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Research Note

Genetic studies for yield and its component traits in RIL population of pearl millet (*Pennisetum glaucum* [L.] R. Br.)

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Abstract
Pearl millet [*Pennisetum glaucum* (L.) R. Br., Poaceae] is an important crop of the semi-arid tropics in Africa and India. A RIL mapping population developed by crossing PT 6029 × PT 6129 was evaluated for various genetic variability parameters. Analysis of variance revealed high significant values for all the 11 characters studied. Phenotypic coefficient of variation (PCV) was higher than genotype coefficient of variation (GCV) for all the characters indicating the influence of environment on the characters. High PCV and GCV were observed for yield per plant and grain weight per ear head. The high heritability was recorded for all the traits except for days to 50% flowering, days to maturity and ear head girth. High heritability coupled with high genetic advance as per cent of mean was observed for 1000 grain weight, number of productive tillers, single ear head grain weight, single ear head weight, single plant yield and plant height. These characters were controlled by additive gene effect. Hence selection based on these characters would be effective for further pearl millet improvement programme. Transgressive segregants were observed for all the 11 traits. These could be used for yield testing apart from utilizing it as pre breeding material. The mapping population could be used for mapping of genes for important traits.

Key words: Pearl millet, PCV, GCV, heritability, genetic advance, transgressive segregants

Pearl Millet [*Pennisetum glaucum* (L.) R.Br.] commonly known as bajra, cat tail millet, and bulrush millet in different parts of the world is a highly cross-pollinated crop. In India it is the fifth most important grain crop next to rice, wheat, maize and sorghum (Singh and Sehgal, 2008) and it is grown in an area of 8.77 million hectares with the production of 10.27 million tonnes (Directorate of Economics and Statistics, GOI, 2011-12). The major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana that account for more than 90 percent of pearl millet acreage in the country. In Tamil Nadu, it is cultivated in an area of about 0.047 million hectares with a production of 0.11 million tonnes and productivity of 2452 kg/ha (Directorate of Economics and Statistics, GOI, 2011-2012).

Genetic variability studies in crops provide basic information regarding the genetic properties of the population studied, based on which breeding strategies are designed for further improvements (Singh *et al.,* 2013). These studies are also helpful in understanding the nature and extent of variability that can be attributed to different causes, sensitive of crops to environmental influences, heritability of the characters and genetic advance that can be realized in practical breeding. Hence, to have a thorough comprehensive idea, it is necessary to have an analytical assessment of yield components. Since heritability is also influenced by environment, the information on heritability alone may not help in pin pointing characters enforcing selection. Nevertheless, the heritability estimates in conjunction with the predicted genetic advance will be more reliable (Johanson *et al.,* 1955). Therefore, an attempt has been made to study the genetic variability, heritability and genetic advance in the present study.

The experimental material comprised of a mapping population derived from cross of agronomically superior inbred line (PT 6029) with golden millet line (PT 6129). The mapping population consisted of 200 RILs and was developed through ear to row method. The experiment was laid out in homogenous block following randomized block

design (RBD), consisted 202 rows (200 RILs along with parents) with two replication during summer 2013 at Department of Millets, Tamil Nadu Agricultural University, Coimbatore. The RILs along with parents were planted in a row of 4 m in length with a spacing of 45 cm × 15 cm. Recommended package of practices were followed. The observation were recorded for five randomly selected plants in each RIL for 11 characters *viz.*, days to 50 % flowering, days to maturity, plant height, number of productive tillers, ear head length (cm), ear head girth (cm), single ear head weight (g), single ear head grain weight (g), 1000 grain weight(g), chlorophyll content and single pant yield (g). Statistical methods suggested by Burton (1952) for variability, Lush (1940) for heritability, Johnson *et al.* (1955) for genetic advance as percent of mean were adopted to find out the respective estimates. Further categorization of estimates was made based on the suggestions of Sivasubramanian and Madhavamenon (1973) for variability, Johnson *et al.* (1955) for heritability and genetic advance as percent of mean.

Analysis of variance for the parents and 200 RIL population had highly significant differences for all 11 traits (Table 1). The existence of wide variability was observed with respect to different traits in the RIL population. The general mean value for each trait and its range among RIL population are given in Table 2.

Genetic variability: In general, the estimates of phenotypic coefficient of variation (PCV) were higher than the estimates of genotypic coefficient of variation (GCV) for all the traits under the study indicating that the substantial influence of the environment in the expression of these traits. These findings corroborate well with those of Fadlalla (2002), Abuali (2006), Sumathi *et al.*, 2010 and Subi and Idris (2013) in pearl millet. The high PCV (50.07) and GCV (40.10) was observed for single plant yield, this was in conformity with the findings of Vidyadhar *et al.* (2006), Lakshmana *et al.* (2009) and Sumanth (2011) followed by single ear head grain weight table 2. High amount of GCV and PCV suggested greater scope of selection of superior genotypes for these traits, indicating variation for these traits contributed markedly to the total variability. Moderate PCV (18.83) and GCV (16.71) were recorded for number of productive tillers followed by single ear head weight, ear head girth, 1000 grain weight and plant height. Similar trend of moderate PCV and GCV value were reported in earlier studies by Vetriventhan and Nirmalakumari (2007), Meenakumari and Nagarajan (2008) and Sumathi *et al.* (2010). Low PCV (8.89) and GCV (7.82) were observed for chlorophyll content followed by days to flowering and days to maturity, this was in conformity with the findings of Sowmiya (2012).

Heritability and genetic advance: The coefficient of variation indicates only the extent of total variability present for the character and does not demarcate the variability into heritable and non-heritable portion. Hence the estimate of heritability, which indicates precisely the heritable expected gain, assumes importance. The information on heritability alone may not help in formulating suitable breeding procedures. Nevertheless, the heritability estimates in conjunction with predicted genetic advance will be more reliable (Johanson *et al.*, 1955). Estimates heritability (broad sense), genetic advance and genetic advance as per cent of mean are furnished in Table 2. The heritability estimates ranged from 40.57 - 86.41. The heritability was high for the characters 1000 grain weight (79.39), number of productive tillers (78.82), chlorophyll content (77.61), single ear head weight (64.89), single plant yield (64.16) and ear head length (61.00). Similar findings were observed for number of productive tillers, ear head length, single ear head weight, 1000 grain weight and single plant yield by Sumanth, 2011 and Ashok, 2012. A perusal of genetic advance as per cent of mean 11 traits revealed that it varied from 3.17-66.16. The genetic advance as per cent of mean was high for the characters single plant yield (66.16), single ear head grain weight (48.61), number of productive tillers (30.56), 1000 grain weight (28.17), single ear head weight (24.18) and plant height (21.16). Similar kinds of results were observed for plant height, number of productive tillers, single ear head weight, single ear head grain weight, 1000 grain weight and single plant yield by Sumanth (2011) and Ashok (2012). The character which exhibited high heritability and genetic advance as per cent of mean indicated the broad sense of additive gene action in its inheritance and such characters could be improved by simple selection methods (Panse, 1957). High heritability (79.39) coupled with high genetic advance as per cent of mean (28.17) was found for 1000 grain weight followed by number of productive tillers, single ear head grain weight, single ear head weight, single plant yield and plant height (table 2), indicates that most likely the heritability is due to additive gene effects and selection may be effective. This was in conformity with findings of Sumanth (2011) and Ashok (2012). High heritability (77.61) couple with moderate genetic advance as per cent of mean (14.21) was observed for the trait chlorophyll content. Moderate heritability (52.14) couple with moderate genetic advance as per cent of mean (19.09) was observed for ear head girth. Moderate heritability (47.28) coupled with low genetic advance (6.97) was observed for the traits days to flowering followed by days to maturity (table 2).

Transgressive segregants: The prime objective of any crop improvement programme is to improve the yield potential. Out of the 200 RILs in the present investigation, 52 lines were early flowering and 43 lines were early maturity as compared to parents. Since, pearl millet is mostly grown in arid and semi arid zone, selection for early flowering and early maturing varieties is desirable. A total of 133 shorter transgressed inbreds was observed (<175.00 cm) and this exhibit the possibility of developing dwarf inbreds in pearl millet. RILs with more number of productive tillers have direct contribution towards yield. Thus, more number of productive tillers was recorded in 39 lines (Fig. 1). With regard to ear head length, 177 lines (>23.00 cm), ear head girth 15 lines (>12.50 cm), single ear head weight 31 lines (>49.50 g), single ear head grain weight 19 lines (32.50 g) and for 1000 grain weight 18 lines (>12.95 g) outperformed the parent. These traits have direct contribution towards the yield in pearl millet. A total of 20 lines outperformed for chlorophyll content (>58.88). In case of single plant yield, 22 lines were isolated which outperformed the parents. Thus, we speculate the possibility development of desirable lines beyond the genetic makeup of the parental lines (Fig. 1).

Based on the present study, the RILs with better mean values for yield attributing traits will be helpful to develop high yielding varieties. The RILs isolated with specific traits could be used as pre breeding material for the improvement of pearl millet. Further the mapping population could be used for mapping of genes/QTLs for yield related traits.

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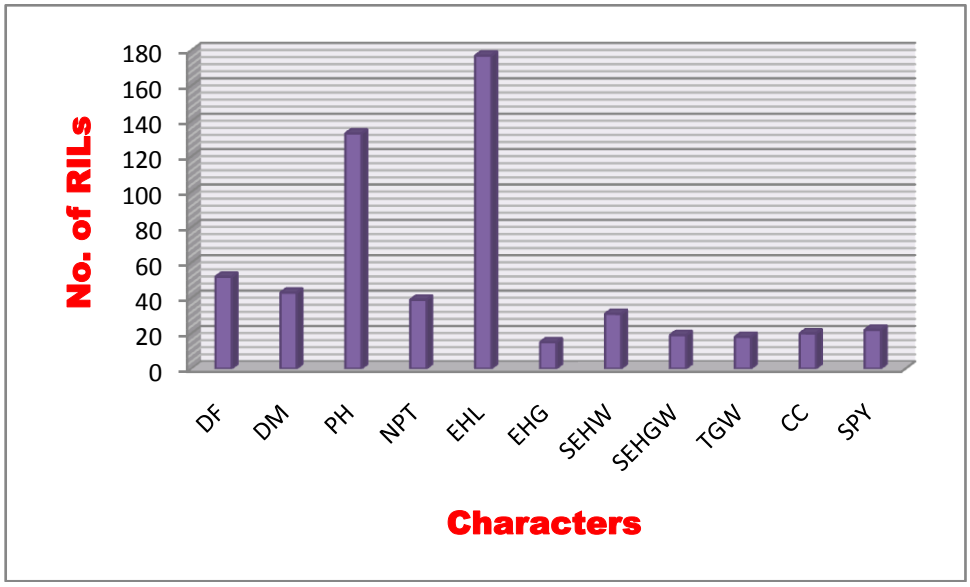
Table 1. Analysis of variance for yield and its component traits in pearl millet

Source of variation	df	Mean square										
		Days to 50 % flowering	Days to maturity	Plant height (cm)	Number of productive tillers	Ear head length (cm)	Ear head girth (cm)	Single ear head weight (g)	Single ear head grain weight (g)	1000 grain weight (g)	Chlorophyll content	Single plant yield (g)
Replication	1	14.148	0.120	258.480	0.003	0.903	0.052	6.298	20.2181	0.030	3.2150	2.590
Treatment	201	17.730**	15.639**	1076.341**	0.892**	26.019**	5.216**	99.145**	88.848**	5.626**	41.807**	2309.042**
Error	201	6.347	6.612	233.610	0.106	6.302	1.640	21.108	12.962	0.6463	13.373	504.330

**** Significant at 1% level**

Table 2. Coefficient of variation, heritability (broad sense), genetic advance and genetic advance as per cent of mean for yield and its component traits in RIL population of pearl millet

Characters	General mean	Range	PCV %	GCV %	Heritability (h^2) %	Genetic advance	GA as per cent of mean
Days to 50% flowering	48.45	41.92-55.43	7.16	4.92	47.28	3.38	6.97
Days to maturity	87.71	82.00-94.80	3.80	2.42	40.57	2.78	3.17
Plant height (cm)	160.25	10.20-198.20	15.97	12.81	64.33	33.92	21.16
Number of productive tillers	3.75	2.25-5.50	18.83	16.71	78.82	1.15	30.56
Ear head length (cm)	27.58	1900-39.70	14.57	11.38	61.00	5.05	18.31
Ear head girth (cm)	9.99	7.65-15.80	18.53	13.38	52.14	1.99	19.09
Single ear head weight (g)	41.77	28.31-64.32	18.56	14.96	64.89	10.37	24.18
Single ear head grain weight (g)	22.53	12.53-40.78	31.66	27.33	74.54	10.95	48.61
1000 grain weight (g)	10.28	7.38-15.34	17.23	15.35	79.39	2.90	28.17
Chlorophyll content	54.60	34.50-61.70	8.89	7.82	77.61	7.76	14.20
Single plant yield (g)	74.91	28.17-172.00	50.07	40.10	64.15	49.56	66.16



DF-days to 50% flowering, DM-days to maturity, PH-plant height,NPT-number of productive tillers, EHL-ear head length, EHG-ear head girth, SEHW-single ear head weight, SEHGW-single ear head grain weight, TGW-1000 grain weight, CC-chlorophyll content, SPY-single plant yield.

Fig 1. Number of positive transgressive segregants in RIL population of pearl millet