

Pearl millet cultivars

developed for A₁ zone

S P Singh¹, Mukesh Sankar S² and C Tara Satyavathi³

Indian Agricultural Research Institute, New Delhi 110 012

Pearl millet is the staple food of the majority of the poor and small-land holders, as well as feed and fodder for livestock in the rainfed regions of the country. It requires less input, matures in short duration and is considered as nutritious food feed and fodder. It is usually grown under the most adverse agro-climatic conditions where other crops like sorghum (Sorghum bicolor) and maize (Zea mays) fail to produce economic yield. It is a rich source of fibres and minerals especially iron, zinc and calcium and rightly said nutri-cereals. Despite all these advantages, it is perceived inferior due to lack of awareness about its nutritional richness, lack of right processing technologies and lack of economic incentives to farmers.

Key words: Cultivars, Pearl millet, Zones

IN India, pearl millet is the third most widely cultivated food crop after rice and wheat. It is grown on 7.128 million ha with an average productivity of 1,132 kg/ha during 2015-16. The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana which account for more than 90% of pearl millet acreage in the country. Most of pearl millet in India is grown in rainy season between June and September. It is also cultivated during the summer from February to May in parts of Gujarat, Rajasthan and Uttar Pradesh and during post-rainy season, *rabi* (November-February) at a small-scale in Maharashtra and Gujarat. In fact for the driest climate such as western Rajasthan, it is compulsion rather than a choice crop for farmers. In these harsh areas farmers can get some grain for food and dry stover as feed for livestock. At present total area under pearl millet is 7.128 million ha in 2015-16 and advance estimates for 2016-17 showed slight increase up to 7.48 million ha. In spite of area shrinkage, the production of pearl millet increased

constantly to 8.06 million tonne in 2015-16 and estimated to reach 9.41 million tonne (advance estimates for 2016-17). As an average of latest data of four years (between 2012-13 and 2015-16) in Rajasthan, Uttar Pradesh, Maharashtra, Haryana and Gujarat accounted for 94.82% of total area under pearl millet and contributed to 87.70% of total production.

Country has been divided into three zones for testing the hybrids and varieties performance in All India Coordinated Pearl Millet Improvement Project (AICPMIP).

Zone A₁: It comprises of the part of Rajasthan, Gujarat and Haryana and its annual rainfall is < 400 mm. The zone is drought prone and has light sandy soils and high temperatures.

Zone A: It comprises of the



remaining part of Rajasthan, Gujarat, Haryana and entire pearl millet growing areas of Uttar Pradesh, northern Madhya Pradesh and Delhi with annual rainfall >400 mm. The zone has sandy to sandy loam soils and irrigation facilities are available in some area.

Zone B: It comprises Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh with > 400 mm rainfall relatively heavy soils and mild temperature conditions. The zone has shorter days when compared with A₁ and A zones.

In the cultivar development, greater emphasis was given on genetic diversification of both seed

Table 1. Pearl millet hybrids and OPVs developed for A₁ zone

Cultivars	Parentage	Area of adaptation	Salient features
*RHB 223 (MH 1998)	ICMA 96666 × RIB 3135 -18	Drier part of Rajasthan, Gujarat and Haryana for early maturity group (A ₁)	Early maturity
JKBH 1008 (MH 1828)	JKMS 1954A × JKR 16010	Rajasthan, Gujarat, Haryana (A ₁)	Early maturing, grey, globular grains; resistant to downy mildew, and blast
MPMH 21 (MH 1777)	ICMA 93333 × MIR 524	Rajasthan, Gujarat, Haryana (A ₁)	Early maturing, grey-brown hexagonal grains, resistant to downy mildew, blast, and smut
HHB 272 (MH 1837)	HMS 47A × AC04/13	Rajasthan, Gujarat, Haryana (A ₁)	Early, grey-globular grains, and resistant to blast
HHB 234(MH 1561)	HMS 7A × H77/833-2-202	Western Rajasthan and drier part of Gujarat and Haryana	Early maturing, candle shaped, ear heads with small bristles, medium seed size and tolerant to downy mildew
Bio 70 (MH 1632)	11A × R 207	Western Rajasthan and drier part of Gujarat and Haryana	Early maturing, conical compact ear heads, yellow anther, globular grey seed and tolerant to downy mildew
HHB-226(MH 1479)	ICMA 843-22 × HBL-11	Western Rajasthan and drier part of Gujarat and Haryana	Medium maturing, medium height, dark green, leaves, candle-shaped bristled ear heads, resistant to downy mildew
RHB-177(MH-1486)	ICMA 843-22 × RIB494	Western Rajasthan and drier part of Gujarat and Haryana	Early maturing, medium-tall, cylindrical bristled ear heads, resistant to downy mildew, light yellow anthers
HHB 216(MH 1421)	HMS 37A × HTP 3/13	Western Rajasthan and drier part of Gujarat and Haryana	Medium maturing, resistant to downy mildew, candle-shaped medium long togo ear heads with brownish long bristled
RHB 154	ICMA 95444 × RIB 57 S/05	Western Rajasthan and drier part of Gujarat and Haryana	Early maturing, medium tall, resistant to downy mildew, tolerant to lodging, light yellow anthers, and cylindrical ear heads
GHB 757	ICMA 92777 × J 2467	Western Rajasthan and drier part of Gujarat and Haryana	Early maturity, medium tall, compact cylindrical-shaped ear heads with purple anthers, and globular grey brown grains
GHB 719	ICMA 95222 × J 2454	Western Rajasthan and drier part of Gujarat and Haryana	Duration 70-75 days to maturity, fully exerted conical-shaped, compact and bristled ear heads, globular, medium in size, grey-grains, and tolerant to drought.
GHB 538	ICMA 95444 × J 2340	Western Rajasthan and drier part of Gujarat and Haryana	Early maturity, highly resistant to moisture stresses, resistance to downy mildew and lodging
HHB 67Improved	ICMA 843-22 × H 77/833-2-202	Western Rajasthan and drier part of Gujarat and Haryana	Extra early maturity, highly resistant to moisture stresses, resistant to downy mildew. The first commercial cultivar developed using marker-assisted selection in India.
HHB 68	842 A × H77 / 833-2	Haryana	Duration 60-62 days, compact conical ear heads, yellow anthers, globular brown grains, resistant to drought, fits well in inter- and multiple-cropping
HHB 67	843A × H77/833 -2	All India	Duration 60-62 days, medium tall, thin stem, medium narrow leaves, semi-compact spindle shape ear heads, yellow anthers, grey globular grains, escapes drought and tolerates salt stress, fits well in inter- and multiple-cropping
Mandor Bajra Composite 2 (MBC 2) (MP 489)	-	Rajasthan, Haryana, and Gujarat	Early maturing, medium height, medium long semi-compact cylindrical ear heads, obvate grey seed
Pusa Composite 443 (MP443)	-	Rajasthan, Haryana, and Gujarat	Early maturity, medium tall, and rod-shaped ear heads with bold grain
CZP 9802	-	Dry areas of Rajasthan, Gujarat and Haryana (Zone A ₁)	Duration 70-72 days, medium tall, good tillering, tillering, thin stem, narrow leaves, thin candle-shaped ear heads, yellowish grains of medium size, drought tolerant, and very high stover

* Notification is awaited

and pollinator parents with the result that more than 113 hybrids were released for various niche ecologies

between 1991 and 2016. As a result, improvement in grain productivity has further increased up to 27 kg/ha/

year between 1991 and 2015. Breeding programme was backed up by strong seed production and

marketing of pearl millet cultivars by both public and private sectors. As a result, pearl millet recorded 124% increase in its productivity since 1986 which is highest among all food crops during last three decades. Same trend of productivity enhancement was not observed in A₁ zone where rainfall is less than 400 mm and distribution of rainfall is very erratic. In Jaisalmer, Bikaner, Sriganganagar, Hanumangarh, Barmer, Jodhpur, Nagaur, Churu, Jhunjhunu, Jalore and Pali district of Rajasthan are included under A₁ zone. This zone is characterized by high temperature and severe moisture stress. A₁ zone of pearl millet includes the rainfed regions of Rajasthan, Haryana and Gujarat where production and productivity of pearl millet is very low even in some of the areas of Rajasthan. It is less than 100 kg/ha. A₁ zone of pearl millet includes the rainfed regions of Rajasthan, Haryana and Gujarat where production and productivity of pearl millet is very low even in some of the areas of Rajasthan. It is less than 100 kg/ha.

Improved pearl millet cultivars have not been as widely adopted in north-western India as in relatively more favourable areas of the country. This zone includes drought prone areas receiving <400 mm of annual rainfall in the adjoining states of Rajasthan, Gujarat and Haryana which fall in A₁ zone. The other two zones are A (northern region of country with >400 mm rainfall) and B (central and southern regions of the country). Out of total area of 4.1 m ha in A₁ zone, 3.2 m ha is in Rajasthan and 0.45 m ha in Gujarat and Haryana. The western regions of Rajasthan thus constitute most of the area in A₁ zone and this zone would require a major focus for research as it represents >40% of the pearl millet area in India.

Choice for cultivars

Both hybrids and open pollinated varieties are available for A₁ zone. However, most of the breeding programme targeted hybrids for A and B zones where there were more chances for success. Greater emphasis was given until 1990s for

OPVs for arid areas on the presumption that genetically heterogeneous OPVs might be useful to exploit population buffering mechanism to provide higher and stable performance under unpredictable environments of arid and drier semi-arid areas. Large number of hybrids and OPVs were tested to assess the comparative advantage of each type of cultivar.

Update of cultivars developed for A₁ zone

Up to April 2017, sixteen hybrids and three populations were developed for this zone. All India Co-ordinated Research Project on Millets and Pearl millet, Chaudhary Charan Singh Haryana Agricultural University, Hisar contributed seven hybrids (HHB 272, HHB 234, HHB 226, HHB 216, HHB 67 Improved, HHB 68 and HHB 67) followed by AICPMIP MRS, Jamnagar which contributed three hybrids (GHB 757, GHB 719 and GHB 538), AICPMIP SKRAU, Jaipur contributed three hybrids (RHB 223, RHB 177 and RHB 154), AICPMIP (Jodhpur) also contributed one hybrid (MPMH 21) for A₁ zone. Thus 14 hybrids were developed by public sector. Three populations namely Mandore Bajra Composite 2 (SKRAU, ARS Mandor, Jodhpur), Pusa Composite 443 (IARI, New Delhi), and CZP 9802 (CAZRI, Jodhpur) were also developed for this zone (Table 1).

Limitations for A₁ zone

This zone has harsh environment, and in this zone pearl millet crop is completely dependent on rainfed varieties. This zone is characterized by very high temperature and drought stress. Low pearl millet productivity in this zone is because of three reasons namely cultivation of local cultivars (in dry areas) that have low yield potential and susceptible to diseases; abiotic stresses such as drought (varying duration and intensity) due to low erratic rainfall, high temperature (heat) and low soil fertility (lack of nitrogen (N) and phosphorous (P)) with soil surface crusting and biotic stresses such as

diseases like downy mildew, smut, ergot and blast etc.

Future priorities and challenges

Productivity of this zone is lowest when it is compared with A and B zones because of adverse weather conditions and several biotic and abiotic stresses. Hybrids and populations were developed for this zone by many AICPMIP centres involved in improvement of pearl millet. Despite this, area under improved cultivars is hardly more than 30 to 40% and most of the farmers are growing local cultivars. Multi-location testing of hybrids and population in this zone indicated superiority of hybrids for grain and fodder yield both. However, availability of seed of hybrid at lower price is a challenge in this region. For this zone, most of the hybrids were developed by public sector and availability of seed of these hybrids is a major constraint. Private sector is not giving much focus in this region because return is less assured. Environmental conditions are very harsh and unpredictable in this zone that is why farmers sometimes have to sow pearl millet crop twice and thrice. Hybrid seed is expensive (₹ 460/1.5 kg) that is why farmers prefer populations in this zone because seed of population is less costly and purchase of seed is not required every year.

SUMMARY

Hybrids can be spread in this region, if seeds of hybrids can be made available to farmers at cheaper rate around ₹ 120/ kg or same price for OPVs. State seed corporations of Rajasthan, Haryana and Gujarat should strengthen the hybrid seed production for A₁ zone for meeting the demand of hybrid seed at reasonable price. Private sector should also adopt more sympathetic approach for solving the problem of hybrid seed production in this harsh zone.

¹Principal Scientist, ²Scientist, Division of Genetics, IARI, New Delhi 110 012, ³Project Co-ordinator, AICRP on Pearl millet, Mandor, Jodhpur (Rajasthan). Corresponding author's (e mail: sumerpalsingh@yahoo.com).