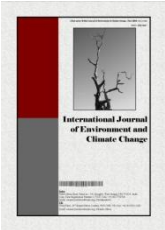

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Assessing Genetic Variability, Correlation, Direct and Indirect Effects of Yield Contributing Characters on Seed Yield in Finger Millet (*Eleusine coracana* L. *Gaertn*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted aiming to study the Assessing genetic variability, correlation, direct and indirect effects of yield contributing characters on seed yield in 20 Finger millet lines in kharif season 2021 in Randomized Block Design (RBD) at Field Experimentation Station, Department of Genetics and Plant Breeding. Phenotypic and genotypic coefficient of variation was found highest in ear head length (25.37& 21.16) and lowest in plant height (3.49 & 1.76), heritability (%) in broad sense for 13 characters were range from (25.30%) to (78.70%). A perusal of genetic advance revealed that it was high for ear head length (40.43) and low for number of fingers (0.45). Phenotypic correlation coefficient analysis revealed that seed yield/plant showed highly significant and positive association with seed yield/plant (0.930) and plant height (0.769) and for genotypic correlation coefficient showed significant and positive association with harvest index (0.930) and plant height (0.769). The phenotypic path analysis showed positive and direct effects on grain yield was exhibited by biological yield and for genotypic path analysis positive and direct effects on grain yield was exhibited by plant height and biological yield.

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Keywords: Yield; genetic variability; finger millet; Eleusine coracana L. Gaertn.

1. INTRODUCTION

Finger millet (*Eleusine coracana* L. *Gaertn*) is commonly known as ragi which is popular among millets in india, specifically in down south. It's higher nutritious nature attracting the urban dwellers and playing key role in counterpart the diabetes. Finger millet is grown as minor millet belongs to a grass family, its water requirement is 30% fewer compare to rice in particular. It is good sources of protein (7.3g) and fiber (3.6g). The cultivated ragi is a tetraploid (2n = 4x = 36). It is mostly a self pollinated crop due to cleistogamy, but it ranges about 1% cross pollination moderated by wind (Purseglove 1972) [1]. Over the years the area under millets is in a steep decline, till the early 1970's the share of millets in the food basket is 20% but now it merely left with 6%, but the silver lining aspect in the entire sequence is that the productivity is increased by the 2.5% [2]. The yield trait is very complicated because it is effected by lot many other factors & traits, it is quiet important to study the direct impact of characters on yield this will further aids to improve the yield potential under variable circumstances, it is a proven fact that the proper understanding of yield associated characters helps in altering the genetic composition and ultimately leads to genetic gain in the particular gene base.

Since yield is a complex trait, knowledge on the association of the different yield components with grain yield and interrelation among themselves is necessary. A study through correlation coefficients on the genotypic values provides dependable basis for selection. Correlation in conjunction with path analysis would give a better insight into cause and effect relationship between different pairs of characters by Venkatesan et al. (2004).

Information on correlations of component traits with yield and among themselves might help to increase selective efficiency [3,4]. The correlation between grain yield and component traits may sometimes be misleading due to an over-estimation or under estimation for its association with other characters. Thus, yield components have ultimate influence on yield, both directly and indirectly (Tukey, 1954).

The path coefficient analysis was originally developed by Wright (1921) but the technique was first used in plant breeding by Dewey and Lu (1959). It is a technique used to find relative contribution of component characters directly on the main characters and indirectly through other characters to increase the efficiency of selection. Path coefficient, which is a standard partial regression coefficient, specifies the cause and effect relationship and measures the relative importance of each variable (Wright, 1921).

Here combination of both correlation and path analysis helps in shedding light on understanding the relationship between the yield and associated characters.In general, yield in finger millet grain yield is greatly influenced by the number of productive tillers per plant, number of fingers per ear head, has been illustrated with the help of both correlation and path co efficient analysis (Sapkal et al. 2019).

2. MATERIALS AND METHODS

The present experiment was carried out at the Field Experimentation Centre of the Department of Genetics and Plant Breeding. The site is located at 25.28 N latitude, 81.54 E longitude and 98 meter above the sea level. It comes under sub-tropical and semi-arid climate. Lies 102 m above sea level. The average annual rainfall is 1042 mm. The present study consists of 20 finger millet lines which were collected from IIMR, Hyderabad grown in *kharif*, 2021. The experiment was laid in a randomized block complete design (RCBD) with 20 genotypes in three replications.

Total thirteen traits were studied *viz.,* days to 50% flowering, days to maturity, plant height, flag leaf length, number of fingers, number of tillers, finger length, peduncle length, ear head length, biological yield, test weight, harvest index and seed yield per plant (g). The quantitative date of all the above traits were recorded from the average of five best plants from each plot and subjected to the following listed data analysis.

Firstly measure of variability is figured with the aid of Coefficient of variation, which is the ratio of standard deviation of a sample to its mean and expressed in percentage. In the present investigation two types of coefficient of variations were estimated *viz*., phenotypic coefficient of

variation (PCV) and genotypic coefficient of variation (GCV).

2.1 Coefficient of Variation (CV)

It is the measure of variability evolved. Coefficient of variation is the ratio of standard deviation of a sample to its mean and expressed in percentage.

CV (%) = (Standard deviation / Mean) X 100

The formulae used to calculate PCV and GCV were stated by Burton, [5].

PCV (%) = (Phenotypic standard deviation /Grand mean) X 100

GCV (%) = (Genotypic standard deviation / Grand mean) x 100

Heritability calculated by the formula given by Lush (1949) and Burton and Devane [5]. Correlation Coefficient was calculated according to the formula suggested by Miller et al. (1958). And later used by Gandhi et al. (1964). Path coefficient analysis is normally to measures the direct and indirect effects of independent variables on the dependent variables. This technique was firstly used by Dewey and Lu (1959).

3. RESULTS AND DISCUSSION

3.1 Genetic Variability

High GCV along with PCV is found in characters such as ear head length (21.16 & 25.37%) followed by in seed yield per plant (18.74 & 23.39%), while it is observed low in plant height (1.76 & 3.49%) as shown in table1.

3.2 Heritability

The normal heritability (broad sense) is ranged from 25.30% (plant height) to 78.70% (number of fingers) as shown in Table 1.

3.3 Genetic Advance

High genetic advance as percentage of mean was found in ear head length (40.43%) in while it is observed low in plant height (0.39%) as shown in Table 1.

3.4 Correlation

The quantitative traits such as harvest index, plant height, number of tillers per plant observed having highly positive significant genotypic and phenotypic correlation with seed yield per plant (0.930**, 0.769**, 0.542**). While positive and non-significant phenotypic and genotypic correlation exhibited between flag leaf length and seed yield per plant is (0.035). Similar results were noticed in [6] where seed yield having highly non-significant negative relation with days to 50% flowering (r_p = -0.154) and negative significant observed in days to 50% flowering (r_g = -0.274**) and number of fingers (r_g = -0.392**). However genotypic correlation having higher significance than phenotypic correlation. Both the genotypic and phenotypic values are clearly illustrated in Table 2 & 3.

Table 1. Genetic parameters of 13finger millet germplasm for agronomic traits evaluated under field conditions during *Kharif*, 2021

Traits	GCV %	PCV %	h^2	GA %
Days to 50% flowering	2.70	5.37	25.40	3.48
Days to maturity	4.58	5.88	60.50	10.67
Plant height (cm)	1.76	3.49	25.30	2.99
Flag leaf sheath	9.01	10.76	70.10	10.90
Number of fingers	14.52	16.37	78.70	0.45
Number of tillers	14.04	16.05	76.50	1.83
Finger length	17.64	21.72	69.60	26.63
Peduncle length	15.33	17.75	74.60	0.39
Ear head length	21.16	25.37	69.60	40.43
Biological yield	17.41	21.72	64.20	6.32
Test weight	13.97	18.74	55.50	11.90
Harvest index	16.50	21.31	59.90	10.65
Seed yield per plant(g)	18.74	23.39	64.20	6.85

GCV- Genetic Coefficient Variance, PCV- Phenotypic Coefficient Variance, h^2- Broad Sense Heritability, GA-Genetic Advance

Table 2. Phenotypic correlation among the different traits evaluated in finger millet during *Kharif,* 2021

	DTF	DTM	PH	FLL	NF	NT	FL	PL	EHL	BY	TW	HI	GYPP
DTF	1	-0.112	-0.075	0.183	0.668**	-0.029	-0.598**	0.188	-0.765**	0.390**	-0.264*	-0.808**	-0.154
DTM		1	0.752**	-0.181	-0.269**	0.301**	0.553**	0.039	0.359**	-0.053	0.275**	0.527**	0.289**
PH			1	0.060	-0.548**	0.349**	0.543**	-0.007	0.465**	-0.004	0.255*	0.722**	0.312**
FLL				1	0.147	0.236*	-0.011	-0.341**	-0.216*	0.228*	0.429**	-0.376**	0.061
NF					1	-0.326**	-0.739**	-0.090	-0.721**	0.323**	-0.108	-0.726**	-0.202
NT						1	0.510**	0.014	0.335**	0.174	0.383**	0.563**	0.397**
FL							1	-0.133	0.943**	-0.402**	0.379**	0.847**	0.493**
PL								1	0.200	-0.338**	-0.556**	0.138	-0.134
EHL									1	-0.599**	0.119	0.889**	0.320**
BY										1	0.382**	-0.301**	0.425**
TW											1	0.100	0.457**
HI												1	0.362**
GYPP													1

** and ** Significant at P<0.05 and P<0.01, respectively*

DF50: Days to 50% flowering, DTM: Days to 50% Maturity, PH: Plant height (cm), FLL: Flag leaf length, NF: Number of fingers, NT: No. of tillers, FL: Finger length, PL: Peduncle length, EHL: Ear head length, BY: Biological Yield (g), TW: Test weight (g), HI: Harvest index (%), GYPP: Grain yield per plant (g)

Table 3. Genotypic correlation among the different traits evaluated in finger millet during *Kharif*, 2021

	DTF	DTM	PH	FLL	NF	NT	FL	PL	EHL	BY	TW	HI	GYPP
DTF	1	-0.112	-0.075	0.183	0.668**	-0.029	-0.598**	0.188	-0.765**	0.390**	-0.264*	-0.808**	-0.154
DTM		1	0.752**	-0.181	-0.269**	0.301**	0.553**	0.039	0.359**	-0.053	0.275**	0.527**	0.289**
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** and ** Significant at P<0.05 and P<0.01, respectively*

DF50: Days to 50% flowering, DTM: Days to 50% Maturity, PH: Plant height (cm), FLL: Flag leaf length, NF: Number of fingers, NT: No. of tillers, FL: Finger length, PL: Peduncle length, EHL: Ear head length, BY: Biological Yield (g), TW: Test weight (g), HI: Harvest index (%), GYPP: Grain yield per plant (g)

Table 4. Phenotypic direct (in bold) and indirect effects of thirteen traits on seed yield in finger millet evaluated in *Kharif*, 2021

	DTF	DTM	PH	FLL	NF	NT	FL	PL	EHL	BY	TW	HI	GYPP
DTF	**0.0020**	0.0002	0.0000	0.0000	0.0005	-0.0005	-0.0006	0.0001	-0.0006	0.0003	-0.0005	-0.0003	-0.1541
DTM	-0.0047	**-0.0438**	-0.0204	0.0039	0.0094	-0.0075	-0.0172	-0.0002	-0.0143	0.0018	-0.0056	-0.0141	0.289**
PH	-0.0025	0.0804	**0.1728**	0.0125	-0.0487	0.0168	0.0350	-0.0056	0.0203	0.0060	0.0164	0.0405	0.312**
FLL	0.0015	0.0115	-0.0094	**-0.1294**	-0.0143	-0.0330	-0.0138	0.0369	0.0140	-0.0225	-0.0424	0.0232	0.0613
NF	0.0055	-0.0574	-0.1916	-0.2713	**0.0201**	-0.0828	-0.0626	0.0794	0.0077	-0.0510	-0.1012	0.0059	-0.2024
NT	-0.0257	0.0193	0.0110	0.0288	-0.0271	**0.1128**	0.0459	-0.0024	0.0296	0.0105	0.0423	0.0140	0.397**
FL	-0.1021	0.1383	0.0715	0.0377	-0.1724	0.1435	**0.3525**	-0.0408	0.2701	-0.0715	0.1440	0.1372	0.493**
PL	0.0040	0.0003	-0.0019	-0.0172	-0.0043	-0.0013	-0.0070	**0.0603**	0.0118	-0.0138	-0.0208	0.0020	-0.1335
EHL	-0.0067	0.0068	0.0024	-0.0023	-0.0115	0.0055	0.0160	0.0041	**0.0208**	-0.0076	0.0040	0.0096	0.320**
BY	0.0630	-0.0191	0.0164	0.0816	0.1394	0.0436	-0.0951	-0.1070	-0.1700	**0.4686**	0.1051	-0.0054	0.425**
TW	-0.0581	0.0318	0.0234	0.0809	-0.0026	0.0926	0.1008	-0.0853	0.0477	0.0554	**0.2469**	-0.0411	0.457**
HI	-0.0251	0.0630	0.0460	-0.0352	-0.0708	0.0244	0.0764	0.0065	0.0907	-0.0023	-0.0327	**0.1962**	0.362**

** and ** Significant at P<0.05 and P<0.01, respectively*

DF50: Days to 50% flowering, DTM: Days to 50% Maturity, PH: Plant height (cm), FLL: Flag leaf length, NF: Number of fingers, NT: No. of tillers, FL: Finger length, PL: Peduncle length, EHL: Ear head length, BY: Biological Yield (g), TW: Test weight (g), HI: Harvest index (%), GYPP: Grain yield per plant (g)

Table 5. Genotypic direct (in bold) and indirect effects of thirteen traits on seed yield in finger millet evaluated in *Kharif*, 2021

	DTF	DTM	PH	FLL	NF	NT	FL	PL	EHL	BY	TW	HI	GYPP
DTF	**-0.3708**	0.0414	0.0276	-0.0679	-0.2476	0.0109	0.2217	-0.0695	0.2836	-0.1445	0.0977	0.2997	-0.274**
DTM	0.0348	**-0.3119**	-0.2346	0.0565	0.0838	-0.0937	-0.1723	-0.0121	-0.1121	0.0165	-0.0856	-0.1644	0.415**
PH	-0.0802	0.8092	**1.0758**	0.0644	-0.5890	0.3758	0.5845	-0.0076	0.5007	-0.0041	0.2744	0.7761	0.769**
FLL	-0.0337	0.0333	-0.0110	**-0.1839**	-0.0271	-0.0435	0.0021	0.0628	0.0397	-0.0419	-0.0790	0.0692	0.0350
NF	0.3234	-0.1301	-0.2651	0.0712	**0.4842**	-0.1576	-0.3577	-0.0436	-0.3490	0.1562	-0.0521	-0.3517	-0.392**
NT	-0.0132	0.1355	0.1575	0.1065	-0.1467	**0.4508**	0.2297	0.0062	0.1509	0.0783	0.1726	0.2536	0.542**
FL	0.5074	-0.4687	-0.4610	0.0096	0.6268	-0.4324	**-0.8484**	0.1132	-0.8000	0.3410	-0.3214	-0.7190	0.490**
PL	-0.0666	-0.0138	0.0025	0.1212	0.0320	-0.0049	0.0474	**-0.3552**	-0.0711	0.1202	0.1975	-0.0491	-0.210*
EHL	-1.0567	0.4965	0.6430	-0.2984	-0.9958	0.4625	1.3027	0.2767	**1.3815**	-0.8278	0.1637	1.2279	0.393**
BY	0.3040	-0.0412	-0.0030	0.1778	0.2517	0.1355	-0.3137	-0.2641	-0.4676	**0.7804**	0.2984	-0.2349	0.449**
TW	0.0500	-0.0521	-0.0484	-0.0816	0.0204	-0.0727	-0.0720	0.1056	-0.0225	-0.0726	**-0.1899**	-0.0191	0.460**
HI	0.1279	-0.0834	-0.1142	0.0595	0.1149	-0.0890	-0.1341	-0.0219	-0.1406	0.0476	-0.0159	**-0.1582**	0.930**

** and ** Significant at P<0.05 and P<0.01, respectively*

DF50: Days to 50% flowering, DTM: Days to 50% Maturity, PH: Plant height (cm), FLL: Flag leaf length, NF: Number of fingers, NT: No. of tillers, FL: Finger length, PL: Peduncle length, EHL: Ear head length, BY: Biological Yield (g), TW: Test weight (g), HI: Harvest index (%), GYPP: Grain yield per plant (g)

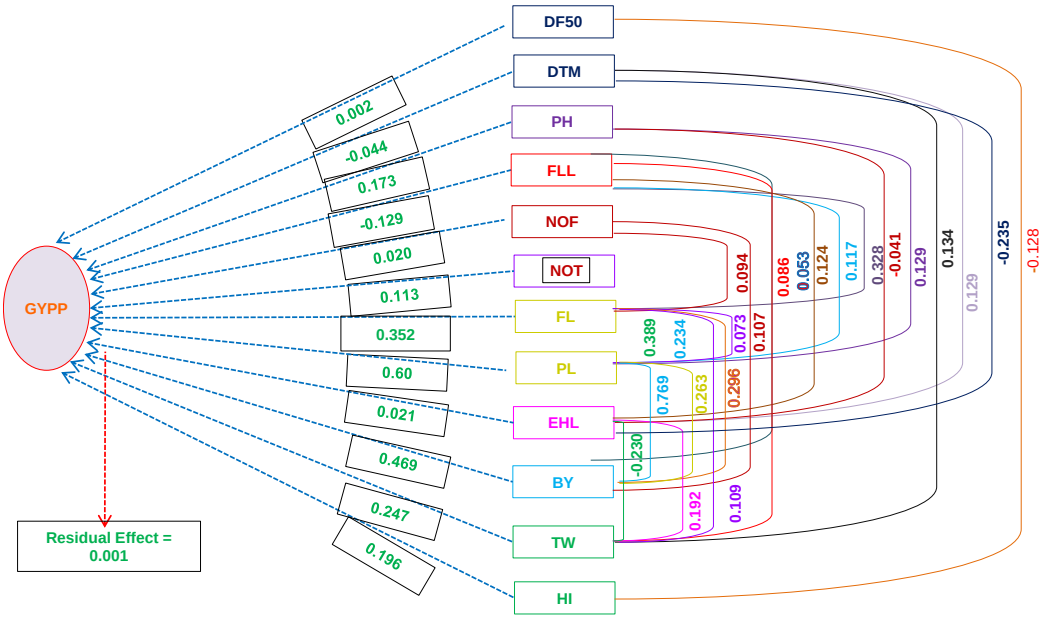

Fig. 1. Phenotypic path diagram showing direct and indirect effects of different traits on seed yield

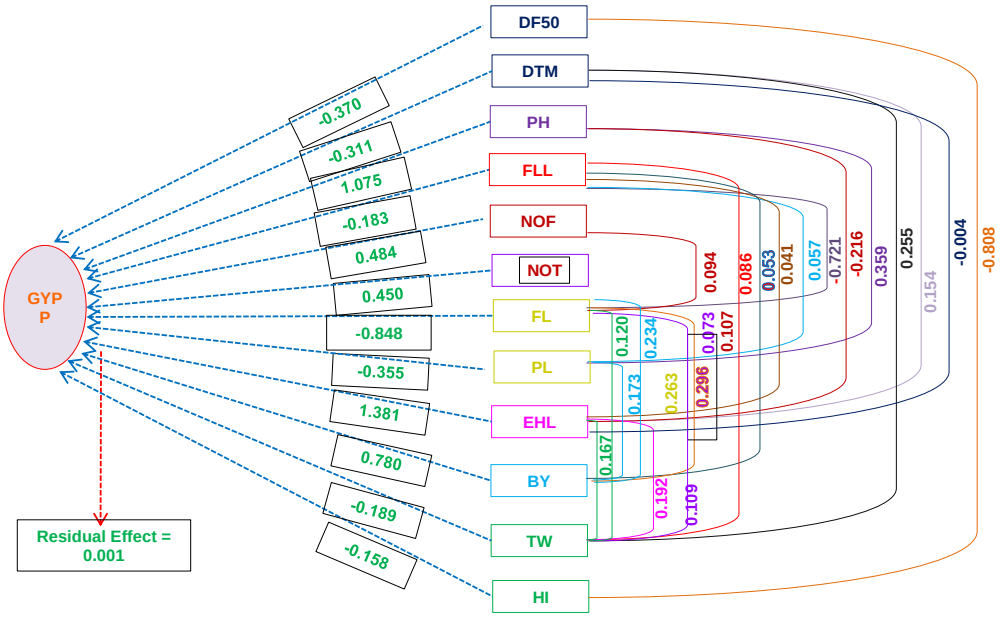

Fig. 2. Genotypic path diagram showing direct and indirect effects of different traits on seed yield

Preliminary studies also revealed the similar results in [7] stated the significant positive genotypic relation with harvest index (0.883**) and phenotypic with harvest index (0.697**). Similarly Chavan et al. [7] also proved phenotypic positive significant correlation between seed yield and harvest index (0.664**).

3.5 Path Analysis

Path analysis in particular having the direct effect of seed yield on characters such as harvest index followed by number of effective pods per plant, plant height, days to maturity, biological yield in descending order [8-10].

At the phenotypic path coefficient analysis test weight (p = 0.493**) followed by test weight (p = 0.457**), biological yield per plant (p = 0.425**), number of tillers (ph = 0.397**) exhibited significant positive direct effect with seed yield per plant and characters such as number of fingers (ph = -0.202) followed by days to 50% flowering (ph = -0.154) and peduncle length (ph = - 133) showed potential negative indirect effect with seed yield per plant, similar results were projected by Chavan et al. [7] and Sapkal et al. (2019).

4. CONCLUSION

It can be concluded from the experimental results that ample amount of significant genetic variability was exploited for further improvement in finger millet of the characters such as harvest index, number tillers, ear head length, plant height and biological yield per plant. Characters like grain yield per plant exhibited a positive association and significant positive phenotypic and genotypic correlation with harvest index, number of tillers, test weight and finger length. Through phenotypic and genotypic path analysis, observed the variable amount of direct and indirect effects of various characters such as plant height, biological yield and number of tillers on grain yield per plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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