Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7400

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (3):** 299-302 (2019)

Research Article

International Journal of Pure & Applied Bioscience

Studies on Genetic Variability Parameters for Grain Yield Components and Grain Mineral Concentration in Pearl Millet

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Received: 31.03.2019 | Revised: 27.04.2019 | Accepted: 5.05.2019

ABSTRACT

A field experiment was carried out in pearl millet (Pennisetum glaucum (L.) R. Br.) to study genetic variability, heritability and genetic advance for grain iron, zinc, yield and its component traits. The observations were recorded on individual plant basis for each replication for days to 50% flowering, plant height, panicle length, panicle girth, total tillers, productive tillers, grain yield per plant, 200-seed weight, iron content in grain and zinc content in grain. The results revealed that the genotypes were significantly different for all the ten characters, indicating sufficient variability in the experimental material. The maximum value of phenotypic coefficient of variation was observed for grain yield per plant followed by effective tillers per plant, total tillers per plant and genotypic coefficient of variation was observed for grain yield per plant followed by total tillers per plant, grain zinc content. 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. Highest heritability was recorded for grain zinc content followed by total tillers, grain iron content and plant height.

Keywords: *Pearl millet, Iron, Zinc, Variability, Heritability, Genetic advance.*

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L) R. Br.] is a major cereal crop grown in the arid and semi-arid tropical regions of Asia and Africa. It is a highly cross-pollinated crop with availability of cytoplasmic-genetic male sterility systems and high heterosis for yield and other traits. Thus, making it suitable for commercial hybrid development. It was grown on 7.12 m ha area with grain production of 8.07 m tonnes and productivity of 1132 kg/ha in India during 2017-18[1]. Nutritionally, pearl millet is a rich source of dietary protein, fat, calcium, phosphorus, iron and zinc and essential amino acids in comparison to other cereals such as maize, rice, sorghum and wheat[11,6,8,7]. It is also the cheapest source of Fe and Zn as compared to other cereals and vegetables.

Cite this article: Kumar, A., Dev vart, R.S., Khatri, S. K., Pahuja, A.K., Dehinwal and Kaushik, J., Studies on Genetic Variability Parameters for Grain Yield Components and Grain Mineral Concentration in Pearl Millet, *Int. J. Pure App. Biosci.* **7(3):** 299-302 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7400

Crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. To improve yield and quality traits, information on genetic variability and heritability is necessary. Grain yield, iron and zinc are complex characters being governed by a large number of minor genes with cumulative, duplicate and dominant effect and highly influenced by environment. This necessitates a thorough knowledge on variability owing to genetic factors, actual heritable genetic variation present in the progeny and the genetic advance that can be achieved through selection. The extent of variability is measured by GCV and PCV which provides information about relative amount of variation in different characters. Hence, to have a thorough comprehensive idea, it is necessary to have an analytical assessment of yield and quality 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[10]. Heritability gives the information on the magnitude of inheritance of quantitative traits, while genetic advance will be helpful in formulating suitable selection procedures. After obtaining the adequate information on variability, heritability and genetic advance for quality traits, yield and its components, breeder has to formulate criteria for isolating superior genotypes from segregating populations.

MATERIAL AND METHODS

The present investigation was carried out during the period of *kharif* 2015 and *kharif* 2016 at Bajra Section, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India. The experimental material for present study comprised of two diverse (for grain iron and zinc content) parents for developing a cross combination. The parent HMS 58B was having low (39, 31 ppm) and parent H2302 was having high (76, 65) iron and zinc respectively. The experimental material consisted of different generations *viz*., P_1, P_2, F_1, F_2, B_1 and B_2 of the cross and these were evaluated in compact family block design with three replications, during *Kharif* 2016 in the research area of Bajra Section, Department of Genetics and Plant Breeding, CCSHAU, Hisar. Among the treatments, the non-segregating generations, *viz*., parents (P_1, P_2) and F_1 were grown in single row of 4m length. The segregating F_2 generation was grown in ten rows of 4m row length and backcrosses B_1 and B_2 were grown in six rows of 4m length. Data were recorded on 15 competitive individual plants in P_1, P_2, and F_1, 190-210 in F_2 and 70-80 plants in B_1 & B_2 for all replicates. The row to row and plant to plant distance was maintained at 45 cm and 10-15 cm, respectively. The coefficients of genotypic and phenotypic variation were calculated by the formula given by Burton and Devane[5]. Heritability percentage in broad sense and genetic advance as percent of mean was calculated for each character as per formula and standard procedure prescribed by Singh and Chaudhary[16]. For range lowest and highest mean values for each character were recorded over the genotypes.

RESULTS AND DISCUSSION

The accomplishment in crop improvement depends on the nature and extent of variability present in the crop. In addition to genetic variability, information on heritability and genetic advance together helps in predicting the phenotypic expression of characters in succeeding generations[10]. Estimates of mean, range, phenotypic (PCV) and genotypic (GCV) coefficients of variability, genetic advance and genetic advance as per cent of mean values have been presented in Table1. The phenotypic coefficients of variability values were higher than genotypic coefficients of variability for all the traits combined with significant differences existed in between them which indicated that the expression of these traits was more influenced by the environmental conditions. Studies on heritability of the traits revealed the extent of heritable nature of variability and also the influence on its expression. Genetic advance reveals the expected genetic gain during selection. GCV and PCV ranged from low to high for traits studied indicating presence of low to high variability in the current populations. Sufficient amount of variability was observed in the F_2 population with respect to all traits in this cross. The maximum value of phenotypic coefficient of variation was observed for grain yield per plant followed by productive tillers per plant, total tillers per plant. Kunjir and Patil[14]; Lakshmana *et al.*[15]; Borkhataria *et al.*[4] and Anuradha *et al*.[2] found similar results. While, high genotypic coefficient of variation was observed for grain yield per plant followed by total tillers per plant, grain zinc content. High to moderate values of GCV and PCV were recorded for grain iron content, zinc content and 200- seed weight. This suggested that there was moderate level of variability for these traits. Therefore, selection may be practiced up to some extent for these traits. Low values of GCV and PCV with moderate to low broad sense heritability and genetic advance were recorded for days to 50% flowering, plant height, panicle length and panicle girth and productive tillers, indicating low scope of selection. Low GCV and PCV indicating lesser variability of various traits in the populations. Similar findings were reported earlier by Kumari M.B. and Nagarajan[13]; Sumathi *et al*.[17] and Kumar *et al*.[12]. Highest heritability was recorded for grain zinc content (95.0%) followed by total tillers (94.8%), grain iron content (93.8%), plant height (84.9%) and grain yield (80.5%). Highest genetic advance as per cent of mean was observed to be 118.12 per cent for grain yield per plant followed by 99.19 per cent for total tillers and 43.96 per cent for grain zinc content. Genetic advance as per cent of mean ranged from 0.86 to 118.12 per cent. In the present study, high broad sense heritability (h^2bs) for grain Fe and Zn revealed that both grain Fe and Zn are highly heritable. The previous studies also reported high broad sense heritability for grain Fe and Zn[18,3,9] in pearl millet. High heritability with high genetic advance indicates preponderance of additive genes which respond to selection. Taking all together, the above findings advocate that genetic improvement of iron and zinc concentrations along with grain yield should be equitably effectual in pearl millet.

Table 1: Estimates of genotypic and phenotypic coefficient of variance, heritability and genetic advance for various quantitative traits in pearl millet cross HMS 58B × H2302

Character	Mean	Range	Phenotype coefficient of variance (PCV)	Genotype coefficient of variance (GCV)	Heritability H^2 (broad sense) %	Genetic Advance	Genetic advance as percent of mean
Days to 50%flowering	47.83	44.0-52.0	3.04	1.12	13.7	0.43	0.86
Plant height (cm)	183.05	115.0-230.0	11.76	10.84	84.9	36.98	20.57
Panicle length (cm)	18.63	10.0-28.0	16.02	10.41	42.2	2.69	13.93
Panicle girth(cm)	1.96	1.00-2.90	18.30	12.35	45.5	0.36	17.07
Total tillers	1.41	1.0-6.0	50.79	49.43	94.8	1.57	99.19
Productive tillers	1.40	1.0-6.0	51.33	9.78	3.70	0.06	3.91
Grain yield	16.33	1.0-74.0	71.23	63.95	80.5	21.11	118.12
200- grain weight	1.51	0.49-2.27	27.38	19.60	51.6	0.43	29.10
Iron (Fe)	58.61	33.3-81.6	19.09	18.49	93.8	20.47	36.89
Zn (Zn)	47.18	25.8-66.9	22.46	21.89	95.0	20.31	43.96

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