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Genetic Variability for Yield and Yield Attributing Traits in Finger Millet (*Eleusine coracana* L. Gaertn) under Irrigation in Central India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out to assess the genetic variability, heritability, genetic advance, correlation coefficient and path coefficient analyses in eighteen finger millet genotypes for seventeen yield and its contributing traits during the *Kharif* season of 2022, at the experimental station of Naini Agricultural Institute in Uttar Pradesh, Central India. The experimental design was a randomized complete block with each genotype in 3 replications. The analysis of variance for mean sum of squares due to genotypes showed significant differences for all the 17 quantitative characters. The genotypes showed the highest mean performance for seed yield per plant IE 175 (13.42) followed by IE 165 (12.42), IE 169 (11.17), IE 136 (11.01). Whereas, genotypic and phenotypic coefficient of variation were found high for number of ears per plant and harvest index. High heritability coupled with high genetic advance as percent of mean were observed for days to 50% flowering, plant height, finger length, ear head length, test weight. Moreover, seed yield per plant exhibited significant and positive correlations with number of fingers per ear, number of ears per plant, biological yield per plant, harvest index at both genotypic and phenotypic levels. It came

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out from the path coefficient analysis that traits like number of fingers per ear, number of ears per plant, biological yield per plant, and harvest index exhibit positive and direct effect on seed yield per plant at both genotypic and phenotypic levels. Hence, the selection of genotypes based on the above-mentioned characters will be useful for crop improvement in Finger millet.

Keywords: Phenotypic correlation; genotypic correlation; path analysis; genetic advance; heritability.

1. INTRODUCTION

Finger millet (*Eleusine coracana* Gaertn L.) is an important millet crop that belongs to the family: Poaceae, subfamily: Chloridoideae, with chromosome number 2n = 36. It is commonly known by various names such as ragi, nachani, and African millet. Finger millet is primarily cultivated in arid and semiarid regions of Africa and Asia, including countries like India, Uganda, Ethiopia, Nepal and Kenya. Finger millet is believed to have originated in East Africa, particularly in the highlands of Ethiopia and Uganda [1]. The origin of finger millet is traced back to the highlands of East Africa, specifically Ethiopia and Uganda [2]. Finger millet has a long history of cultivation in India. It was introduced to India several thousand years ago. Finger millet has been an important traditional crop in India, particularly in the southern and central regions. Finger millet cultivation in India can be traced back to ancient times. Archaeological evidence suggests that finger millet was grown in the Indian subcontinent as early as 2000 BCE [3] "India is the largest producer with an area, production and productivity of 1.19 million hectares, 1.98 million ton and 1661 kg per ha, respectively" (Sood et al*.,* 2019). "Finger millet is highly nutritious as its grains contain 65- 75% carbohydrates, 5-8% protein, 15 -20% dietary fiber and 2.5-3.5% minerals. It also contains 5-8% eleusinin, a quality protein, which our body can easily absorb. Ancient Indian texts like the Rigveda mention finger millet as a staple food. Traditional dishes made from finger millet, such as ragi mudha (finger millet balls), ragi roti (finger millet flatbread), and ragi malt (finger millet porridge), are part of the culinary heritage of many Indian communities" [4]. "Worldwide cultivation of Finger millet is majorly grown in semi-arid tropics of Asia and Africa. More than 40.0% of global millet consumption is held by African countries mainly Niger, Mali, Nigeria, Burkina, and Sudan. Around 4.5 tons of finger millet are produced worldwide every year" (Ceasar et al*.,* 2018). Finger millet comprises 11% of India's total production of major millets, according to the 4th Advanced Estimates of Major Millet Production for the Period of 2021-2022. In India, Major millet is cultivated over an area of 14 million hectares with a production of 16.3 million tones giving an average productivity of 1561 kg per ha.

Agronomically and Environmentally, Finger millet is beneficial to human kind and to soil respectively. Finger millet having the adaptability to diverse agro-ecological zones, including arid and semiarid regions, it is highly valued. Finger millet has resilience to adverse climatic conditions has the ability to withstand drought, high temperatures, and poor soil fertility, making it an important crop in areas with limited agricultural resources [5]. Finger millet is typically grown as a rainfed crop, relying therefore on rainfall for its water requirements [4]. Finger millet exhibits excellent drought tolerance, allowing it to thrive in regions with limited water availability [5]. This cereal crop has the ability to improve soil fertility through its root exudates, which enhance microbial activity and nutrient availability in the soil. It contributes to carbon sequestration by storing carbon in its aboveground biomass and root systems, thereby mitigating greenhouse gas emissions. The extensive root system of finger millet helps prevent soil erosion, particularly on slopes, by holding the soil together. Finger millet cultivation supports agrobiodiversity by preserving traditional landraces and genetic diversity within the crop [6, 7-10].

The yield of finger millet still has to be greatly improved. Therefore, the current research focuses on examining the Finger millet yield and the features that contribute to it. Additionally, identifying the best genotype to farm in the Prayagraj area, which influences millet improvement in Uttar Pradesh, an Indian state that produces little millet.

2. MATERIALS AND METHODS

2.1 Site Characteristics

The study was carried out at the experimental station of Naini Agricultural Institute in Prayagraj (Allahabad), U.P., during the *Kharif* season of 2022. The university is located on the left side of

Table 1. Experimental material

S. No.	Genotypes	S. No.	Genotypes
1	IE 101	10	IE 163
2	IE 102	11	IE 165
3	IE 111	12	IE 168
4	IE 120	13	IE 169
5	IE 121	14	IE 170
6	IE 136	15	IE 172
7	IE 139	16	IE 174
8	IE 150	17	IE 175
9	IE 161	18	FIN 7669 (Check)

Allahabad Rewa National Highway, about 5 km from Prayagraj city. All types of facilities necessary for cultivation of successful crop including field preparation inputs, irrigation facilities were provided from the Department of Genetics and Plant Breeding. Prayagraj district is geographically located at 25.57° North latitude and 81.56° East longitude. Its elevation is 98 m above mean sea level. The climate of prayagraj district is humid subtropic climate The major soil types of prayagraj district are red clay soils , red shallow loamy soils, deep calcareous black soils (3.1%) and medium calcareous soils (30%). The total average rainfall in Uttar Pradesh of 990 mm, respectively. Average minimum and maximum temperature of the year of study were 25°C and 44°C, respectively.

2.2 Finger Millet Genotypes Tested

As much as 18 Finger Millet genotypes including one check (Table 1) were tested. The experimental materials for this research were obtained from the SHUATS department of genetics and plant breeding in Prayagraj.

2.3 Experimental Design

The experiment was laid out following a randomized complete block design with 18 finger millet genotypes in three replications. Sowing for all the genotypes was done on 20 July 2022, with a spacing of 20 cm between rows and 10 cm between plants. The crop was raised as per the recommended package of practice.

3. RESULTS AND DISCUSSION

3.1 Phenotypic Correlations within Agronomic Traits

Phenotypic correlation coefficient analysis revealed that seed yield per plant exhibit high significant and positive correlation with number of fingers per ear (0.3414**), flag leaf with (0.4484*), Number of ears per plant (0.5786**), biological yield per plant (0.468**), Harvest Index (0.5204**).

3.2 Genotypic Correlations within Agronomic Traits

Genotypic Correlation coefficient analysis revealed that seed yield per plant exhibited significant and positive correlation with Flag Leaf Length (0.9922*), Number of Fingers per Ear (0.472**), Finger Width (0.6593*), Ear Head Width (0.2747**), Number of Ears per Plant (0.4862**), Biological Yield per Plant (0.4688**), Harvest Index (0.601*) [11-13].

These results are in agreement with the findings of Jadhav et al. [14], Jyotsna et al. [15], Kumari et al. [16], Negi et al. [17], Gohel et al. [18], Bhavsar et al. [19], Chavan et al. [20], Hema et al. [21].

3.3 Performances of Finger Millet Genotypes Tested

Out of 18 genotypes of Finger Millet evaluated for various characters, all genotypes found to be superior for seed yield per plant over check variety FIN 7669 The genotypes IE 175 (13.42) followed by IE 165 (12.42), IE 169 (11.17), IE 136 (11.01) showed high mean performance for seed yield per plant.

3.4 Phenotypic, Genotypic and Environmental Variances

The results of present study also revealed that there was a comparative higher degree of genotypic correlation coefficients than their phenotypic counterparts in most of the characters studied. This indicated that there was a higher degree of association between two characters of genotypic association, their phenotypic association was lessened due to the influence of environment [22-29].

Table 2. Analysis of variance (ANOVA) for 17 quantitative traits of finger millet genotypes

S No.	Source	Mean Sum of Squares (MSS)		
		Replication	Genotypes	Error
	Degree of Freedom	2	17	34
1	Days to 50%Flowering	3.9074	249.315**	2.986
2	Days to Maturity	4.5000	56.441**	4.069
3	Plant Height	137.0341	1017.531**	93.074
4	Flag Leaf Length	23.7472	47.198**	60.362
5	Number of Fingers per Ear	1.2474	1.928**	0.633
6	Number of Productive Tillers	1.4896	0.601**	0.491
7	Flag Leaf Width	0.0003	0.027**	0.005
8	Finger Length	0.3324	6.004**	0.419
9	Finger Width	0.1593	0.035**	0.037
10	Ear Head Length	1.4798	7.075**	1.134
11	Ear Head Width	0.8233	0.263**	0.125
12	Number of Ears per Plant	0.6896	8.748**	2.033
13	Peduncle Length	4.1302	5.684**	4.358
14	Biological Yield per Plant	527.4311	208.718**	182.488
15	Harvest Index	529.1512	473.142**	102.728
16	Test Weight	0.0039	0.215**	0.041
17	Seed Yield per Plant	0.8042	20.941**	7.181

Table 3. Genetic parameters for 17 quantitative traits in finger millet genotypes

Traits	GCV	PCV	% h^2 (Broad Sense)	Genetic Advancement 5%	Genetic Advancement as % of Mean 5%
Days to 50%Flowering	13.96	14.04	98.80	18.55	28.58
Days to Maturity	2.94	3.06	92.79	8.29	5.84
Plant Height	15.77	16.55	90.85	34.47	30.97
Flag Leaf Length	5.74	10.87	17.90	2.28	6.25
Number of Fingers per Ear	11.96	14.59	67.19	1.11	20.19
Number of Productive Tillers	7.11	16.62	18.41	0.17	6.26
Flag Leaf Width	10.87	12.14	77.78	0.16	20.03
Finger Length	17.94	18.60	93.01	2.71	35.64
Finger Width	3.26	12.89	7.69	0.01	1.70
Ear Head Length	14.43	15.75	83.98	2.66	27.24
Ear Head Width	6.04	8.32	52.27	0.32	9.02
Number of Ears per Plant	30.37	34.67	76.75	2.70	54.82
Peduncle Length	5.97	12.36	23.32	0.66	5.94
Biological Yield per Plant	9.51	26.84	12.57	2.16	6.95
Harvest Index	33.90	38.31	78.29	20.25	61.78
Test Weight	10.14	11.28	80.56	0.45	18.80
Seed Yield per Plant	25.69	31.69	65.71	3.58	42.90

3.5 Genotypic and Phenotypic Coefficient of Variation (PCV, PCV)

PCV values observed for all the traits (Table 3), ranged from 3.06 (Days to Maturity) to 38.31 (Harvest Index). Similarly, GCV values observed for all the traits ranged from 2.94 (Days to Maturity) to 33.90 (Harvest index). These results are in agreement with the findings of Hema et al.,[21].

Table 4. Direct and Indirect effects of 17 quantitative characters on seed yield at phenotypic level

Traits	DFF	DM	PH	FLL	NFE	NPT	FLW	FL	FW	EHL	EHW	NEP	PL	BYP	HI	TW	SYP
DFF	**0.4615**	0.1513	0.2491	0.0819	0.0512	0.0024	0.0879	0.2904	0.1938	0.3279	0.2786	-0.2418	-0.1365	0.0712	-0.2381	-0.1407	-0.1661
DM	0.0391	**0.1193**	0.0786	0.0551	0.0205	-0.0417	0.0241	0.0262	-0.0004	0.0349	0.034	-0.0831	-0.0166	0.0109	-0.0742	-0.0607	-0.4203
PH	0.0891	0.1087	**0.1651**	0.07	0.0999	0.0107	0.0224	0.0487	0.0786	0.0745	0.1059	-0.1195	-0.0248	0.065	-0.1106	-0.0384	-0.1783
FLL	0.0246	0.0639	0.0587	**0.1384**	0.0293	0.0058	0.0738	-0.0226	0.0038	-0.0122	0.016	-0.0389	0.0038	0.0396	-0.0832	-0.0093	-0.1348
NFE	0.0016	0.0025	0.0089	0.0031	**0.0148**	0.0022	0.0029	0.001	0.0067	0.0026	0.0072	-0.0046	0.0026	0.0077	-0.003	-0.0012	**0.3414****
NPT	-0.0005	0.0362	-0.0067	-0.0043	-0.0153	**-0.1036**	0.003	0.0159	-0.0228	0.0124	0.0074	-0.0282	-0.0318	-0.0434	0.0035	-0.0311	0.2069
FLW	0.0303	0.0321	0.0215	0.0849	0.0317	-0.0046	**0.159**	-0.0157	0.0366	-0.0131	0.0061	-0.0171	-0.0065	0.013	-0.048	-0.0866	**0.4484***
FL	-0.1819	-0.0634	-0.0852	0.0473	-0.0201	0.0444	0.0285	**-0.2891**	-0.1009	-0.276	-0.1547	0.1458	0.0647	0.0391	0.0029	0.0995	-0.1394
FW	-0.0126	0.0001	-0.0143	-0.0008	-0.0137	-0.0066	-0.0069	-0.0105	**-0.03**	-0.0103	-0.0217	0.0092	0.0059	-0.0079	0.0069	0.0042	0.1474
EHL	-0.109	-0.0449	-0.0692	0.0136	-0.0272	0.0184	0.0126	-0.1464	-0.0527	**-0.1534**	-0.0951	0.0789	0.0407	-0.0003	0.009	0.0518	-0.0133
EHW	0.2547	0.1202	0.2707	0.0488	0.2064	-0.0304	0.0162	0.2258	0.3048	0.2615	**0.4219**	-0.2019	-0.1592	0.1176	-0.1025	-0.1154	0.247
NEP	-0.1399	-0.1861	-0.1932	-0.075	-0.0841	0.0726	-0.0288	-0.1347	-0.0818	-0.1373	-0.1278	**0.267**	0.0436	0.048	0.146	0.1087	**0.5786****
PL	-0.0558	-0.0263	-0.0283	0.0052	0.0332	0.058	-0.0077	-0.0422	-0.0369	-0.05	-0.0712	0.0308	**0.1887**	0.066	-0.022	0.0683	0.0145
BYP	0.081	0.0481	0.2067	0.1504	0.2733	0.2199	0.0428	-0.071	0.1382	0.0012	0.1463	0.0943	0.1835	**0.525**	-0.2193	0.1104	**0.468****
HI	-0.646	-0.7783	-0.8389	-0.7528	-0.2577	-0.0428	-0.3776	-0.0127	-0.2887	-0.0735	-0.3041	0.6847	-0.1461	-0.5229	**1.252**	0.1655	**0.5204****
TW	-0.0022	-0.0037	-0.0017	-0.0005	-0.0006	0.0022	-0.0039	-0.0025	-0.001	-0.0024	-0.002	0.0029	0.0026	0.0015	0.001	**0.0072**	0.132
SYP	-0.1661	-0.4203	-0.1783	-0.1348	**0.3414****	0.2069	**0.4484****	-0.1394	0.1474	-0.0133	0.247	**0.5786****	0.0145	**0.468****	**0.5204****	0.132	-0.1661

** 5% Level of Significance

* 1% Level of Significance

DFF: Days to 50%Flowering, DM: Days to Maturity, PH: Plant Height, FLL: Flag Leaf Length, FLW: Flag Leaf Width, NFE: Number of Fingers per Ear, NPT: Number of Productive Tillers, FL: Finger Length, FW: Finger Width, EHL: Ear Head Length, EHW: Ear Head Width, NEP: Number of Ears per Plant, PL: Peduncle Length, BYP: Biological Yield per Plant, HI: Harvest Index, TW: Test Weight, SYP: Seed Yield per Plant

Table 5. Direct and Indirect effects of 17 quantitative characters on seed yield at genotypic level

Traits	DFF	DM	PH	FLL	NF	NPT	FLW	FL	FW	EHL	EHW	NEP	PL	BYP	HI	TW	SYP
DFF	**-1.7201**	-0.5978	-1.0117	0.589	-0.2638	-0.0235	-0.3683	-1.1256	2.9889	-1.3277	-1.4051	0.9919	1.0333	-0.9153	0.9992	0.5372	-0.188
DM	0.0271	**0.0781**	0.0546	-0.0791	0.02	-0.066	0.0168	0.0184	0.0086	0.0291	0.0327	-0.0675	-0.0351	0.0066	-0.0587	-0.0468	**-0.5805***
PH	0.5538	0.6585	**0.9416**	-0.8923	0.6751	0.0944	0.1226	0.2842	-1.4612	0.4861	0.8179	-0.856	-0.3263	0.8314	-0.7197	-0.3128	-0.2877
FLL	0.1347	0.3983	0.3727	**-0.3933**	0.1034	-0.1053	0.3965	-0.1197	-1.4429	-0.0835	0.0174	-0.4301	0.1628	-0.0919	-0.542	0.0348	**0.9922***
NFE	0.0331	0.0554	0.1549	-0.0568	**0.2161**	0.0544	0.0687	0.0273	-0.6445	0.0487	0.1625	-0.1016	0.1773	0.3912	-0.0719	-0.052	**0.472****
NPT	-0.0021	0.1279	-0.0152	-0.0406	-0.0381	**-0.1515**	0.0421	0.0472	-0.1925	0.0489	0.0757	-0.0678	-0.2588	-0.092	0.0138	-0.1295	0.0546
FLW	0.0938	0.0944	0.057	-0.4414	0.1392	-0.1217	**0.4378**	-0.0464	-0.2886	-0.0392	-0.0127	-0.1059	-0.0474	-0.0182	-0.175	-0.2995	-0.0651
FL	-0.0503	-0.0181	-0.0232	-0.0234	-0.0097	0.0239	0.0081	**-0.0768**	0.1069	-0.0775	-0.0582	0.0448	0.0421	0.0328	-0.0046	0.0307	-0.155
FW	0.3269	-0.0207	0.2919	-0.6901	0.5611	-0.239	0.124	0.2617	**-0.1881**	0.3016	0.6053	-0.2915	-0.5207	0.2864	-0.1403	-0.1794	**0.6593***
EHL	1.8908	0.9138	1.2647	0.5199	0.5523	-0.791	-0.2191	2.4707	-3.9278	**2.4496**	2.4063	-1.3824	-1.8055	0.3638	0.019	-0.8788	0.0598
EHW	-0.1936	-0.0991	-0.2058	0.0105	-0.1782	0.1184	0.0068	-0.1795	0.7625	-0.2328	**-0.237**	0.1956	0.2456	-0.0204	0.0397	0.0829	**0.2747****
NE	-1.6244	-2.4348	-2.5607	3.0797	-1.3246	1.2601	-0.6814	-1.6431	4.3656	-1.5896	-2.3255	**2.8168**	1.1637	-1.1617	1.7469	1.3039	**0.4862****
PL	0.1323	0.0991	0.0763	0.0912	-0.1807	-0.3762	0.0238	0.1208	-0.6097	0.1624	0.2283	-0.091	**-0.2203**	-0.4277	0.0173	-0.2065	0.0999
BYP	0.0357	0.0057	0.0592	0.0157	0.1214	0.0407	-0.0028	-0.0286	-0.1021	0.01	0.0058	-0.0276	0.1302	**0.067**	-0.0846	0.0452	**0.4688****
HI	0.281	0.3636	0.3698	-0.6666	0.161	0.0442	0.1933	-0.0288	-0.3609	-0.0038	0.081	-0.3	0.038	0.6103	**-0.4838**	-0.0644	**0.601***
TW	-0.1069	-0.205	-0.1138	-0.0303	-0.0824	0.2926	-0.2342	-0.1367	0.3265	-0.1228	-0.1198	0.1585	0.321	0.231	0.0456	**0.3424**	0.2075
SYP	-0.188	**-0.5805***	-0.2877	**0.9922***	**0.472****	0.0546	-0.0651	-0.155	**0.6593***	0.0598	**0.2747****	**0.4862****	0.0999	**0.4688****	**0.601***	0.2075	1

*** 5% Level of Significance*
** 1% Level of Significance*

Table 6. Phenotypic correlation coefficient between yield and its components traits in finger millet

Traits	DFF	DM	PH	FLL	NFE	NPT	FLW	FL	FW	EHL	EHW	NEP	PL	BYP	HI	TW	SYP
DFF	1	0.3278	**0.5398****	0.1775	0.1109	0.0053	0.1906	**0.6293***	0.42	**0.7105***	**0.6037***	**-0.524****	-0.2958	0.1543	**-0.516****	-0.305	-0.1661
DM		1	**0.6586***	**0.4616****	0.1719	-0.3493	0.2018	0.2194	-0.0037	0.2927	0.2848	-0.6968*	-0.1391	0.0915	**-0.6217***	**-0.5092****	-0.4203
PH			1	0.424	**0.6048***	0.0647	0.1354	0.2947	**0.4761****	0.4514	**0.6417***	-0.7237*	-0.1501	0.3937	**-0.6701***	-0.2327	-0.1783
FLL				1	0.2117	0.0418	**0.5337****	-0.1636	0.0275	-0.0885	0.1157	-0.2809	0.0276	0.2865	**-0.6013***	-0.0671	-0.1348
NFE					1	0.1478	0.1993	0.0694	**0.4574****	0.1775	**0.4892****	-0.3149	0.1757	**0.5206****	-0.2058	-0.0825	**0.3414****
NPT						1	-0.0291	-0.1535	0.22	-0.1196	-0.0719	0.2719	0.3074	0.4189	-0.0342	0.3003	0.2069
FLW							1	-0.0986	0.2299	-0.0823	0.0383	-0.1077	-0.0409	0.0815	-0.3016	**-0.5446****	**0.4484***
FL								1	0.3491	**0.9547***	**0.5352****	**-0.5044****	-0.2237	-0.1353	-0.0101	-0.3442	-0.1394
FW									1	0.3433	**0.7224***	-0.3064	-0.1953	0.2633	-0.2306	-0.1409	0.1474
EHL										1	**0.6198***	**-0.5144****	-0.2651	0.0022	-0.0587	-0.3376	-0.0133
EHW											1	**-0.4785****	-0.3773	0.2788	-0.2429	-0.2736	0.247
NEP												1	0.1633	0.1797	**0.5469***	0.407	**0.5786****
PL													1	0.3495	-0.1167	0.3617	0.0145
BYP														1	-0.4177	0.2103	0.468**
HI															1	0.1322	**0.5204****
TW																1	0.132
SYP																	1

*** 5% Level of Significance*

** 1% Level of Significance*

DFF: Days to 50%Flowering, DM: Days to Maturity, PH: Plant Height, FLL: Flag Leaf Length, FLW: Flag Leaf Width, NFE: Number of Fingers per Ear, NPT: Number of Productive Tillers, FL: Finger Length, FW: Finger Width, EHL: Ear Head Length, EHW: Ear Head Width, NEP: Number of Ears per Plant, PL: Peduncle Length, BYP: Biological Yield per Plant, HI: Harvest Index, TW: Test Weight, SYP: Seed Yield per Plant

Table 7. Genotypic correlation coefficient between yield and its components traits in Finger millet

Traits	DFF	DM	PH	FLL	NFE	NPT	FLW	FL	FW	EHL	EHW	NEP	PL	BYP	HI	TW	SYP
DFF	1	0.3475	**0.5882****	-0.3424	0.1534	0.0136	0.2141	**0.6544***	-1.7377	**0.7719***	**0.8169***	**-0.5767****	**-0.6007***	**0.5321****	**-0.5809***	-0.3123	-0.188
DM		1	**0.6994***	-0.0126	0.2563	**-0.8444***	0.2157	0.2353	0.1098	0.3731	0.4182	**-0.8644***	**-0.4497****	0.0845	**-0.7516***	**-0.5986***	**-0.5805***
PH			1	**-0.9476***	**0.7169***	0.1002	0.1302	0.3018	**-0.5518***	**0.5163***	**0.8686***	**-0.9091***	-0.3465	**0.8829***	**-0.7643***	-0.3322	-0.2877
FLL				1	-0.2628	0.2678	-0.0081	0.3043	**0.6683***	0.2122	-0.0444	0.0934	-0.4139	0.2337	0.378	-0.0885	**0.9922***
NF					1	0.2516	0.318	0.1265	**-0.9825***	0.2255	**0.7519***	**-0.4702****	**0.8204***	**0.8105***	-0.3328	-0.2405	**0.472****
NPT						1	-0.2779	-0.3117	0.2705	-0.3229	**-0.4999****	**0.4473****	**0.7079***	0.6072	-0.0913	**0.8545***	0.0546
FLW							1	-0.1061	**-0.6592***	-0.0894	-0.0289	-0.2419	-0.1082	-0.0416	-0.3996	**-0.6841***	-0.0651
FL								1	-0.3914	0.0086	**0.7577***	**-0.5833***	**-0.5483***	-0.4271	0.0596	-0.3993	-0.155
FW									1	**-0.6034***	-0.2178	**0.5498***	**0.768***	-1.5224	**0.7461***	**0.9536***	**0.6593***
EHL										1	**0.9823***	**-0.5643***	**-0.7371***	0.1485	0.0078	-0.3588	0.0598
EHW											1	**-0.8256***	-0.0363	0.0862	-0.1675	-0.3499	**0.2747****
NE												1	0.4131	-0.4124	**0.6202***	**0.4629****	**0.4862****
PL													1	**0.9418***	-0.0785	**0.9375***	**0.0999**
BYP														1	-0.4177	0.2103	**0.4688****
HI															1	0.1331	**0.601***
TW																1	0.2075
SYP																	1

*** 5% Level of Significance*

** 1% Level of Significance*

DFF: Days to 50%Flowering, DM: Days to Maturity, PH: Plant Height, FLL: Flag Leaf Length, FLW: Flag Leaf Width, NFE: Number of Fingers per Ear, NPT: Number of Productive Tillers, FL: Finger Length, FW: Finger Width, EHL: Ear Head Length, EHW: Ear Head Width, NEP: Number of Ears per Plant, PL: Peduncle Length, BYP: Biological Yield per Plant, HI: Harvest Index, TW: Test Weight, SYP: Seed Yield per Plant

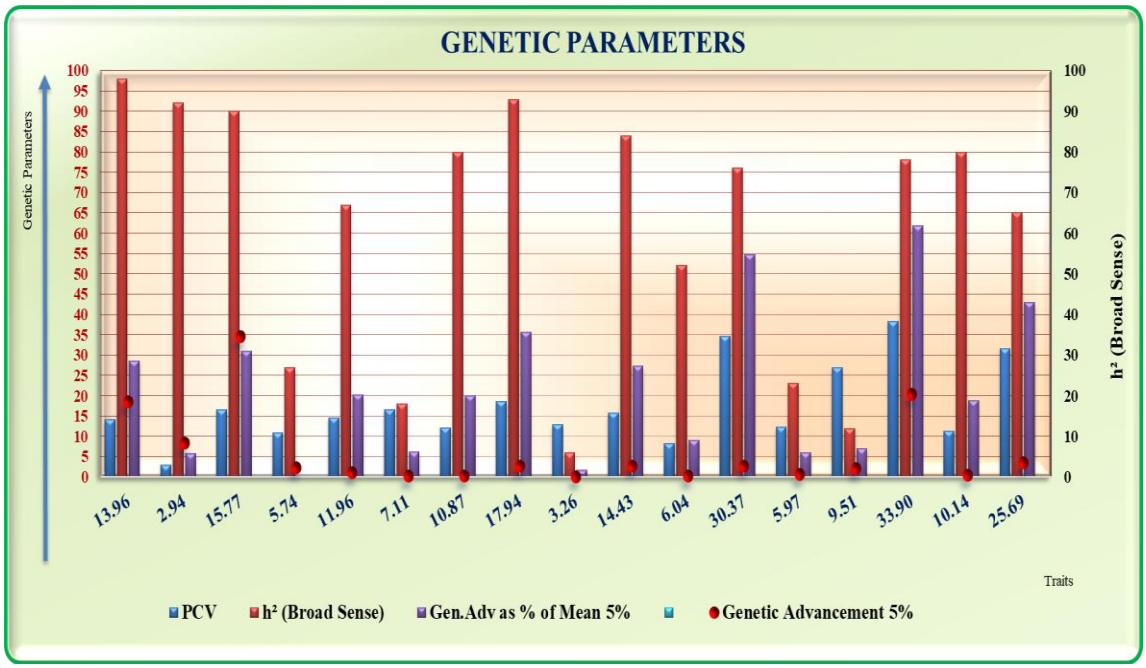

Fig. 1. Bar diagram depicting GCV, PCV, heritability and genetic advance for 17 quantitative characters of Finger millet

3.6 Heritability and Genetic Advance

Very high values of heritability (broad sense) (≥80%) were observed for Days to 50%Flowering (98.00%), Finger Length (93.00%), Days to Maturity (92.00%), Plant Height (90.00%), Ear Head Length (84.00%), Flag Leaf Width (80.00%), and Test Weight (80.00%). Higher values (≥60%) were recorded for Harvest Index (78.00%), Number of Ears per Plant (76.00%), Number of Fingers per Ear (67.00%), and Seed Yield per Plant (65.00%). Therefore, these characters are predominantly governed by additive gene action and could be improved through individual plant selection owing to their high heritability values. Genetic advance as % of mean varied from 6.25% for Seed Yield per Plant to 61.78% for Days to 50%Flowering. Higher values of genetic advance (>20%) were recorded for Days to 50%Flowering (61.78%), Days to Maturity (54.82%), Plant Height (42.90%), Flag Leaf Length (35.64%), Number of Fingers per Ear (30.97%), Number of Productive Tillers (28.58%), Flag Leaf Width (27.24%), Finger Length (20.19%), Finger Width (20.03%). A moderate value of genetic advance (10-20%) was recorded for Ear Head Length (18.80%). Lower values of this parameter were recorded for Ear Head Width (9.02%), Number of Ears per Plant (6.95%), Peduncle Length (6.26%), Biological Yield per Plant (5.94%), Harvest Index (5.84%), Test Weight (1.70%), Seed Yield per Plant (6.25%). These results are in agreement with the findings of Jyotsna et al. [15], Sao et al. [30], Anuradha et al. [31], Chavan et al. [32], Keerthana et al. [33], Anusha Udamala et al. [34].

3.7 Path Analysis

3.7.1 Genotypic path coefficient analysis

A review of the result on route coefficient for yield and yield components genotypic reveals that they are generally of similar direction and magnitude. Furthermore, the genotypic route coefficient was found to be larger in size that the phenotypic path coefficient, showing the masking influence of environment**.** Genotypic Path coefficient analysis revealed that maximum positive direct effect was due to its Flag Leaf Length (0.9922*), Number of Fingers per Ear (0.472**), Finger Width (0.6593*), Ear Head Width (0.2747**), Number of Ears per Plant (0.4862**), Biological Yield per Plant (0.4688**), Harvest Index (0.601*). Days to Maturity (-0.5805*) exhibited significant and negative correlation with seed yield per plant. Ear Head Length (0.0598), Peduncle Length (0.0999), Test Weight (0.2075) exhibited positive and non-significantly correlated with seed yield per plant. Days to 50% Flowering (-0.188), Plant

Height (-0.2877), Flag Leaf Width (-0.0651), Finger Length (-0.155) exhibited non-significant and negative correlation with seed yield per plant.

3.7.2 Phenotypic path coefficient analysis

The phenotypic correlation is used to calculate phenotypic path coefficients. It categories phenotypic coefficients as direct or indirect impacts on measurements (Dewey and lu, 1959) Phenotypic Path coefficient revealed that maximum positive direct effect on seed yield was depicted number of fingers per ear (0.3414**), flag leaf with (0.4484*), Number of ears per plant (0.5786**), biological yield per plant (0.468**), Harvest Index (0.5204**). Number of productive tillers (0.2069), ear head width (0.247), peduncle length (0.0145), Test weight (0.132) exhibited non-significant but positive correlation with seed yield per plant. Days to 50% flowering (-0.1661), days to maturity (-0.4203), plant height (-0.1783) flag leaf length (-0.1348) and finger length (-0.1394), finger width (-0.1474), ear head length (-0.0133) were non-significantly and negatively correlated with seed yield per plant.

These results are in agreement with the findings of Jyotsna et al. [15], Kumari et al. [16], Negi et al. [35], Gohel et al. [18], Sapkal et al. [36], Bhavsar et al. [19], Soe et al. [30], Hema et al. [21].

4. CONCLUSION

Based on the work in 18 Genotypes of Finger millet on 17 quantitative characters, it is concluded that all genotypes tested have shown significant differences. The genotype IE 175 has shown the highest mean performance for seed yield per plant. Whereas, genotypic and phenotypic coefficient of variation were found high for number of ears per plant and harvest index. High heritability coupled with high genetic advance as percent of mean were observed for days to 50% flowering, plant height, finger length, ear head length, test weight. Moreover, the seed yield per plant exhibited significant and positive correlations with number of fingers per ear, number of ears per plant, biological yield per plant, harvest index at both genotypic and phenotypic levels. The Path Coefficient Analysis showed that number of fingers per ear, number of ears per plant, biological yield per plant, harvest index positive and direct effect on seed yield per plant at both genotypic and phenotypic levels. Hence the selection of genotypes based on the above-mentioned characters will be useful for crop improvement in Finger millet.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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