Forage Res., **42** (3) : pp. 180-183 (2016) **http://forageresearch.in**

COMPARATIVE PERFORMANCE OF HYBRIDS AND POPULATIONS UNDER DIFFERENT MANAGEMENT CONDITIONS FOR SUSTAINABLE PEARL MILLET PRODUCTION

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(Received : 5 October 2016; Accepted : 8 December 2016)

SUMMARY

The experiment was conducted at the research farm of Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar from 2007 to 2010. The experiment consisted of eight treatments viz., two management levels i. e. Farmers practices [No application of DAP, sub-optimal use of N @ 25-30 kg/ha, no gap filling and thinning and hardly one interculture operation] and recommended package of practices under rainfed situation [Nitrogen @ 40 kg/ha and P_2O_5 @ 20 kg/ha, gap filling and thinning (three weeks after sowing) and one interculture operation] along with four cultivars i. e. two hybrids (RHB 121 and GHB 558) and two populations (Pusa 383 and Raj 171). The adoption of recommended practices enhanced the productivity by 23.5 and 18.5 per cent in hybrids and populations, respectively, as compared to farmer's practices. Among hybrids and populations; the hybrid GHB 558 (30.58 q/ha) produced significantly higher grain yield than RHB 121 hybrid (27.10 q/ha), populations Raj 171 (26.91 q/ha) and Pusa 383 (26.64 q/ha). Sustainable yield index (SYI) was quite higher in recommended package of practices (0.61) than the farmer's practices (0.33). The SYI was comparable in the population Raj 171 (0.66), hybrid GHB 558 (0.65) and RHB 121 (0.63) but quite superior to Pusa 383 (0.49) in the recommended package of practices. In farmer's practices, the SYI was found maximum in hybrid GHB 558 (0.42) and it was followed by Raj 121 (0.37), RHB 121 (0.30) and Pusa 383 (0.22) cultivars. The study indicated better performance of both the hybrids GHB 558 and RHB 121 than the populations Raj 171 and Pusa 383 under both the management levels.

Key words : Pearl millet, hybrids, populations, farmer's practices, sustainable yield index (SYI)

India is a pioneer country of world in pearl millet production. India accounts for 42 per cent of total world area under pearl millet and share of pearl millet in India's coarse cereal grains production is 24 per cent. India is the largest producer of pearl millet in the world occupying an area of 7.1 million hectares, production of 9.1 million tonnes per year with average productivity of 12.72 q/ha during 2014-15 (Anonymous, 2015). In India, pearl millet, which accounts for more than 90 per cent of the total area under it, is mostly cultivated on marginal and sub-marginal lands of the states of Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana. In Haryana during 2014-15, it was grown in an area of 0.38 million hectares with production and average productivity of 0.67 million tonnes and 17.49 q/ha, respectively (Anonymous, 2015). Increased and stabilized production of pearl millet is essential for the well-being of millions of people living in these regions. The crop is mostly confined to low fertile water deficit soils. Because of its remarkable ability to withstand and grow in harsh environment, reasonable and nearly assured harvests are obtained. Thus, strategies for increasing and sustaining agricultural productivity will have to focus on using available land and nutrient resources more effectively than in the past.

Pearl millet crop is grown under the environmental conditions with limited and erratic rainfall, high temperatures, and poor soil conditions with low nutrient levels too harsh for other cereal crops. For this reason, average yields are lower than other cereals, but improved production practices combined with appropriate selection of hybrids or populations result in increased grain and stover yield. The traditional populations from drier part of Rajasthan, India are good

sources of drought adaptation (Yadav *et al.*, 2016) and are commonly grown by the local farmers (Khairwal *et al.*, 2009). However, they are potentially low yielding and often fail to capitalize on availability of additional resources in favourable years (Bidinger *et al.*, 2006). On the other hand, hybrids have a greater yield potential under better endowed conditions but lack adaptation to severe drought conditions (Yadav and Bidinger, 2007). Station and on-farm research/demonstration trials clearly indicate that adoption of improved production technologies enhance pearl millet grain yield well above subsistence level.

It is often desired to identify a treatment from dry land field experiments that gives significantly higher yield and is sustainable over a range of weather conditions to increase and stabilize production. Sustainability yield index (SYI) is used to identify the sustainable practices over the period which denotes the minimum guaranteed yield as a per cent to the maximum observed yield, with high probability. The magnitude of index has a unique feature of comparison of magnitude and direction of a superiority of a practice based on the performance in related weather parameters especially rainfall. The present experiment was conducted with an objective to see the comparative performance of different hybrids and composites under different management practices on sustainable basis.

MATERIALS AND METHODS

The experiment was conducted at the research farm of Department of Genetics & Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar from 2007 to 2010. The experimental site is located at 28°4′ latitude and 76°35′ E longitude at an altitude of about 266 metres above mean sea level. The experiment consisted of eight treatments consisting of two management levels i. e. farmer's practices [No application of DAP, sub-optimal use of nitrogen @ 25-30 kg/ha, no gap filling and thinning and hardly one interculture operation] and recommended package of practices under rainfed situations [Nitrogen @ 40 kg/ha and P_2O_5 @ 20 kg/ha, gap filling and thinning (three weeks after sowing) and one interculture operation] with four cultivars i. e. two hybrids (RHB 121 and GHB 558) and two populations (Pusa 383 and Raj 171). The experiment was laid out in factorial randomized block design with three replications. Half dose of nitrogen through urea as a basal and remaining was top-dressed at 25-30 days after sowing of the crop. The soil of the field is derived from Indo-Gangetic alluvium and is sandy loam in texture having 63.3 per cent sand, 17.6 per cent silt and 19.1 per cent clay contents, alkaline in reaction with pH value of 7.9, low in organic carbon (0.35), EC (0.32 dS/m) and available N (196 kg/ha), whereas medium in available P (18 kg/ha) and high in available K (335 kg/ha).

Full dose of phosphorus was applied as single super phosphate at the time of sowing. Pearl millet hybrids and populations were sown with seed rate of 5.0 kg/ha during the middle of July and harvested in last week of September. The soil sample was collected from 0-15 cm depth with the help of the auger in **kharif** 2007 before sowing of the pearl millet. The average maximum temperature and minimum temperature during pearl millet growing season (July-September) was 35.4°C and 25.1°C, respectively. The average rainfall received during pearl millet growing seasons of 2007, 2008, 2009 and 2010 was 156.1, 373.2, 329.6 and 657.5 mm, respectively.

The sustainable yield index (SYI) was calculated by the formula developed by Ehrenfeld (1987) :

$$SYI = \frac{Y - \alpha}{Y_{max}}$$

Where, Y is the estimated average yield of a practice over years, α is its estimated standard deviation and Y max is the observed maximum yield in the experiment. The index takes values between zero and unity.

RESULTS AND DISCUSSION

The data pertaining to grain yield of pearl millet presented in Table 1 showed significantly increased yield by recommended package of practices over farmer's practices. The study conducted with different management practices from 2007 to 2010 revealed that recommended package of practices (30.46 q/ha) produced 21.1 per cent more grain yield than farmer's practices (25.16 q/ha). The range of grain yield was between 22.55 to 29.63 q/ha in the farmer's practice, whereas this range was 28.81 to 34.43 q/ha in the recommended package of practices (Table 2). The adoption of recommended practices enhanced the productivity by 23.5 and 18.5 per cent, respectively, in

TABLE 1
Performance of pearl millet hybrids and populations as affected by management practices

Treatment	Grain yield (q/ha)					Stover yield (q/ha)				
	2007	2008	2009	2010	Mean	2007	2008	2009	2010	Mean
Farmer's practice	29.63	23.67	22.55	24.79	25.16	98	111	108	109	107
Recommended package of practices	34.43	29.18	29.43	28.81	30.46	105	120	118	121	116
C. D. (P=0.05)	1.11	1.88	1.32	1.23	-	2.0	4.0	3.0	2.0	-
RHB-121	32.50	25.97	26.20	23.75	27.10	94	102	102	94	98
GHB-558	34.75	28.82	28.66	30.09	30.58	99	113	113	122	112
Raj-171	29.60	25.90	24.50	27.64	26.91	106	117	117	124	116
Pusa 383	31.27	25.00	24.59	25.71	26.64	106	118	118	120	116
C. D. (P=0.05)	1.57	2.66	1.87	1.74	-	3.0	6.0	4.0	3.0	-

hybrid and population as compared to farmer's management. Rani (2007) reported that yield attributes were significantly improved with increasing levels of management. Similar improvement in the yield to the tune of 34 and 32 per cent in hybrid and improved variety with the adoption of improved management as compared to local management were reported (The mean data from 1985-1988 of Aurangabad, Jaipur, Jam Nagar, Kanpur and Jodhpur centers) (Anonymous, 1988). Experiment conducted during 1987-88 at different locations showed that use of hybrids and improved varieties alone increased grain yield by 21 and 12 per cent at Pune; 52 and 34 per cent at Kanpur and 42 and 14 per cent at Hisar as compared to locals. The studies conducted from 2005 to 2010 at nine locations among three zones (Zone A1, A and B) showed that optimum management gave 30.3 - 42.8, 21.6- 42.3 and 7.9-18.7 per cent more grain yield than low management, whereas increase in fodder yield was 7.7-35.6, 9.45-19.2 and 9.74-17.00 per cent in Zone A1, A and B, respectively (Anonymous, 2011).

TABLE 2
Sustainable yield index (SYI) among pearl millet hybrids and populations (2007-2010) as affected by management practices

Treatment	Grain yield (q/ha)					SYI
	2007	2008	2009	2010	Mean	
Farmer's practice						
RHB-121	23.43	30.30	21.79	21.87	24.35	0.30
GHB-558	25.13	31.30	25.62	27.02	27.27	0.42
Raj-171	23.60	27.80	20.9	25.94	24.56	0.37
Pusa 383	22.50	29.13	21.87	24.32	24.46	0.22
Mean	23.67	29.63	22.55	24.79	25.16	0.33
Recommended package of practices						
RHB-121	28.50	34.70	30.60	25.63	29.86	0.63
GHB-558	32.50	38.20	31.70	33.16	33.89	0.65
Raj-171	28.20	31.40	28.10	29.35	29.26	0.66
Pusa 383	27.50	33.40	27.30	27.09	28.82	0.49
Mean	29.18	34.43	29.43	28.81	30.46	0.61

The perusal of the data in Table 2 reveals that under both management practices the yield of hybrids was more than the populations. Among hybrids and populations : GHB 558 (30.58 q/ha) produced significantly higher grain yield than RHB 121 hybrid (27.10 q/ha), population Raj 171 (26.91 q/ha) and Pusa 383 (26.64 q/ha). The grain yield improvement was 5.51 and 6.62 q/ha in the hybrids RHB 121 and GHB 558, whereas it was 4.70 and 4.36 q/ha in the recommended package of practices than farmer's practice. The study further indicated better performance of both the hybrids than the populations Raj 171 and Pusa 383.

Sustainable yield index (SYI) of the experiment for the period **kharif** 2007 to **kharif** 2010 was calculated and SYI was quite higher in recommended package and practices (0.61) than the farmer's practices (0.33). In farmer's practices, the SYI was found maximum in hybrid GHB 558 (0.42) and followed by Raj 121 (0.37), RHB 121(0.30) and Pusa 383 (0.22). The SYI was comparable in the population Raj 171 (0.66), hybrid GHB 558 (0.65) and RHB 121 (0.63) but quite superior over Pusa 383 (0.49) in the recommended package of practices. Recommendable sustainable practices derived on the basis of sustainability index revealed that any practice yielding SYI>0.66 was considered as recommendable for package of practices of a crop in a region and SYI of 0.50 to 0.65 as highly promising. A practice with SYI <0.33 is believed to be undependable.

CONCLUSION

The performance of hybrids was found better

as compared to populations under both management levels and further revealed that recommended package of practices produced 21.1 per cent higher grain yield than farmer's practices.

REFERENCES

Anonymous. 1988 : *Annual Report.* All India Co-ordinated Pearl Millet Improvement Project, Mandor, Jodhpur.

Anonymous. 2011 : *Annual Report.* All India Co-ordinated Pearl Millet Improvement Project, Mandor, Jodhpur.

Anonymous. 2015 : Accessed from agricrop.nic.in. Department of Agriculture, Co-operation and Farmers' Welfare.

Bidinger, F. R., A. G. Bhaskar Raj, and C. T. Hash. 2006 : Zonal adaptation in pearl millet cultivar types. *Indian J. Genet. and Plant Breed.* **66** : 207-211.

Ehrenfeld, David 1987 : Sustainable agriculture and the challenge place. *Amer. J. Alternative Agric.* **2** : 184-187.

Khairwal, I. S., K. N. Rai, O. P. Yadav, B. S. Rajpurohit, and S. Negi. 2009 : *Pearl Millet Cultivars : Seeds of Choice*. All India Co-ordinated Pearl Millet Improvement Project, Mandor, Jodhpur. 36 pp.

Rani, S. 2007 : Comparative performance of pearl millet hybrids and composites under different management levels. M. Sc. thesis, CCS Haryana Agricultural University, Hisar.

Yadav, O. P., and F. R. Bidinger. 2007 : Utilization, diversification and improvement of landraces for enhancing pearl millet productivity in arid environments. *Ann. Arid Zone*, **46** : 49-57.

Yadav, A. K., R. K. Arya, M. K. Singh, D. Kumar and R. Panchta. 2016 : Heat tolerance in pearl millet : A Review. *Forage Res.* **42** : 65-81.