International Scholars Journals

African Journal of Plant Breeding ISSN 2375-074X, Vol. 11 (1), pp. 001-005, January, 2024. Available Online at www.internationalscholarsjournals.com © International Scholars Journals

Research Article

Character association and path coefficient analysis for yield and yield contributing traits of finger millet (*Eleusine coracana* (L.) Gaertn) genotypes in North-Western Ethiopia

Tafere Mulualem Emrey*

Department of Agricultural Research, Ethiopian Institute of Agricultural Research, Agricultural Research Center Addis, Ababa, Ethiopia

Received: 10-Oct-2023, Manuscript No. AJPB-23-116833; Editor assigned: 13-Oct-2023, Pre QC No. AJPB-23-116833 (PQ); Reviewed: 27-Oct-2023, QC No. AJPB-23-116833; Revised: 24-Dec-2023, Manuscript No. AJPB-23-116833 (R); Published: 03-Jan-2024

ABSTRACT

The present investigation was undertaken for the three consecutive years from 2011 to 2013 main cropping season with the objective to know the relationships among yield contributing characters and identify their direct and indirect effects on yield. The experiment was carried out in Randomized Complete Block Design (RCBD) with four replications at two locations. Correlation coefficient and direct and indirect effects in 10 different genotypes with one standard check namely Baruda were analyzed using appropriate software. Number of fingers per plant (r_p=0.409), stand count at harvest (r_p=0.468) and disease score (r_p=-0.444) had significant positive and negative correlations at phenotypic level. Characters exerted positive phenotypic direct effect on grain yield includes plant height (0.008), number of tillers per plot (0.053), number of fingers per plot (0.237), finger length (0.006) and stand count at harvest (0.034). Therefore, characters with highest positive phenotypic direct effect on grain yield are more likely to be considered for future crop improvement.

Keywords: Character, Ethiopia, Finger millet, Path analysis

INTRODUCTION

Finger millet (*Eleusine coracana* (L.) Gaertn) is widely cultivated in arid and semi-arid regions of Africa and South Asia which is a rich source of seed protein, fibre and minerals such as iron, calcium and manganese (Upadhyaya et al., 2010). It is one of the most important grain crop grown after maize and sorghum in north western Ethiopia. It is considered as an ideal crop for changing food habits of people due to its nutritional richness, high photosynthetic efficiency and good resistance to biotic and abiotic stresses. The genetic potential of finger millet serves as an indispensable resource for understanding their tolerance to abiotic stresses through selection. The efficiency of selection for yield mainly depends on the direction and magnitude of association between yield and its component characters and among themselves. The character association provides information on the nature and extent of association between pairs of metric traits and helps in selection for the improvement of the character. Correlation gives only the relation between two variables whereas, path coefficient analysis allows separation of the direct and indirect effects through other attributes by partitioning the correlations (Wright, 1921). In light of the above scenario, the present study was carried out with the objective of investigating the character associations and their direct and indirect effects on yield in finger millet genotypes.

MATERIALS AND METHODS

The experiment was conducted at two locations in Metekel zone, namely Pawe and Manbuk for three consecutive years (2011 to 2013 main cropping seasons). Geographically, Pawe is located 575 km away from Addis Ababa with a latitude of 11° 15′N and a longitude of 36° 05' E at an elevation of 1150 m.a.s.l, and Manbuk is a town located at a latitude, longitude and elevation of

*Corresponding author. Tafere Mulualem Emrey, E-mail: tafere_mulualem@yahoo.com

11° 17′ N, 36° 13′ E and 1200 m.a.s.l respectively. With the Nitisol type, the area has a single rain pattern, and the average annual rainfall is between 1500 mm and 1800 mm. The average annual low temperature is 16°C, and the average annual high temperature is 32°C.

A total of elven finger millet genotypes (PWRFM-1 to PWRFM-10 and a standard check variety Baruda) which were advanced from preliminary yield trials were used. Randomized Complete Block Design (RCBD) with four replications. Each plot has five rows with 0.75 m row spacing and row length of 3 m. For the purpose of plot management and data recording 1.5 m path was left between each block. Both urea and DAP fertilizer were used at the recommended rate of 100 kg/ha. The whole DAP was applied at once during sowing whereas split application was done for urea. The remaining agronomic activities were applied uniformly as per the recommendations.

The common agronomic characters of finger millet which includes days to flowering, days to maturity, plant height, number of tillers per plant, number of fingers per plant, length of fingers, and stand count at harvest, lodging and grain yield were collected. The collected data were subjected for analysis of variance using SAS 9.3 software. The significance of the mean sum of squares for each character was tested against the corresponding error degrees of freedom using 'F' Test (Fisher and Yates, 1967). The correlation was estimated using the formula suggested by Miller et al. (1958) and the path coefficient analysis initially suggested by Wright (1921) and described by Dewey and Lu (1959) allows partitioning of correlation coefficient into direct and indirect contributions (effects) of various traits towards dependent variable and thus helps in assessing the cause-effect relationship as well as effective selection. Genetic correlations were further partitioned into direct and indirect effects using the path coefficient analyses following the method of Dewey and Lu (1959).

RESULTS AND DISCUSSION

Correlation coefficient estimates of yield and related agronomic characters

Grain yield is the result of multiplicative interactions of several other characters that are termed as yield components, which referred to as super character. Therefore, identification of important yield components and information about their relationships with yield and also with each other is very essential in variety development. In this respect, the correlation coefficient which provides symmetrical measurement of degree of association between two variables or characters, help us in understanding the nature and magnitude of association among yield and yield related components. The genotypic correlation coefficients between different characters were generally similar in sign and nature to the corresponding phenotypic correlation coefficients in the experiment. However, genotypic correlations were higher in magnitude than the corresponding phenotypic values. Misra et al., (2008); Ali et al., (2013) and Suryanarayana et al., (2014) also reported higher estimates of genotypic correlation than the corresponding phenotypic correlation coefficients between yield and yield related components in finger millet.

The present study revealed that grain yield had significant positive and negative correlations at phenotypic levels with number of fingers per plant (r_p=0.409), stand count at harvest (r_p=0.468) and disease score (r_p=-0.444). Characters that showed significant positively at both genotypic and phenotypic levels are plant height with finger length (r_g=0.391, r_p=0.817), days to maturity with days to 50% flowering (r_g=0.943, rp=0.762) and number of fingers per plant with days to maturity (r_g=0.743, r_p=0.469). This finding is in agreement with results obtained by Arya et al., (2017, Bhasker et al., 2017, Negi et al, 2017 Singh et al, 2018. On the other hand, disease score had a significant negative correlation at phenotypic level with number of fingers per plant (r_p=-0.200) and number of tillers per plant (r_p=-0.667). Similarly, number of tiller had significant positive correlation at phenotypic level with number of fingers per plant (r_p=0.234). The present finding is in agreement with results obtained by Muduli et al., (2012), Eric et al., (2016), Arya et al., (2017) and Singh et al., (2018).

However, correlation study only provides information on the relationship and does not give an idea on the cause of this relation and sometimes information obtained is misleading with respect to identification of yield components. Therefore, path coefficient analysis is a tool to partition the observed correlation coefficient in direct and indirect effects of yield components on grain yield to provide clear picture of character associations for formulating efficient selection strategy. Path analysis differs from simple correlations in that it points out the cause and their relative importance, whereas the latter measure simply the mutual association ignoring the causality, Wright, (1921) and Dewey and Lu, (1959) explained (Table 1).

Table 1. Estimates of genotypic and phenotypic correlation coefficients for different agronomic characters of finger millet.

Characters		DF	DM	PHT	DS	NTPP	NFPP	FL	LODG	STCN	YD
DF	r_g	1	0.943***	0.033	0.727	0.115	0.695	0.306	-0.791**	-0.782**	-0.561
	r_p	1	0.762***	0.131	-0.155	0.184**	0.414***	0.273***	-0.488***	-0.002	-0.081
DM	r_g		1	-0.038	0.839**	0.325	0.743**	0.288	-0.844	-0.599	-0.43
	r_p		1	0.105	-0.213**	0.332***	0.469***	0.252***	-0.400***	0.049	0.011
PHT	r_g			1	-0.404	0.22	0.236	0.817**	0.528	-0.297	-0.138
	r_p			1	-	0.082	0.510***	0.391***	0.354***	0.252***	0.275

					0.472***						
DS	r_g				1	0.419	0.539	-0.112	-0.936***	-0.248	-0.421
	r_p				1	-0.200**	-0.667***	-0.096	-0.181**	-0.362***	-0.444***
NTPP	r_g					1	0.439	0.195	-0.143	0.186	-0.111
	r_p					1	0.234***	0.115	-0.021	-0.014	0.1
NFPP	r_g						1	0.393	-0.446	-0.31	-0.072
	r_p						1	0.15	0.101	0.390***	0.409***
FL	r_g							1	0.19	-0.338	-0.215
	r_p							1	0.097	-0.005	0.006
LODG	r_g								1	0.408	0.425
	r_p								1	0.207**	0.231**
STCN	r_g									1	0.61
	r_p									1	0.468***

Note: *,** significant at 5%and 1% levels, respectively, r_g=genotypic correlation, r_p=phenotypic correlation, DF: Days to 50% Flowering; DM: Days to Maturity; PHT: Plant Height; DS: Disease Score; NTPP: No. of Tillers Per Plant; NFPP: No. of Fingers Per Plant; FL: Finger Length; LODG: Lodging; STCN: Stand Count

Phenotypic and genotypic path-coefficient analysis

Path-coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation coefficient into the measures of direct and indirect effects (Singh and Narayanan, 1993).

The information obtained by this technique helps in indirect selection for genetic improvement of yield. In the present investigation, the genotypic correlation coefficient was further divided into direct and indirect effects using path-coefficient analysis.

The phenotypic direct and indirect effects of yield related characters on yield were illustrated in Table 2. Hence, as shown in the Table 2 below traits exerted positive phenotypic direct effect on grain yield includes plant height (0.008), number of tillers per plot (0.053), number of fingers per plot (0.237), finger length (0.006) and stand count at harvest (0.034). Whereas, characters days to flowering, days to maturity, disease score and lodging exerted negative direct effect on grain yield. The highest and positive phenotypic direct effect on grain yield were recorded by stand count at harvest (0.304) followed by number of fingers per plot (0.237). Hence, these characters are more likely to be considered for further selection procedures to higher grain yield.

Table 2. Phenotypic path coefficient analysis showing direct (diagonal and bold) and indirect (off diagonal) effect of different characters on grain yield in finger millet.

Characters	**DF**	**DM**	**PHT**	**DS**	**NTPP**	**NFPP**	**FL**	**LODG**	**STCN**	**YD**
DF	-0.207	-0.016	0.001	0.031	0.01	0.098	0.002	0.002	-0.001	-0.081
DM	-0.158	-0.021	0.001	0.042	0.018	0.111	0.002	0.002	0.015	0.011
PHT	-0.027	-0.002	0.008	0.094	0.004	0.121	0.002	-0.001	0.077	0.275***
DS	0.032	0.005	-0.004	-0.198	-0.011	-0.158	-0.001	0.001	-0.11	-0.444**
NTPP	-0.038	-0.007	0.001	0.04	0.053	0.056	0.001	0	-0.004	0.1
NFPP	-0.086	-0.01	0.004	0.132	0.013	0.237	0.001	0	0.118	0.409***
FL	-0.057	-0.005	0.003	0.019	0.006	0.036	0.006	0	-0.001	0.006
LODG	0.101	0.009	0.003	0.036	-0.001	0.024	0.001	-0.004	0.063	0.231
SCNT	0	-0.001	0.002	0.072	-0.001	0.093	-2.758	-0.001	0.304	0.468***

Note: *,** significant at 5%and 1% levels, respectively, rg=genotypic correlation, rp=phenotypic correlation, DF: Days to 50% Flowering; DM: Days to Maturity; PHT: Plant Height; DS: Disease Score; NTPP: No. of Tillers Per Plant; NFPP: No. of Fingers Per Plant; FL: Finger Length; LODG: Lodging; STCN: Stand Count

Similarly, the genotypic direct and indirect effects of yield contributing characters on grain yield were presented in Table 3. Thus, days to maturity (2.487), disease score (0.206), number of fingers per plot (0.906), and lodging (1.601) exerted positive genotypic direct effect on grain yield. On the other hand, characters days to flowering, plant height, number of tillers per plot, finger length and stand count exerted negative genotypic direct effect on grain yield. The maximum and positive genotypic direct were observed by days to maturity (2.487) followed by lodging, number of fingers per plot and disease score with the value of 1.601, 0.906 and 0.206 respectively (Table 3). These results are in confirmation with the findings of Ganapathy et al., (2011), Anuradha et al., (2013), Kumar (2014), Jyothsna et al., (2016) and Negi et al., (2017).

Table 3. Genotypic Path coefficient analysis showing direct (diagonal and bold) and indirect (off diagonal) effect of different characters on grain yield in finger millet.

Characters	DF	DM	PHT	DS	NTPP	NFPP	FL	LODG	STCN	YD
DF	-2.804	2.346	-0.032	0.15	-0.06	0.629	-0.008	-1.265	0.484	-0.561
DM	-2.644	2.487	0.037	0.173	-0.168	0.673	-0.008	-1.35	0.371	-0.43
PHT	-0.093	-0.095	-0.974	-0.083	-0.114	0.214	-0.021	0.844	0.184	-0.138
DS	-2.037	2.086	0.394	0.206	-0.217	0.488	0.003	-1.498	0.154	-0.421
NTPP	-0.323	0.809	-0.215	0.086	-0.517	0.398	-0.005	-0.229	-0.115	-0.111
NFPP	-1.947	1.847	-0.23	0.111	-0.227	0.906	-0.01	-0.713	0.192	-0.072
FL	-0.857	0.717	-0.796	-0.023	-0.101	0.356	-0.026	0.305	0.209	-0.215
LODG	2.217	-2.098	-0.514	-0.193	0.074	-0.404	-0.005	1.601	-0.253	0.425
SCNT	1.572	-1.07	0.134	-0.087	0.057	-0.065	0.006	0.681	-0.619	0.61

Note: *,** significant at 5%and 1% levels, respectively, r_g=genotypic correlation, r_p=phenotypic correlation, DF: Days to 50% Flowering; DM: Days to Maturity; PHT: Plant Height; DS: Disease Score; NTPP: No. Of Tillers Per Plant; NFPP: No. of Fingers Per Plant; FL: Finger Length; LODG: Lodging; STCN: Stand Count

CONCLUSION

The genotypic correlation was generally similar in nature and higher in magnitude than corresponding phenotypic correlation coefficients. Correlation and path analysis concluded that the number of tillers per plot, number of fingers per plot, finger length, influenced the grain yield more than any of the other characters. Hence, it would be worth to lay more emphasis on these characters in selection programmer to improve the grain yield in finger millet.

ACKNOWLEDGMENTS

The author is gratefully acknowledged to McKnight Foundation for the financial support to carry out the research and for the sorghum and millet research team for technical support during field experimentation.

REFERENCES

Ali K, Ramesh B, Gangwar LK, Imran M, Kam-boj G (2013). Variability, heritability and correlation among agro-morphological traits in Finger millet (*Eleusine coracana* (L.) Gaertn). Progress. Res. 8: 95-98.

Arya R, Bhatt A, Kumar V, Singh DP (2017). Correlation analysis of some growth, yield and quality parameters of barnyard millet germplasm. J. Pharmacogn. Phytochem. 6: 1426-1429.

Bhasker K, Shashibhushan D, Krishna M, Bhave MHV (2017). Correlation and path analysis for grain yield and it components in pearl millet (*Pennisetum glaucum* (L). R.Br.). Bull. Env. Pharmacol. Life Sci. 6: 104-106.

Dewey DR, KH Lu (1959). A correlation and path coefficient analysis of components of crescent wheat grass seed production. Agro. J. 51: 515-518.

Eric MO, Pangirayi T, Paul S, Mwangi G, Rathore A (2016). Correlations, path coefficient analysis and heritability for quantitative traits in finger millet landraces. Philippine. J. Sci. 145: 197-208.

Fisher RA, Yates F (1967). Statistical Tables for Biological Agricultural and Medical Research. Olivar. Boyd. Edington.

Miller PA, Williams C, Robinson HF, RE Comstock (1958). Estimates of genotypic and Environmental variances and co-variances in upland cotton and their implications in selection. Agric. J. 50: 126–131.

Misra RC, Sahu PK, Pradhan B, Das S, Mishra CHP (2008). Character association, path-coefficient and selection indices in Finger millet (*Eleusine coracana*). Enviro. Eco. 26: 166-170.

Muduli KC, Pradhan K, Dash GB, Misra RC (2012). Association analysis among micro mutant lines in finger millet *(Eleusine coracana* Gaertn.). Environ. Ecol 30: 343-347.

Negi S, Bhatt A, Kumar V (2017). Character association and path analysis for yield and its related traits in finger millet (*Eleusine coracana* (L.) Gaertn.) Genotypes. J Applied Natural Sci. 9: 1624-1629.

Singh O, Gowthami R, Singh K, Shekhawat N (2018). Assessment of inter-characters' associations in the germplasm of pearl millet over five years in hot arid climate of Rajasthan, India. Int. J. Curr. Microbiol. App. Sci. 7: 3133-3149.

Singh P, Narayanan SS (1993). Biometrial techniques in plant breeding. Kalyani Publishers, New Delhi.

Suryanarayana L, Sekhar D, Rao NV (2014). Inter relationship and cause-effect analysis in Finger millet (*Eleusine coracana* (L.) Gaertn) genotypes. Int. J. Curr. Micro. App. Sci. 3: 937-941.

Upadhyaya HD, Ramesh S, Sharma S, Singh SK, Varshney SK, Sarma ND, Ravishankar CR, et al. (2011). Genetic diversity for grain nutrients contents in a core collection of finger millet (*Eleusine coracana* (L.) Gaertn.) germplasm. Field Crops Res. 121: 42-52.

Wright S (1921). Correlation and causation. J. Agric. Res. 20: 557-85.