantly higher than other cultivars under tested. An increase in pearlmillet grain yield to the tune of 72.12 and 61.14% was recorded with the sowing of hybrid 'MH 2155' and 'KBH 108' over the lowest yielding cultivar 'Pusa 383'. It might be due to potential of different varieties. Maurya et al. [9] also observed differences in pearlmillet grain yield while working in kharif season with different varieties. The higher grain yield with MH 2155' and 'KBH 108' was due to better expression of yield attributing characters which led towards an increase in grain yield. The interaction effect between dates of sowing and pearlmillet varieties was found to be non-significant.

Economics

The economic parameters for pearlmillet were calculated and presented in Table 2. The maximum gross returns, net returns and benefit: cost ratio were obtained when the crop was sown on 10-15 July. Consequently, 10-15 July sown crop gave significantly higher economic efficiency over late sowing. This was because of the higher productivity with favourable environmental conditions was associated with the respective treatments. Among the pearlmillet cultivars, hybrids were more economical than the varieties except 'MPMH 17' and 'MH 2107'. Pearlmillet hybrid 'MH 2155' recorded significantly higher gross returns, net returns, benefit: cost ratio and economic efficiency followed by 'KBH 108'. Similar findings were reported by Mishra et al. [5] in grain sorghum cultivars.

Conclusion

Pearl millet sown on 10-15 July recorded the highest grain as well as stover yields. The higher net returns, benefit: cost ratio and economic efficiency was also recorded on 10-15 July sown crop. Pearlmillet hybrid 'MH 2155' recorded the highest grain yield which was statistically comparable with 'KBH 108'. The hybrid 'MH 2155' also recorded the maximum net returns, benefit: cost ratio and economic efficiency followed by 'KBH 108'.

References

1. White JW, Reynolds MP (2003) A physiological perspective on modeling temperature response in wheat and maize crops p. 8 -17.
2. Andhale RP, Shinde SH, Pawar VS (2003) Effect of sowing dates on growth and yield of pearlmillet during summer season. J Agrometeorol 5(2): 102-105.
3. DES (2016) Area, production and productivity of crops. In Agricultural Statistics at a Glance. Directorate of economics and statistics. Department of Agriculture, Cooperation and farmers welfare, Ministry of Agriculture and farmers welfare, Government of India, New Delhi, India, pp. 102.
4. Gomez KA, Gomez AA (1984) Statistical procedure for Agricultural Research. John Willey, New York, USA, pp. 693.
5. Mishra JS, Thakur NS, Singh P, Kubsad VS, Kalpana R, et al. (2015) Productivity, nutrient use efficiency, and economics of rainy-season grain sorghum as influenced by fertility levels and cultivars. Indian J Agron 60(1): 76-81.
6. Gouri V, Rao BB, Devi TC, Kumari MB, Ankaiah R (2013) Thermal requirement of rabi maize in North Coastal Zone of Andhra Pradesh. J Agrometeorol 15(2): 167-169.
7. Prakash V, Mishra JS, Kumar R, Kumar S, Dwivedi SK, et al. (2017) Thermal utilization and heat use efficiency of sorghum cultivars in middle Indo Gangetic Plains. J Agrometeorol 19(1): 29-33.
8. Gupta M, Sharma C, Sharma R, Gupta V, Khushu MK (2017) Effect of sowing time on productivity and thermal utilization of mustard under sub-tropical irrigated conditions of Jammu. J Agrometeorol. 19(2): 137-141.
9. Maurya SK, Nath S, Patra SS, Rout S (2016) Effect of different sowing dates on growth and yield of pearlmillet varieties under Allahabad condition. International Journal of Science and Nature 7(1): 62-69.

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