CHARACTER ASSOCIATION AND PATH CO-EFFICIENT ANALYSIS AMONGINBRED LINES OF PEARL MILLET (*Pennisetum glaucum* (L.) R. BR.)

Abstract:

A field experimentwith 70 pearl millet inbred lines was carried out for analysis of character association and path coefficient for 21 metric traits. A perusal of character association indicated highly significant positive association of panicle weight, green fodder yield plant^{-1}, dry fodder yield plant^{-1}, number of productive tillers plant^{-1}, spike girth, plant height, leaf blade length, number of nodes plant^{-1}, spike length, harvest index, threshing percentage, leaf blade width and specific leaf area at 45 DAS with grain yield plant^{-1} as well as among themselves at both phenotypic and genotypic levels. Path coefficient analysis indicated that kernel yield plant^{-1} exhibited high positive direct effect on panicle weightfollowed by threshing percentage and green fodder yield plant^{-1}. Critical analysis of results obtained from character association and path analysis indicated that grain yield plant^{-1} had strong positive association with panicle weight which also had high magnitude of positive direct effect. This reveals the importance of this component trait in selection of superior genotypes for higher yield in genotypes of pearlmillet.

Keywords:*Character association, Path coefficient analysis, Phenotypic, Residual effect.*

Introduction

Pearl millet (*Pennisetum glaucum* (L.) R. Br., 2n = 14) is an annual, C_4 cereal crop with high photosynthetic efficiency and belongs to the family Gramineae. Pearl millet is commonly known as a poor man's food and important among nutritious cereals. The composition of grains (per 100g) reveals carbohydrates (67.5g), protein (11.6g), fat (5g), fiber (1.2g), mineral matter (2.3g), calcium (42mg) and phosphorus (296mg). The grain consists high amount of vitamins (thiamine, riboflavin and niacin) and minerals (P, K, Mg, Fe, Zn, Cu and Mn). It being rich source of energy is comparable to rice, wheat, maize and sorghum. Protein content of pearl millet is higher than barley (11.5%), maize (11.1%), sorghum (10.4%) and rice (7.2%). It has a low glycemic index (GI), which helps in weight loss.

This crop grows well in harsh environments where other crops fail. Improvements in crop production, availability, storage, utilisation, and consumption will significantly contribute to the food and nutrition security of the people who live in these areas. Though pearl millet is the staple cereal for many millions of poor people in semi-arid regions,the crop has received little attention. So, a strong emphasis is placed on selection for yield and nutritive characters in the pearl millet breeding programme. Before putting a strong emphasis on breeding for traits, understanding the relationship between yield and yield attributes, as well as the interrelationship between yield and nutritional quality traits, will allow the breeder to improve yield while also improving nutritional quality traits. The correlation coefficient may aid in identifying characters with little or no significance in the selection programme. The presence of correlation can be attributed to the presence of linkage, pleiotropic effect of genes, physiological and developmental relationship, environmental effect, or a combination of all of these factors. On the other hand,correlation coefficients, might occasionally mislead the selection and must be divided into direct and indirect effects. Then path coefficient analysis is used to calculate the direct and indirect impacts of each variable as well as their contribution to yield. Phenotypic and genotypic correlations were computed for 21 characters in 70pearlmillet inbred lines to know the nature of association existing among the characters.

Material and Methods

70pearl millet inbred lines (S_6 generation) were evaluated during *Rabi*, 2021 in a Randomized Block Design (RBD), replicated twice at Agricultural Research Station, Perumallapalle, Tirupati. Each genotype was represented by three row plot of 3 m length with inter and intra-row spacing of 60 cm and 15 cm respectively. Standard crop husbandry practices and plant protection measures suggested for this crop were followed to raise a healthy crop. Data were recorded on five randomly selected competitive plants of each genotypereplication^{-1} for 21metric traits.

Genotypic and phenotypic correlation coefficients were calculated using the method given by Johnson *et al.* (1955) to determine the degree of association of the characters with yield and also among the yield components.Path coefficient analysis was carried out by the procedure originally proposed by Wright (1921) which was subsequently elaborated by Dewey and Lu (1959) to estimate the direct and indirect effects of the individual characters on yield.The data was analysed through software - Indostat 9.2 version.

RESULTS AND DISCUSSION

Phenotypic and genotypic correlations were computed for 21 characters in 70 pearl millet genotypes to know the nature of association existing among the characters.

Correlation of Physiological, Yield and Quality Components with Grain Yield Plant^{-1}

The phenotypic (r_p) and genotypic (r_g) correlation coefficients obtained for all the characters are furnished in Table 1.

Grain yield plant^{-1} had highly significant positive correlation with panicle weight (r_p=0.890**; r_g=0.906**), followed by green fodder yield plant^{-1} (r_p=0.718**; r_g=0.770**), dry fodder yield plant^{-1} (r_p=0.712**; r_g=0.777**), number of productive tillers plant^{-1} (r_p=0.559**; r_g=0.581**), spike girth (r_p=0.446**; r_g=0.536**), plant height (r_p=0.436**; r_g=0.477**), leaf blade length (r_p=0.345**; r_g=0.428**), number of nodes plant^{-1} (r_p=0.334**; r_g=0.381**), 1000 grain weight (r_p=0.316**; r_g=0.372**), spike length (r_p=0.313**; r_g=0.341**), harvest index (r_p=0.307**; r_g=0.253**), threshing percentage (r_p=0.238**; r_g=0.209**), leaf blade width (r_p=0.228**; r_g=0.250**) and specific leaf area at 45DAS (r_p= 0.217*; r_g= 0.331*) at both phenotypic and genotypic levels.

Non-significant positive correlation of grain yield plant^{-1} was observed with specific leaf area at 65 DAS (r_p= 0.134; r_g= 0.152), days to 50% flowering (r_p= 0.027; r_g= 0.019), days to maturity (r_p= 0.025; r_g= 0.013), SPAD chlorophyll meter reading at 65 DAS (r_p= 0.009; r_g= 0.005) and SPAD chlorophyll meter reading at 45 DAS (r_p= 0.008; r_g= -0.038).

Similar kind of highly significant positive association of grain yield plant^{-1} with panicle weight was reported by Dehinwal*et al* (2017); with dry fodder yield plant^{-1} by Vinodhana*et al.* (2013),Dehinwal*et al* (2017), Patil *et al.* (2021) and Yadav *et al.* (2022); with 1000 grain weight by Naveen *et al*. (2016), Talawar*et al*. (2017), Singh *et al*. (2018) and Patil *et al.* (2021);with harvest index by Dapke*et al.* (2014), Kumar *et al*. (2016), Singh *et al*. (2018), Patil *et al.* (2021) and Goswami*et al.* (2023). Similarly, positive association of grain yield plant^{-1} with plant height, number of productive tillers plant^{-1}, panicle length and panicle girth was reported earlier by Bhasker *et al*. (2017), Anuradha *et al.* (2018), Patil *et al.* (2021), Shasibhusan*et al.* (2021) and Yadav *et al.* (2022).

From the present investigation on character association it is displayed that significant and positive correlation of grain yield plant^{-1} with panicle weight followed by green fodder yield plant^{-1}, dry fodder yield plant^{-1}, number of productive tillers plant^{-1}, spike girth, plant height, leaf blade length, number of nodes plant^{-1}, spike length, harvest index, threshing percentage, leaf blade width and specific leaf area at 45 DAS at both phenotypic and genotypic levels. This indicated possibility of simultaneous selection of all these characters for yield improvement.

PATH CO-EFFICIENT ANALYSIS

Path coefficient analysis was conducted using grain yield plant-1 as dependent variable and all other characters which showed significant correlations with grain yield plant^{-1} as independent variables. Various direct and indirect effects of component traits on grain yield were discussed here under and the results were presented in Table 2 and 3.

Among the yield components, panicle weight (P = 1.011; G = -0.297) had very high positive direct effect on grain yield plant^{-1}. Threshing percentage (P = 0.53; G = -0.571) exhibited a high positive direct effect on single plant grain yield. Hence direct selection based on these characters would be rewarded in increasing the grain yield plant^{-1}. Green fodder yield plant^{-1}(P=0.139; G = -3.382) exhibited a low positive direct effect on single plant grain yield. The characters *viz.*, number of productive tillers plant^{-1} (P=0.056, G=0.54), leaf blade length (P=0.041, G=0.132), number of nodes plant^{-1} (P=0.039, G=0.503), spike length (P=0.032, G=0.794), SPAD Chlorophyll Meter Reading at 45 DAS (P=0.031, G=-0.288), spike girth (P=0.018, G=0.626) exerted negligible positive direct effect on grain yield plant^{-1} indicating direct selection for improving these characters might be ineffective.Similar positive direct effects of component traits observed with grain yield plant^{-1} were reported by Dapke*et al*. (2014) and Nehra *et al*. (2017) for leaf blade length; Dapke*et al*. (2014), Kumar *et al*. (2014b) and Naveen *et al*. (2016) for spike length; Dapke*et al*. (2014) and Naveen *et al*. (2016) for panicle weight and Nehra *et al*. (2017) for green fodder yield plant^{-1}.

On contrary, the traits *viz.,* 1000 grain weight (P=-0.002, G=-0.352), plant height (P=-0.017, G=-0.335), leaf blade width (P=-0.034, G=0.253), harvest index (P=-0.136, G=1.729), dry fodder yield plant^{-1}(P=-0.139, G=3.82) depicted negligible and negative direct effect on grain yield plant^{-1}. Similar results were revealed by Dehinwal*et al*. (2017) and Nehra *et al*.(2017) for leaf blade width; Dapke*et al*. (2014) and Goswami*et al.* (2023) for plant height and Yadav *et al*. (2022) for 1000 grain weight.

Path coefficient analysis reflected that panicle weight had very high positive direct effect on grain yield plant^{-1} and most of the characters exerted high positive indirect effect through panicle weight. While, threshing percentage exhibited a high direct and positive effect on grain yield plant^{-1}.In the present study, phenotypic (0.158) and genotypic (0.191) residual effects were of low magnitude, indicating the appropriateness of characters chosen and insignificant effect of other characters not included in the present study.

Conclusion

A perusal of character association indicated highly significant positive association of panicle weight, green fodder yield plant^{-1}, dry fodder yield plant^{-1}, number of productive tillers plant^{-1}, spike girth, plant height, leaf blade length, number of nodes plant^{-1}, spike length, harvest index, threshing percentage, leaf blade width and specific leaf area at 45 DAS with grain yield plant^{-1} as well as among themselves at both phenotypic and genotypic levels. Hence, these characters could be used in the further selection programme for improvement of grain yield plant^{-1}. Path coefficient analysis indicated that grain yield plant^{-1} was mainly a product of direct and indirect effects of panicle weight, threshing percentage and green fodder yield plant^{-1}. Hence, major emphasis should be given on these characters in selection programme to isolate superior parental lines with higher genetic potential for grain yield.Critical analysis of results obtained from character association and path analysis indicated that grain yield plant^{-1} had strong positive association with panicle weight which also had high magnitude of positive direct effect. This reveals the importance of this component trait in selection of superior genotypes for higher yield inpearlmillet.

Table 1.Phenotypic (r_p) and Genotypic (r_g) correlation coefficients among grain yield and its components in 70 inbred lines of pearl millet

Trait		DF	DM	SCMR 45	SCMR 65	SLA 45	SLA 65	LSL	LBL	LBW	NN	SL
DF	r_p	**1.000**	0.989**	-0.220**	-0.042	0.178*	0.133	0.215*	0.340**	0.305**	0.088	0.464**
	r_g	**1.000**	0.996**	-0.327**	-0.056	0.239**	0.135	0.372**	0.457**	0.494**	0.142	0.572**
DM	r_p		**1.000**	-0.218**	-0.035	0.200*	0.128	0.215*	0.341**	0.294**	0.082	0.481**
	r_g		**1.000**	-0.345**	-0.044	0.247**	0.109	0.354**	0.440**	0.459**	0.155	0.589**
SCMR 45	r_p			**1.000**	0.185*	-0.107	0.008	0.102	-0.011	0.079	0.139	-0.101
	r_g			**1.000**	0.163	-0.313**	-0.184*	-0.119	-0.125	-0.074	0.355**	-0.238**
SCMR 65	r_p				**1.000**	-0.162	-0.039	0.151	0.089	0.107	-0.127	0.056
	r_g				**1.000**	-0.389**	-0.078	-0.088	0.009	0.046	-0.301**	0.074
SLA 45	r_p					**1.000**	0.511 **	0.161	0.142	-0.058	0.021	0.177 *
	r_g					**1.000**	0.727**	0.345**	0.255**	0.198*	-0.046	0.291**
SLA 65	r_p						**1.000**	0.120	0.083	0.017	0.018	0.091
	r_g						**1.000**	0.337**	0.126	0.015	0.208*	0.060
LSL	r_p							**1.000**	0.519**	0.277**	0.147	0.237**
	r_g							**1.000**	0.761**	0.205*	0.417**	0.441**
LBL	r_p								**1.000**	0.476**	0.288**	0.495**
	r_g								**1.000**	0.524**	0.448**	0.699**
LBW	r_p									**1.000**	0.175*	0.381**
	r_g									**1.000**	0.325**	0.501**
NN	r_p										**1.000**	0.159
	r_g										**1.000**	0.293**
SL	r_p											**1.000**
	r_g											**1.000**

Cont.

* Significant at 5% level (r=0.166); ** Significant at 1 % level (r=0.217).

Table 1. (Contd..)

Trait		SG	NPT	PH	1000 GW	PW	GFY	DFY	TH	HI	GYP
DF	r_p	0.330**	-0.170*	0.507**	-0.022	0.247**	0.358**	0.354**	-0.429**	-0.439**	0.027
	r_g	0.411**	-0.221**	0.571**	-0.025	0.251**	0.401**	0.407**	-0.505**	-0.558**	0.019
DM	r_p	0.334**	-0.171*	0.508**	-0.024	0.253**	0.359**	0.354**	-0.453**	-0.453**	0.025
	r_g	0.410**	-0.227**	0.563**	-0.029	0.252**	0.398**	0.403**	-0.526**	-0.573**	0.013
SCMR 45	r_p	0.118	0.094	0.088	0.143	0.059	0.033	0.040	0.317**	0.302**	0.217*
	r_g	0.247**	0.019	0.119	0.217**	0.135	0.034**	0.022	0.448**	0.526**	0.331**
SCMR 65	r_p	0.265**	0.074	0.023	0.181*	0.124	0.064	0.067	-0.061	-0.013	0.134
	r_g	0.495**	0.014	-0.046	0.465**	0.094	-0.094	-0.100	0.035	0.280**	0.152
SLA 45	r_p	-0.020	-0.007	0.206*	-0.040	0.075	0.184*	0.176*	-0.190*	-0.237**	0.008
	r_g	-0.013	-0.064	0.276**	-0.053	0.041	0.249**	0.260**	-0.236**	-0.400**	-0.038
SLA 65	r_p	-0.053	0.022	0.090	0.019	0.010	0.093	0.098	-0.031	-0.088	0.009
	r_g	-0.043	-0.023	0.157	-0.036	-0.026	0.117	0.109	0.081	-0.027	0.005
LSL	r_p	0.115	-0.063	0.362**	0.125	0.170*	0.190*	0.182*	-0.140	-0.146	0.121
	r_g	0.237**	-0.040	0.746**	0.308**	0.317**	0.494**	0.513**	-0.321**	-0.424**	0.213*
LBL	r_p	0.331**	-0.027	0.547**	0.180*	0.390**	0.413**	0.413**	-0.129	-0.131	0.345**
	r_g	0.509**	-0.103	0.700**	0.241**	0.464**	0.555**	0.555**	-0.146	-0.196*	0.428**
LBW	r_p	0.353**	-0.034	0.344**	0.043	0.326**	0.359**	0.362**	-0.174*	-0.180*	0.228**
	r_g	0.516**	-0.070	0.473**	-0.011	0.426**	0.547**	0.544**	-0.360**	-0.394**	0.250**
NN	r_p	0.107	0.013	0.502**	0.115	0.264**	0.307**	0.299**	0.106	0.040	0.334**
	r_g	0.099	-0.073	0.659**	0.202*	0.313**	0.407**	0.419**	0.124	-0.032	0.381**
SL	r_p	0.424**	-0.102	0.610**	-0.015	0.470**	0.511**	0.511**	-0.347**	-0.322**	0.313**
	r_g	0.430**	-0.150	0.696**	-0.047	0.543**	0.620**	0.620**	-0.497**	-0.498**	0.341**

Cont.

* Significant at 5% level; ** Significant at 1 % level.

Table 1. (Contd..)

Trait		SG	NPT	PH	1000 GW	PW	GFY	DFY	TH	HI	GYP
SG	r_p	**1.000**	-0.055	0.467**	0.330**	0.496**	0.461**	0.461**	-0.069	-0.017	0.446**
	r_g	**1.000**	-0.052	0.483**	0.374**	0.611**	0.573**	0.575**	-0.113	-0.034	0.536**
NPT	r_p		**1.000**	-0.056	0.070	0.549**	0.406**	0.405**	0.001	0.073	0.559**
	r_g		**1.000**	-0.128	0.116	0.565**	0.408**	0.410**	0.044	0.110	0.581**
PH	r_p			**1.000**	0.247**	0.513**	0.636**	0.637**	-0.164	-0.246**	0.436**
	r_g			**1.000**	0.289**	0.560**	0.701**	0.701**	-0.199*	-0.301**	0.477**
1000 GW	r_p				**1.000**	0.227**	0.152	0.150	0.228 **	0.266**	0.316**
	r_g				**1.000**	0.251**	0.176*	0.178*	0.325**	0.382**	0.372**
PW	r_p					**1.000**	0.851**	0.843**	-0.198 *	-0.082	0.890**
	r_g					**1.000**	0.909**	0.919**	-0.199*	-0.137	0.906**
GFY	r_p						**1.000**	0.996**	-0.255**	-0.335**	0.718**
	r_g						**1.000**	1.006**	-0.301**	-0.342**	0.770**
DFY	r_p							**1.000**	-0.249**	-0.342**	0.712**
	r_g							**1.000**	-0.310**	-0.331**	0.777**
TH	r_p								**1.000**	0.903**	0.238**
	r_g								**1.000**	0.973**	0.209*
HI	r_p									**1.000**	0.307**
	r_g									**1.000**	0.253**
GYP	r_p										**1.000**
	r_g										**1.000**

* Significant at 5% level; ** Significant at 1 % level.

DF : Days to 50% flowering
DM : Days to maturity
SCMR 45 : SPAD Chlorophyll Meter Reading at 45 DAS
SCMR 65 : SPAD Chlorophyll Meter Reading at 65 DAS
SLA 45 : Specific leaf area at 45 DAS (cm^2g^{-1})
SLA 65 : Specific leaf area at 65 DAS ($cm^2 g^{-1}$)
LSL : Leaf sheath length (cm)

LBL : Leaf blade length (cm)
LBW : Leaf blade width (cm)
NN : No of nodes plant^{-1}
SL : Spike length (cm)
SG : Spike girth (cm)
NPT : Number of productive tillers plant^{-1}
PH : Plant height (cm)

1000 GW : 1000 grain weight (g)
PW : Panicle weight (g)
GFY : Green fodder yield plant^{-1}(g)
DFY : Dry fodder yield plant^{-1}(g)
TH : Threshing (%)
HI : Harvest index (%)
GYP : Grain yield plant^{-1}(g)

Table 2 Estimates of genotypic path coefficients among grain yield and its components in 70 inbred lines of pearl millet

Trait	SCMR 45	LSL	LBL	LBW	NN	SL	SG	NPT	PH	TSW	PW	GFY	DFY	TH	HI	Correlation with GYP
SCMR 45	**-0.288**	-0.111	0.127	-0.019	0.178	-0.189	0.154	0.010	-0.040	-0.076	-0.040	-0.114	0.084	-0.256	0.909	**0.331****
LSL	0.034	**0.926**	-0.775	0.052	0.210	0.350	0.149	-0.021	-0.250	-0.108	-0.094	-1.670	1.961	0.184	-0.733	**0.213***
LBL	0.036	0.704	**-1.019**	0.132	0.225	0.555	0.318	-0.056	-0.235	-0.085	-0.138	-1.876	2.121	0.083	-0.338	**0.428****
LBW	0.021	0.190	0.534	**0.253**	0.163	0.402	0.323	-0.038	-0.159	0.004	-0.126	-1.850	2.076	0.205	-0.682	**0.250****
NN	-0.102	0.386	0.456	0.082	**0.503**	0.233	0.062	-0.039	-0.221	-0.071	-0.093	-1.377	1.601	-0.071	-0.056	**0.381****
SL	0.069	0.408	-0.712	0.128	0.148	**0.794**	0.269	-0.081	-0.233	0.017	-0.161	-2.096	2.369	0.284	-0.861	**0.341****
SG	-0.071	0.220	-0.519	0.130	0.050	0.342	**0.626**	-0.028	-0.162	-0.132	-0.181	-1.939	2.195	0.064	-0.059	**0.536****
NPT	-0.006	-0.037	-0.105	-0.018	-0.037	-0.119	-0.033	**0.540**	0.043	-0.041	-0.168	-1.381	1.566	-0.025	0.190	**0.581****
PH	-0.034	0.690	-0.714	0.119	0.331	0.552	0.302	-0.069	**-0.335**	-0.102	-0.166	-2.370	2.678	0.114	-0.520	**0.477****
TSW	-0.063	0.285	-0.245	-0.003	0.102	-0.037	0.234	0.063	-0.097	**-0.352**	-0.074	-0.595	0.681	-0.186	0.660	**0.372****
PW	-0.039	0.294	-0.473	0.108	0.157	0.431	0.383	0.305	-0.188	-0.088	**-0.297**	-3.075	3.512	0.114	-0.237	**0.906****
GFY	-0.010	0.457	-0.566	0.138	0.205	0.492	0.359	0.220	-0.235	-0.062	-0.270	**-3.382**	3.841	0.172	-0.591	**0.770****
DFY	-0.006	0.475	-0.566	0.137	0.211	0.492	0.360	0.221	-0.235	-0.063	-0.273	-3.400	**3.820**	0.177	-0.573	**0.777****
TH	-0.129	-0.298	0.149	-0.091	0.062	-0.395	-0.071	0.024	0.067	-0.114	0.059	1.019	-1.184	**-0.571**	1.682	**0.209****
HI	-0.151	-0.393	0.199	-0.100	-0.016	-0.395	-0.021	0.059	0.101	-0.134	0.041	1.156	-1.266	-0.556	**1.729**	**0.253****

* Significant at 5% level (r=0.166); ** Significant at 1 % level (r=0.217). Genotypic residual effect: 0.191.

SCMR 45	**:**	**SPAD chlorophyll meter reading at 45 DAS**	**SG**	**:**	**Spike girth (cm)**	**GFY**	**:**	**Green fodder yield plant^{-1}(g)**
LSL	**:**	**Leaf sheath length (cm)**	**NPT**	**:**	**Number of productive tillers plant^{-1}**	**DFY**	**:**	**Dry fodder yield plant^{-1}(g)**
LBL	**:**	**Leaf blade length (cm)**	**PH**	**:**	**Plant height (cm)**	**TH**	**:**	**Threshing (%)**
LBW	**:**	**Leaf blade width (cm)**	**1000 GW**	**:**	**1000 grain weight (g)**	**HI**	**:**	**Harvest index (%)**
NN	**:**	**No of nodes plant^{-1}**	**PW**	**:**	**Panicle weight (g)**	**GYP**	**:**	**Grain yield plant^{-1}(g)**
SL	**:**	**Spike length (cm)**						

Table 3 Estimates of phenotypic path coefficients among grain yield and its components in 70 inbred lines of pearl millet

Trait	SCMR 45	LBL	LBW	NN	SL	SG	NPT	PH	TSW	PW	GFY	DFY	TH	HI	Correlation with GYP
SCMR 45	**0.031**	0.000	-0.003	0.005	-0.003	0.002	0.005	-0.002	0.000	0.060	0.005	-0.010	0.168	-0.041	**0.217***
LBL	0.000	**0.041**	-0.016	0.011	0.016	0.006	-0.002	-0.009	0.000	0.394	0.057	-0.102	-0.068	0.018	**0.345****
LBW	0.002	0.019	**-0.034**	0.007	0.012	0.006	-0.002	-0.006	0.000	0.330	0.050	-0.089	-0.092	0.025	**0.228****
NN	0.004	0.012	-0.006	**0.039**	0.005	0.002	0.001	-0.009	0.000	0.267	0.043	-0.074	0.056	-0.005	**0.334****
SL	-0.003	0.020	-0.013	0.006	**0.032**	0.008	-0.006	-0.011	0.000	0.475	0.071	-0.126	-0.184	0.044	**0.313****
SG	0.004	0.014	-0.012	0.004	0.013	**0.018**	-0.003	-0.008	-0.001	0.501	0.064	-0.114	-0.036	0.002	**0.446****
NPT	0.003	-0.001	0.001	0.001	-0.003	-0.001	**0.056**	0.001	0.000	0.555	0.057	-0.100	0.001	-0.010	**0.559****
PH	0.003	0.022	-0.012	0.020	0.019	0.008	-0.003	**-0.017**	-0.001	0.519	0.089	-0.157	-0.087	0.033	**0.436****
TSW	0.004	0.007	-0.002	0.005	-0.001	0.006	0.004	-0.004	**-0.002**	0.230	0.021	-0.037	0.121	-0.036	**0.316****
PW	0.002	0.016	-0.011	0.010	0.015	0.009	0.031	-0.009	-0.001	**1.011**	0.118	-0.208	-0.105	0.011	**0.890****
GFY	0.001	0.017	-0.012	0.012	0.016	0.008	0.023	-0.011	0.000	0.861	**0.139**	-0.246	-0.135	0.046	**0.718****
DFY	0.001	0.017	-0.012	0.012	0.016	0.008	0.023	-0.011	0.000	0.853	0.139	**-0.247**	-0.132	0.047	**0.712****
TH	0.010	-0.005	0.006	0.004	-0.011	-0.001	0.000	0.003	-0.001	-0.200	-0.036	0.062	**0.530**	-0.123	**0.238****
HI	0.009	-0.005	0.006	0.002	-0.010	0.000	0.004	0.004	-0.001	-0.083	-0.047	0.085	0.478	**-0.136**	**0.307****

* Significant at 5% level (r=0.166); ** Significant at 1 % level (r=0.217). Phenotypic residual effect: 0.158.

SCMR 45	:	**SPAD chlorophyll meter reading at 45 DAS**	**SG**	:	**Spike girth (cm)**	**GFY**	:	**Green fodder yield plant^{-1}(g)**
LBL	:	**Leaf blade length (cm)**	**NPT**	:	**Number of productive tillers plant^{-1}**	**DFY**	:	**Dry fodder yield plant^{-1}(g)**
LBW	:	**Leaf blade width (cm)**	**PH**	:	**Plant height (cm)**	**TH**	:	**Threshing (%)**
NN	:	**No of nodes plant^{-1}**	**1000 GW**	:	**1000 grain weight (g)**	**HI**	:	**Harvest index (%)**
SL	:	**Spike length (cm)**	**PW**	:	**Panicle weight (g)**	**GYP**	:	**Grain yield plant^{-1}(g)**

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