The Journal of Phytopharmacology 2021; 10(2): 139-143
Online at: www.phytopharmajournal.com

Research Article

ISSN 2320-480X
JPHYTO 2021; 10(2): 139-138
March- April
Received: 17-03-2021
Accepted: 12-04-2021
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doi: 10.31254/phyto.2021.10211

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Assessment of Correlation and Path Coefficient Analysis for Yield Attributing and Quality Traits in promising rice varieties cultivated in Tamil Nadu

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ABSTRACT

In this study 55 promising rice varieties cultivated in Tamil Nadu was selected and raised in Randomized Block design with two replications. To reveal the nature and degree of correlation and path analysis between yield and quality traits. The results of correlation analysis showed traits like number of filled grains per panicle, productive tillers per plant had positive significant association with the single plant yield. The direct and indirect effects through path coefficient analysis unveils maximum positive direct effect of single plant yield with number of productive tillers recorded followed by days to fifty percent flowering, number of filled grains, gel consistency, 1000 grain weight and hulling percentage in both genotypical and phenotypical path analysis Therefore, the trait number of productive tillers per plant plays a major role in shaping the single plant yield in rice on which selection pressure has to be applied for increasing the seed yield.

Keywords: Rice, *Oryza sativa*, Association, Direct and Indirect effects, Genotypical, Phenotypical.

INTRODUCTION

Rice (*Oryza sativa* L.) is a vital staple food globally especially in India. Around half of the world's population hinge on rice for their existence. In view of the increasing population, the main aim of plant breeders is to develop new rice varieties with grain yield along with good quality traits. According to [1] the production of rice of world will have to produce 60% more by 2030 compared with that of 1995 report. Hence, for food security and poverty alleviation in India by increasing production of rice plays a crucial role. About 66% of people worldwide especially Asian countries like India, rice is considered as an essential and stable food providing nearly 20% of energy reported by [2]. Investigation of relationship among yield and quality traits a significant task of evaluating the possibility of a combined selection of two or more traits instead of selecting the secondary traits as genetic gains for primary traits under consideration reported by [3]. Measuring the degree of correlation among traits conferring higher yield and quality traits is more important in selection process reported by [4]. A positive correlation between yield and quality traits permits the simultaneous improvement of both the traits while limiting selection to any one of the correlated traits. In contrast, a negative significant relationship between two traits requires equal weightage to be given during selection for two traits. At genotypic level, observing a positive correlation is due to presence of linkage in coupling phase and repulsion phase for negative association of linkage of genes arises governing 2 different traits reported by [5]. Path analysis has been used to establish the relationship between predictor variables and response variables reported by [6]. Path coefficient analysis supports plant breeders in improving yield with improved quality traits by finding traits direct and indirect effects. In view of the above discussion, Therefore the present investigation was, take on toward understanding the correlation coefficient among single plant yield (SPY) and quality traits then path coefficient analysis with 55 highly cultivated varieties in Tamil Nadu.

MATERIALS AND METHODS

The experimental material used in the study consists of 55 genotypes (Table 1) of rice grown in a completely randomized block design with two replications at AC& RI, Killikulam (TNAU) during kharif 2017. Eighteen days aged seedlings of 55 genotypes were transplanted in 3 rows of 2.0 m length by maintaining a spacing of 20,15 cm among rows and plants respectively. The experiment crop was raised by applying of fertilizers, 120:60:40 kg/ha at the rate of N, P and K respectively and standard agronomic cultural practices were followed. Five sample plants were randomly selected from each entry excluding the border plants to minimize error due to the border effect and the following data were recorded: for important quantitative and qualitative traits such as days to fifty percent flowering (DFF), number of productive tillers per plant (NPT), Number of filled grains per panicle (NFG), plant height (PH) (cm),

panicle length (PL) (cm), thousand grain weight (1000 GWT) (g), and single plant yield (SPY) (g).

Observations on physico-chemical quality traits was recorded *viz*, Hulling Percentage (HP), milling percentage (MP) (%), grain length (GL) (mm), grain breadth (GB) (mm), head rice recovery (HRR) (%), Grain length to breadth ratio (L/B), Grain length after cooking (GLAC)(mm), Grain breadth after cooking (GBAC)(mm), Linear expansion ratio (LER), Breadth wise expansion ratio (BER), Alkali spreading value (ASV), Gel consistency (GC)(mm) and Amylose content (AC) (%). Hulling and milling percentage was taken through the using SATAKE company make laboratory huller and polisher. The milling percentage was calculated. observation of Head rice recovery (HRR) was recorded. Grain length and Grain breadth of 10 whole milled rice were measured by using graph sheet and grain length/breadth ratio was calculated as per [9]. Grain length and breadth of cooked grains besides linear and breadth wise elongation ratio were recorded with the help of graph sheet to quantify cooking traits. Alkali spreading value, gel consistency and amylose content were estimated by following the standard procedures. Correlation coefficient analysis was worked out using the origin pro software. The direct, indirect effect of path analysis, for yield and quality traits on single plant yield was calculated as per proposed by [7,8].

RESULTS AND DISCUSSION

In this current investigation, single plant yield exhibited significantly positive correlation with Number of productive tillers per plant (NPT) and 1000 grain weight (1000 GWT) the results are presented in Figure 1. Inter correlation among yield components and their quality traits, Days to 50% flowering (DFF) with Plant height (PH), Panicle length (PL), Number of filled grains per panicle (NFG), length elongation ratio (LER) showed significantly positive correlation and significant negative association with number of productive tillers, grain breadth, head rice recovery and breadth expansion ratio. Similar results were reported by [10,11] for Days to 50% flowering (DFF) with Plant height (PH). Plant height showed positive significant association with days to fifty percent flowering, panicle length, Linear elongation ratio and negative significant association with number of productive tillers, hulling, milling percentage, head rice recovery, and breadth wise elongation ratio these results are agreed with [6, 12] positive correlation of plant height with panicle length. Number of productive tillers exhibited positive significant correlation with single plant yield, head rice recovery, breadth wise expansion ratio and significantly negative correlation with Days to 50% flowering (DFF), Plant height (PH), Grain length, Grain breadth after cooking and Linear elongation ratio (LER). Panicle length showed significant positive correlation with days to fifty percent flowering, plant height, linear elongation ratio and negative correlation with hulling, milling percentage, head rice recovery, and Breadth wise elongation ratio (BER), parallel results was akin by the results of [13, 14] for plant height (PH).

Number of filled grains per panicle (NFG) exhibited positive significant correlation by Days to 50% flowering (DFF), single plant yield and linear elongation ratio, single plant yield with Number of productive tillers (NPT) also Number of filled grains per panicle (NFG) the observation was taken to findings of [15,16, 17, 18] for single plant yield with number of filled grains per panicle. Hulling percentage revealed positive significant association with head rice recovery, breadth wise expansion ratio and negatively with plant height, panicle length, linear elongation ratio, gel consistency and amylose content, milling percentage unveiled positive significant association with head rice recovery, breadth wise expansion ratio and negatively with plant height, panicle length, linear elongation ratio, gel consistency and amylose content. Head rice recovery displayed significant positive correlation with number of productive tillers, hulling percentage, milling percentage, breadth wise expansion ratio and significantly negative correlation with Days to 50% flowering (DFF), Plant height (PH), panicle length and linear elongation ratio, where grain length revealed positive significant correlation with grain length to breadth ratio (L/B ratio), Grain length after cooking (GLAC) besides alkali spreading value (ASV) these results are agreed with [19] for Grain length after cooking (GLAC) and Grain length to breadth ratio (L/B ratio). Grain breadth exhibited significant positive correlation by grain breadth after cooking (GBAC) and negative for Plant height (PH), Grain length to breadth ratio (L/B ratio), grain length after cooking and linear elongation ratio, similar results were given by [19] for positive association with kernel breadth after cooking and significant and negative association with L/B ratio. L/B ratio revealed significant positive association with grain length, grain length after cooking, alkali spreading value and negatively with grain breadth, grain breadth after cooking these findings already reported by [19] for positive association with grain length and negatively significant with grain breadth. Grain length after cooking exhibited positive significant association towards panicle length, Grain length (GL), Grain length to Breadth (L/B) ratio, Linear elongation ratio (LER), alkali spreading value and negative with number of productive tillers, head rice recovery, grain breadth and breadth wise expansion ratio, similar findings already reported by [19] for positive association with L/B ratio.

Grain breadth after cooking exhibited positive significant correlation with grain breadth and negative significant association towards Number of productive tillers (NPT), Grain length (GL) and grain length to breadth (L/B) ratio. Linear elongation ratio presented positive significant association to days to fifty percent flowering (DFF), plant height (PH), panicle length (PH), number of filled grains per panicle (NFG), grain length after cooking (GLAC) besides significantly negative association towards number of productive tillers, Hulling percentage (HP), Milling percentage (MP), Head rice recovery (HRR), Grain breadth (GB) and Breadth wise expansion ratio (BER) alike results were agreed with Priyanka [19] positive for grain length after cooking and negatively significant for grain breadth. Breadth wise expansion ratio exhibited positive significant association with number of productive tillers, Hulling, Milling percentage, Head rice recovery and negative significant with days to 50% flowering, Plant height, Panicle length, Grain length after cooking (GLAC), Linear elongation ratio (LER) then gel consistency (GC), Alkali spreading value (ASV) revealed positive significant association with grain length, L/B ratio, grain length after cooking (GLAC) and Amylose content, Gel consistency with amylose content and significant negative association with Hulling percentage (HP), Milling percentage (MP) and Breadth wise expansion ratio (BER), amylose content revealed positively significant correlation with alkali spreading value, gel consistency and negative significant association with hulling percentage and milling percentage.

In view of single plant yield as effect and other quantitative and quality traits as sources, genotypic associations were divided by with system of path analysis to reveal direct and indirect effect of yield and quality traits towards single plant yield (Table 2) and genotypical path diagram was presented in Figure 2. In the present study, number of filled grains per panicle showed between yield and quality characters, at genotypic level number of productive tillers per plant(NPT)

(0.6844) showed the extreme direct effect followed by Grain length after cooking(GLAC) (0.858), , Number of filled grains per panicle(NFG) (0.5124), Grain breadth after cooking(GBAC) (0.5043), Days to 50% flowering(DFF) (0.3464), gel consistency (0.2903), 1000 grain weight (0.2602), hulling percentage (0.2123) On the other hand, negative direct effect were observed for Amylose content (-0.0042), panicle length (-0.026), alkali spreading value (-0.0863) , milling percentage (-0.0894), breadth wise expansion ratio (-0.1013), Plant height (PH) (-0.2042), Grain length to breadth (L/B) ratio (-0.2529), Grain length (GL) (-0.4515), Grain breadth(GB) (-0.4822) then Linear elongation ratio (LER) (-0.5082). At phenotypic level higher direct effect was observe for number of productive tillers per plant (0.6434) grain breadth after cooking (0.7446), Days to 50% flowering (DFF) (0.5846), number of filled grains per panicle (0.4951), grain breadth after cooking (0.4597), gel consistency (0.3798), 1000 grain weight (0.3266), breadth wise expansion ratio (0.232), hulling percentage (0.2165), panicle length (0.0283) and plant height (0.0248), residual effect at genotypic level (0.315) shows that traits in this study contribute 67% single plant yield variability. These results were akin with the findings of [16, 20] for panicle length and [21] for thousand grain weight.

Table 1: List of 55 varieties used for assessment of correlation and path analysis

S. No.	Variety
1	ADT 42
2	CO 33
3	ASD 16
4	ADT 47
5	IR 64
6	ASD 17
7	ADT 36
8	Pusa basmati
9	ADT 45
10	Anjali
11	ADT 37
12	ADT 43
13	ADT 48
14	ADT 41
15	ASD 20
16	MDU 5
17	ASD 2
18	ASD 7
19	TPS 4
20	TN 1
21	ASD 9
22	Annada
23	ASD 1
24	ASD 18
25	IR 50
26	BPT 5204
27	ADT 39
28	ADT 19
29	CO 50
30	CO 39
31	ADT 46
32	Kavya
33	ADT 49
34	JGL 3855
35	CO 45
36	Abhya
37	CR 1009
38	CO 49
39	Swarna
40	ADT 38
41	JGL 3844
42	JGL 1798
43	CO 43
44	IR 20
45	ASD 14
46	Jaya
47	IR 72
48	IR 28
49	POKKALI
50	IRRI 104
51	TPS 3
52	BRNS(WP) 5
53	ASD 19
54	BRNS (WP)22-2
55	Krishna Hemavathi (K.H)

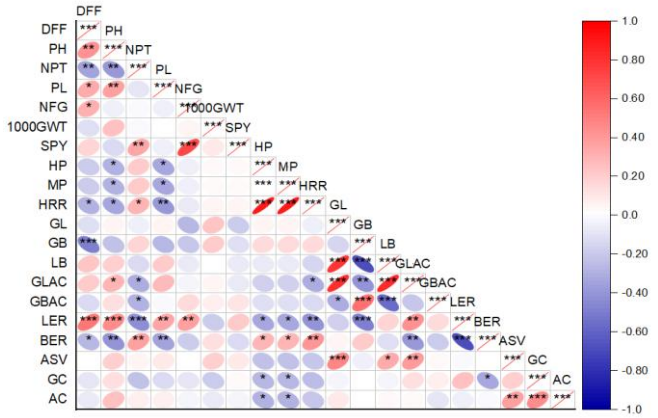

Figure 1: Parson correlation and coefficient analysis among yield and quality traits

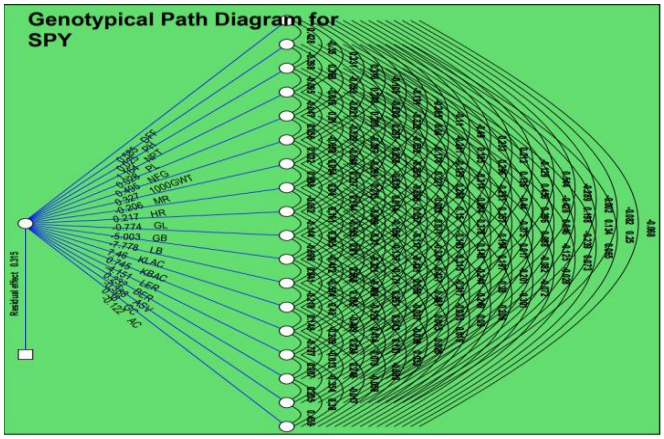

Figure 2: Genotypical path diagram of yield associated and quality traits

Table 2: Direct and indirect effects of yield related traits and quality traits on grain yield

		DFF	PH	NPT	PL	NFG	1000GW T	MP	HP	GL	GB	LB	GLAC	GBAC	LER	BER	ASV	GC	AC	spy
DFF	**G**	**0.5846**	0.2502	-0.2044	0.1937	0.1846	-0.0616	-0.1115	-0.1667	-0.0643	-0.2864	0.1353	0.1246	-0.0756	0.3179	-0.1692	-0.0009	-0.0478	-0.0397	0.1797
	P	**0.3464**	0.1477	-0.1179	0.1142	0.1089	-0.0362	-0.0654	-0.0984	-0.038	-0.1655	-0.0787	0.0731	-0.0444	0.1844	-0.091	0.0006	-0.0286	-0.0235	0.1796
PH	**G**	0.0106	**0.0248**	-0.0099	0.0091	-0.0015	0.0061	-0.0072	-0.008	0.001	-0.006	0.0046	0.0073	0.0034	0.0113	-0.0106	0.0049	0.0033	0.0062	-0.1388
	P	-0.087	**-0.2042**	0.0794	-0.0749	0.0121	-0.05	0.0587	0.0651	-0.0082	0.0484	-0.0377	-0.0599	-0.027	-0.0913	0.0791	-0.038	-0.0274	-0.0508	-0.1388
NPT	**G**	-0.4072	-0.4634	**1.1643**	-0.111	-0.0182	-0.0244	0.2351	0.3337	-0.0611	0.2072	-0.1507	-0.3652	-0.3392	-0.5127	0.461	0.0534	-0.2779	0.0761	0.3564
	P	-0.2329	-0.2661	**0.6844**	-0.0631	-0.0123	-0.0117	0.137	0.1921	-0.0351	0.1113	-0.0847	-0.2123	-0.1949	-0.2932	0.2434	0.0395	-0.1598	0.0449	0.3513
PL	**G**	0.0094	0.0105	-0.0027	**0.0283**	-0.0013	0.0003	-0.0093	-0.011	0.0017	-0.0075	0.0063	0.0075	-0.0001	0.0101	-0.0106	0.0025	-0.0035	0.0021	-0.0467
	P	-0.0086	-0.0095	0.0024	**-0.026**	0.0012	-0.0002	0.0083	0.01	-0.0015	0.0067	-0.0056	-0.0068	0.0002	-0.0091	0.0089	-0.0022	0.0032	-0.0019	-0.0467
NFG	**G**	0.1563	-0.0292	-0.0077	-0.0232	**0.495**	0.0276	-0.0288	-0.0315	-0.1292	-0.1085	-0.0336	-0.0164	0.0741	0.187	-0.0958	0.0085	-0.0407	-0.014	0.7188
	P	0.1611	-0.0302	-0.0092	-0.0235	**0.5124**	0.0285	-0.0281	-0.032	-0.1329	-0.1077	-0.0363	-0.0166	0.0743	0.1904	-0.0926	0.0061	-0.0421	-0.0143	0.7148
1000GW T	**G**	-0.0344	0.0812	-0.0068	0.0031	0.0182	**0.3266**	0.007	0.0178	0.0741	0.0703	0.0045	0.0187	0.0233	-0.0631	0.0468	0.0643	-0.0656	-0.0236	0.093
	P	-0.0272	0.0637	-0.0044	0.0015	0.0145	**0.2602**	0.0061	0.0143	0.0589	0.0544	0.0029	0.0148	0.0192	-0.0491	0.0306	0.0469	-0.0513	-0.0184	0.092
MP	**G**	0.0392	0.06	-0.0416	0.0676	0.012	-0.0044	**-0.2058**	-0.1848	-0.0083	-0.0297	0.0142	0.034	0.0241	0.0687	-0.0648	0.0503	0.0577	0.0619	0.0228
	P	0.0169	0.0257	-0.0179	0.0287	0.0049	-0.0021	**-0.0894**	-0.0789	-0.0036	-0.0123	0.006	0.0146	0.0108	0.0292	-0.0256	0.0204	0.0248	0.0265	0.0233
HP	**G**	-0.0617	-0.0696	0.062	-0.0838	-0.0138	0.0118	0.1945	**0.2165**	-0.0112	0.0348	-0.0335	-0.067	-0.0296	-0.0912	0.0924	-0.047	-0.0538	-0.0447	0.0578
	P	-0.0603	-0.0676	0.0596	-0.0815	-0.0133	0.0116	0.1872	**0.2123**	-0.0105	0.0329	-0.0321	-0.0647	-0.0293	-0.0875	0.0815	-0.0445	-0.0522	-0.0436	0.0571
GL	**G**	0.0852	-0.031	0.0406	-0.0452	0.2021	-0.1757	-0.0312	0.04	**-0.7744**	0.1113	-0.6231	-0.6272	0.2482	0.1327	-0.0503	-0.3727	0.0271	-0.0698	-0.1912
	P	0.0496	-0.0182	0.0232	-0.026	0.1171	-0.1021	-0.0182	0.0224	**-0.4515**	0.063	-0.3583	-0.3643	0.1427	0.0779	-0.025	-0.2041	0.0158	-0.0401	-0.1906
GB	**G**	2.4507	1.2071	-0.8904	1.3263	1.0964	-1.0771	-0.721	-0.8044	0.7193	**-5.0029**	3.4815	2.0625	-2.841	2.4907	-1.256	0.1839	-0.0247	-0.097	-0.1188
	P	0.2305	0.1143	-0.0784	0.1246	0.1014	-0.1009	-0.0662	-0.0747	0.0673	**-0.4822**	0.3364	0.1938	-0.2621	0.2299	-0.0833	0.0214	-0.0017	-0.0097	-0.1159
LB	**G**	-1.8005	-1.4356	1.0067	-1.7153	0.5282	-0.1078	0.5375	1.2047	-6.2578	5.4125	**-7.7775**	-6.5444	4.5405	-1.4381	0.9775	-2.6712	0.2806	-0.2029	-0.0767
	P	-0.0575	-0.0467	0.0313	-0.0546	0.0179	-0.0028	0.0171	0.0383	-0.2007	0.1764	**-0.2529**	-0.2095	0.1427	-0.0437	0.0203	-0.0831	0.0088	-0.0061	-0.0755
GLAC	**G**	1.5901	2.2047	-2.3399	1.9643	-0.2473	0.4267	-1.2337	-2.3094	6.0423	-3.0754	6.277	**7.4597**	-1.6229	3.2101	-3.05	3.0887	0.9738	0.2444	-0.0642
	P	0.1812	0.2518	-0.2661	0.2236	-0.0278	0.0488	-0.1403	-0.2616	0.6923	-0.3448	0.7109	**0.858**	-0.1833	0.3701	-0.3217	0.3301	0.1122	0.0275	-0.0641
GBAC	**G**	-0.0963	0.1013	-0.2169	-0.0029	0.1115	0.0532	-0.087	-0.1017	-0.2387	0.4229	-0.4347	-0.162	**0.7446**	0.1101	-0.1558	0.0181	0.0592	-0.0615	0.1186
	P	-0.0647	0.0668	-0.1436	-0.0031	0.0731	0.0373	-0.0607	-0.0695	-0.1594	0.2741	-0.2846	-0.1077	**0.5043**	0.0732	-0.0876	0.0138	0.0395	-0.0411	0.1176
LER	**G**	-2.2569	-1.8938	1.8276	-1.4806	-1.568	0.8024	1.386	1.7486	0.7115	2.0665	-0.7675	-1.7862	-0.6135	**-4.1507**	3.0588	0.0555	-1.0281	0.2387	0.2181
	P	-0.2706	-0.2272	0.2177	-0.1777	-0.1888	0.0959	0.1661	0.2094	0.0877	0.2422	-0.0878	-0.2192	-0.0738	**-0.5082**	0.339	0.0092	-0.1243	0.0283	0.2136
BER	**G**	-0.0671	-0.0994	0.0919	-0.087	-0.0449	0.0332	0.0731	0.099	0.0151	0.0582	-0.0292	-0.0948	-0.0485	-0.171	**0.232**	0.0015	-0.0821	-0.0039	-0.1295
	P	0.0266	0.0392	-0.036	0.0347	0.0183	-0.0119	-0.029	-0.0389	-0.0056	-0.0175	0.0081	0.038	0.0176	0.0676	**-0.1013**	-0.0014	0.0325	0.0019	-0.1196
ASV	**G**	0.0006	-0.0769	-0.0178	-0.034	-0.0066	-0.0764	0.095	0.0842	-0.1869	0.0143	-0.1334	-0.1608	-0.0094	0.0052	-0.0026	**-0.3884**	-0.0796	-0.1475	0.0828
	P	-0.0001	-0.0161	-0.005	-0.0074	-0.001	-0.0155	0.0196	0.0181	-0.039	0.0038	-0.0284	-0.0332	-0.0024	0.0016	-0.0012	**-0.0863**	-0.0167	-0.031	0.083
GC	**G**	-0.0311	0.0508	-0.0906	-0.0474	-0.0312	-0.0763	-0.1064	-0.0944	-0.0133	0.0019	-0.0137	0.0496	0.0302	0.0941	-0.1344	0.0779	**0.3798**	0.1743	0.0216
	P	-0.0239	0.0389	-0.0678	-0.036	-0.0239	-0.0572	-0.0805	-0.0715	-0.0101	0.001	-0.0101	0.038	0.0227	0.071	-0.0931	0.0563	**0.2903**	0.1325	0.021
AC	**G**	0.0083	-0.0305	-0.008	-0.009	0.0035	0.0088	0.0367	0.0252	-0.011	-0.0024	-0.0032	-0.004	0.0101	0.007	0.002	-0.0464	-0.056	**-0.122**	-0.0229
	P	0.0003	-0.001	-0.0003	-0.0003	0.0001	0.0003	0.0012	0.0009	-0.0004	-0.0001	-0.0001	-0.0001	0.0003	0.0002	0.0001	-0.0015	-0.0019	**-0.0042**	-0.0232
R^2	**G**	0.1051	-0.0034	0.415	-0.0013	0.3558	0.0304	-0.0047	0.0125	0.1481	0.594	0.5965	-0.4791	0.0883	-0.9052	-0.03	-0.0322	0.0082	0.0028	
	P	0.0622	0.0283	0.2404	0.0012	0.3663	0.0239	-0.0021	0.0121	0.086	0.055	0.0191	-0.055	0.0593	-0.1085	0.0121	-0.0072	0.0061	0	

CONCLUSION

Examining of the results on yield and quality traits correlations results Number of filled grains per panicle (NFG), Number of productive tillers per plant (NPT) showed significant positive correlation to single plant yield. Breakdown of genotypic correlation into components for direct and indirect effects over path analysis results that the Number of productive tillers (NPT) registered extreme direct effect on grain yield positively in both genotypical besides phenotypical path analysis. Therefore, productive tillers per plant (NPT) plays a main character in decisive of single plant yield (SPY) in rice on which selection pressure has to be applied for increasing the seed yield.

Conflict of interest

None declared.

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HOW TO CITE THIS ARTICLE
Naik MVK, Pillai MA, Saravanan S. Assessment of Correlation and Path Coefficient Analysis for Yield Attributing and Quality Traits in promising rice varieties cultivated in Tamil Nadu. J Phytopharmacol 2021; 10(2):139-143.