CHARACTER ASSOCIATION STUDIES FOR YIELD ATTRIBUTING TRAITS ACROSS DIFFERENT SEASONS IN PEARL MILLET(*Pennisetum glaucum* (L.) R. Br)

ABSTRACT

The purpose of the present investigation was to assess the association of different characters among 36 advanced hybrids, 12 B lines and 3 R lines with grain yield per plotpooled across the seasons *Kharif* and summer and to demonstrate the direct and indirect effects of various characters on grain yield. The results on correlation in the present study revealed that, in general, the genotypic correlation coefficients were higher than their corresponding phenotypic correlations. Grain yield had genotypically significant positive correlation with most of the characters under study viz. plant height (0.955), effective tillers per plant (0.848), flag leaf length (0.992), flag leaf width (0.985), leaf length (0.987), leaf width (0.971), panicle length (0.234), panicle width (0.153), maximum PS II efficiency (0.215), fresh biomass (0.994), dry biomass (0.993), harvest index (0.997), 1000 seed weight (0.990) across the two seasons indicatinganyincreaseinthesetraitswillincreasetheyield. The genotypic path analysis revealed high positive direct effect on grain yield per plot with respect to plant height, panicle width, actual PS II efficiency, fresh biomass, dry biomass and 1000 seed weight indicatingimportanceofthesecharacters,whichcanbestrategicallyusedtoimprovetheyieldof pearl millet.

INTRODUCTION

Pearl millet (*Pennisetum glaucum*) is indeed a significant and ancient cereal crop. Its origin in Africa highlight its adaptation to harsh environments and its long history of cultivation. Being a diploid with a chromosomal number of 2n = 14 (Sattler *et al*., 2019) it has a relatively simple genome compared to some other cereals, which can facilitate breeding and genetic studies. Its nutritional profile, including high levels of protein, fiber, and essential minerals, further enhances its value as a staple crop in various regions. Its ability to thrive in harsh and marginal environments makes it an essential crop for food security in challenging regions. Its resilience to drought and ability to grow in low-rainfall conditions (150-700 mm annually) further enhances its role in sustainable agriculture. With a production of 36 million tons, it is grown on roughly 27 million ha in more than 30 countries, with the majority of crop area reported in Asia (>10 million ha) and Africa (approximately 18 million ha) (Yadav and Rai 2013). With an area of about 7.57 million ha, 10.86 million tonnes of production on average, and productivity of 1436 kg ha-1, India is the world's top producer of pearl millet (Rani *et al*., 2023).It is grown in the areas of Andhra Pradesh, Uttar Pradesh, Gujarat, Haryana, Maharashtra, Karnataka, and Telangana.In pearl millet and all other crop plants, grain production is a quantitative trait that is polygenetically controlled. Grain yield character selection alone is not particularly effective or efficient; selection based on its components and secondary characters may be more successful and dependable. The characteristics that contribute to grain yield are identified by the correlation coefficient analysis, which also assesses the strength and direction of the association between plant attributes. Path analysis is helpful in indirect selection since it tells us about the direct and indirect effects of

independent factors on the dependent variable and helps identify the characters that contribute to yield.

MATERIALS AND METHODS

The experimental material for the present investigation comprises of 36 Hybrids with a single standard check (Kaveri Super Boss) 12 B lines and 3 R lines (Table 1) of pearl millet developed at ICAR-Indian Institute of Millets Research, Hyderabad evaluated in a randomized block design with three replications during *kharif* of 2022 and summer of 2023. Each entry was sown in two rows of 3m length at a spacing of 45cm × 15cm. Observations were recorded on five competitive plants in each genotype in each replication for days to 50% flowering, days to maturity, plant height (cm), number of effective tillers per plant, flag leaf length (cm), flag leaf width (cm), leaf length (cm),leaf width (cm), actual photosystem II efficiency (ΦPSII), maximum photosystem II efficiency (F_v/F_m), panicle length (cm), panicle width (cm),fresh biomass (kg/plot), dry biomass (kg/plot), grain yield (kg/plot), harvest index (%) and 1000 seed weight (gm). The genotypic correlations between yield and its component traits and among themselves were worked out as per the methods suggested by Al-Jibouri*et al*. (1958). Path coefficient analysis was carried out as suggested by Wright (1921) and Dewey and Lu (1959). The simple correlation coefficients already estimated at genotypic level were utilized for this purpose. By keeping yield as dependent variable and other sixteen characters as independent variables, various direct and indirect effects were estimated.

Table 1:List of lines, testers and hybrids used in the experiment

Lines	Testers	hybrids
04999B	123R	04999B × 123R
	124R	04999B × 124R
	132R	04999B × 132R
843-22B	123R	843-22B × 123R
	124R	843-22B × 124R
	132R	843-22B × 132R
221B	123R	221B × 123R
	124R	221B × 124R
	132R	221B × 132R
242B	123R	242B × 123R
	124R	242B × 124R
	132R	242B × 132R
246B	123R	246B × 123R
	124R	246B × 124R
	132R	246B × 132R
252B	123R	252B × 123R
	124R	252B × 124R
	132R	252B × 132R
260B	123R	260B × 123R
	124R	260B × 124R
	132R	260B × 132R
262B	123R	262B × 123R
	124R	262B × 124R
	132R	262B × 132R
264B	123R	264B × 123R
	124R	264B × 124R
	132R	264B × 132R
269B	123R	269B × 123R
	124R	269B × 124R
	132R	269B × 132R

274B	123R	274B × 123R
	124R	274B × 124R
	132R	274B × 132R
291B	123R	291B × 123R
	124R	291B × 124R
	132R	291B × 132R

RESULTS AND DISCUSSION

1. Correlation studies:

The purpose of a correlational study is to establish the presence or absence of relationship among the different characters used in the study. This association may be due to pleiotropic action or linkage or both. The pattern of association among the yield contributing traits helps to determine superior genotypes from genetically divergent population based on the interconnection between them. Here in this case the character association is worked out under pooled conditions.In general the genotypic correlation is much higher than phenotypic correlation for most of the traits (Table 2), indicating that inherent association between various characters studied. Grain yield per plot exhibited highly significant positive correlation with plant height (0.955, 0.809), effective tillers per plant (0.848, 0.712), flag leaf width (0.985, 0.839), leaf length (0.987, 0.660), leaf width (0.971, 0.689), panicle length (0.234, 0.153), panicle width (0.153, 0.107), maximum PS II efficiency (0.215, 0.136), fresh biomass (0.994, 0.900), dry biomass (0.993, 0.897), harvest index (0.997, 0.785), 1000 seed weight (0.990, 0.913) number whereas, days to maturity (-0.982, 0.904), days to 50% flowering (-0.177, -0.112), flag leaf length (-0.992, -0.793), actual PS II efficiency (-0.976, -0.905) which showed highly significant negative correlation at both genotypic and phenotypic levels. The similar result obtained by Choudhary *et al*. (2012) in pearl millet for plant height, effective tillers per plant and days to 50% flowering, Ezeaku*et al*. (2015) for plant height and panicle length.Similar results were reported for grain yield with 1000 seed weight by Gupta *et al*. (2009) and Sankar *et al*. (2013) and with Harvest index by Arya *et al*. (2009), Kumar *et al*. (2016), Dapke *et al*. (2014) and Abuali *et al*. (2012).

2. Path coefficient analysis:

Studying the path co-efficient analysis, which considers both the causal and degree relationships, is required because the estimation of correlation alone may frequently be deceptive due to the mutual cancellation of component traits.When more number of characters are included in the study the estimation of correlations will become too much complex. Hence genotypic and phenotypic correlation was partitioned into direct and indirect effects to know the relative importance of the components (Table 3).With respect to the yield contributing traits, the characters days to 50% flowering (0.034), plant height (0.343), effective tillers per plant (0.100), flag leaf length (0.164), leaf length (0.004), panicle width (0.321), actual PS II efficiency (0.424), fresh biomass (0.542), dry biomass (0.983),1000 seed weight (0.147)showed positive direct effect on grain yield per plot at genotypic level. While days to maturity(-0.600), flag leaf width (-0.047), leaf width (-0.248), panicle length (-0.131), maximum PS II efficiency (-0.411) and harvest index (-0.664) had direct negative effect on grain yield per plot. Similar results were reported by Choudhary *et al.* (2012) for dry biomass, Pallavi *et al*. (2020) for panicle length, Dapke *et al*. (2014) for number of effective tillers per plant.Similar results were reported by Talawar*et al.* (2017) for effective tillers per

plant and panicle length through plant height, Kalagare*et al*. (2021) and Kumari *et al*. (2018) on grain yield through flag leaf length, Bikash *et al*. (2013) and Choudhary *et al*. (2012) on grain yield through harvest index.

Residual effect

The residual effect was 0.310 and -0.016 for path analysis at phenotypic and genotypic levels. As residual effect is low, it indicates that all the characters studied contributed for grain yield.

CONCLUSION

The studies on correlation coefficient indicated that the characters viz. plant height, effective tillers per plant, flag leaf width, leaf length, leaf width,fresh biomass, dry biomass, harvest index and 1000 seed weight recorded high significant positive correlation on grain yield per plot. Similarly, path coefficient analysis revealed that the character dry biomass exhibited highest positive direct effect on grain yield per plot followed by fresh biomass, actual PS II efficiency, plant height and panicle width. Based on these studies, plant height, effective tillers per plant, panicle width, leaf length, fresh biomass, dry biomass and 1000 seed weight were the predominant yield contributing characters in pearl millet.

Table 2 Genotypic (r_g)and Phenotypic (r_p) correlation coefficient for grain yield and other traits in pearl millet

Characters	r_g/r_p	Days to 50% flowering	Days to maturity	Plant Height (cm)	Effective tillers/ plant	Flag leaf length (cm)	Flag leaf width (cm)	Leaf length (cm)	Leaf width (cm)	Panicle length (cm)
Days to 50% flowering	r_g	1	0.218**	-0.121*	-0.162**	0.207**	-0.179**	-0.307**	-0.163**	0.206**
	r_p	**1**	0.172 **	-0.096	-0.092	0.145 *	-0.133*	-0.110	-0.057	0.103
Days to maturity	r_g		1	-0.912**	-0.808**	0.994**	-0.977**	-0.899**	-0.995**	-0.194**
	r_p		1	-0.761 **	-0.668 **	0.777 **	-0.820 **	-0.621 **	-0.673 **	-0.128 *
Plant Height (cm)	r_g			1	0.829**	-0.956**	0.970**	0.959**	0.976**	0.357**
	r_p			1	0.663**	-0.710 **	0.765 **	0.589 **	0.638 **	0.275 **
Effective tillers/plant	r_g				1	-0.876**	0.843**	0.926**	0.889**	0.185**
	r_p				1	-0.628 **	0.667 **	0.518 **	0.573 **	0.102
Flag leaf length (cm)	r_g					1	-0.965**	-0.956**	-0..995**	-0.198**
	r_p					1	-0.711 **	-0.509 **	-0.557**	-0.112 *
Flag leaf width (cm)	r_g						1	0.956**	0.968**	0.277**
	r_p						1	0.698 **	0.737 **	0.183 **
Leaf length (cm)	r_g							1	0.964**	0.269**
	r_p							1	0.722 **	0.162 **
Leaf width (cm)	r_g								1	0.316**
	r_p								1	0.132 *
Panicle length (cm)	r_g									1
	r_p									**1**
Panicle width (cm)	r_g									
	r_p									
Actual PS II efficiency (ΦPSII)	r_g									
	r_p									
Maximum PS II efficiency (F_v/F_m)	r_g									
	r_p									
Fresh biomass (kg/plot)	r_g									
	r_p									
Dry biomass (kg/plot)	r_g									
	r_p									
Harvest index (%)	r_g									
	r_p									
1000 seed weight (g)	r_g									
	r_p									
Grain yield (kg/plot)	r_g									
	r_p									

*p < 0.05 and **p < 0.01, $\mathbf{r_g}$ is genotypic correlation coefficient, $\mathbf{r_p}$ is phenotypic correlation coefficient

Table 2 (Continued). Genotypic (r_g)and Phenotypic (r_p) correlation coefficient for grain yield and other traits in pearl millet

Characters	G/P	Days to 50% flowering	Panicle width (cm)	Days to maturity	Actual PS II efficiency (ΦPSII)	Plant Height (cm)	Maximum efficiency (F_v/F_m)	Effective tillers per Plant	Fresh biomass (kg/plot)	Flag leaf length (cm)	Dry biomass (kg/plot)	Flag leaf width (cm)	Harvest index (%)	Leaf length (cm)	1000 seed weight (g)	Leaf width (cm)	Grain yield (kg/plot)	Panicle length (cm)
Days to 50% flowering	r_g		0.384**		0.237**		0.342**		-0.192**		-0.198**		-0.252**		-0.237		-0.177**	
	r_p		0.219 **		0.184 **		0.161**		-0.137 *		-0.133 *		-0.150 **		-0.190 **		-0.112*	
Days to maturity	r_g		-0.101		0.953**		-0.164**		-0.966**		-0.961**		-0.971**		-0.957**		-0.982**	
	r_p		-0.067		0.896 **		-0.103		-0.875**		-0.864 **		-0.763 **		-0.884 **		-0.904**	
Plant Height (cm)	r_g		0.306**		-0.919**		0.428**		0.928**		0.915**		0.858**		0.941**		0.955**	
	r_p		0.223 **		-0.808 **		0.266 **		0.794 **		0.805 **		0.643 **		0.810**		0.809**	
Effective tillers/plant	r_g		0.232**		-0.840**		0.351**		0.816**		0.839**		0.789**		0.811**		0.848**	
	r_p		0.133 *		-0.733 **		0.226 **		0.685 **		0.711**		0.579 **		0.710 **		0.712**	
Flag leaf length (cm)	r_g		-0.190**		0.950**		-0.237**		-0.985**		-0.941**		-0.989**		-0.993**		-0.992**	
	r_p		-0.108		0.838 **		-0.157 **		-0.770 **		-0.792 **		-0.634 **		-0.784 **		-0.793**	
Flag leaf width (cm)	r_g		0.201**		-0.980**		0.299**		0.998**		0.997**		0.967**		0.997**		0.985**	
	r_p		0.116 *		-0.852 **		0.110		0.836**		0.833 **		0.732**		0.852 **		0.839**	
Leaf length (cm)	r_g		0.157**		-0.980**		0.180**		0.989**		0.984**		0.926**		0.990**		0.987**	
	r_p		0.105		-0.639 **		0.080		0.664 **		0.636 **		0.563 **		0.648 **		0.660**	
Leaf width (cm)	r_g		0.267**		-0.970**		0.313**		0.992**		0.931**		0.994**		0.953**		0.971**	
	r_p		0.097		-0.686 **		0.097		0.679 **		0.680 **		0.598 **		0.685 **		0.689**	
Panicle length (cm)	r_g		0.767**		-0.179**		0.411**		0.226**		0.177**		0.139*		0.193**		0.234**	
	r_p		0.703 **		-0.120 *		0.243 **		0.139*		0.104		0.043		0.144 *		0.153**	
Panicle width (cm)	r_g		1		-0.168**		0.801**		0.111*		0.119*		-0.077		0.113*		0.153**	
	r_p		**1**		-0.1		0.414 **		0.083		0.090		-0.067		0.093		0.107	
Actual PS II efficiency (ΦPSII)	r_g				1		-0.220**		-0.952**		-0.970**		-0.929**		-0.954**		-0.976**	
	r_p				1		-0.118 *		-0.889 **		-0.909 **		-0.774 **		-0.914 **		-0.905**	
Maximum PS II efficiency (F_v/F_m)	r_g						1		0.200**		0.224**		-0.008		0.192**		0.215**	
	r_p						**1**		0.116 *		0.152 **		-0.308 **		0.106		0.136*	
Fresh biomass (kg/plot)	r_g								1		0.974**		0.993**		0.986**		0.994**	
	r_p								**1**		0.883 **		0.786 **		0.914 **		0.900**	
Dry biomass (kg/plot)	r_g										1		0.962**		0.969**		0.993**	
	r_p										**1**		0.834 **		0.890 **		0.897**	
Harvest index (%)	r_g												1		0.977**		0.997**	
	r_p												**1**		0.795 **		0.785**	
1000 seed weight (g)	r_g														1		0.990**	
	r_p														1		0.913**	
Grain yield (kg/plot)	r_g																1	
	r_p																1	

*p < 0.05 and **p < 0.01, $\mathbf{r_g}$ is genotypic correlation coefficient, $\mathbf{r_p}$ is phenotypic correlation coefficient

Characters	G/P	Panicle width (cm)	Actual PS II efficiency (ΦPSII)	Maximum PS II efficiency (F_v/F_m)	Fresh biomass (kg/plot)	Dry biomass (kg/plot)	Harvest index (%)	1000 seed weight (gm)	Grain yield (kg/plot) r_{g/r_p}
Days to 50% flowering	**G**	**0.0349**	0.0076	-0.0042	-0.0057	0.0072	-0.0063	-0.0107	-0.0057	0.0072
	P	**0.0462**	0.0080	-0.0045	-0.0043	0.0067	-0.0062	-0.0051	-0.0027	0.0048
Days to maturity	**G**	-0.1312	**-0.6000**	0.5472	0.4848	-0.6027	0.5867	0.6594	0.5972	0.1169
	P	-0.0470	**-0.2727**	0.2076	0.1822	-0.2120	0.2237	0.1693	0.1827	0.0251
Plant Height (cm)	**G**	-0.0415	-0.3121	**0.3488**	0.2846	-0.3282	0.3331	0.2635	0.2352	0.1227
	P	-0.0052	-0.0412	**0.0542**	0.0359	-0.0385	0.0415	0.0319	0.0346	0.0149
Effective tillers per plant	**G**	-0.0163	-0.0809	0.0830	**0.1001**	-0.0877	0.0845	0.0927	0.0890	0.0186
	P	-0.0030	-0.0214	0.0213	**0.0320**	-0.0201	0.0214	0.0166	0.0184	0.0033
Flag leaf length (cm)	**G**	0.0341	0.1652	-0.1572	-0.1441	**0.1644**	-0.1752	-0.1999	-0.1835	-0.0326
	P	-0.0078	-0.0415	0.0379	0.0335	**-0.0534**	0.0380	0.0272	0.0298	0.0060
Flag leaf width (cm)	**G**	0.0086	0.0468	-0.0465	-0.0404	0.0510	**-0.0479**	-0.0506	-0.0464	-0.0133
	P	-0.0018	-0.0113	0.0105	0.0092	-0.0098	**0.0137**	0.0096	0.0101	0.0025
Leaf length (cm)	**G**	-0.0014	-0.0051	0.0050	0.0043	-0.0057	0.0049	**0.0047**	0.0055	0.0013
	P	-0.0052	-0.0291	0.0276	0.0243	-0.0239	0.0327	**0.0468**	0.0338	0.0076
Leaf width (cm)	**G**	0.0457	0.2778	-0.2725	-0.2483	0.3114	-0.2704	-0.3250	**-0.2791**	-0.0884
	P	0.0004	0.0049	-0.0047	-0.0042	0.0041	-0.0054	-0.0053	**-0.0073**	-0.0010
Panicle length (cm)	**G**	-0.0272	0.0256	-0.0471	-0.0244	0.0261	-0.0365	-0.0355	-0.0417	**-0.1316**
	P	0.0012	-0.0014	0.0031	0.0011	-0.0013	0.0020	0.0018	0.0015	**0.0112**
Panicle width (cm)	**G**	0.1236	-0.0327	0.0986	0.0747	-0.0611	0.0648	0.0505	0.0858	0.2466
	P	-0.0025	0.0008	-0.0026	-0.0015	0.0013	-0.0013	-0.0012	-0.0011	-0.0081
Actual PS II efficiency	**G**	0.1007	0.4042	-0.3900	-0.3565	0.4455	-0.4156	-0.4709	-0.4285	-0.0763
	P	-0.0131	-0.0637	0.0575	0.0521	-0.0595	0.0605	0.0454	0.0488	0.0085
Maximum PS II efficiency	**G**	-0.1409	0.0678	-0.1765	-0.1446	0.0979	-0.1231	-0.0742	-0.1292	-0.1694
	P	0.0060	-0.0038	0.0099	0.0084	-0.0058	0.0041	0.0030	0.0036	0.0090
Fresh biomass (kg/plot)	**G**	-0.1046	-0.5247	0.5041	0.4430	-0.5458	0.5417	0.6024	0.5389	0.1228
	P	-0.0165	-0.1052	0.0956	0.0824	-0.0926	0.1005	0.0798	0.0817	0.0168
Dry biomass (kg/plot)	**G**	-0.1951	-0.9451	0.9001	0.8255	-1.0240	0.9800	1.0858	1.0140	0.1741
	P	-0.0120	-0.0776	0.0724	0.0639	-0.0711	0.0748	0.0571	0.0611	0.0094
Harvest index (%)	**G**	0.1680	0.6457	-0.5706	-0.5244	0.6573	-0.6428	-0.7483	-0.6608	-0.0925
	P	-0.0129	-0.0653	0.0551	0.0496	-0.0542	0.0626	0.0482	0.0512	0.0037
1000 seed weight (gm)	**G**	-0.0349	-0.1412	0.1388	0.1196	-0.1478	0.1471	0.1637	0.1508	0.0286
	P	-0.0395	-0.1836	0.1683	0.1476	-0.1630	0.1770	0.1347	0.1423	0.0299

Table 3. Genotypic (G) andPhenotypic (P) path coefficient analysis for grain yield and its component characters in pearl millet

Days to 50% flowering	**G**	0.0134	0.0083	0.0120	-0.0067	-0.0069	-0.0088	-0.0083	-0.177**
	P	0.0101	0.0085	0.0075	-0.0063	-0.0062	-0.0070	-0.0088	-0.112*
Days to maturity	**G**	0.0611	-0.5719	0.0988	0.5800	0.5769	0.5832	0.5747	-0.982**
	P	0.0183	-0.2443	0.0281	0.2387	0.2357	0.2081	0.2410	-0.904**
Plant Height (cm)	**G**	0.1053	-0.3157	0.1472	0.3188	0.3143	0.2948	0.3233	0.955**
	P	0.0121	-0.0438	0.0144	0.0430	0.0436	0.0349	0.0439	0.809**
Effective tillers per plant	**G**	0.0233	-0.0842	0.0352	0.0817	0.0841	0.0790	0.0812	0.848**
	P	0.0043	-0.0235	0.0073	0.0220	0.0228	0.0186	0.0228	0.712**
Flag leaf length (cm)	**G**	-0.0313	0.1728	-0.0391	-0.1654	-0.1713	-0.1627	-0.1649	-0.992**
	P	0.0058	-0.0448	0.0084	0.0411	0.0423	0.0339	0.0419	-0.793**
Flag leaf width (cm)	**G**	-0.0097	0.0470	-0.0143	-0.0478	-0.0478	-0.0463	-0.0478	0.985**
	P	0.0016	-0.0117	0.0015	0.0115	0.0114	0.0101	0.0117	0.839**
Leaf length (cm)	**G**	0.0007	-0.0052	0.0008	0.0052	0.0052	0.0053	0.0052	0.987**
	P	0.0049	-0.0299	0.0038	0.0311	0.0298	0.0264	0.0303	0.66**
Leaf width (cm)	**G**	-0.0746	0.2821	-0.0876	-0.2771	-0.2879	-0.2776	-0.2855	0.971**
	P	-0.0007	0.0050	-0.0007	-0.0050	-0.0050	-0.0044	-0.0050	0.689**
Panicle length (cm)	**G**	-0.1010	0.0237	-0.0542	-0.0298	-0.0233	-0.0183	-0.0255	0.234**
	P	0.0079	-0.0013	0.0027	0.0016	0.0012	0.0005	0.0016	0.153**
Panicle width (cm)	**G**	**0.3213**	-0.0542	0.2575	0.0360	0.0384	-0.0249	0.0364	0.153**
	P	**-0.0116**	0.0012	-0.0048	-0.0010	-0.0010	0.0008	-0.0011	0.107
Actual PS II efficiency (ΦPSII)	**G**	-0.0715	**0.4240**	-0.0935	-0.4039	-0.4116	-0.3943	-0.4047	-0.976**
	P	0.0071	**-0.0710**	0.0084	0.0632	0.0646	0.0550	0.0650	-0.905**
Maximum PS II efficiency (F_v/F_m)	**G**	-0.3299	0.0907	**-0.4116**	-0.0827	-0.0924	0.0036	-0.0794	0.215**
	P	0.0153	-0.0044	**0.0370**	0.0043	0.0056	-0.0114	0.0039	0.136*
Fresh biomass (kg/plot)	**G**	0.0608	-0.5170	0.1091	**0.5428**	0.5289	0.5391	0.5353	0.994**
	P	0.0101	-0.1069	0.0140	**0.1202**	0.1062	0.0946	0.1099	0.900**
Dry biomass (kg/plot)	**G**	0.1174	-0.9540	0.2206	0.9578	**0.9830**	0.9461	0.9531	0.993**
	P	0.0081	-0.0817	0.0137	0.0793	**0.0898**	0.0749	0.0800	0.897**
Harvest index (%)	**G**	0.0515	0.6178	0.0058	-0.6599	-0.6395	**-0.6644**	-0.6497	0.997**
	P	-0.0058	-0.0663	-0.0264	0.0673	0.0713	**0.0855**	0.0680	0.785**
1000 seed weight (gm)	**G**	0.0167	-0.1407	0.0284	0.1453	0.1429	0.1441	**0.1474**	0.990**
	P	0.0195	-0.1901	0.0221	0.1899	0.1851	0.1652	**0.2077**	0.913**

Table 3 (Continued). Genotypic (G) and Phenotypic (P) path coefficient analysis for grain yield and its component characters in pearl millet

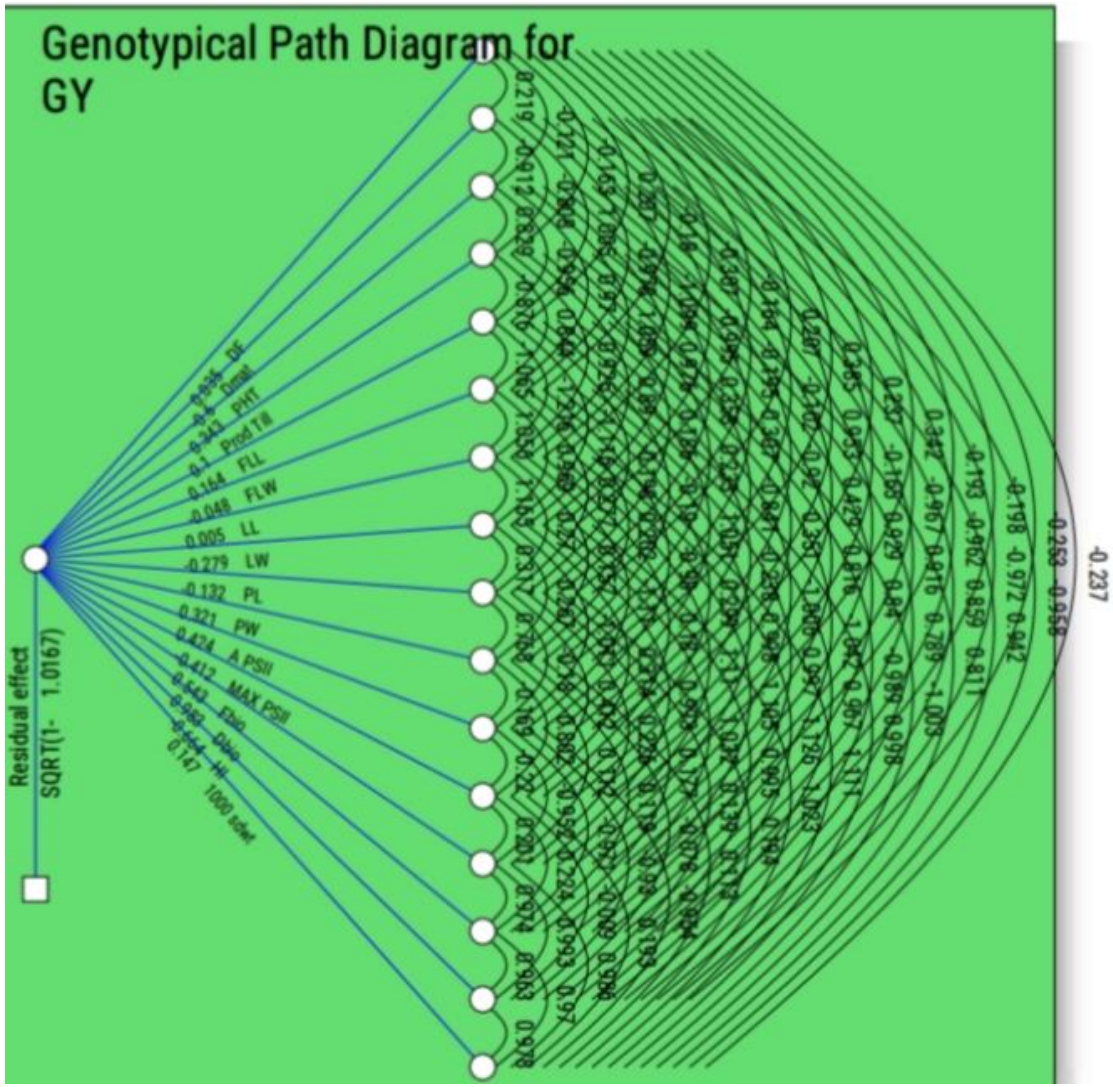

Fig 1 Genotypic path diagram for grain yield and other related traits in pearl millet.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist

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