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Research Note

Pearl millet for health and nutritional security

Ruchika Bhardwaj[1]*, Manpreet Kaur[1], Meenakshi Goyal[1], RS Sohu[1] and C T Satyavathi[2]
Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana.
[2]Division of Genetics. IARI, New Delhi
*E-mail:ruchipau@gmail.com

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Abstract

Six genotypes of pearl millet *viz*., PHB 2168, PHB 2884, PHB 3053 (three hybrids) and PCB 164, PC 443, PC 334 (three composites), were analyzed for various agronomic and quality traits as well as popping potential. PHB 3053 registered maximum plant height followed by PC 334. Ear length was found maximum for PCB 164 followed by PHB 2884 and PHB 3053, whereas, ear girth was found maximum for PHB 3053 followed by PC 334. The grain yield was found maximum for PHB 2884 (18.91 q/ha) followed by PHB 3053 (18.89 q/ha). The maximum popping yield (0.63 g/50 g) and popping yield per cent (39.07%) was found in PC 443 followed by PAU composite PCB 164 (27.33%). Crude protein per cent was found higher in popped product than raw grains. PC 334 registered highest crude protein content. Crude fibre, ash and fat content were found lower in popped product than normal grains.

Keywords: Pearl millet, grain yield, popping yield, quality traits.

Pearl millet (*Pennisetum glaucum* L. R.Br.) also known as bajra is an important coarse grain cereal crop and ranks fifth after rice, wheat, maize and sorghum (http://www.aicpmip.in/pcr2011.pdf). India is the largest producer of pearl millet both in terms of area (8.69 mha) and production (10.05mt) with an average productivity of 1156 kg/ha (Anonymous, 2013).

Pearl millet is a multipurpose crop which is grown for food, feed, green and dried (karvi) forages. Both grain and stover of pearl millet have a better mineral profile than many other cereals. With the subsidized cheaper availability of rice and wheat under Public Distribution system (PDS), increase in the per capita income, growing urbanization, changing tastes and preferences, the annual per capita consumption of pearl millet both in rural and urban areas has fallen steeply. However, the use of pearl millet is increasing in the brewing industry, in poultry, animal feed and fodder. Use of pearl millet is also increasing in traditional foods and snacks like porridge, chappati, khichri, laddoo, mathi etc; baked products like cake, biscuits etc; extruded products like sev, kurkure; flakes and pops and many more. Pearl millet is gluten free grain and is the only grain that retains its alkaline properties after being cooked which is ideal for people with wheat allergy (Iren Leder, 2004).

Keeping this in view, the present investigation was undertaken to study the various agronomic and nutritional parameters in pearl millet genotypes which can help popularizing pearl millet not only in the traditional areas but elsewhere also.. The efforts were made to develop pops from different pearl millet genotypes.

An experiment was carried out during *kharif* 2013 at Pearl millet Research Farm, Department of Plant Breeding and Genetics, PAU, Ludhiana. Six genotypes of pearl millet *viz*., PHB 2168, PHB 2884, PHB 3053, PCB 164, PC 443 and PC 334 were evaluated in three replications for various agronomic and quality traits as well as popping potential. PHB 2168 and PHB 2884 are released hybrids of PAU whereas, hybrid PHB 3053 is in the advance stage of testing; PCB 164 is PAU composite whereas, PC 443 and PC 334 are composites from IARI, Pusa. The composite PC 443 is the identified genotype of IARI for good popping yield. The traits *viz*., plant height (cm), ear length (cm), ear girth (cm), grain yield (g), popping yield (g/50g sample), popping yield percent (%), crude protein (%), ash (%), crude fibre (%) and fat (%) were estimated. The quality traits were calculated using methods by AOAC (1970).

To record the popping yield, 50g of grain sample from each entry per replication were roasted in a pan over *chullah* in field. Then per cent of pops formed out of 50g were calculated to find out popping yield per cent from the whole grain yield obtained from each entry. All the quality traits were studied in raw as well as popped products. The data were analysed to study the variation observed in all the genotypes for different traits studied.

The six genotypes differ significantly for all the traits studied *viz*., plant height, ear length, ear girth, grain yield, popping yield, popping yield percent and 1000 seed weight (Table 1). The differences were significant for quality traits of the popped product *viz*., crude protein, ash protein, crude fibre and fat per cent of popped grains (Table 3). Chauhan *et al.* (2012) also reported significant differences for popping yield.

The hybrid PHB 3053 registered maximum plant height (239.89 cm) followed by PC 334 (226.67 cm), PHB 2168 (215.78 cm), PC 443 (210.67 cm), PCB 164 (210.11 cm), PHB 2884 (202.66 cm). Ear length was maximum for PCB 164 (28.78 cm), followed by PHB 2884 and PHB 3053 (26.67 cm), PC 334 (25.33 cm), PHB 2168 (25.11 cm) and PC 443 (19.72 cm). Ear girth was found to be maximum for PHB 3053 (11.55 cm) followed by PC 334 (10.89 cm), PHB 2884 (10.44 cm), PCB 164 (10.22 cm), PHB 2168 (9.55 cm) and PC 443 (8.77 cm). But the grain yield was maximum for PHB 2884 (18.91 q/ha) followed by PHB 3053 (18.89 q/ha), PHB 2168 (17.73 q/ha), PC 334 (15.56 q/ha), PCB 164 (12.00q/ha) and PC 443 (10.00 q/ha). The maximum popping yield was found in PC 443 (0.63 g/50 g) with maximum popping yield per cent of 39.07% (Table 1). The PAU composite PCB 164 had 27.33% popping per cent followed by PC 334 (22.72%), PHB 2884 (20.27%), PHB 2168 (17.55%) and PHB 3053 (13.72%). Hence The composites PC 443 and PCB 164 were identified as best genotypes for popping although other genotypes also showed good potential of popping. Chauhan *et al.* (2012) also found PC 443 as a genotype for ready to eat popped up snacks. They also reported that if optimum processing conditions are provided popping yield can be increased from 30 to 64%. The PAU hybrid PHB 2168 accounted highest 1000 seed weight of 10.87g.

The trends of phenotypic co-efficient of variation (PCV) and genotypic co-efficient of variation (GCV) (Table 2) showed higher values of PCV than GCV for all the traits studied. The narrow range of difference between PCV and GCV indicated the less influence of environment in the inheritance of these traits. Similar findings have been reported by Kunjir and Patil (1986), Borkhataria *et al*. (2005). This also indicated that any selection pressure operated on these traits may help in early generation improvement of the trait. Highest PCV (26.29) and GCV (19.22) were recorded for popping yield. The GA% was also highest for this trait (28.95) with high heritability estimates of 53.46%. This indicated that the trait is governed by additive gene action and direct selection is effective for the trait. In general the heritability estimates were high for all the traits *viz*., plant height, ear length, ear girth, popping yield and 1000- seed weight except grain yield where heritability estimates were found 25.11%. This indicated that for selection to higher grain yield, the traits having high heritability and %GA can be more effective and reliable selection indices.

Regarding the quality traits (Table 3), the crude protein content of normal grains varied from 7.09 to 8.92% whereas, popped grains registered 7.16 to 9.02% and the interaction was also found to be significant. The highest crude protein content in the popped product was observed in PC 334 (9.02%). Among all the genotypes, crude protein content of the popped grains was higher than raw grains. Similar findings were reported by Choudhury *et al.* (2011). This may be due to the fact that seed coat contains less protein than endosperm (Mac Masters *et al.* 1971) and the removal of seed coat while popping may be the reason for increased protein content of the popped millet. Nithya *et al.* (2007) reported loss of crude protein in the heat treated grains which could be due to denaturation and degradation of protein. Lower fat, crude fibre and ash content among popped grains was also reported by Choudhury *et al.* (2011). In cereals, fat content is found to be more in the outer seed coat, hence higher fat content was found in the raw samples (Mac Masters *et al.* 1971). As the popped seeds were more with the endospermic material, the fat content was lower in popped samples than in raw seeds. The highest fat per cent was found in the hybrid PHB 2884 (6.00%) in the popped grains.

In millet seeds there are two sources of fibre *i.e.* hull or pericarp and the cell wall structural components. During popping, endosperm puffs out and localized rupture of the cell wall occurs in the expanded endosperm. In popping, the seed coat gets removed to some extent which could be the reason for lower fibre content of popped samples as compared to raw samples (Hulse *et al.* 1980). The highest fibre content was found in composite PCB 164 (6.06%) in the popped grains which indicated presence of more fibre content in PC 443.

Reduced level of mineral in the popped millet samples may be due to greater concentration of minerals present in the germ and bran layers than in the endosperm (Mac Masters *et al.* 1971) which contributes to a greater extent towards the amount of total mineral content in the whole seeds. The composite PC 443 registered maximum ash per cent (4.85 %) in the popped grains.

Thus, pearl millet has considerable scope to be utilized as ready to eat popped up snacks. Also, it has good nutritional quality which will help in developing low cost dietary formulations. Owing to its potential role as high energy food for poor, diabetic people as well as people allergic to gluten, its potentiality for health and nutritional security needs to be explored.

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Table 1. Mean of ancillary characters and popping potential of different pearl millet genotypes

Genotype	Plant height (cm)	Ear length (cm)	Ear girth (cm)	Grain yield (q/ha)	Popping yield (g/50g)	Popping yield (%)	1000 seed weight (g)
PC 443	210.67	19.72	8.77	10.00	0.63	39.07	9.00
PC 334	226.67	25.33	10.89	15.56	0.56	22.72	10.57
PHB 2168	215.78	25.11	9.55	17.73	0.46	17.55	10.87
PHB 2884	202.66	26.67	10.44	18.91	0.57	20.27	10.55
PHB 3053	239.89	26.67	11.55	18.89	0.37	13.72	8.87
PCB 164	210.11	28.78	10.22	12.00	0.39	21.33	8.91
CD (5%)	8.28	1.06	0.89	2.81	0.97	2.34	2.00

Table 2. Variability parameters for different traits in pearl millet

Trait	Heritability(%)	Genetic Advance (%)	PCV	GCV	Genetic advance as percentage of Mean
Plant height(cm)	89.32	11.83	6.43	6.08	217.64
Ear length (cm)	96.44	24.22	12.19	11.97	25.38
Ear girth (cm)	77.88	16.65	10.38	9.16	10.24
Popping yield (g/50g)	53.46	28.95	26.29	19.22	0.51
1000 seed weight (g)	50.99	12.49	11.89	8.49	9.80
Grain yield (kg/plot)	25.11	7.40	14.30	7.16	4.79

Table 3. Quality characteristics of pearl millet genotypes*

Genotype	Crude protein (%)		Crude fibre (%)		Ash (%)		Fat (%)	
	Popped	Normal	Popped	Normal	Popped	Normal	Popped	Normal
PC 443	8.02	7.97	4.60	8.83	4.85	4.91	5.23	5.40
PC 334	9.02	8.84	5.70	9.60	3.79	4.32	5.20	5.23
PHB 2168	8.14	7.16	5.13	8.70	3.59	3.82	5.10	5.90
PHB 2884	8.79	8.32	5.60	9.10	3.76	4.55	6.00	6.16
PHB 3053	8.67	7.09	5.70	6.33	3.18	4.34	5.23	5.90
PCB 164	8.92	7.59	6.06	7.96	3.13	3.58	5.23	5.40
CD (5%)	0.51	NS	1.04	1.60	1.30	NS	1.05	0.85
CD (5%)								
Popping	NS		0.46		0.33		NS	
Varieties	0.32		0.80		0.58		0.51	
Popping X Varieties	0.45		1.13		NS		NS	

*The values are mean of three replicates