Frontiers in Crop Improvement, Vol. 7 (1) : 19-23 (2019)
Print ISSN : 2393-8234, Online ISSN : 2454-6011

ASTHA FOUNDATION
Meerut (U.P.) INDIA

MORPHOLOGICAL CHARACTERIZATION OF FINGER MILLET (*ELEUSINECORACANA* L. GAERTN.) GERMPLASM COLLECTED FROM UTTARAKHAND

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ABSTRACT

The present study was carried out on 94 finger millet germplasm collected from Uttarakhand hills and evaluated at Pantnagar. Observations were recorded on twenty characters at different stages of crop development and at the time of harvesting. These characters included eight qualitative and twelve quantitative traits. Analysis of variance revealed highly significant differences among accessions and checks for most of the characters except finger number, productive tillers per plant, finger length and ear head length. It reflected sufficient variability for further improvement through selection. There was sufficient variability found for all the characters among the various accessions, which could offer greater scope for improvement. Elevated GCV valueswith respect to ECV for most of the characters indicated towardseffectivenessin achieving higher gain through suitable selection procedures. Peduncle length, biological yield/plot and finger width, which records high heritability in combination with high genetic advance as percent of mean indicated the preponderance of additive genetic effects in their expression therefore, phenotypic selection for these characters in segregating generations would likely to be more effective.

Key words : *Finger millet, germplasm,variability, heritability, genetic advance.*

Finger millet or ragi (*Eleusinecoracana* L. Gaertn.), an important arid and semi-arid food crop, occupies unique position in agriculture due to high adaptability and nutritional value. Finger millet belongs to sub-species coracana, family Poaceae and genus *Eleusine* in the tribe *Eragrostideae*.It shows adaptability to diverse agro ecological zones, higher elevations, dry and rained conditions better than any other tropical cereal. It is alsopromoted as a part of malnutrition solution due to its richness in carbohydrates (65-70%), dietary fibers (2.5-3.5%), fat (1-1.5%), minerals (2.5-3%) and proteins (5-8%). Globally, it is cultivated over 25 countries in Africa (East and South) and Asia (Middle East and Far East), while in India it widely grown in Karnataka, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, Gujarat and Maharashtra and in the hilly regions of Uttar Pradesh and Uttarakhand.

Besides so much importance of finger millet over centuries, more concentrated research efforts are geared only in recent years to evolve improved varieties and to develop sustainable production technology. In order to achieve the prime goal ofplant breeder, that is increased yield potential, knowledge of variability, inheritance, direction and magnitude of association between various traits and their stable performance are pre-requisite. Genetic variability, heritability and genetic advance are important factors which provide opportunity to plant breeder for selecting high yielding genotypes or to combine or transfer genes having desirable traits. Plant genetic resources are of potential use to humanity, provides the raw material for breeding new varieties of crops. Therefore, characterization of germplasm is an important step towards the utilization of genetic resources.

Regardless of the vast materials available and the urgent need to improve finger millet unit productivity through genetic manipulation, little is known about their variability, major characters and the potential usefulness of the individual accessions stored in the gene bank. Therefore, investigating and identifying plants for the genetic variation available in the breeding materials is the first step of plant breeding and so vital for successful crop improvement program. The present investigation aims towards the exploration of variability among the finger millet germplasm and studying their genetic parameters.

MATERIALS AND METHODS

Theexperimental material for the present research was collected from Uttarakhandhills covering Champawat, Pithoragarh, Bageshwar and Chamoli districts. A collection of 94 finger milletgermplasm accessionsalong with seven check varieties were evaluated at Pantnagar Centre for Plant Genetic Resource, G.B Pant University of Agriculture and Technology, Pantnagar. The experiment was laid out in augmented block design with three blocks; each consisted of forty rowsincluding,sevenrandomly placed checks (VL-348, VL-352, VL-347, VL-315, VL-149 and VL-324)within each block. Observations were recordedfor twenty characters either on plot basis or on a sample of randomly selected ten plants per plot at different stages of development and at the time of harvesting. These observations includedeight qualitative traits*viz.,*plant growth habit, pigmentation at leaf juncture, leaf sheath pubescence, stem culm branching, ear shape,

Table-1 : General mean, range of variability and superior accessions of finger millet for yield and its components.

Parameter	General Mean	Range	Best Check	No of superior entries	Top five germplasm accessions
Flag Leaf Length (cm)	28.41	16.05 to 42.30	PRM-2	18	GP-2016-193, GP-2016-144 , GP-2016-119 , GP-2016-201, GP-2017-427
Flag Leaf Width (cm)	2.56	0.54 to 4.06	VL-347	16	GP-2017-393, GP-2017-390 , GP-2018-1035,GP-2018-1216, GP-2017-456
Peduncle Length (cm)	19.48	10.76 to 30.98	VL-315	17	GP-2016-122, GP-2018-1041, GP-2016-201, GP-2018-1044, GP-2017-427
Ear Head Length (cm)	9.79	4.08 to 18.27	VL-348	17	GP-2016-123, GP-2016-127, GP-2018-1173, GP-2018-1177, GP-2016-232
Finger Length	9.88	1.92 to 14.07	VL-315	23	GP-2016-127, GP-2016-123, GP-2018-1175, GP-2017-449, GP-2018-1173
Finger Width	1.88	0.17 to 1.62	VL-324	24	GP-2016-119, GP-2018-1216, GP-2018-1144, GP 2017-3, GP-2018-1215
Number of Finger	6.48	1.62 to 9.84	VL-347	4	GP-2016-127, GP-2016-123, GP-2018-1175 , GP-2017-449 , GP-2018-1173
Number of Productive Tillers per plant	4.62	1.13 to 8.68	VL-315	13	GP-2016-201, GP-2018-1214, GP-2016-129, GP-2016-125, GP-2018-1043
Plant Height (m)	1.65	0.77 m to 1.64	VL-348	26	GP-2018-1034, GP-2018-1175, GP-2018-1141, GP-2018-1038, GP-2017-410
Grain Yield/plot (g)	36.71	4.04 to 98.45	VL-348	4	GP-2018-1177, GP-2016-124, GP-2016-122, GP-2016-120
Biological yield/plot (kg)	3.04	0.46 to 3.72	PRM-2	4	GP-2016-324, GP-2017-396, GP-2016-236, GP-2016-125
Harvest index (%)	2.71	0.16 to 9.31	VL-324	16	GP-2016-122, GP-2018-1034, GP-2018-1177, GP-2016-196, GP-2018-1036

finger branching, finger position of branching, finger multiple whorl andtwelve quantitative traits*viz.,*plant height (cm), flag leaf blade length (cm), flag leaf blade width (cm), peduncle length (cm), ear head length (cm), finger length (cm), finger width (cm), finger number, number of productive tillers per plant, grain yield per plot and biological yield per plot.The analysis of variance for augmented design was done using the method given by (1, 2) as described by (3,4). Both genotypic and phenotypic coefficients of variability were computed for each character as per method suggested by (5). Heritability coefficient (h^2) and Genetic advance (GA) for each character was computed by adopting the formulae given by (6).

RESULTS AND DISCUSSION

Characterization of the finger millet germplasm for qualitative traits : Morphological evaluation was based on visually observable characters on growth, plant stature, pigmentation and finger characteristics. Most of the finger millet accessions exhibitederect growth habit, except 25, which showed semi-erect growth habit, while none of the accessions found to be prostrate for growth habit. Pigmentation at leaf juncture was not found in any of the germplasm accessions of present collection. Leaf sheath pubescence was found present in 60 finger millet accessions, while it was absent in remaining 34 accessions. All the accessions exhibited stem Culm branching. A very few accessions had compact (07) or fist type (09) ear shape, while most of the accessions hadopen (40)and semi compact (38)ear heads. Thumb position of finger branching was observed in most of the accessions (93) besides one, which showed all finger position of finger branching. Finger branching was also absent in most of the accessions except seven while only two accessions had multiple whorl fingers and among other accessions, it was absent.

Table-2 : Genotypic (GCV) and phenotypic (PCV) coefficient of Variability, heritability (h2b) and genetic advance (GA) for different characters in finger millet.

Characters	GCV	PCV	ECV	h^2_b	GA	GA % of Mean
Flag leaf length (cm)	16.72	17.57	5.37	91	9.73	32.80
Flag leaf width (cm)	38.97	39.22	4.43	99	0.75	79.77
Peduncle length (cm)	14.19	17.39	10.07	67	4.76	23.83
Ear head length (cm)	16.38	22.11	14.85	55	2.39	25.01
Finger length	23.54	28.70	16.41	67	2.64	39.78
Finger width	23.24	28.31	16.17	67	0.33	39.31
Number of Finger	17.17	22.55	14.61	58	1.69	26.93
Productive tiller per plant	29.59	36.78	21.85	65	1.92	49.03
Plant Height (m)	9.92	10.53	3.52	89	0.25	19.27
Grain Yield/plot (g)	49.43	51.29	13.67	93	36.48	98.15
Biological yield/plot (kg)	31.67	41.45	26.73	58	0.76	49.86
Harvest index (%)	55.48	62.89	29.62	78	2.86	100.00

Mean performance and ranges of variations : In the present investigation, significant differences among accessions were recorded for all the characters studied except finger number and productive tillers per plant, thus indicated sufficient variability for further improvement through selection. Analysis of variances showed highly significant differences among check varieties for plant height, flag leaf blade length, flag leaf blade width, peduncle length, finger width, grain yield per plot and biological yield per plot, however non-significant differences were observed for finger length, ear head length, finger number and number of productive tillers per plant.The mean performance of accessions for different quantitative characters along with range of variation and superior accessions were presented in Table 1. Critical perusal of Table1revealed wide range of variation among the accessions collected from hills with appreciable number of accessions surpassing the best check for most of the characters except grain yield, for which a few accessions exhibited significant superiority over the best check.

The results revealed that the number of productive tillers per plant varied from 1.13 to 8.68 and 13 accessions exhibited significant superiority over best check VL-315 (5.77). GP-2016-201 (8.68), GP-2018-1214 (7.80), GP-2016-129 (7.53), GP-2016-125 (7.18) and GP-2018-1043 (7.13) were the top most accessions in producing productive tillers. A total of 18 finger millet accessions showed significant superiority over best check PRM-2 (34.10 cm) for flag leaf length, while the range for this trait varied from 16.05 to 42.30 cm. The top performers were GP-2016-193 (42.30 cm), GP-2016-144 (41.01 cm), GP-2016-119 (40.93 cm), GP-2016-201 (40.44 cm) and GP-2017-427 (39.61 cm). In case of flag leaf width VL 347 (1.02 cm) was found best check, in comparison to which 16 accessions were outperformed with GP-2017-393 (4.06 cm), GP-2017-390 (2.78 cm), GP-2018-1216 (1.23 cm) and GP-2017-456 (1.19 cm) accession found at the top. The range for this character expended from 0.54 to 4.06 cm.

The range of peduncle length varied from 10.76 to 30.98 cm. For peduncle length out of 17 significantly superior accessions over the best check VL-315 (23.87 cm), the top five are as follow; GP-2016-122 (30.98 cm), GP-2018-1041 (29.81 cm), GP-2016-201 (29.66 cm), GP-2018-1044 (28.21 cm), GP-2017-427 (25.50 cm). The range of ear head length varied from 4.08 to 18.27 cm and the variety VL-348 (11.17 cm) was found the best check. and GP-2016-123 (18.27cm), GP-2016-127 (15.40 cm), GP-2018-1173 (14.57cm), GP-2018-1177 (14.20 cm) and GP-2016-232 (14.13cm) were the top most. Finger length ranges from 1.92 to 14.07 cm and 23 accessions surpassed the best check VI-315 (7.52 cm) significantly; among them the top most were GP-2016-127 (14.07 cm), GP-2016-123 (13.82 cm), GP-2018-1175 (11.67 cm), GP-2017-449 (11.48 cm) and GP-2018-1173 (10.73 cm). Range for finger width varied from 0.17 to1.62 cm, while VL-324 (0.97 cm) emerged as superior check for this character. A total of 24 finger millet accessions were outperformed significantly over best check and GP-2016-119 (1.62 cm), GP-2018-1216 (1.50 cm), GP-2018-1144 (1.47 cm), GP 2017-3 (1.22 cm) and GP-2018-1215 (1.22 cm) were toped the list. Finger number ranged from 1.62 to 9.84 among the accession and onlyfour accessions were found significantly superior over the best check VL-347 (8.94). Accessions viz., GP-2017-402 (9.84), GP-2016-324 (9.34) GP-2016-122 (9.10) and GP-2016-188 (9.06) were the top performers for figure number.

Range for plant height varies from 0.77 m to 1.64 m. A total of 26 finger millet accessions found to be

significantly superior than dwarfest check VL-348 (1.19 m) and the dwarf five accessions were GP-2018-1034 (0.77 m), GP-2018-1175 (0.98 m), GP-2018-1141 (1.00 m), GP-2018-1038 (1.06 m) and GP-2017-410 (1.07 m). Biological yield varied from 0.46 to 3.72 kg/plot. Superiority for biological yield over highest yielder check PRM-2 (3.00 kg/plot) was shown only by four accessions *viz*; GP-2016-324 (3.72 kg/plot), GP-2017-396 (3.22 kg/plot), GP-2016-236 (3.22 kg/plot) and GP-2016-125 (3.22 kg/plot). Similarly, range for grain yield widely varied from 4.04 to 98.45 g/plot and only four accessions, GP-2018-1177 (98.45gm/plot), GP-2016-124 (97.44gm/plot), GP-2016-122 (90.21gm/plot) and GP-2016-120 (88.51gm/plot) outperform the best check VL-348 (83.27gm/plot).Genetic variability offers the raw material for improvement in the characters through breeding. Wide rangeamong genotypes forthe charactersrevealed very high variation, which provides ample scope for improvement of these characters. All the characters exhibited high variability owe to the habitat of the accessions as the accessions were collected from different geographical areas of Uttarakhand.

Genotypic and Phenotypic coefficient of variations : The data recorded for various quantitative characters was utilized to estimate genetic parameters, which would be helpful in deciding the selection strategies for improvement of those traits alongwith yield as well. The results for genetic parameters for different traits are presented in Table 2, which represents the estimates of coefficients of variability, heritability and genetic advance. For genotypic coefficient of variation characters like harvest index (55.48) followed by grain yield/plot (49.43), flag leaf width (38.97), biological yield /plot (31.67), productive tiller per plant (29.59),finger length (23.54) and finger width (23.24) reflected high genetic as well as phenotypic variability. Numberof finger (17.17), flag leaf length (16.72), ear head length (16.38) and peduncle length (14.19)were exhibited moderate genetic variability however lowest GCV was showed by plant height (9.92). All the characters reflected more contribution of genotypic variations to the total phenotypic variation with negligible impact of the environment for the expression of trait,which suggest ample scope of selection for improvement in these characters. (7) also reported similar results). Estimates of PCV and GCV suggested that the environment had slight effects on the expressions of the characters. (8) also recorded high values for PCV and GCV for main ear length and grain yield per plant and moderate for no of basal tillers per plant, no. of leaves on the main tillers, no. of productive tillers per plant and total no. of finger on the main ear. High genotypic and phenotypic variances were highestwas reported by (9) for biological yield per plant followed by plant height, days to 50 per cent flowering and harvest index.

Heritability and genetic advance : The heritability and Genetic advance as per cent mean were categorized as low (0-30%), moderate (30-60%) and high (>60%) category as given by (10).As presented in Table 2 critical analysis of estimatesrevealed that flag leaf width (99), grain yield/plot (93), flag leaf length (91), plant height (89),harvest index (78),peduncle length, finger length,finger width (67 each) and productive tiller per plant (65) exhibited high heritability, while rest of the traits like biological yield/plot andnumber of finger (58 each) and ear head length (55) were moderately heritable characters. Accordingly, estimates of genetic advance expressed as per cent of mean werecategorized as high for harvest index (100), grain yield (98.15) andflag leaf width (79.77) whilebiological yield/plot (49.86), productive tiller per plant (49.03), finger length (39.78), finger width (39.31) and flag leaf length (32.80) exhibited moderate genetic gain. Rest of the characters like number of finger (26.93), ear head length (25.01), peduncle length (23.83) and plant height (19.27) showed low genetic advance under selection. Highheritability coupled with high genetic advance as percent of mean for harvest index, grain yield and flag leaf widthindicated the preponderance of additive genetic effects in their expression therefore, phenotypic selection for these characters in segregating generations would likely to be more effective.High heritability coupled with high genetic advance was observed by (9) for biological yield per plant, plant height and days to 50 per cent flowering.High heritability coupled with moderate genetic advance as percent of mean for productive tillers per plant, finger length and width and flag leaf length also suggesting that gene action governing these characters is under the influence of dominant effect so one can go for the progeny test for the improvement of these character.However in case ofthe characters where both heritability and genetic advance had low values that indicates high influence of environmental factor,this implies that, beside the genetic factors, environmental factors also have high contributions for the variations observed.These results were in accordance with (11), whichrevealed high phenotypic and genotypic coefficients of variation, heritability and genetic advance as per cent of mean for the traits *viz*., number of basal tillers per plant, no. of productive tillers per plant, main ear width and grain yield per plant. Further (12) also reported that that moderate to high variability coupled with high heritability and high genetic advance as per cent of mean were observed for days to 50% flowering, plant length (cm), number of tillers per plant, number of fingers per ear and main ear length (cm) suggesting the predominance of additive type of gene action in controlling these traits.The high values of heritability estimates coupled with maximum genetic advance over mean were also obtained by (13) for the characters like plant height, productive tillers per plant, panicle length and fodder yield.

ACKNOWLEDGEMENT

Authors are thankful to Head, Genetics and Plant Breeding, Director Research and Nodal Officer, PCPGR, G B Pant University of Agriculture and Technology, Pamtnagar for providing research facilities during course of the present study. The financial help provided by G B Pant National Institute of Himalyan Environment and Sustainable Development, KosiKatarmal (Almora) through the project under National Mission on Himalyan Studies is hereby duly acknowledged.

REFERENCES

1. Federer, W.T. (1956). Augmented (or Hoonuiaku) designs.Hawaii. *Plant. Rec. 55 :* 191-208.
2. Federer, W.T. (1996). Augmented Design with one way elimination of heterogeneity. *Biometrics. 17 :* 447-475.
3. Federer, W.T. and Ragavarao, D. (1975). On Augmented Design. *Biometrics. 31:* 29-35.
4. Petersen, R.G. (1985). Design and Analysis of Experiments. Marcel Dekke, New York.
5. Burton, G.W. and De Vane, E.H. (1953). Estimating heritability in tall Festuca (*Festucaarundinaceae*) from replicated clonal material. *Agron. J. 45:* 478 – 481.
6. Johnson, H.W.; Robinson, H.F. and Comstock, R.E. (1955). Genotypic and phenotypic correlations and their implications in selection of soybean. *Agron. J. 47:* 477 – 483.
7. Kaluthanthri, D.V.S. and Dasanayaka, P.N. (2016). Assessment of genetic diversity of some finger millet (*Eleusinecoracana* (L.) Gaertn. accessions using morphological markers. *Journal of Tropical Forestry and Environment*, 6(2): 25-35.
8. Das, R., Sujatha, M. and Pandravada, S. R. (2017). Assessment of variability, heritability, genetic advance in finger millet (*Eleusinecoracana*Gaertn) germplasm lines. *Environment and Ecology*, 34(4): 1829-1833.
9. Negi, S., Kumar, V. and Bhatt, A. (2017). Genetic diversity among finger millet [*Eleusinecoracana* (L.) Gaertn] genotypes for yield and its contributing traits. *Int. J. Curr. Microbiol. App. Sci,* 6(8): 3332-3337.
10. Robinson, H. E., Comstock, R. E. and Harvay, P.H. 1949. Genotypic and phenotypic correlations in corn and their implications in selection. *Agron. J.*, **43**: 283- 287
11. Mahanthesha, M., Sujatha,M., Meena, A.K. and Pandravada, S.R. (2017). Studies on variability, heritability and genetic advance for quantitative characters in finger millet [*Eleusinecoracana* (L.) Gaertn] germplasm. *Int. J. Integr. Sci.*, 6(6): 970-974.
12. Singamsetti, A., Patro, T.S.S.K., Anuradha, N. and Divya, M. (2018). Studies on genetic variability for yield and yield attributing traits in finger millet (*Eluesinecoracana* L. Gaertn). *Int. J. Curr. Microbiol. App. Sci.* 7: 90-95.
13. Bhasker K., Shashibhushan D., Murali K.K., and BhaveM.H.V. (2017). Genetic variability, heritability and genetic advance of grain yield in pearl millet [*Pennisetumglaucum* (L.) R.Br.]. *Int. J. Pure App. Biosci.* 5 (4): 1228-1231.

Received : December-2018; Revised : January-2018; Accepted : January-2018