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RESEARCH ARTICLE :

Inter-relationship analysis of yield and yield component traits in little millet (*Panicum sumatrense*) genotypes

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SUMMARY : The study was conducted to determine the correlation and path co-efficients among the 30 little millet genotypes, comprised of 26 germplasm accessions and four check varieties *viz.*, CO $_2$, CO 3, CO (Samai) 4 and OLM 203. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications during summer, 2013 (Jan – May) at Millets Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Both at genotypic and phenotypic levels single plant grain yield showed positive and significant correlation with plant height (0.696 and 0.694), panicle length (0.678 and 0.599), days to 50 per cent flowering (0.608 and 0.530), peduncle length (0.556 and 0.429), flag leaf length (0.549 and 0.515) and thousand grain weight (0.448 and 0.441), respectively. Flag leaf width (-0.424 and -0.405) exhibited significant but negative genotypic and phenotypic correlation co-efficients with single plant grain yield. Path co-efficient analysis revealed that among the 11 yield component traits studied, panicle length (1.661), flag leaf width (0.941), culm branches per plant (0.812), plant height (0.678), thousand grain weight (0.564), days to 50 per cent flowering (0.470), panicle exertion (0.452) and peduncle length (0.350) exerted high positive direct effect on single plant grain yield while, basal tillers per plant (-1.635), flag leaf length (-0.910) and single plant dry fodder yield (-0.716) showed high negative direct effect on single plant grain yield. From the above results of path co-efficient analysis, it might be concluded that improvement in single plant grain yield could be brought about by selection for late flowering, tall plant stature, long peduncle, lengthy panicle and bolded size seeds in the material studied.

KEY WORDS :
Little millet, Yield component traits, Correlation, Path co-efficient analysis, Inter relationship analysis

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BACKGROUND AND OBJECTIVES

Little millet (*Panicum sumatrense* Roth. ex. Roem. and Schultz.) is an important indigenous small millets crop. It is well known for its drought tolerance and is considered as one of the least water demanding crops. Little millet is used as food in situations where other food grains generally can't be raised or available. Being an eco-friendly crop, it is suitable for vulnerable agro-ecosystems and shall be a preferred crop for sustainable and green agriculture. Grain yield is a complex character, the magnitude and expression of which depends on the influence of its component characters and is not only affected directly by each component character but also indirectly through other associated characters. Therefore, it becomes necessary to determine the association of the yield components with grain yield. Hence, an attempt was made in the present study to understand the direction and extent of association of component characters with grain yield and yield component traits and among themselves in the 30 little millet genotypes.

RESOURCES AND METHODS

The study was carried out with 30 littlemillet genotypes, maintained at the small millets germplasm bank of Department of Millets, Tamil Nadu Agricultural University, Coimbatore. Thirty genotypes comprised of 26 germplasm accessions and four check varieties *viz.*, CO_2, CO_3, CO (Samai) 4 and OLM 203 and the experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications during summer, 2013 (Jan – May) at Millets Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Recommended agronomic practices were followed to maintain a good crop stand. Observations on 12 quantitative traits *viz.*, days to 50 per cent flowering (DF), plant height (PH), basal tillers per plant (BT), culm branches per plant (CB), peduncle length (PEL), panicle length (PL), panicle exertion (PE), flag leaf length (FLL), flag leaf width (FLW), thousand grain weight (TGW), single plant dry fodder yield (DFY) and single plant grain yield (SPY) were recorded on five randomly selected plants in each entry based on descriptors for *Panicum sumatrense* (IBPGR, 1985). Phenotypic and genotypic correlations were worked out using the formulae suggested by Falconer (1964). Path co-efficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959) was used to calculate the direct and indirect contributions of various traits to yield.

OBSERVATIONS AND ANALYSIS

Both at genotypic and phenotypic levels single plant grain yield showed positive and significant correlation with plant height (0.696 and 0.694), panicle length (0.678 and 0.599), days to 50 per cent flowering (0.608 and 0.530), peduncle length (0.556 and 0.429), flag leaf length (0.549 and 0.515) and thousand grain weight (0.448 and 0.441), respectively. Flag leaf width (-0.424 and -0.405) exhibited significant but negative genotypic and phenotypic correlation co-efficients with single plant grain yield. Basal tillers per plant had significant positive genotypic (0.380) and non-significant positive phenotypic (0.344) associations with single plant grain yield. Significant and positive association of plant height with grain yield was observed earlier by Nirmalakumari *et al.* (2010); Sasamala *et al.* (2010) in little millet.

Days to 50 per cent flowering recorded significant and positive association with plant height, panicle length, single plant dry fodder yield, flag leaf length, peduncle length and basal tillers per plant. Plant height had significant and positive association with flag leaf length, peduncle length and panicle length. Basal tillers per plant showed significant positive correlations with culm branches per plant, panicle exertion, panicle length and thousand grain weight. Panicle length exhibited significant positive associations with flag leaf length and panicle exertion. Significant and negative genotypic and phenotypic inter correlations of flag leaf length was observed with flag leaf width

From the above results of association of yield with the component traits revealed that days to 50 per cent flowering, panicle length, plant height, peduncle length, flag leaf length, thousand grain weight and basal tillers per plant were the important yield components and due weightage should be given on these characters in selection programme for yield improvement in little millet. Flag leaf width showed negative and significant correlation with yield. Significant negative correlation between these components with grain yield suggested some sort of multiple selection criteria for simultaneous yield improvement through these component traits which would prove useful.

Correlation co-efficients are helpful in determining the component of a complex trait like yield; they do not provide an exact picture of the relative importance of direct and indirect influence of each of the component characters towards yield. Path coefficient analysis furnishing the inter relationship of different yield components would provide better index for selection rather than correlation co-efficients. Among the 11 yield component traits studied, panicle length (1.661), flag leaf width (0.941), culm branches per plant (0.812), plant height (0.678), thousand grain weight (0.564), days to 50

Table 1 : Estimates of phenotypic and genotypic correlation co-efficients for 12 characters in 30 little millet genotypes

		DF	PH	BT	CB	PEL	PL	PE	FLL	FLW	TGW	DFY	SPY
DF	pcc	1.000	0.450*	0.290	0.130	0.280	0.329	0.131	0.302	-0.100	0.104	0.352	0.530**
	gcc	1.000	0.514**	0.363*	0.160	0.383*	0.449*	0.137	0.385*	-0.129	0.128	0.405*	0.608**
PH	pcc		1.000	0.170	0.090	0.463**	0.359	0.252	0.651**	-0.399*	0.327	0.215	0.694**
	gcc		1.000	0.188	0.097	0.598**	0.407*	0.260	0.693**	-0.422*	0.331	0.218	0.696**
BT	pcc			1.000	0.564**	0.229	0.463**	0.573**	0.115	-0.358	0.341	-0.049	0.344
	gcc			1.000	0.694**	0.354	0.599**	0.652**	0.123	-0.419*	0.377*	-0.048	0.380*
CB	pcc				1.000	0.355	0.324	0.530**	0.216	-0.248	0.132	-0.022	0.172
	gcc				1.000	0.157	0.287	0.506**	0.162	-0.376*	0.122	-0.060	0.189
PEL	pcc					1.000	0.720**	0.438*	0.583**	-0.365*	0.182	0.473**	0.429*
	gcc					1.000	0.810**	0.431*	0.626**	-0.667**	0.199	0.537**	0.556**
PL	pcc						1.000	0.484**	0.556**	-0.587**	0.244	0.210	0.599**
	gcc						1.000	0.527**	0.592**	-0.760**	0.283	0.212	0.678**
PE	pcc							1.000	0.403*	-0.588**	0.248	0.000	0.214
	gcc							1.000	0.402*	-0.668**	0.246	-0.015	0.220
FLL	pcc								1.000	-0.468**	0.246	0.146	0.515**
	gcc								1.000	-0.582**	0.253	0.144	0.549**
FLW	pcc									1.000	-0.218	0.012	-0.405*
	gcc									1.000	-0.239	-0.008	-0.424*
TGW	pcc										1.000	0.112	0.441*
	gcc										1.000	0.112	0.448*
DFY	pcc											1.000	0.110
	gcc											1.000	0.111

*and ** indicate significance of values at P=0.05 and 0.01, respectively
pcc – Phenotypic correlation co-efficient, gcc – Genotypic correlation co-efficient, PH – Plant height (cm), DF –Days to 50 per cent flowering, BT – Basal tillers per plant, CB – Culm branches per plant, PEL - Peduncle length (cm), PL – Panicle length (cm), PE – Panicle exertion (cm), FLL – Flag leaf length (cm), FLW – Flag leaf width (cm), TGW – Thousand grain weight (g), DFY – Single plant dry fodder yield and SPY – Single plant grain yield

Table 2 : Path co-efficient analyses for 12 characters in 30 little millet genotypes

	DF	PH	BT	CB	PEL	PL	PE	FLL	FLW	TGW	DFY	SPY
DF	0.470	0.349	-0.594	0.130	0.134	0.746	0.062	-0.350	-0.121	0.072	-0.290	0.608**
PH	0.242	0.678	-0.308	0.078	0.209	0.676	0.117	-0.630	-0.397	0.187	-0.156	0.696**
BT	0.171	0.128	-1.635	0.564	0.124	0.994	0.295	-0.112	-0.395	0.213	0.034	0.380*
CB	0.075	0.065	-1.135	0.812	0.055	0.476	0.229	-0.148	-0.354	0.069	0.043	0.189
PEL	0.180	0.406	-0.579	0.128	0.350	1.346	0.195	-0.569	-0.627	0.112	-0.384	0.556**
PL	0.211	0.276	-0.979	0.233	0.283	1.661	0.238	-0.539	-0.715	0.160	-0.152	0.678**
PE	0.064	0.176	-1.066	0.411	0.151	0.876	0.452	-0.366	-0.629	0.139	0.011	0.220
FLL	0.181	0.470	-0.201	0.132	0.219	0.984	0.182	-0.910	-0.548	0.143	-0.103	0.549**
FLW	-0.061	-0.287	0.686	-0.306	-0.233	-1.263	-0.302	0.530	0.941	-0.135	0.005	-0.424*
TGW	0.060	0.224	-0.617	0.099	0.070	0.470	0.111	-0.230	-0.225	0.564	-0.080	0.448*
DFY	0.191	0.148	0.078	-0.049	0.188	0.353	-0.007	-0.131	-0.007	0.063	-0.716	0.111

Residual effect: 0.122 * and ** indicate significance of values at P=0.05 and 0.01, respectively
PH – Plant height (cm), DF –Days to 50 per cent flowering, BT – Basal tillers per plant, CB – Culm branches per plant, PEL - Peduncle length (cm), PL – Panicle length (cm), PE – Panicle exertion (cm), FLL – Flag leaf length (cm), FLW – Flag leaf width (cm), TGW – Thousand grain weight (g), DFY – Single plant dry fodder yield and SPY – Single plant grain yield

per cent flowering (0.470), panicle exertion (0.452) and peduncle length (0.350) exerted high positive direct effect on single plant grain yield while, basal tillers per plant (-1.635), flag leaf length (-0.910) and single plant dry fodder yield (-0.716) showed high negative direct effect on single plant grain yield. Bedis *et al.* (2006), Kadam *et al.* (2009) and Andualem and Tadesse (2011) in finger millet reported high positive direct effect of plant height on single plant grain yield. Nirmalakumari *et al.* (2010) reported negative negligible direct effect of flag leaf length in little millet.

From the above results of path co-efficient analysis, it might be concluded that improvement in single plant grain yield could be brought about by selection for late flowering, tall plant stature, long peduncle, lengthy panicle and bolded size seeds in the material studied. High positive direct effect and significant positive correlation with single plant grain yield showed the significance of these traits in yield improvement. The genotypic association of plant height and days to 50 per cent flowering was significantly positive suggesting the true perfect association of these characters and also indicating their role in simultaneous selection, while selecting genotypes with high grain yield. Hence, direct selection for these traits would be rewarding for yield improvement, which will also reduce the undesirable effect of the component traits studied. High indirect positive effects through panicle length resulted in positive and significant correlation for characters like basal tillers per plant and flag leaf length inspite of their high negative direct effects. Therefore, panicle length should be considered simultaneously for selection to improve yield. A negative indirect effect via panicle length is the main reason for negative significant correlation of flag leaf width. This necessitates restricted simultaneous selection to nullify the undesirable indirect effects of panicle length. The residual effect determines how best the causal factors account for the variability of the dependent factor. Low residual value in this study indicated the adequacy of the characters included in the present study.

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