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Association Analysis of F_2 Generation in Rice (*Oryza sativa*. L.)

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ABSTRACT

The association between yield traits was worked out in F_2 generation in 36 crosses of rice. Seed yield had highly significant positive correlations with total biomass both phenotypically and genotypically and 1000 weight genotypically. Path analysis revealed that number of filled grains per panicle had the highest positive and direct effect on grain yield followed by total biomass, kernel length and harvest index. Number of filled grains per panicle showed highly positive indirect effect through panicle density, total biomass and days to 50% flowering on grain yield. The study revealed that genetic improvement of grain yield in rice is admissible by selecting character having high positive correlation and positive direct effect.

***Keywords**: Character association, path analysis, rice.*

INTRODUCTION

Rice is life and prince among the cereals and is the staple food in areas of high population density and fast population growth[13]. Substantial improvement in yield and quality traits had mere achieved through conventional breeding methods *i.e.,* hybridization followed by selection in segregating generations to isolate promising pure lines at the end. Among the segregating generations F_2 generation is most crucial, where selection has to be done more critically. Hence to exercise effective selection, a thorough knowledge on association between yield and yield components is regenerated. Correlation coefficient enables to identity characters or combination of characters, which might be useful as indicators of high yield by way of evaluating the relative influence of various characters on grain yield and among themselves as well. It provides reliable information on the consequence of selection for simultaneous improvement of desirable yield component characters. Path coefficient analysis is the best method to evaluate the cause and effect relationship between yield and its contributing traits. The present study was undertaken to derive information on genotypic and phenotypic correlations, direct and indirect effect on various traits.

MATERIALS AND METHODS

The material used in the present study consisted of 36 F_2's evolved by crossing of nine parents *viz.,* MTU-1010, IR-64, MTU-1001, BPT-5204, NLR-34449, JGL-1798, Erramallelu, JGL-3844 and JGL-11690 in diallel mating design. All the 36 F_2's were evaluated during *rabi* 2008-09 at Regional Agricultural Research Station, ANGRAU, Jagtial, Karimnagar district of Andhra Pradesh. Seeds of 36 crosses was soaked in water for 24 hours and incubated for 48 hours. The germinated seedlings were transferred to wet beds and proper care was taken to raise a healthy nursery. All the entries after attaining an age of 28 days were transplanted in the main field with 3.0 m row length of 12 rows by adopting a spacing of 20 cm between the row and 15 cm between the plants within a row replicated thrice and all

recommended package of practices were followed to raise a healthy crop. All the biometrical observations were recorded on 30 randomly selected plants in a replication during flowering to maturity stage *viz.*, days to 50 per cent flowering, plant height, panicle length, number of productive tillers per plant, number of filled grains per panicle, panicle density, 1000 grain weight, total biomass, harvest index, grain yield per plant, hulling percent, kernel length, kernel breadth and L/B ratio. The mean values recorded for fourteen character in F_2 generation were used for statistical analysis. The genotypic and phenotypic correlation coefficients were estimated and path coefficient analysis was done as per Dewey and Lu[3] and Singh and Chaudhary[14].

RESULTS AND DISCUSSION

Analysis of variance revealed that the entries were significantly differing for all the characters under study. The association among yield and its contributing characters provided reliable information on nature and direction of their relationship. Correlation studies provided reliable information on the consequences of selection for simultaneous improvement of desirable yield component characters.

In the present study, correlation coefficients were worked out involving populations of 36 crosses in F_2 generation derived from 9 x 9 diallel mating. An over view of correlation studies indicated that plant height, 1000 grain weight, total biomass, harvest index, hulling percent, kernel length and breadth were positively associated with yield, whereas productive tillers per plant and kernel length/breadth ratio exhibited significant negative association with it (Table 1). Phenotypic and genotypic correlations were employed to determine the direct and indirect effects of yield components on grain yield and grain characteristics in rice (Table 2).

Significant negative genotypic and positive non significant phenotypic association of productive tillers per plant with grain yield was observed in the present study[12,6]. In the present study negative association of kernel length/breadth ratio was observed with grain yield as reported earlier by Krishna Veni and Shobha Rani[9] and Krishna *et al.*[6].

Total biomass yield per plant showed significant and positive association with grain yield. Similar findings were also reported by Panwar and Mashiat Ali[12] and Yugandhar Reddy *et al.*[16]. Positive association of harvest index with grain yield per plant obtained in the present investigation was in conformity with the results of Chitra *et al.*[2] and Yugandhar Reddy[16]. The trait kernel length showed significant positive genotypic correlation with grain yield, where as, Krishna Veni and Shobha Rani[9] and Krishna *et al.*[6] reported significant negative association with this trait. The other quality trait, kernel breadth had positive correlation with yield[9].

Association analysis among yield component characters revealed that days to 50 per cent flowering showed significant negative association with panicle length, 1000 grain weight, harvest index, kernel length and kernel length/breadth ratio, similar results of negative association was reported by Eradasappa *et al.*[4] for panicle length; Krishna Veni and Shobha Rani[9] and Krishna *et al.*[6] for 1000 grain weight; Panwar and Mashiat Ali[12] and Anbumalarmathi and Nadarajan[1] for harvest index; Krishna *et al.*[6] for kernel length and Krishna Naik *et al.*[7] for kernel L/B ratio. Whereas, positive significant association of days to 50 per cent flowering with filled grains per panicle was in confirmity with the results of Kavitha and Sree Rami Reddi[5], Madhavilatha[10] and Krishna Naik *et al.*[7] and total biomass in accordance to Panwar and Mashiat Ali[12].

Plant height recorded negative significant association with productive tillers per plant[11,1] Panicle density and kernel length/breadth ratio. Whereas, positive and significant association was reported with panicle length by Chitra *et al.*[2] and Krishna *et al.*[6], with 1000 grain weight by Panwar and Mashiat Ali[12] and Krishna *et al.*[6], total biomass, hulling per cent and with kernel length and breadth[6].

The trait panicle length exhibited significant and positive association with 1000 grain weight[6], harvest index, kernel length and breadth[6] Number of productive tillers plant showed significant negative correlation with filled grains per panicle[7], panicle density, harvest index and positive association is reported with total biomass[12]. The character number of filled grains per panicle had significant positive association with panicle density, total biomass and hulling percentage, while significant negative association was recorded with 1000 grain weight[6], harvest index, kernel length[9,6] kernel breadth and kernel L/B ratio by Krishna *et al.*[6]. Panicle density had significant negative association with the characters, 1000 grain weight, harvest index, kernel length, kernel breadth and kernel length/breadth ratio and with total biomass and hulling percentage the association was positive.

The character test weight observed the positive and significant association with harvest index[12,1] Kernel length and Kernel length/breadth ratio[6]. The trait harvest index correlated positively and significant with kernel length and kernel length/breadth ratio. Kernel length had significant positive correlation with kernel breadth[6] and Kernel length/breadth ratio[9,6] while, kernel breadth had significant negative association with kernel L/B ratio.

The positive association of plant height with grain yield per plant obtained in the present study is in conformity with the results of Madhavilatha[10] and Krishna *et al.*[6]. Positive association of test weight with yield observed in the present study which is in agreement with the findings of Anbumalarmathi and Nadarajan[1].

It is quite possible that a trait showing positive direct effect on yield may have a negative indirect effect via other component traits. Path analysis permits the estimation of direct effects of various characters on yield as well as their indirect effects via other component traits. Thus through the estimates of direct and indirect effects, it determines the yield components and provides basis for selection of superior genotypes from the diverse breeding populations.

Number of filled grains per panicle, was found to have maximum direct positive effect on grain yield per plant (Table 2). These results are in agreement with the earlier reports of Malini *et al.* and Krishna *et al.*[6]. Positive direct effect of plant height on yield in the present study is in conformity with the results of Krishna Veni and Shobha Rani[9] and Krishna *et al.*[6], Positive direct effect of total biomass on grain yield was reported by Panwar and Mashiat Ali[12] and Yugandhar Reddy *et al.*[16] which is in conformation with the present findings.

In the present study, number of filled grains per panicle exhibited positive indirect effect on grain yield via panicle density, hulling percentage, days to 50 per cent flowering[1] and total biomass[12], whereas 1000 grain weight exhibited positive indirect effect on yield via panicle density, number of filled grains per panicle[7], hulling percent[10] and days to 50 per cent flowering[6].

The character total biomass recorded positive indirect effect on yield through days to 50 per cent flowering, productive tillers per plant, kernel breadth, panicle density, hulling percent, plant height, number of filled grains per panicle and 1000 grain weight[10,12].

Harvest index had indirect positive effect through 1000 grain weight, kernel length/breadth ratio[15]. Kernel length and panicle length[16]. Among the grain quality characters kernel length/breadth ratio showed positive indirect effect on grain yield through days to 50 per cent flowering, Plant height, panicle length, filled grains per panicle, Panicle density, total biomass and kernel breadth[10,11], productive tillers per plant[7].

The lower residual effect indicated that different characters other than the characters considered in this study influence the grain yield considerably. It is evident from the study that selection for the improvement of grain yield can be efficient based on filled grains per panicle, total biomass, 1000 grain weight and harvest index.

Table 1 : Phenotypic and genotypic correlation coefficients among Grain yield per plant and other quality characters of F_2 progenies in rice

Character	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of productive tillers/plant	No. of filled grains/ Panicle	Panicle density	1000 grain weight (g)	Total biomass (g)	Harvest Index (%)	Hulling per cent	Kernel length (mm)	Kernel breadth (mm)	Kernel L/B ratio	Grain yield/ Plant (g)
Days to 50% flowering	**1.0000**	0.0039 (-0.0280)	-0.3206** (-0.4047**)	0.0257 (0.0243)	0.2205* (0.2591**)	0.2718** (0.3168**)	-0.3114** (-0.3368**)	0.3255** (0.6296**)	-0.2696** (-0.5898**)	0.2322* (0.3642**)	-0.5056** (-0.5365**)	0.0350 (0.0567)	-0.4905** (-0.5610**)	0.0878 (0.1486)
Plant height (cm)		**1.0000**	0.6137** (0.7824**)	-0.0326 (-0.1961*)	-0.0400 (-0.0814)	-0.1550 (-0.2118*)	0.3647** (0.5427**)	0.3223** (0.2081*)	0.0438 (-0.0282)	0.2401* (0.1779)	0.3325** (0.4407**)	0.4166** (0.6077**)	-0.1051 (-0.1912*)	0.3452** (0.3079**)
Panicle length (cm)			**1.0000**	-0.1812 (-0.4836**)	-0.0008 (-0.0619)	-0.1838 (-0.2261*)	0.3855** (0.5462**)	0.0152 (-0.2811**)	0.1096 (0.2053*)	0.0017 (-0.1184	0.3397** (0.4157**)	0.3518** (0.4351**)	-0.0517 (-0.0588)	0.1128 (-0.1046)
No. of productive tillers/plant				**1.0000**	-0.2403* (-0.3242**)	-0.2114* (-0.2464*)	-0.0012 (0.0456)	0.1137 (0.5058**)	-0.0612 (-0.9626**)	0.0840 (0.0080)	-0.0012 (0.0029)	0.0120 (0.1658)	-0.0030 (-0.1559)	0.0592 (-0.4173**)
No. of filled grains/ Panicle					**1.0000**	0.9825** (0.9859**)	-0.5440** (-0.6829**)	0.1462 (0.2036*)	-0.2027* (-0.2495**)	0.2377* (0.4511**)	-0.5201** (-0.6367**)	-0.1896* (-0.2162*)	-0.2951** (-0.3946**)	-0.0191 (-0.0275)
Panicle density						**1.0000**	-0.6042** (-0.7590**)	0.1373 (0.2410*)	-0.2158* (-0.2711**)	0.2295* (0.4525**)	-0.5768** (-0.6938**)	-0.2516** (-0.2864**)	-0.2830** (-0.3759**)	-0.0405 (-0.0087)
1000 grain weight (g)							**1.0000**	0.0224 (0.0913)	0.2118* (0.3743**)	-0.2331* (-0.4435**)	0.7025** (0.7819**)	0.6255** (0.6872**)	0.0267 (0.0647)	0.1848 (0.6003**)
Total biomass (g)								**1.0000**	-0.3556** (-0.7132**)	0.0268 (0.2682**)	-0.0464 (-0.0075)	0.2997** (0.5716**)	-0.3406** (-0.5898**)	0.6596** (0.5206**)
Harvest Index (%)									**1.0000**	-0.0305 (-0.0744)	0.2344* (0.4499**)	-0.0535 (0.0164)	0.2719** (0.4143**)	0.4599** (0.2321*)
Hulling per cent										**1.0000**	-0.1117 (-0.2942**)	-0.2374* (-0.4701**)	0.1193 (0.1617)	-0.0053 (0.3422**)
Kernel length (mm)											**1.0000**	0.4468** (0.4695**)	0.4784** (0.4910**)	0.155 (0.5523**)
Kernel breadth (mm)												**1.0000**	-0.5693** (-0.5367**)	0.2508** (0.8527**)
Kernel L/B ratio													**1.0000**	-0.1045 (-0.3396**)

* Significant at 5 per cent level; ** Significant at 1 per cent level; the values in the parenthesis are genotypic correlations

Table 2: Phenotypic and genotypic path coefficients of quality, yield and yield components of rice in F_2 progenies

Character	Days to 50% flowering	Plant height (cm)	Panicle length (cm)	No. of productive tillers/plant	No. of filled grains/ Panicle	Panicle density	1000 grain weight (g)	Total biomass (g)	Harvest Index (%)	Hulling per cent	Kernel length (mm)	Kernel breadth (mm)	Kernel L/B ratio	Grain yield/ Plant (g)
Days to 50% flowering	**0.0067 (-0.2292)**	0.0000 (0.0064)	-0.0022 (0.0928)	0.0002 (-0.0056)	0.0015 (-0.0594)	0.0018 (-0.0726)	-0.0021 (0.0772)	0.0022 (-0.1443)	-0.0018 (0.1352)	0.0016 (-0.0835)	-0.0034 (0.1230)	0.0002 (-0.0130)	-0.0033 (0.1286)	0.0878 (0.1486)
Plant height (cm)	0.0000 (-0.0113)	**0.0049 (0.4051)**	0.0030 (0.3169)	-0.0002 (-0.0794)	-0.0002 (-0.0330)	-0.0008 (-0.0858)	0.0018 (0.2198)	0.0016 (0.0843)	0.0002 (-0.0114)	0.0012 (0.0721)	0.0016 (0.1785)	0.0020 (0.2462)	-0.0005 (-0.0775)	0.3452** (0.3079**)
Panicle length (cm)	0.0078 (0.6075)	-0.0149 (-1.1746)	**-0.0243 (-1.5012)**	0.0044 (0.7260)	0.0000 (0.0929)	0.0045 (0.3394)	-0.0094 (-0.8199)	-0.0004 (0.4219)	-0.0027 (-0.3082)	0.0000 (0.1778)	-0.0083 (-0.6240)	-0.0086 (-0.6531)	0.0013 (0.0882)	0.1128 (-0.1046)
No. of productive tillers/plant	0.0002 (-0.0024)	-0.0002 (0.0190)	-0.0011 (0.0469)	**0.0059 (-0.0970)**	-0.0014 (0.0314)	-0.0012 (0.0239)	0.0000 (-0.0044)	0.0007 (-0.0490)	-0.0004 (0.0933)	0.0005 (-0.0008)	0.0000 (-0.0003)	0.0001 (-0.0161)	0.0000 (0.0151)	0.0592 (-0.4173**)
No. of filled grains/ Panicle	0.0388 (1.7711)	-0.0070 (-0.5567)	-0.0001 (-0.4229)	-0.0423 (-2.2161)	**0.1762 (6.8361)**	0.1731 (6.7398)	-0.0958 (-4.6683)	0.0258 (1.3921)	-0.0357 (-1.7053)	0.0419 (3.0839)	-0.0916 (-4.3527)	-0.0334 (-1.4783)	-0.0520 (-2.6975)	-0.0191 (-0.0275)
Panicle density	-0.0470 (-2.2664)	0.0268 (1.5150)	0.0317 (1.6174)	0.0365 (1.7630)	-0.1697 (-7.0537)	**-0.1727 (-7.1545)**	0.1044 (5.4304)	-0.0237 (-1.7239)	0.0373 (1.9392)	-0.0396 (-3.2377)	0.0996 (4.9635)	0.0434 (2.0488)	0.0489 (2.6893)	-0.0405 (-0.0087)
1000 grain weight (g)	0.0136 (0.0392)	-0.0159 (-0.0632)	-0.0168 (-0.0636)	0.0001 (-0.0053)	0.0237 (0.0795)	0.0264 (0.0884)	**-0.0436 (-0.1165)**	-0.0010 (-0.0106)	-0.0092 (-0.0436)	0.0102 (0.0517)	-0.0307 (-0.0911)	-0.0273 (-0.0800)	-0.0012 (-0.0075)	0.1848 (0.6003**)
Total biomass (g)	0.3039 (0.9222)	0.3010 (0.3047)	0.0141 (-0.4117)	0.1062 (0.7409)	0.1366 (0.2983)	0.1282 (0.3529)	0.0209 (0.1337)	**0.9338 (1.4647)**	-0.3321 (-1.0445)	0.0250 (0.3928)	-0.0434 (-0.0110)	0.2798 (0.8372)	-0.3180 (-0.8639)	0.6596** (0.5206**)
Harvest Index (%)	-0.2150 (-0.7555)	0.0349 (-0.0362)	0.0874 (0.2629)	-0.0488 (-1.2331)	-0.1616 (-0.3195)	-0.1721 (-0.3472)	0.1689 (0.4791)	-0.2836 (-0.9135)	**0.7975 (1.2810)**	-0.0243 (-0.0953)	0.1870 (0.5763)	-0.0427 (0.0210)	0.2168 (0.5306)	0.4599** (0.2321*)
Hulling per cent	-0.0035 (-0.0473)	-0.0036 (-0.0231)	0.0000 (0.0154)	-0.0013 (-0.0010)	-0.0036 (-0.0586)	-0.0035 (-0.0588)	0.0035 (0.0576)	-0.0004 (-0.0348)	0.0005 (0.0097)	**-0.0151 (-0.1229)**	0.0017 (0.0382)	0.0036 (0.0611)	-0.0018 (-0.0210)	-0.0053 (0.3422**)
Kernel length (mm)	-0.0916 (-0.7676)	0.0602 (0.6304)	0.0615 (0.5947)	-0.0002 (0.0041)	-0.0942 (-0.9109)	-0.1045 (-0.9926)	0.1272 (1.1187)	-0.0084 (-0.0107)	0.0425 (0.6436)	-0.0202 (-0.4209)	**0.1811 (1.4307)**	0.0809 (0.6747)	0.0866 (0.7025)	0.155 (0.5523**)
Kernel breadth (mm)	-0.0049 (-0.0984)	-0.0578 (-1.0553)	-0.0488 (-0.7555)	-0.0017 (-0.28798)	0.0263 (0.3755)	0.0349 (0.4973)	-0.0867 (-1.1934)	-0.0416 (-0.9927)	0.0074 (-0.0284)	0.0329 (0.8164)	-0.0620 (-0.8153)	**-0.1387 (-1.7366)**	0.0789 (0.9321)	0.2508** (0.8527**)
Kernel L/B ratio	0.0786 (0.9866)	0.0168 (0.3363)	0.0083 (0.1033)	0.0005 (0.2742)	0.0473 (0.6940)	0.0454 (0.6611)	-0.0043 (-0.1137)	0.0546 (1.0373)	-0.0436 (-0.7285)	-0.0191 (-0.2843)	-0.0767 (-0.8635)	0.0913 (0.9439)	**-0.1603 (-1.7586)**	-0.1045 (-0.3396**)

Bold values are direct effects; Phenotypic residual effect = 0.1083; Genotypic residual effect = 0.1192; the values in the parenthesis are genotypic path coefficients

REFERENCES

1. Anbumalarmathi, J. and Nadarajan, N. Association analysis of yield and drought tolerant characters in rice (*Oryza sativa* L.) under drought stress. *Agric. Sci. Digest.* **28:** 89-92 (2008)
2. Chitra, S., Ananda Kumar, C. R. and Vivekanandan, P. Correlation and path analysis Assam Rice Collection (*Oryza sativa* L.). *The Andhra Agric. J.* **52:** 388-91 (2005)
3. Dewey, D. R. and Lu, K. H. Correlation and path coefficient analysis of components of crested wheat grass seed production. *J. of Agron*. **51:** 515-18 (1959)
4. Eradasappa, E., Nadarajan, N., Ganapathy, K. N., Shanthala, J. and Satish, R. G. Correlation and path analysis for yield and its attributing traits in rice (*Oryza sativa* L.). *Crop Res*. **34:** 156-59 (2007)
5. Kavitha, S. and Sree Rama Reddi, N. Correlation and path analysis of yield components in Rice. *The Andhra Agric. J.* **48:** 311-14 (2001)
6. Krishna, L., Raju, Ch. D. and Raju, Ch. S. Genetic variability and correlation in yield and grain quality characters of rice germplasm. *The Andhra Agric. J.* **55:** 276-79 (2008)
7. Krishna Naik, R., Sreenivasulu Reddy, P., Ramana, J. V. and Srinivasa Rao, V. Correlation and Path Coefficient Analysis in rice (*Oryza sativa* L.). *The Andhra Agric. J.* **52:** 52-55 (2005)
8. Krishna Veni, B. and Shobha Rani, N. Association and path analysis for yield components in F_2 generation of rice. *The Andhra Agric. J.* **52:** 290-92 (2005)
9. Krishna Veni, B. and Shobha Rani, N. Association of grain yield with quality characteristics and other yield components in rice. *Oryza* **43:** 320-22 (2006)
10. Madhavilatha, L. Studies on genetic divergence and isozyme analysis on rice *(Oryza sativa* L). M.Sc. (Ag.) Thesis, Acharya N. G. Ranga Agricultural University, Hyderabad (2002)
11. Nayak, A. R., Chaudhary, D. and Reddy, J. N. Correlation and path analysis in scented rice (*Oryza sativa* L.). *Indian J. of Agric. Res.* **35:** 186-89 (2001)
12. Panwar, L. L. and Mashiat Ali. Correlation and path analysis of yield and yield components in transplanted rice. *Oryza* **44:** 115-20 (2007)
13. Poonam, S., Mandal, S., Kumar, N. and Verrma, D. K. Quality indices in rice. *A Review Agric.Res.* **21:** 178-85 (2000)
14. Singh, R. K. and Chaudhary, B. D. *Biometrical methods in Quantitative Genetic Analysis.* Kalyani Publishers, New Delhi, Ludhiana, 39-78 (1985)
15. Vinothini, S. and Ananda Kumar, C. R. Correlation Path Coefficient Analysis in Drought Tolerant Rice cultures for yield. *The Andhra Agric. J.* **52:** 373-377 (2005)
16. Yugandhar Reddy, M., Subhash Chandra Yadav., Suresh Reddy, B., Lavanya, G. R. and Suresh Babu, G. Character association and component analysis in rice. *Oryza* **45:** 239-241 (2008)