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Deciphering the Correlation and Path Coefficient for Yield and Yield Component Traits in Finger Millet (*Eleusine coracana*) Germplasm Collected from Uttarakhand

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Abstract

The present investigation was carried out with an objective to decipher the character association and estimate the direct and indirect effects of yield component traits on grain yield per plot of finger millet germplasm accessions which were grown during *Kharif 2020*. The experiment was laid out in randomized block design (RBD) with three replications. Experiment material consisted of 23 different accessions and 6 checks of finger millet namely, VL324, VL347, VL348, VL352, VL315 and VL149. Grain yield was significantly correlated with its component characters like biological yield per plot, 1000 grain weight, finger number on main ear,number of productive tillers per plant, ear head length, flag leaf blade width and flag leaf blade length. Genotypic path analysis showed 50% flowering, finger number on main ear, number of productive tillers per plant, peduncle length, finger length, 1000 grain weight, biological yield, and plant height recorded positive direct effect on grain yield per plot. Phenotypic path analysis also revealed that biological yield per plot, number of productive tillers per plant, 1000 grain weight, ear head length, flag leaf blade length, finger length, finger number on main ear, peduncle length, days to 50% flowering and plant height recorded positive direct effect on grain yield. Thus, 1000 grains weight, biological yield per plot, number of productive tillers per plant, finger length, peduncle length, days to 50% flowering, finger number on main ear and plant height to be important yield components that can be used to improve the yield potential of finger millet genotypes.

Key words : *Correlation, Eleusine coracana, finger millet, path coefficients, yield components.*

Introduction

Finger millet (*Eleusine coracana* (L.) Gaertn) is a popular food cereal crop in Asia and Africa's semi-arid tropics. It ranks fourth among millets in terms of global production, behind sorghum, pearl millet and foxtail millet (1). This crop is adaptable to wide range of environments as it can withstand adverse conditions of moisture and temperature (2). It has long been a staple crop of dry land marginal farming systems, due to its modest yield ability for grain and fodder under little or no input conditions (3). Finger millet is thought to have originated in the highlands of Ethiopia and Uganda, it was domesticated at least 5000 years ago in western Uganda and the Ethiopian highlands before being introduced to India around 3000 years ago (4).

India is the world's largest producer of finger millet. In 2019-20 it was cultivated over 0.99 million hectares with aproduction of 1.74 million tones and an average productivity of 1761 kg per hectare (5). In India, finger millet is primarily grown and consumed in Karnataka, Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra, Uttarakhand, Rajasthan, Gujarat, and Goa. Karnataka produced about 53% of the country's total finger millet, with Tamil Nadu (15%), Uttarakhand (10%), and Andhra Pradesh (7.5%) following closely behind (6).

Finger millet (*Eleusine coracana* (L.) Gaertn. subsp. *coracana*) is a nutrient-dense tetraploid (2n = 4x = 36) cereal crop. It belongs to the family Poaceae, genus Eleusine in the tribe Eragrostideae and is believed to have been domesticated in the east-African region from wild finger millet (*Eleusine coracana* (L.) Gaertn. subsp. *africana* (7). The nutritional potential of finger millet entrenched with good proportion of dietary fiber, calcium and phytochemicals. Finger millet contains large proportion of carbohydrates with low glycemic index which is recommended for diabetic patients. It has a good balance of essential amino acids and micronutrients *viz.,* calcium and iron (8,9).

Grain yield *per se* is a product of direct and indirect interaction of many component traits. Therefore, to improve the gain yield it is important to estimate the contribution and relation of each of the traits with grain yield. Understanding the relationship between yield and its component traits also help breeder in selection of desirable genotypes. Correlation and the path coefficient investigation (10) are biometrical tools for complete determination of the impact of the independent variables on the dependent one and to find direct and indirect effects (11). Therefore, the present study was conducted in finger millet to study the correlation and path coefficient effects of different yield components on grain yield.

Materials and Methods

The current investigation was conducted at the Pantnagar Center for Plant Genetic Resources (PCPGR), Govind Ballabh Pant University of Agriculture and Technology,

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Pantnagar, Udham Singh Nagar, Uttarakhand, during the *kharif* 2020. The investigation's experimental material consisted of 23 germplasm accessions with six checks, namely VL324, VL347, VL348, VL352, VL315 and VL149. These germplasms/landraces were procured from four districts of Uttarakhand *viz.* Bageshwar, Chamoli, Pauri Garhwal and Pithoragarh. The experiment was laid in Randomized Complete Block Design with three replications. Each entry was allotted to a single row plot measuring 2 meter long and plot to plot spacing was kept to 30 centimeter.

The observations were recorded on five randomly selected plants from each treatment in each replication for 14 quantitative traits viz., days to 50% flowering, flag leaf blade length, flag leaf blade width, peduncle length, ear head length, number of productive tillers per plant, finger number on main ear, finger length, finger width, plant height, day to maturity, 1000 grain weight, biological yield per plotand grain yield per plot were studied.

The data for different characters were statistically analyzed for significance by using analysis of variance technique described by (11). To understand the association among the different characters, genotypic and phenotypic correlation coefficient were worked out by adopting the method described by (13). Genotypic and phenotypic correlation coefficient were partition into direct and indirect effect by path analysis as suggested by (11).

Results and Discussion

Analysis of variances was carried out for 14 metric characters comprising yield and component characters under randomized complete block design and results revealed that genotype's mean square values were highly significant for all the characters under study. This indicates sufficient genetic variability is present among the genotypes undertaken for study. Correlation coefficients at genotypic and phenotypic level were worked out among fourteen different characters in all possible combinations and are furnished in Table-1.

Highly positive significant genotypic and phenotypic correlations were observed between grain yield per plot with biological yield per plot (0.685 and 0.580, respectively), 1000 grain weight (0.519 and 0.446, respectively), finger number on main ear (0.654 and 0.375, respectively), number of productive tillers per plant (0.920 and 0.597, respectively), ear head length (0.575 and 0.470, respectively), flag leaf blade width (0.576 and 0.322, respectively) and flag leaf blade length (0.910 and 0.566, respectively). Grain yield per plot has significant and negative genotypic and phenotypic correlation with days to maturity (0.682 and -0.512, respectively), finger width (-0.672 and -0.312, respectively), days to 50% flowering (-0.562 and -0.487, respectively). (14) also reported positive significant correlation of grain yield with number of productive tillers per plant, finger number on main ear, grain weight and negative significant with days to maturity and days to 50% flowering. Grain yield per plant was positively correlated with 1000 grains weight (15) and with productive tillers (16) had also reported correlation of grain yield with number of productive tillers per plant, finger number on main ear, finger length, 1000 grains weight at genotypic and phenotypic levels**.** (17) reportednumber of productive tillers per plant, finger number on main ear and biological yieldsignificantpositive correlation with grain yield per plant at genotypic and phenotypic levels.

For genotypic path coefficient analysis, grain yield per plot was taken as a dependent variable and other fourteen characters as independent variables.Days to 50% flowering (1.259) showed highest positive direct effect ongrain yield per hectare followed byfinger number on main ear (0.855), number of productive tillers per plant (0.499), peduncle length (0.430), finger length (0.381), 1000 grain weight (0.338), biological yield (0.219), and plant height (0.121) recorded positive direct effect on grain yield per plot. Meanwhile, days to maturity (-0.786) exerted highest negative direct effect on grain yield followed by ear head length (-0.449), finger width (-0.218), flag leaf blade width (-0.091) and flag leaf blade length (-0.062). Further, estimates of genotypic path coefficient are enumerated in Table-2.

At phenotypic level path coefficient analysis for grain yield per plot revealed that only ten character namely biological yield per plot (0.362), number of productive tillers per plant (0.239), 1000 grain weight (0.211), ear head length (0.177), flag leaf blade length (0.168), finger length (0.142), finger number on main ear (0.086), peduncle length (0.054), days to 50% flowering (0.030) and plant height (0.018) recorded positive direct effect on grain yield. While, highest negative direct effect on grain yield was exerted by flag leaf blade width (0.037) followed by days to maturity (-0.146) and finger width (-0.154).

Path analysis revealed that 1000 grains weight, biological yield per plot, number of productive tillers per plant, finger length, peduncle length, days to 50% flowering, finger number on main ear and plant height showed true relationship by cementing positive association and direct effect on grain yield per plot both at genotypic and phenotypic levels. High direct effect along positive andhigh indirect effect through other characters provides a better chance for a character to be selected through breeding programmes. Positive association of grain yield per plot with yield attributing traits are also reported by (16) for plant height, number of productive tillers per plant, finger number on main ear and biological yield per plot both at genotypic and phenotypic levels. (18) for plant height, ear head length, days to maturity at phenotypic level andnumber of productive tillers per plant,

Table-1 : Estimates of Phenotypic (above diagonal) and Genotypic (below diagonal) correlation coefficient among yield and yield component characters in Finger millet.

Character	DF	FLBL	FLBW	PL	EHL	TLN	FNE	FL	FW	PH	DM	1000 GW	BY	GY
DF		-0.436**	-0.150^{NS}	0.050^{NS}	-0.250*	-0.437**	-0.442**	0.013^{NS}	0.105^{NS}	-0.161^{NS}	0.856**	-0.293**	-0.168^{NS}	-0.487**
FLBL	-0.764**		0.525**	-0.029^{NS}	0.422**	0.438**	0.484**	0.070^{NS}	-0.139^{NS}	0.096^{NS}	-0.416**	0.318**	0.137^{NS}	0.566**
FLBW	-0.314**	0.499**		0.084^{NS}	0.415**	0.258*	0.314**	0.178^{NS}	-0.171^{NS}	-0.185^{NS}	-0.208^{NS}	-0.003^{NS}	0.084^{NS}	0.322**
PL	-0.045^{NS}	-0.277**	0.132^{NS}		0.004^{NS}	-0.024^{NS}	-0.374**	-0.072^{NS}	-0.074^{NS}	0.124^{NS}	0.052NS	-0.181^{NS}	-0.133^{NS}	-0.081^{NS}
EHL	-0.330**	0.552**	0.471**	-0.055^{NS}		0.332**	0.322**	0.528**	-0.159^{NS}	-0.002^{NS}	-0.269*	-0.097^{NS}	0.052^{NS}	0.470**
TLN	-0.719**	0.870**	0.345**	-0.238*	0.463**		0.281**	0.108^{NS}	-0.076^{NS}	0.226*	-0.466**	0.185^{NS}	0.239*	0.597**
FNE	-0.777**	0.869**	0.533**	-0.415**	0.613**	0.578**		0.107^{NS}	0.008^{NS}	0.006^{NS}	-0.358**	0.106^{NS}	0.109^{NS}	0.375**
FL	0.045^{NS}	-0.032^{NS}	0.353**	0.261*	0.936**	0.322**	0.143^{NS}		0.085^{NS}	0.010^{NS}	0.028^{NS}	-0.207^{NS}	0.083^{NS}	0.242*
FW	0.206^{NS}	-0.814**	-0.682**	-0.349**	-0.573**	-0.373**	-0.428**	-0.324**		0.139^{NS}	0.201^{NS}	-0.107^{NS}	-0.159^{NS}	-0.312**
PH	-0.267*	0.090^{NS}	-0.496**	-0.305**	0.178^{NS}	0.454**	0.214*	0.268*	0.300**		-0.129^{NS}	-0.097^{NS}	-0.027^{NS}	0.066^{NS}
DM	1.005**	-0.950**	-0.449**	0.052^{NS}	-0.398**	-0.956**	-0.882**	-0.000^{NS}	0.212*	-0.172^{NS}		-0.298**	-0.138^{NS}	-0.512**
1000 GW	-0.322**	0.515**	-0.001^{NS}	-0.420**	-0.122^{NS}	0.295**	0.374**	-0.347**	-0.228*	-0.263*	-0.366**		0.372**	0.446**
BY	-0.201^{NS}	0.332**	0.209*	-0.245*	0.051^{NS}	0.540**	0.237*	0.157^{NS}	-0.227*	-0.007^{NS}	-0.187^{NS}	0.472**		0.580**
GY	-0.562**	0.910**	0.576**	-0.169^{NS}	0.575**	0.920**	0.654**	0.403**	-0.672**	0.104^{NS}	-0.682**	0.519**	0.685**	

** Significance at 1%, * Significance at 5% NS=not significant

DF = days to 50% flowering, FLBL = flag leaf blade length, FLBW = flag leaf blade width, PL = peduncle length, EHL=ear head length, TLN = number of productive tillers per plant, FNE = finger number on main ear, FL = finger length, FW = finger width, PH=plant height, DM = days to maturity, 1000GW=1000 grains weight, BY = biological yield per plot, GY = grain yield per plot

Table-2 : Genotypic path matrix exhibiting direct (diagonal) and indirect effects of grain yield contributing characters on grain yield per plot in finger millet.

Character	DF	FLBL	FLBW	PL	EHL	TLN	FNE	FL	FW	PH	DM	GW	BY
DF	1.259	-0.962	-0.396	-0.057	-0.415	-0.906	-0.979	0.057	0.259	-0.336	1.265	-0.405	-0.253
FLBL	0.047	-0.062	-0.031	0.017	-0.034	-0.054	-0.054	0.002	0.051	-0.006	0.059	-0.032	-0.021
FLBW	0.028	-0.045	-0.091	-0.012	-0.043	-0.031	-0.048	-0.032	0.062	0.045	0.041	0.000	-0.019
PL	-0.020	-0.119	0.057	0.430	-0.023	-0.103	-0.178	0.112	-0.150	-0.131	0.022	-0.180	-0.105
EHL	0.148	-0.248	-0.212	0.025	-0.449	-0.208	-0.275	-0.420	0.258	-0.080	0.179	0.055	-0.023
TLN	-0.359	0.434	0.172	-0.119	0.231	0.499	0.288	0.161	-0.186	0.227	-0.477	0.147	0.269
FNE	-0.665	0.743	0.455	-0.355	0.524	0.495	0.855	0.122	-0.366	0.183	-0.754	0.320	0.203
FL	0.017	-0.012	0.134	0.099	0.356	0.123	0.054	0.381	-0.123	0.102	0.000	-0.132	0.060
FW	-0.045	0.177	0.149	0.076	0.125	0.081	0.093	0.071	-0.218	-0.065	-0.046	0.050	0.049
PH	-0.032	0.011	-0.060	-0.037	0.022	0.055	0.026	0.033	0.036	0.121	-0.021	-0.032	-0.001
DM	-0.790	0.747	0.353	-0.041	0.313	0.751	0.693	0.000	-0.167	0.135	-0.786	0.288	0.147
GW	-0.109	0.174	0.000	-0.142	-0.041	0.100	0.127	-0.117	-0.077	-0.089	-0.124	0.338	0.160
BY	-0.044	0.073	0.046	-0.054	0.011	0.118	0.052	0.034	-0.050	-0.002	-0.041	0.103	0.219

Residual effect = 0.04395

DF = days to 50% flowering, FLBL = flag leaf blade length, FLBW = flag leaf blade width, PL = peduncle length, EHL = ear head length, TLN = number of productive tillers per plant, FNE = finger number on main ear, FL = finger length, FW = finger width, PH = plant height, DM = days to maturity, 1000GW = 1000 grains weight, BY = biological yield per plot, GY = grain yield per plot.

days to 50% flowering and finger number on main ear at genotypic level. (19) for flag leaf blade length and finger length. (20) for finger length, and finger number on main ear. (21) for number of productive tillers per plant at genotypic level and (22) for number of productive tillers per plant, panicle length, days to flowering, biological yield per plant at genotypic level.

Critical analysis of result obtained from character association and path analysis indicated that the character 1000 grains weight, biological yield per plot, number of productive tillers per plant, finger length, peduncle length, days to 50% flowering, finger number on main ear and plant height showed true relationship by cementing positive association and direct effect on grain yield per plot both at genotypic and phenotypic levels for improving the ultimate grain yield of the crop. Thus, direct selection for these traits will be beneficial in yield improvement programme.

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