The Pharma Innovation Journal 2023; 12(11): 891-894

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(11): 891-894

www.thepharmajournal.com
Received: 01-09-2023
Accepted: 06-10-2023

S Muthuramu
Associate Professor (PBG) & Head, Agricultural Research Station, TNAU, Paramakudi, Tamil Nadu, India

K Thangaraj
Professor (PBG), Department of Plant Breeding & Genetics, Agricultural College and Research Institute, TNAU, Madurai, Tamil Nadu, India

Corresponding Author:
S Muthuramu
Associate Professor (PBG) & Head, Agricultural Research Station, TNAU, Paramakudi, Tamil Nadu, India

Heritable variation and association of yield traits in advanced rice genotypes grown under dry direct seeded condition

S Muthuramu and K Thangaraj

Abstract
In order to study genetic variation, genetic inheritance, genetic advancement, and the relationship between yield and related characteristics of 17 advanced rice cultures, the experiment was carried out with dry direct seeded rice. All of the treatments have significant implications for the numerous features under study, according to the analysis of variance. With the exception of days to 50% blooming and panicle length, all features had a moderate GCV, whereas the number of effective tillers per plant, the number of spikes per square meter plot area, and grain yield showed the highest magnitude of PCV. Plant height was shown to have a high genetic progress and high heritability, which suggests that additive gene action plays a substantial role in the generational transmission of this feature. Straw yield was found to have a positive correlation with plant height, the number of effective tillers per plant, the number of spikes per square meter, and the length of the panicles. These results suggest that selecting for straw yield will help develop high-yielding genotypes in rainfed environments by simultaneously improving these traits. Days to 50% blooming, harvest index, and straw output all showed strong direct effects, while the number of effective tillers per plant had a somewhat direct impact on grain production. To increase grain yield under dry direct-sown rice cultivation, greater weight should be placed on the characteristics of straw yield, plant height, number of effective tillers per plant, number of spikes per square meter, and panicle length.

Keywords: Variability, heritability, genetic gain, trait association, dry direct seeded rice

Introduction

About 90% of people in South-East Asia eat rice (*Oryza sativa* L.) as a staple diet, making it the most vital cereal food crop in the world. Rainfed rice has become more and more popular since intense cultivation of the existing high-yielding cultivars has increased genetic vulnerability, reduced irrigation water availability, and broken down resistance genes against developing pathogen races. Due to the reduced cost of production and lack of irrigation facilities, it is significant in cropping systems (Fageria *et al*., 2014) [7]. Furthermore, the absence of suitable varieties of rice under such ecoclimatic conditions causes poor productivity in the majority of areas under rainfed rice agriculture. Therefore, a breakthrough in the form of increased biological effectiveness through recombination and the generation of new kinds adapted to rainfed conditions would be required in order to boost the productivity level.

It is therefore desirable to gather, assess, and make use of the diversity that is now accessible to satisfy certain needs with regard to specific ecosystems, as the success of producing new variations will rely on the effective utilization of existing variability. Crop improvement is achievable with the application of suitable selection techniques once parental variation has been established. Choosing for components of yield will make it easier to increase overall yield because these components are more frequently inherited than total yield. Determining which features should be prioritized throughout the selection process will be made much easier with an understanding of the degree of correlation between those traits and better yield. When qualities are positively correlated, it is appropriate to focus selection on just one of the connected traits while simultaneously improving the other trait. According to Nadarajan *et al*. (2016) [16], there is a positive connection at the genetic level resulting from the coupling phase of linkages and a negative correlation arising from the repulsion phase of linkages of alleles controlling two distinct phenotypes.

The link between predictor and responder variables has been arranged using path analysis. Path analysis has the benefit of allowing the correlation coefficient to be divided into its constituent parts.

The path coefficient, also known as the standardized partial regression coefficient, is one component that assesses the direct influence of a predictor variable on its response variables, while the other component is the indirect influence(s) of an a predictor variables on the response variable via additional predictor factors (Deway and Lu, 1959) [6]. Plant breeders can discover features on which pressure of selection needs to be applied to improve yield with the help of path coefficient analysis. Therefore, this study was carried out to choose prospective genotypes and determine the most essential characters for breeding programs by taking advantage of 16 advanced rainfed rice genotypes' genetic variability, heritability, genetic gain, and association with yield and related attributes.

Materials and Methods

Experimental site and characters

The seventeen advanced rice cultures that made up the experimental material were assessed in Rabi 2022–2023 at the Agricultural Research Station (TNAU), Paramakudi, India, using a randomized block design with three replications. The experimental location is 42 meters above MSL and receives an average of 840 mm of rainfall annually. It is situated at latitudes 9" 21' N and longitudes 78" 22' E. The soil type at this location is clay loam, with a pH of 8.0. Every genotype was grown on a 5 x 2 m plot with 15 x 10 cm intervals. The agronomic recommendations were adhered to in order to improve crop stand. The following quantitative traits were studied: days to flowering at fifty percent plant height (cm), number of effective tillers per plant, number of panicles per square meter plot area, panicle length, grain yield (kg), straw yield (kg), and harvest index. The data was collected on ten randomly selected plants from every replication.

Statistical analysis

The value of significance for every character was tested using an analysis of variance applied to mean values, following the Panse and Sukhatme (1967) [18] technique. The formula provided by Burton (1952) [5] was used to compute the genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV). As recommended by Sivasubramanian and Menon (1973) [20], PCV and GCV were categorized. Broad sense heritability (h2[b]) was determined using the formulas proposed by Allard (1960) [4]. The Johnson *et al*., (1955) [9] recommended category for heritability (h^2[b]). Genetic advance (GA) was calculated using the formula provided by Allard (1960) [4], and Johnson et al. (1955) [9] proposed a classification scheme for genetic advance expressed as a percentage over mean. The genotypic correlation coefficients among the yield components and between the yield and its components were calculated. As recommended by Al-Jibouri *et al*. (1958) [2], the relevant genotypic variances and covariances were computed using the analysis of variance and covariance data using the mean squared values and mean sum of products. Using the path analysis approach proposed by Dewey and Lu (1959) [6], the relative influence of eight components on yield both directly (direct effects) and indirectly (*via* other features) was assessed. For this, the already-estimated basic correlation coefficients at the genotypic level were used. In order to evaluate the direct and indirect effects, simultaneous equations expressing the fundamental link among path coefficients were solved, with yield remaining the dependent variable and the remaining eight attributes the independent variables. Lenka and Misra's (1973) [13] scale was used to categorize the direct and indirect effects.

Results and Discussions

Variability

For every character under study, the ANOVA showed significant variations in the genotypes, confirming the presence of genetic variability (Table 1). A breeder can compare the degree of variability across various traits by using the genotypic coefficient of variation, which quantifies the range of variability present in the crop. Examining the coefficient of variability revealed that every character under study exhibited a broad range of variability at the genotypic and phenotypic levels. For every characteristic, the magnitude of the phenotypic coefficient of variation (PCV) exceeded the genotypic coefficient of variation (GCV); this could be because genotypes and environment interact more strongly (Kavitha and Reddy, 2002 [10]; Muthuramu and Ragavan, 2020) [14]. For the number of effective tillers per plant, the number of spikes per square meter of plot area, the grain yield, the straw yield, and the harvest index, there were significant disparities in the magnitudes of PCV and GCV. The number of effective tillers per plant, the number of spikes per square meter of plot area, and the grain yield showed the highest magnitude of PCV. With the exception of days to fifty percent flowering and panicle length, all attributes had a moderate GCV (Table 2). This is consistent with the findings of Muthuramu and Ragavan (2020) [14] and Kumar *et al*. (2018) [11].

Heritability and genetic advance

Burton (1952) [5] noted that the degree of diversity in the population, along with the strength of selection and heredity, all affect the benefits of selection. Genetic progress, then, is an additional crucial selection criterion that, despite its independence, captures the anticipated genetic advancement that is being selected for. According to Panse (1957) [17], a character with additive gene action will have high heritability and high genetic advance, while a character with non-additive gene action will likely have high heritability and low genetic advance, leaving good room for future development. Plant height was found to have a significant genetic gain and strong heritability (Table 2). It suggests that selection might be successful and that the heritability is most likely the result of additive gene effects. This result closely aligns with the conclusions of Kumar *et al*. (2018) [11], Akshay *et al*. (2022) [1], and Allam *et al*. (2015) [3].

Association studies

For each rice genotype, the following genotypic correlations were calculated: days to 50% blooming, plant height, number of productive tillers per plant, number of panicles per square meter, panicle length, straw yield per plot, and harvest index (%). Table 3 presents the findings. In the current study, there was a negative and significant correlation between grain yield and plant height, but a positive and significant association with days to 50% flowering, number of productive tillers per plant, and harvest index (Table 3). This was consistent with the results of the following studies: Vanisree *et al*. (2013) [21], Islam *et al*. (2015) [8], Shinde *et al*. (2015) [19], Muthuramu and Sakthivel (2016) [15], Lalitha *et al*. (2019) [12], Muthuramu and Ragavan (2020) [14] and Akshay *et al*. (2022) [1]. Breeders may find it easier to choose the direction and degree of pressure for selection to apply to related qualities in order to simultaneously develop these traits if they are aware of the relationships between yield traits. In the current study, plant height, the number of effective tillers per plant, the number of spikes per square meter, and the length of the panicles all positively and significantly correlated with straw yield. Plant height and the quantity of fruitful tillers per plant were positively and significantly correlated with the trait of spikes per square meter. Similarly, a strong and positive correlation was found between the harvest index and the days to 50% flowering. Islam *et al*. (2015) [8], Lalitha *et al*. (2019) [12], Muthuramu and Ragavan (2020) [14], and Akshay *et al.* (2022) [1] all reported findings that were similar.

Given the discussion above, it is possible to conclude that the harvest index, number of effective tillers per plant, and days to 50% blooming should all be considered during the selection process because they showed a strong and positive link with grain output. Selection based on straw yield is very effective for generating high yielding varieties under rainfed conditions, as it will bring about concurrently processed improvement of these traits. The trait, straw yield, had a positive correlation with plant height, suggesting number of effective tillers per plant, number of spikes per square meter, and panicle length. As a result, the study's findings are consistent with those previously stated.

Days to 50% blooming, straw production, and harvest index were found to have a strong direct effect on grain output in the current study, while the number of effective tillers per plant had a moderate direct effect (Table 4). This was consistent with the results of the following studies: Vanisree *et al.* (2013) [21], Islam *et al.* (2015) [8], Shinde *et al.* (2015) [19], Muthuramu and Sakthivel (2016) [15], Lalitha *et al.* (2019) [12], Muthuramu and Ragavan (2020) [14] and Akshay *et al.* (2022) [1]. The trait straw yield was found to have moderate indirect effects on grain yield through plant height and the number of panicles per square meter, and strong indirect effects on grain yield through the number of effective tillers per plant and panicle length. 79% of the variability in grain output is attributed to the variables under investigation, according to the genotypic residual effect (0.21). It suggests that in order to completely explain the difference in grain production, a few other factors that have not been examined here must be taken into consideration.

Table 1: Analysis of variance for different traits in dry direct seeded rice genotypes

Source of variation	Degrees of freedom	Days to 50% flowering	Plant Height	Effective tillers per plant	Spikes per square meter	Panicle length	Grain yield	Straw yield	Harvest index
Replication	2	2.19	7.72	7.82	2207.08	1.85	62401.96	3575882.35	0.004
Genotypes	16	77.02**	433.34**	7.24**	5319.00**	7.07**	901121.32**	3555367.65**	0.006**
Error	32	1.57	25.54	2.80	1373.68	2.89	297766.54	1127757.35	0.002

**significant at P=0.01 level

Table 2: Estimates of mean, variability, heritability and genetic advance in dry direct seeded rice genotypes

Traits	Mean	PV	GV	PCV	GCV	h^2	GAM
Days to 50% flowering	74.98	26.72	25.15	6.89	6.69	94.12	13.37
Plant height	77.17	161.47	135.93	16.47	15.11	84.18	28.56
Effective tillers per plant	8.76	4.28	1.48	23.61	13.88	34.54	16.80
Spikes per square meter	194.86	2688.79	1315.11	26.61	18.61	48.91	26.81
Panicle length	20.79	4.29	1.39	9.96	5.67	32.41	6.65
Grain yield	3204.90	498884.80	201118.26	22.04	13.99	40.31	18.30
Straw yield	7070.58	193690.78	809203.43	19.68	12.72	41.78	16.94
Harvest index	0.31	0.003	0.001	18.92	11.02	33.93	13.22

GV=Genotypic Variation; PV=Phenotypic Variation; GCV=Genotypic Co-efficient of Variation; PCV=Phenotypic Co-efficient of Variation; h^2=Heritability (Broad sense); GAM=Genetic Advance as % of Mean.

Table 3: Genotypic correlation coefficients for yield and its related traits in dry direct seeded rice genotypes

Characters	Days to 50% flowering	Plant Height	Effective tillers per plant	Spikes per square metre	Panicle length	Straw yield	Harvest index	Grain yield
Days to 50% flowering	1.0000	-0.0391	-0.2056	-0.3835*	0.2113	-0.0021	0.3748*	0.4904**
Plant Height		1.0000	-0.2150	0.6225**	0.2180	0.3225*	-0.6920**	-0.4359**
Effective tillers per plant			1.0000	0.3671*	-0.2101	0.6080**	0.1067	0.6003**
Spikes per square meter				1.0000	0.1395	0.3385*	-0.2768	-0.0594
Panicle length					1.0000	0.7638**	-0.6628**	0.0514
Straw yield						1.0000	-0.4614**	0.2893
Harvest index							1.0000	0.7027**
Grain yield								1.0000

Note: * indicates significance at 5%, ** indicates significance at 1%

Table 4: Direct and indirect effects of yield related traits on grain yield in dry direct seeded rice genotypes

Characters	Days to 50% flowering	Plant Height	Effective tillers per plant	Spikes per square metre	Panicle length	Straw yield	Harvest index	Grain yield	Residual effect
Days to 50% flowering	0.3245	0.0132	0.0170	-0.0962	-0.0289	-0.0016	0.2624	0.4904**	0.21
Plant Height	-0.0127	-0.3384	0.0178	0.1561	-0.0298	0.2554	-0.4844	-0.4359**	
Effective tillers per plant	-0.0667	0.0728	-0.0828	0.0920	0.0288	0.4816	0.0747	0.6003**	
Spikes per square metre	-0.1245	-0.2106	-0.0304	0.2507	-0.0191	0.2681	-0.1937	-0.0594	

Panicle length	0.0686	-0.0738	0.0174	0.0350	-0.1369	0.6051	-0.4639	0.0514	
Straw yield	-0.0007	-0.1091	-0.0504	0.0849	-0.1045	0.7921	-0.3230	0.2893	
Harvest index	0.1216	0.2341	-0.0088	-0.0694	0.0907	-0.3655	0.7000	0.7027**	

Note: * indicates significance at 5%, ** indicates significance at 1% Diagonal values (in bold) denote the direct effects

Conclusion

The variability investigations lead to the conclusion that plant height is a variable that is mostly inherited by additive gene action and has a high heritability and genetic progress. In the rainfed rice habitat, this characteristic could therefore be used as useful selection factors throughout the breeding program. According to association studies, in order to increase grain output under a dry direct seeded rice farming technique, greater weight should be placed on the characteristics of straw yield, plant height, number of effective tillers per plant, number of spikes per square meter, and panicle length.

References

1. Akshay M, Sathish Chandra B, Rukmini Devi K, Hari Y. Genetic variability studies for yield and its attributes, quality and nutritional traits in rice (*Oryza sativa* L.). The Pharma Innovation Journal. 2022;11(5):167-172.
2. Al-Jibouri HR, Miller PA, Robinson HF. Genotypic and environmental variances and covariances in aneupland cotton cross of inter specific origin. Agronomy Journal. 1958;50:633-636.
3. Allam CR, Jaiswal HK, Qamar A, Challa V, Reddy YS. Variability, heritability and genetic advance studies in some indigenous genotypes of basmati rice (*Oryza sativa* L.). Electronic Journal of Plant Breeding. 2015;6(2):506-511.
4. Allard RW. Principles of Plant Breeding. 1st ed. London, UK: John Wiley and Sons; c1960. p. 83-88.
5. Burton GW. Quantitative inheritance of grasses. In: Proceedings of 6th International Grassland Congress. 1952;1:277-283.
6. Dewey DR, Lu KH. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal. 1959;51:515-518.
7. Fageria NK, Carvalho MCS, dos Santos FC. Response of upland rice genotypes to nitrogen fertilization. Communications in Soil Science and Plant Analysis. 2014;45(15):2058–2066.
8. Islam MA, Raffi SA, Hossain MA, Hasan AK. Character association and path coefficient analysis of grain yield and yield related traits in some promising early to medium duration rice advanced lines. Int. J Expt. Agric. 2015;5(1):8-12.
9. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soyabeans. Agronomy Journal. 1955;47:314-318.
10. Kavitha S, Reddy SR. Variability, heritability and genetic advance of some importanttraits in rice (*Oryza sativa* L.). The Andhra Agriculture Journal. 2002;49(3-4):222-224.
11. Kumar S, Chauhan MP, Tomar A, Kasana RK. Coefficient of variation (GCV & PCV), heritability and genetic advance analysis for yield contributing characters in rice (*Oryza sativa* L.). Journal of Pharmacognosy and Phytochemistry. 2018;7(3):2161-2164.
12. Lalitha R, Mothilal A, Arunachalam P, Senthil N, Hemalatha G. Genetic variability, correlation and path analysis of grain yield, grain quality and its associated traits in EMS derived M4 generation mutants of rice (*Oryza sativa* L.). Electronic Journal of Plant Breeding. 2019;10(3):1140-1147.
13. Lenka D, Misra B. Path co-efficient analysis of yield in rice varieties. Ind J Agric Sci. 1973;43:376-379.
14. Muthuramu S, Ragavan T. Evaluation of Variability, Heritability and Genetic Diversity in Rainfed Rice Genotypes. Int. J Curr. Microbiol. App Sci. 2020;9(6):1167-1174.
15. Muthuramu S, Sakthivel S. Correlation and Path Analysis for Yield Traits in Upland Rice (*Oryza sativa*). Research Journal of Agricultural Sciences. 2016;7(4/5):763-765.
16. Nadarajan N, Manivannan N, Gunasekaran M. Quantitative genetics and Biometrical Techniques in Plant breeding, Kalyani Publishers, Ludhiana, India; c2016. p. 324. (ISBN: 9789327258271).
17. Panse VG. Genetics of quantitative characters in relation to plant breeding. Indian J Genet. 1957;17:318-328.
18. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 2nd Edition. ICAR, New Delhi, India; c1967. p. 381.
19. Shinde SR, Kumar K, Pawar RM. Genetic studies in upland rice (*Oryza sativa* L.). Int J Plant Sci. 2015;10(1):33-37.
20. Sivasubramanian S, Menon PM. Genotypic and phenotypic variability in rice. Madras Agric J. 1973;60(9-12):1093-96.
21. Vanisree S, Swapna K, Raju D, Raju S, Sreedhar M. Genetic variability and selection criteria in rice. J biological and scientific opinion. 2013;1(4):341-346.