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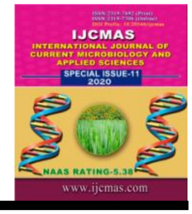

Original Research Article

Genetic Analysis for Yield and Yield Attributes in Finger Millet [*Eleusine coracana* (L.) Gaertn.]

Sanyam Patel[1*], Harshal E. Patil[1], V. L. Ladumor[1] and Vipul B. Parekh[2]

[1]Hill Millet Research Station, Navsari Agricultural University, Waghai (Dangs), Gujarat -394 730, India
[2]Department of Biotechnology, Navsari Agricultural University, Waghai (Dangs) -396 450, India
**Corresponding author*

Keywords

Finger millet, Variability, Correlation and path coefficient, Quantitative characters

A B S T R A C T

A total of 36 finger millet accessions constituted of 29 landraces and seven released varieties were evaluated for 12 morphological characters including grain yield at Hill Millet Research Station, NAU, Waghai, Gujarat, during *Kharif* 2017. The objectives were to assess the variability, correlation and path coefficient analysis among the quantitative characters. This research was carried out using randomized block design with three replications. Moderate genotypic and phenotypic coefficient of variation found for the traits *viz.*, number of fingers per earhead, number of productive tillers per plant, straw yield per plant, grain yield per plant, finger length, harvest index and main earhead indicating ample scope of variation for these traits, allowing further improvement by selection of these traits. Low value of genotypic coefficient of variation and phenotypic coefficient of variation was found for the traits *viz.*, days to 50% flowering, finger width, days to maturity, plant height and 1000 grain weight indicating low variability for these traits. High heritability estimates were observed for days to 50% flowering, days to maturity, plant height, number of productive tillers per plant, number of fingers per earhead, main earhead length, finger length, 1000 grain weight, grain yield per plant, straw yield per plant and harvest index showing low environmental influence on these traits and presence of additive gene action for these traits. Hence, priority can be given to these traits during selection to get more genetic gains. Genotypes *viz;* WN 550, GNN 6 and GNN-7 were high yielding among all thirty six genotypes in finger millet so they can be considered for varietal development and release for further selection.

Introduction

Finger millet [*Eleusine coracana* (L.) Gaertn.] subspecies coracana belongs to family *Poaceae*. It is an important cereal crop amongst the small millets and ranks third in importance among millets in the country in area and production after sorghum and pearl millet. Finger millet is very adaptable and thrives at higher elevations than other tropical cereals and adapted for its valued food grains. Small Millets have adaptability to wide range of geographical areas and agro-ecological diversity makes it more versatile. (Patel *et al.*, 2018)

Finger millet is an important 'Nutricereal' because of its excellent nutritive value of the grains and the storage properties. Finger millet is a good source of micronutrients and dietary fibres and consumed both in native and processed form (Rao and Murlikrishna, 2001). Finger millet grains contain higher levels of minerals like Ca, Mg, and K (Devi *et al.*, 2014).

It also has high levels of amino acids like methionine, lysine and tryptophan (Bhatt *et al.*, 2011) and polyphenols (Chandrasekara and Shahidi, 2011). With high fiber and protein content, millets are preferred as dietary foods for people with diabetes and cardiovascular diseases (Patil *et al.*, 2019). Finger millet straw makes good fodder and contains up to 61 per cent total digestible nutrients.

Genetic variability is important for improvement of any crop through selection. More variability leads to more genetic gain through selection. The basic information on the existence of genetic variability and diversity in a population and the relationship between different traits is essential for any successful plant breeding programme. Due to these reasons this study was done to assess variability by taking different parameters *viz.*, Phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance. Knowledge of correlation between yield and its component traits may be helpful in selection of suitable plant type. For obtaining the information on actual contribution of each character to yield, it is necessary to partition the correlation into direct and indirect effects through path analysis.

Therefore, correlation in association with path analysis would help in identifying suitable selection criteria for improving the yield. Hence, the present investigation will be undertaken to characterize the germplasm accessions, to assess the variability and to determine the interrelationship among yield and its contributing characters in finger-millet.

Materials and Methods

This research was conducted during the *Kharif*, 2017 at Hill Millet Research Station, Navsari Agricultural University, Waghai, The Dangs. Experimental material comprised of thirty-six diverse genotypes of finger millet. These genotypes were laid out in Randomized Block Design along with respective checks in three replications. The seedlings were planted at 22.5×7.5 cm^2 spacing. Five randomly selected plants from each genotype in each replication were used to record observations formorphological characters.

Genetic variability analysis of each quantitative trait was carried out using different variability parameters. Phenotypic, genotypic and environmental variances were estimated according to the methods suggested by Johnson *et al.*, (1955[a]) and Phenotypic and genotypic coefficient of variation were calculated using formulae suggested by Cockerham (1963), whereas estimation of heritability and expected genetic advance were computed using the formula according to Allard (1960) and Johnson *et al.*,(1955[b]), respectively.

Analysis of covariance for all possible pairs of fourteen characters was carried out using the procedure of Panse and Sukhatme (1978) for each family. The cause and effect relationship between two variables cannot be known from simple correlation coefficient. Therefore, path analysis suggested by Dewey and Lu (1959) was adopted for each genotype separately in order to partition the genotypic correlation between variables with seed yield into direct and indirect effects of those variables on yield.

Results and Discussion

Analysis of Variance

The analysis of variance indicating the mean sum of squares for all the twelve characters studied, are summarised in Table 1. The genotypic differences were highly significant for all the twelve characters indicating considerable amount of genetic variability among the genotypes tested in the present study, suggesting ample scope for improvement of yield and various yield attributing characters.

Mean performance of genotypes

The mean performance of all thirty-six genotypes for twelve characters is shown in table 4. The variability parameters like mean, range, genotypic, phenotypic and environmental variances for twelve characters are presented in table 2. Similarly, phenotypic coefficient of variation and genotypic coefficients of variation for all the characters are presented in table 3. From the mean table it can be concluded that among thirty-six genotypes WN 550 is high yielding followed by GNN-6 and GNN-7. (Patil *et al.,* 2018)

PCV and GCV estimates

The values of phenotypic coefficient of variation were higher than genotypic coefficient of variation for most of the characters indicating the influence of environmental factors. Moderate genotypic and phenotypic coefficient of variation found for the traits *viz.,* number of fingers per earhead, number of productive tillers per plant, straw yield per plant, grain yield per plant, finger length, harvest index and main earhead length. These results indicated the presence of wide variation for these characters under study to allow further improvement by selection of the individual traits. Moderate genotypic and phenotypic coefficient of variation for such traits were also observed by Saundaryakumari and Singh (2015) for finger length, number of fingers per earhead and Devaliya *et al.,* (2018) for number of fingers per earhead, number of productive tillers per plant, main earhead length, grain yield per plant and straw yield per plant in finger millet while Patil *et al.,* (2018) for panicle length in little millet. The lower value of genotypic coefficient of variation and phenotypic coefficient of variation observed for the traits *viz.,* days to 50% flowering, finger width, days to maturity, plant height and 1000 grain weight indicating the presence of low variability for these traits. Similar results were also obtained by Suryanarayana *et al.,* (2014) for days to 50% flowering and days to maturity and Devaliya *et al.,* (2018) for days to 50% flowering, days to maturity, plant height and 1000 grain weight in finger millet while Jyotsna *et al.,* (2016) for plant height and days to maturity and Patil *et al.,* (2017) for plant height in little millet. In the present study, the difference between PCV and GCV were lower for the characters *viz.,* days to 50%flowering, days to maturity, plant height, number of fingers per earhead, main earhead length, finger length and 1000 grain weight suggesting negligible role of environment in the expression of traits, therefore improvement by phenotypic selection is possible.

Heritability and genetic advance estimates

High heritability estimates were noticed for days to 50% flowering, days to maturity, plant height, number of productive tillers per plant, number of fingers per earhead, main earhead length, finger length, 1000 grain weight, grain yield per plant, straw yield per plant and harvest index indicating that these characters are less influenced by the environmental fluctuations and largely governed by additive genes, so selection could be rewarding for improvement of such yield attributes. Moderate heritability estimates were observed for finger width revealing higher environmental influence in the expression these traits. Genetic advance expressed as percentage of mean was observed high for number of number of fingers per earhead, productive tillers per plant, grain yield per plant, straw yield per plant, main earhead length, finger length and harvest index and was recorded moderate for characters *viz.*, days to 50% flowering, days to maturity and 1000 grain weight. However, plant height had recorded low genetic advance as expressed as percentage of mean. In present investigation, high heritability coupled with high genetic advance was observed for the traits *viz.,* number of fingers per earhead, number of productive tillers per plant, main earhead length, finger length, grain yield per plant, straw yield per plant and harvest index indicating that these characters were governed by additive gene action, hence, there are good chances of improvement of these traits through direct selection. High value of heritability associated with low genetic advance as percentage of mean was found for plant height showed the predominance of non-additive gene action in the expression of this trait. Hence, breeder should use suitable methodology to use both additive and non-additive gene action simultaneously for significant improvement. The characters *viz.*, days to 50% flowering, days to maturity and 1000 grain weight showed high heritability coupled with moderate genetic advance as per cent of mean. High heritability accompanied with moderate genetic advance as per cent of mean indicated that the genotypes under study were diverse with immense genetic potential and further improvement in this trait is possible by adopting simple selection technique. The results of present study, which revealed comparative higher degree of genotypic correlation coefficients than their phenotypic counterparts in most of the characters, indicated that there was a higher degree of association between two characters of genotypic association. Whereas, their phenotypic association was lessened due to the influence of environment. However, in few cases, the phenotypic correlation was slightly higher than their genotypic counterparts, which implied that the non-genetic cause inflated the value of genotypic correlation because of the influence of the environmental factors.

Correlation

In the present investigation, grain yield per plant was found to be highly significant and positively correlated with plant height, number of productive tillers per plant, 1000 grain weight, straw yield per plant and harvest index at both genotypic and phenotypic levels and finger width had highly significant correlation with grain yield per plant at genotypic level indicating that these attributes were mainly influencing the grain yield in finger millet. Thus, selection practiced for the improvement in a character will automatically result in the improvement of other character even though direct selection for improvement has not been made for the yield character. Similar results exhibiting highly significant and positive correlation between grain yield and other traits as obtained in the present investigation were also reported by Shet *et al.*, (2010) for finger width and 1000 grain weight; Haradari *et al.*, (2012) for plant height and number of productive tillers per plant; Dhamdhere *et al.*, (2013) for straw yield per plant; Devaliya *et al.*, (2018) for number of productive tillers per plant and straw yield per plant in finger mille (Table 5 and 6).

Table.1 Analysis of variance for twelve traits in thirty-six genotypes of finger millet

Source of variation	Degree of freedom	DF	DM	PH	PTP	FPE	MEL	FL	FW	TW	GY	SY	HI
Replication	2	6.40	30.73	32.21	0.05	0.27	0.32	0.91	0.003	0.001	1.32	4.22	7.47
Genotypes	35	258.03^{**}	301.37^{**}	185.44^{**}	0.85^{**}	5.85^{**}	3.57^{**}	2.95^{**}	0.02^{**}	0.07^{**}	5.32^{**}	45.42^{**}	40.87^{**}
Error	70	22.23	40.39	29.48	0.16	0.41	0.19	0.32	0.01	0.004	0.68	4.10	6.48
S.Em.±	-	2.72	3.67	3.13	0.24	0.37	0.25	0.33	0.05	0.04	0.48	1.17	1.47
C.D at 5 %	-	7.68	10.35	8.84	0.66	1.04	0.71	0.92	0.14	0.11	1.35	3.30	4.15
C.D at 1 %	-	10.19	13.74	11.74	0.88	1.38	0.95	1.23	0.18	0.14	1.79	4.38	5.50
C.V %	-	5.12	5.02	4.52	14.40	9.41	4.85	7.88	10.12	2.44	9.98	8.64	9.66

***significant at 5% level**
****significant at 1% level**

DF	Days to 50 % flowering	PTP	No. of productive tillers per plant	FL	Finger length (cm)	GY/P	Grain yield per plant (g)
DM	Days to maturity	FPE	Number of fingers per earhead	FW	Finger width (cm)	SY/P	Straw yield per plant (g)
PH	Plant height (cm)	MEL	Main ear head length (cm)	TW	1000-Grain weight (g)	HI	Harvest index (%)

Table.2 Range, mean and components of variance for twelve traits in thirty-six genotypes of Finger millet

Sr. No.	Characters	Range	Mean	Component of variance		
				Genotypic	Phenotypic	Environmental
1.	Days to 50% flowering	67.67-112	92.04	78.60	100.83	22.23
2.	Days to maturity	105.33-145	126.55	87.00	127.38	40.39
3.	Plant height (cm)	92-136.4	120.13	51.99	81.47	29.48
4.	Number of productive tillers per plant	1.83-3.8	2.83	0.23	0.39	0.16
5.	Number of fingers per earhead	5.1-11	6.79	1.81	2.22	0.41
6.	Main earhead length (cm)	6.77-11.43	9.03	1.13	1.32	0.19
7.	Finger length (cm)	5.4-10.27	7.19	0.88	1.20	0.32
8.	Finger width (cm)	0.67-1.03	0.84	0.005	0.012	0.007
9.	1000-Grain weight (g)	2.37-3.06	2.69	0.023	0.027	0.004
10.	Grain yield per plant (g)	5.20-10.85	8.29	1.54	2.23	0.68
11.	Straw yield per plant (g)	14.82-33.22	23.43	13.77	17.87	4.10
12.	Harvest index (%)	19.64-34.20	26.35	11.46	17.94	6.48

Table.3 Genotypic and phenotypic coefficient of variation, heritability, genetic advance and genetic advance as per cent of mean for twelve traits in thirty-six genotypes of Finger millet

Sr. No.	Characters	GCV%	PCV%	Heritability (Broad sense %)	Genetic advance	Genetic advance (% of mean)
1	Days to 50% flowering	9.633	10.91	77.956	16.125	17.521
2	Days to maturity	7.371	8.919	68.294	15.878	12.547
3	Plant height (cm)	6.002	7.513	63.813	11.865	9.877
4	Number of productive tillers per plant	16.973	22.057	59.217	0.761	26.906
5	Number of fingers per earhead	19.837	21.956	81.626	2.507	36.919
6	Main earhead length (cm)	11.755	12.718	85.432	2.021	22.382
7	Finger length (cm)	13.024	15.222	73.205	1.651	22.955
8	Finger width (cm)	8.664	13.32	42.304	0.097	11.608
9	1000-Grain weight (g)	5.607	6.115	84.093	0.285	10.593
10	Grain yield per plant (g)	14.997	18.015	69.296	2.131	25.717
11	Straw yield per plant (g)	15.839	18.042	77.068	6.712	28.644
12	Harvest index (%)	12.848	16.073	63.902	5.576	21.158

Table.4 Genotypic and phenotypic correlations of grain yield per plant with other characters in thirty-six genotypes of Finger millet

Characters		DF	DM	PH	PTP	FPE	MEL	FL	FW	TW	SY/P	HI
GY/P	Rg	0.072^{NS}	0.110^{NS}	0.433**	0.388**	0.201*	0.139^{NS}	0.195*	0.281**	0.800**	0.342**	0.512**
	Rp	0.044^{NS}	0.054^{NS}	0.350**	0.334**	0.219*	0.155^{NS}	0.182^{NS}	0.110^{NS}	0.632**	0.291**	0.557**
DF	Rg	**1.000**	1.045**	0.146^{NS}	0.116^{NS}	-0.496**	0.408**	0.495**	0.014^{NS}	0.016^{NS}	0.530**	-0.428**
	Rp	**1.000**	0.847**	0.112^{NS}	0.009^{NS}	-0.398**	0.327**	0.418**	-0.018^{NS}	0.029^{NS}	0.386**	-0.284**
DM	Rg		**1.000**	0.140^{NS}	-0.002^{NS}	-0.480**	0.439**	0.609**	0.076^{NS}	0.026^{NS}	0.553**	-0.413**
	Rp		**1.000**	0.024^{NS}	0.016^{NS}	-0.343**	0.316**	0.420**	0.024^{NS}	0.041^{NS}	0.386**	-0.266**
PH	Rg			**1.000**	0.147^{NS}	-0.176^{NS}	0.120^{NS}	0.190*	0.193*	0.176^{NS}	0.538**	-0.150^{NS}
	Rp			**1.000**	0.057^{NS}	-0.113^{NS}	0.169^{NS}	0.182^{NS}	0.123^{NS}	0.155^{NS}	0.431**	-0.097^{NS}
PTP	Rg				**1.000**	-0.147^{NS}	-0.118^{NS}	-0.175^{NS}	0.049^{NS}	0.326**	-0.060^{NS}	0.339**
	Rp				**1.000**	-0.147^{NS}	-0.118^{NS}	-0.155^{NS}	0.082^{NS}	0.245*	-0.028^{NS}	0.272**
FPE	Rg					**1.000**	-0.100^{NS}	-0.267**	-0.183^{NS}	0.135^{NS}	-0.391**	0.563**
	Rp					**1.000**	-0.037^{NS}	-0.154^{NS}	-0.129^{NS}	0.127^{NS}	-0.303**	0.457**
MEL	Rg						**1.000**	0.922**	-0.000^{NS}	-0.013^{NS}	0.038^{NS}	0.054^{NS}
	Rp						**1.000**	0.819**	0.012^{NS}	0.016^{NS}	0.057^{NS}	0.068^{NS}
FL	Rg							**1.000**	0.208*	-0.002^{NS}	0.265**	-0.073^{NS}
	Rp							**1.000**	0.133^{NS}	0.015^{NS}	0.259**	-0.072^{NS}
FW	Rg								**1.000**	0.167^{NS}	0.302**	-0.012^{NS}
	Rp								**1.000**	0.151^{NS}	0.185^{NS}	-0.040^{NS}
TW	Rg									**1.000**	0.150^{NS}	0.531**
	Rp									**1.000**	0.121^{NS}	0.405**
SY/P	Rg										**1.000**	-0.623**
	Rp										**1.000**	-0.617**
HI	Rg											**1.000**
	Rp											**1.000**

**** Significant at 1% level * Significant at 5% level**

DF	Days to 50 % flowering	PTP	No. of productive tillers per plant	FL	Finger length (cm)	GY/P	Grain yield per plant (g)
DM	Days to maturity	FPE	Number of fingers per earhead	FW	Finger width (cm)	SY/P	Straw yield per plant (g)
PH	Plant height (cm)	MEL	Main ear head length (cm)	TW	1000-Grain weight (g)	HI	Harvest index (%)

Table.5 Direct and indirect effects of twelve causal variables on grain yield per plant in thirty-six genotypes of Finger millet

Characters	DF	DM	PH	PTP	FPE	MEL	FL	FW	TW	SY/P	HI	Grain yield Correlation Coefficient
DF	**0.2442**	-0.2708	-0.0054	-0.0107	0.1088	0.1892	-0.2564	0.0001	-0.0024	0.7345	-0.6586	0.072^{NS}
DM	0.2552	**-0.2591**	-0.0052	0.0002	0.1054	0.2038	-0.3155	0.0002	-0.0039	0.7656	-0.6362	0.110^{NS}
PH	0.0356	-0.0363	**-0.0371**	-0.0136	0.0386	0.0558	-0.0983	0.0004	-0.0265	0.7446	-0.2303	0.433^{**}
PTP	0.0283	0.0006	-0.0055	**-0.0926**	0.0322	-0.0549	0.0905	0.0001	-0.0492	-0.0835	0.5217	0.388^{**}
FPE	-0.1211	0.1245	0.0065	0.0136	**-0.2193**	-0.0466	0.1382	-0.0004	-0.0204	-0.5409	0.8668	0.201^{*}
MEL	0.0996	-0.1138	-0.0045	0.0110	0.0220	**0.4641**	-0.4775	0.0001	0.0019	0.0525	0.0837	0.139^{NS}
FL	0.1209	-0.1578	-0.0071	0.0162	0.0585	0.4278	**-0.5180**	0.0004	0.0003	0.3664	-0.1127	0.195^{*}
FW	0.0034	-0.0197	-0.0072	-0.0045	0.0401	-0.0002	-0.1077	**0.0021**	-0.0253	0.4186	-0.0191	0.281^{**}
TW	0.0039	-0.0067	-0.0065	-0.0302	-0.0296	-0.0060	0.0010	0.0004	**-0.1509**	0.2077	0.8175	0.800^{**}
SY/P	0.1295	-0.1433	-0.0200	0.0056	0.0857	0.0176	-0.1371	0.0006	-0.0226	**1.3846**	-0.9592	0.342^{**}
HI	-0.1045	0.1071	0.0056	-0.0314	-0.1236	0.0252	0.0379	0.0001	-0.0802	-0.8631	**1.5388**	0.512^{**}

Residual effect = 0.0561 (Bold figures = Direct effects) ** Significant at 1% level * Significant at 5% level

DF	Days to 50 % flowering	PTP	No. of productive tillers per plant	FL	Finger length (cm)	GY/P	Grain yield per plant (g)
DM	Days to maturity	FPE	Number of fingers per earhead	FW	Finger width (cm)	SY/P	Straw yield per plant (g)
PH	Plant height (cm)	MEL	Main ear head length (cm)	TW	1000-Grain weight (g)	HI	Harvest index (%)

Table.6 Mean value for twelve quantitative characters of finger millet

Sr. No.	Genotypes	DF	DM	PH	PTP	FPE	MEL	FL	FW	TW	GY	SY	HI
1	PR 1507	105.67	141.33	122.20	2.20	7.77	10.17	7.73	0.83	2.58	6.75	26.66	20.18
2	WN 550	97.00	135.33	119.20	2.83	8.13	8.97	7.27	0.73	3.04	10.85	24.52	30.80
3	WN 585	77.00	109.67	113.47	2.90	10.13	9.17	6.53	0.87	2.74	9.61	18.53	34.20
4	OEB 601	89.00	119.67	129.93	2.77	6.53	9.33	6.60	0.80	2.73	7.42	22.40	24.98
5	VR 1101	92.00	124.00	130.00	3.57	7.20	9.03	6.60	0.80	2.64	9.61	26.64	26.37
6	PR 1511	91.00	123.67	111.53	2.33	5.53	9.47	7.00	0.73	2.55	6.75	21.04	24.32
7	WN 559	92.33	127.33	127.07	1.97	6.63	10.47	8.73	0.93	2.60	7.74	26.01	22.91
8	OEB 602	84.00	115.67	120.67	3.57	5.17	6.77	5.40	0.77	2.53	6.55	24.02	21.45
9	RAuF 15	86.00	120.33	121.67	3.60	11.00	8.50	6.53	0.70	2.74	9.97	22.82	30.56
10	ML 181	99.67	134.33	122.00	2.83	5.70	9.90	7.93	0.77	2.47	6.94	19.42	26.37
11	VL 390	87.00	119.67	92.00	2.33	8.17	8.77	6.07	0.67	2.38	5.20	15.45	25.29
12	IIMRFM-6655	86.33	118.67	111.87	1.83	9.23	8.67	7.20	0.77	2.79	8.16	18.17	31.05
13	KMR 663	99.67	133.67	123.73	2.73	6.20	9.63	7.20	0.80	2.64	7.49	19.04	28.26
14	KWFM 49	106.00	142.67	114.40	3.10	6.93	10.07	8.07	0.83	2.56	6.96	17.55	29.03
15	RAuF 13	87.00	122.67	126.60	2.80	7.07	9.67	7.73	0.97	3.06	9.84	24.64	28.56
16	ML 322	90.00	123.33	123.87	3.27	5.73	10.10	8.33	0.83	2.75	8.85	22.27	28.43
17	VL 389	68.67	106.67	106.13	2.60	7.97	7.80	6.27	0.87	2.68	7.36	14.82	33.21
18	PRS 38	84.00	117.00	136.40	2.07	8.40	9.13	7.13	0.87	2.50	8.84	24.16	26.80

Sr. No.	Genotypes	DF	DM	PH	PTP	FPE	MEL	FL	FW	TW	GY	SY	HI
19	KMR 632	99.00	137.33	119.07	2.97	6.10	11.43	10.27	0.87	2.55	8.80	27.27	24.38
20	KOPN 1059	102.33	145.00	123.47	2.43	5.93	9.93	8.27	0.83	2.67	8.89	28.15	24.01
21	TNEC 1292	85.67	118.00	128.80	3.33	7.83	8.77	6.93	0.80	2.84	8.53	19.43	30.54
22	GPU 97	99.00	132.00	126.47	2.13	5.47	10.43	8.80	0.90	2.51	8.21	28.40	22.44
23	TNEC 1294	96.67	129.33	112.40	3.80	5.10	7.73	6.27	1.03	2.62	6.91	20.54	25.22
24	GPU 96	100.00	140.33	117.87	2.27	5.77	7.63	6.87	0.87	2.73	8.19	25.66	24.10
25	GossigoanMarubadhan	112.00	145.00	120.73	2.87	6.47	6.90	6.13	0.93	2.75	8.87	33.22	21.15
26	GPU 45	85.67	118.67	123.67	2.90	6.23	8.10	6.13	0.73	2.55	7.11	22.79	23.84
27	VL 352	67.67	105.33	117.80	2.23	8.33	7.07	5.73	1.03	2.58	7.16	23.77	23.43
28	GPU 67	90.00	122.67	118.40	2.23	5.90	8.13	6.67	0.77	2.76	8.73	25.52	25.44
29	PR 202	88.33	121.00	131.73	3.33	5.60	7.33	6.13	0.80	2.71	9.29	24.27	27.73
30	GN-1	94.00	127.67	120.40	2.57	5.63	8.93	7.13	0.77	2.64	6.76	27.69	19.64
31	GN-2	96.33	130.33	116.87	2.73	5.80	9.17	7.33	0.73	2.78	7.34	26.37	21.78
32	GN-3	95.00	131.33	117.33	3.07	5.87	9.73	8.53	0.93	2.70	8.40	26.10	24.34
33	GN-4	93.00	129.00	118.80	3.27	6.33	9.40	7.33	0.83	2.75	9.84	25.45	27.91
34	GN-5	93.67	130.33	119.33	3.40	6.07	9.27	7.47	0.87	2.78	9.86	24.19	28.97
35	GNN-6	97.33	129.33	119.40	3.53	6.00	9.40	7.27	0.93	2.87	10.42	23.33	30.81
36	GNN-7	95.33	127.33	119.40	3.47	6.53	10.07	7.33	0.90	3.03	10.07	23.22	30.24

DF	Days to 50 % flowering	PTP	No. of productive tillers per plant	FL	Finger length (cm)	GY/P	Grain yield per plant (g)
DM	Days to maturity	FPE	Number of fingers per earhead	FW	Finger width (cm)	SY/P	Straw yield per plant (g)
PH	Plant height (cm)	MEL	Main ear head length (cm)	TW	1000-Grain weight (g)	HI	Harvest index (%)

The grain yield per plant expressed significant positive correlation with traits, number of fingers per earhead at both genotypic and phenotypic levels and finger length at genotypic level in present investigation, which were also displayed by John (2007), Wolie and Dessalegn (2011) for number of fingers per earhead.

Path Analysis

In order to achieve a clear picture of inter-relationship of various component traits with yield, direct and indirect effects were calculated using path analysis at genotypic level. The highest positive direct effect on grain yield was recorded for harvest index followed by straw yield per plant, main earhead length, days to 50% flowering and finger width. Thus, these traits turned out to be the major components of grain yield per plant. This result is in accordance with Nirmalakumari *et al.,* (2010) for days to 50% flowering; Shet *et al.,* (2010) for finger width; Priyadharshini *et al.,* (2011) for harvest index, days to 50% flowering and main earhead length; Das *et al.,* (2013[a]) for finger width; Kumar *et al.,* (2014) for straw yield per plant and harvest index; Jadhav *et al.,* (2015) for days to 50% flowering and Devaliya *et al.,* (2018) for days to 50% flowering, straw yield per plant.

In general, indirect effects of all the traits namely plant height, productive tillers per plant, finger width and 1000-grain weight was small and negligible. Indirect effects *via* the characters *viz.,* days to 50 per cent flowering, days to maturity, number of fingers per earhead, main ear head length, finger length, straw yield per plant and harvest index were high. Therefore, indirect selection practiced on these characters will results in the improvement of respective characters and ultimately grain yield. The analysis of variance for all the traits revealed differences among the genotypes studied, indicating sufficient amount of variability present among thirty-six genotypes under study. On the basis of *per se* performance WN-550, GNN-6 and GNN-7 were found promising genotypes as they recorded higher grain yield per plant. These genotypes could be further evaluated for isolating high yielding, early maturing and better genotype selection techniques. Moderate genotypic and phenotypic coefficient of variation found for the traits *viz.,* number of fingers per earhead, number of productive tillers per plant, straw yield per plant, grain yield per plant, finger length, harvest index and main earhead length. This indicated considerable amount of variability in the genotypes for these traits. High heritability estimates were noticed for days to 50% flowering, days to maturity, plant height, number of productive tillers per plant, number of fingers per earhead, main earhead length, finger length, 1000 grain weight, grain yield per plant, straw yield per plant and harvest index suggesting the existence of sufficient heritable variation and so selection based on phenotypic value could be effective for isolating better types. Genetic advance expressed as percentage of mean was observed high for number of number of fingers per earhead, productive tillers per plant, grain yield per plant, straw yield per plant, main earhead length, finger length and harvest index indicating presence of additive gene action for these traits. High heritability coupled with high to moderate genetic advance expressed as percentage of mean for traits *viz.,* number of fingers per earhead, number of productive tillers per plant, main earhead length, finger length, grain yield per plant, straw yield per plant and harvest index, days to 50% flowering, days to maturity and 1000 grain weight may be attributed to the preponderance of additive gene action and these traits possess high selective value. The magnitudes of genotypic correlation were higher as compared to the corresponding phenotypic correlations for majority of studied traits of finger millet, thereby indicating the presence of an inherent relationship between the variables. Grain yield per plant was found to be significantly and positively correlated with plant height, number of productive tillers per plant, 1000 grain weight, straw yield per plant, harvest index and number of fingers per earhead at both genotypic and phenotypic levels while finger length at genotypic level only. Path coefficient analysis revealed positive direct effect on grain yield per plant was recorded by harvest index, straw yield per plant, main earhead length, days to 50% flowering and finger width. Hence, these traits were considered as the most important yield contributors and due emphasis should be given while attempting yield improvement in finger millet.

The final conclusion obtained from the studies on variability, correlations, path coefficient analysis in finger millet is that, number of productive tillers per plant, number of fingers per earhead, main earhead length, straw yield per plant and harvest index are the most important component characters for improvement of grain yield per plant, hence these traits should be considered as selection criteria for grain and fodder yield improvement in finger millet.

References

Allard, R. W. (1960). "*Principle of Plant Breeding*" John Willey and Sons. New York.

Bhatt, D., Negi, M., Sharma, P., Saxena, S. C., Dobriyal, A. K. and Arora, S. (2011). Responses to drought induced oxidative stress in five finger millet varieties differing in their geographical distribution. *Physiol. Mol. Biol. Plants,* 17: 347–353.

Chandrasekara, A., Shahidi, F. (2011). Inhibitory activities of soluble and bound millet seed phenolics on free radicals and reactive oxygen species. *J. Agric. Food Chem.*, 59: 428–436.

Cockerham, C. C. (1963). Estimation of genetic variance in statistical Genetics and Plant breeding. *National research council*, Washington, DC, p.53.

Das, R., Sujatha, M., Pandravada, S R., and Sivasankar, A. (2013[a]). Trait relationship and path coefficient analysis in finger millet (*Eleusine coracana* (L.) Gaertn). *Journal of Progressive Agriculture,* 4(1): 81-84.

Devaliya, S. D., Singh, M., Intwala, C. G. and Bhagora R. N. (2018). Genetic variability studies in finger millet (*Eleusine coracana*(L.) Gaertn.). *I. J. P.A.B.*, 6(11): 2319-7706.

Devi, P. B., Vijayabharathi, R., Sathyabama, S., Malleshi, N. G. and Priyadarisini, V. B. (2014). Health benefits of finger millet (*Eleusine coracana* L.) polyphenols and dietary fiber: a review. *J. Food Sci. Technol.,* 51: 1021–1040.

Dewey, P. R. and Lu, K. H. (1959). A Correlation and path coefficient analysis of components of crested Wheat Grass seed production. *Agronomy Journal*, 51(9):515-518.

Dhamdhere, D. H., Pandey, P. K., Shrotria, P. K., and Ojha, O. P. (2013). Character association and path analysis in finger millet [*Eleusine coracana* (L.) Gaertn]. *Pantnagar Journal of Research,* 11(2): 199-203.

Haradari, C., Ugalat. J. and Nagabhushan (2012). A study on Character association, genetic variability and yield components of finger millet (*Eleusine coracana* (L.) *Journal of Crop and Weed,* 8(2): 32-35.

Jadhav, R., Ratnababu, D., Ahamad, M. L. and Rao, S. (2015). Character association and path coefficient analysis for grain yield and yield components in finger millet (*Eleusine coracana* (L.) Gaertn). *Electronic Journal of Plant Breeding*, 6 (2): 535-539.

John, K. (2007). Estimates of genetic parameters and character association in finger millet (*Eleusine coracana* (L.) Gaertin). *Agricultural Sciences Digest*, 27(2): 95-98.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955[a]). Estimates of genetic and environmental variability in soybean. *Agron. J*, 47: 314-318.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. (1955[b]). Genotypic and phenotypic correlations in soybeans and their implication in selection. *Agron. J*, 47: 477 - 483.

Jyotsna, S., Patro, T. S. S. K., Sandh, R. Y., Neeraja, B., Ashok, S. and Triveni, U. (2016). Studies on genetic parameters, character association and path analysis of yield and its components in little millet (*Panicum sumatrense*). *International Journal of Agriculture Sciences*, 8 (5): 1018-1020.

Kumar, D., Tyagi, V. and Ramesh, B. (2014). Path coefficient analysis for yield and its contributing traits in finger millet. *International Journal of Advanced Research*, 2 (8): 235-240.

Nirmalakumari, A., Salini, K. and Veerabadhiran, P. (2010). Morphological characterizitation and evaluation of little millet germplasm. *Electronic Journal of Plant Breeding*, 1 (2): 148-155.

Panse, V. G. and Shukhatme, P. V. (1978). “Statistical methods for agricultural workers”. I.C.A.R., New Delhi. Third Edd. P: 100.

Patel S. N., Patil H. E., Patel S. P. and Patel U. M. (2018). Genetic Diversity Study in Relation to Yield and Quality Traits in Little Millet (*Panicum miliare* L.). *Int. J. Current Microbiol. App. Sci.* 7 (06): 2702-2711.

Patil H. E. and Patel B. K. (2018). Red seeded, Early maturing Finger Millet Variety 'GN-8' for Cultivation in Gujarat. *International Journal of Agriculture Sciences*, 10 (18): 7225-7229.

Patil Harshal E., Patel B. K. and Vikas Pali. (2019). Nutritive evaluation of finger millet [*Eleusine coracana* (L.) Gaertn.] genotypes for quality improvement. *International Journal of Chemical Studies*, 2019; 7 (4): 642-646

Patil Harshal E., Patel B. K., Vavdiya P. and Pali Vikas (2018). Breeding for Quality Improvement in Small Millets: A Review. *International Journal of Genetics*, 10 (9): 507-510.

Priyadharshini, C., Nirmalakumari, A., Jhon, J. A., and Raveendran, M. (2011). Genetic variability and trait relationships in finger millet hybrids. *Madras Agric. J.*, 98 (1-3):18-21.

Rao, M. S., and Muralikrishna, G. (2001). Non-starch polysaccharides and bound phenolic acids from native and malted finger millet (*Eleusine coracana*) variety Indaf-15). *Food Chemistry*, 72 (2), 187-192.

Saundaryakumari and Singh, S. K. (2015). Assessment of genetic diversity in promising finger millet (*Eleusine coracana* L.) genotypes. *International Quarterly Journal of Environmental Sciences*, 10 (2): 825-830.

Shet, R. M., Jagadeesha, N., Lokesh, G. Y., Gireesh, C. and Gowda, J. (2010). Genetic variability, association and path coefficient studies in two interspecific crosses of finger millet (*Eleusine coracana* (L.) Gaertn). *International Journal of Plant Sciences*, 5 (1): 24-29.

Suryanarayana, L., Sekhar, D. and Rao, V. D. (2014). Genetic variability and divergence studies in finger millet (*Eleusine coracana* (L.) Gaertn.). *International Journal of Current Microbiology and Applied Sciences*, 3 (4): 931-936.

Wolie, A. and Dessalegn, T. (2011). Correlation and path coefficient analysis of some yield related traits in finger millet (*Eleusine coracana* (L.) Gaertn.) germplasms in northwest Ethiopia. *African Journal of Agriculture research*, 6 (22): 5099-5105.