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Character Association Analysis for Grain Iron and Zinc Concentrations and Grain Yield Components in Rice Genotypes

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ABSTRACT

The present study was undertaken with the objective to determine the degree of association between grain yield and its component characters along with grain iron and zinc content characters in rice genotypes. Thirty seven genotypes were evaluated for identifying their efficiency with respect to ten characters. The correlation studies revealed that strong positive significant association of grain yield with plant height, panicle length, no. of productive tillers per hill, no. of grains per panicle, no. of filled grains per panicle and 1000 grain weight. Grain iron content had strong positive significant association with grain zinc content.

Key words: *Zinc, Grain, Iron, Genotypes, Rice.*

INTRODUCTION

Micronutrients, including iron and zinc, are essential elements for a balanced human nutrition, required in small amounts. These two minerals are essential for human well-being and an adequate iron and zinc supply helps prevent, respectively, iron deficiency anemia and strengthen the immune system, which are two frequent problems in developing countries[2].

Rice is a staple food for millions of people and having great importance in food and nutritional security. Rice is the second most widely consumed in the world next to wheat. From poorest to richest person in this world consume rice in one or other form. In the last two decades, new research findings generated by the nutritionists have brought to light the importance of micronutrients, vitamins and proteins in maintaining good health, adequate growth and even acceptable levels of cognitive ability apart from the problem of protein energy malnutrition. Biofortification[19] is a genetic approach which aims at biological and genetic enrichment of food stuffs with vital nutrients (vitamins, minerals and proteins).

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Ideally, once rice is biofortified with vital nutrients, the farmer can grow indefinitely without any additional input to produce nutrient packed rice grains in a sustainable way. This is also the only feasible way of reaching the malnourished population in India. In this context breeders are now focusing on breeding for nutritional enhancement to overcome the problem of malnutrition.

To breed cultivars with good agronomic, nutritional, culinary, and commercial characteristics, the relationships between these traits must be known. The degree of association between two variables is given by the correlation, mathematically defined as the average product of deviations of two variables from their own means (Griffiths et al[10]). For breeding, the phenotypic, genetic and environmental correlations between two traits can be estimated. (falconer[5]).

The interpretation and quantification of the magnitude of a correlation can result in an erroneous selection strategy, since a correlation can be high due to the effect of other traits (Cruz et al.[4]). This study was undertaken at Jagtial, Telangana with an aim to analyze the relationships of grain iron and zinc concentrations with grain yield and other agronomic traits in rice genotypes.

MATERIALS AND METHODS

The experiment was conducted at RARS JAGTIAL, Telangana, India, during kharif 2013 season. The experimental material comprised of 37 rice genotypes. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The nursery was sown in raised beds and healthy nursery was raised at all the locations following uniform package of practices. Thirty days old seedlings were transplanted following a spacing of 20 x 15 cm with a row length of 4.5 m for each entry. The packages of practices as recommended by ANGRAU were adopted as per schedule throughout the crop growth period with need based plant protection measures. Fertilizers were applied at the rate of 120 kg Nitrogen, 60 kg Phosphorus and 40 kg potash ha^{-1}. Nitrogen was applied 3 times by broadcasting at transplanting; tillering stage and panicle initiation, phosphorous and potash were applied as basal at the time of transplanting by broadcasting method. Necessary precautions were taken to maintain the crop very well.

Data on days to 50% flowering (DFF), days to maturity (DM) recorded at respective stage of crop while, plant height (PH), panicle length (PL), productive tillers per plant (PT) were recorded at harvest and number of grains per panicle (GPP), test-weight (TW), grain iron content (Fe), grain zinc content (Zn) and grain yield per plant (GY) recorded after harvest. Estimation of iron and zinc Iron and zinc content of grain samples were estimated by Atomic Absorption Spectrophotometer [3]. One gram of seed was taken and powdered it in the grinder (non metallic grinder). Powdered seed sample was digested in tri-acids (HNO3+HCl4+H2SO4) mixture (10:4:1) in micro-oven digester. The digested sample was cooled for 30 minutes and the volume was made up to 50 ml with double distilled water. Then a known quantity of aliquot was used for subsequent analysis. A suitable blank was run simultaneously to account for the contamination from the reagents. Zinc and Iron content were estimated in the aliquot of seed extract by using Atomic Absorption Spectrophotometer (AAS) at 213.86 nm for zinc and 248.33 nm for iron. Correlation of individual characters on grain yield were estimated (table 1).

RESULTS AND DISCUSSION

Grain yield is a complex character and is dependent on its contributing traits. A study was envisaged on character association, to assess the relationships among yield and its components and to have an insight into the causes for higher yield in hybrids and varieties. Simple correlations were worked out on yield and yield contributing characters in 37 Genotypes (Table 1).

Days to 50 % flowering

Days to 50% flowering recorded significant negative association with grain yield per plant and with plant height had positive significant association, positive non-significant association with no. of grains per panicle, no. of filled grains per panicle, grain zinc content and panicle length. Non-significant negative association with productive tillers per hill, 1000 grain weight and grain iron content.

In the present study similar type of association were reported by Nandeshwar *et al*[16] for grain yield per plant, Yadhav *et al*[25] for kernel length, seed yield per plant, Badhru *et al*[1] for 1000 seed weight.

Plant height (cm)

Plant height recorded significant positive association with grain yield per plant, days to 50% flowering, panicle length, productive tillers per hill, no. of grains per panicle, no. of filled grains per panicle and 1000 grain weight and non significant association with grain zinc content. This trait had non-significant negative association with grain iron content.

The similar association with height reported by Nayak *et al*[17], Ravindra Babu *et al*,[24] Yadhav *et al*[25], Rajamadhan *et al*[23] for panicle length, Badhru *et al.*[1] for effective tillers per plant and 1000 seed weight, kernel length, breadth and seed yield per plant.

Panicle length (cm)

Panicle length had positive and significant association with grain yield per plant, plant height, no. of productive tillers per hill, no. of filled grains per panicle and no. of grains per panicle and positive non significant association with grain zinc content and days to 50% flowering. Panicle length had negative non significant with grain iron content.

Similar results were reported by Padmaja *et al*[20] and Ravindra Babu *et al*[24] for 1000 seed weight, Yadhav *et al*[25], Rajamadhan *et al*[23] and Bhadru *et al*[1] for seed yield per plant.

Number of productive tillers per plant

This trait exhibited positive and significant association with grain yield per plant, plant height, panicle length, no. of grains per panicle, no. of filled grains per panicle1000 grain weight and grain zinc content and days to 50% flowering had positive non significant association with this trait.

Panwar *et al.*[22], Pankaj Garge *et al*[21], Padmaja *et al*[20], Rajamadhan *et al*[23], Bhadru *et al*[1] and Ravindra Babu *et al*[24] also reported a strong association between productive tillers and grain yield per plant.

Total number of grains per panicle

This trait exhibited positive and significant association with grain yield per plant, plant height, panicle length, no. of grains per panicle, no. of filled grains per panicle, 1000 grain weight and grain zinc content. Days to 50% flowering had positive non significant association and grain iron content recorded negative non significant association with this trait.

Bhadru *et al*[1] reported positive significant correlation with 1000 seed weight, Yadhav *et al*[25] for 1000 seed weight and seed yield per plant and Nandeshwar *et al*[16], Ravindra Babu *et al*[24] for seed yield per plant as observed in the present study.

Number of filled grains per panicle

Filled grains per panicle is an important yield contributing factor especially in rice, as they are characterized by larger sink size. This trait recorded positive and significant association with grain yield per plant, plant height, panicle length, no. of grains per panicle, no. of filled grains per panicle, 1000 grain weight and grain zinc content and positive non significant association with days to 50% flowering. The trait, total number of filled grains per panicle recorded negative non significant association with grain iron content.

Earlier, Nandan *et al*[15] also observed positive association between filled grains per panicle and 1000 seed weight, Padmaja *et al*[20] for seed yield per plant, Panwar *et al.*[22] for seed yield per plant, 1000 seed weight reported same kind of association with filled grains per panicle.

1000 grain weight

1000 grain weight is an important yield contributing factor especially in rice, as they are characterized by larger sink size. This trait recorded positive and significant association with grain yield per plant, plant height, panicle length, no. of grains per panicle, no. of filled grains per panicle, 1000 grain weight and positive non significant association with grain zinc content. The trait, total number of filled grains per panicle recorded negative non significant association with grain iron content and days to 50% flowering.

Similar results were obtained by Padmaja *et al*[20] for 1000 seed weight, seed yield per plant.

Grain iron content
Grain iron content recorded non significant negative association with grain yield per plant, plant height, days to 50% flowering, panicle length, productive tillers per plant, no. of grains per panicle, total number of filled grains per panicle and 1000 grain weight. This trait had positive and significant association with grain zinc content.

Grain zinc iron content
This trait exhibited positive significant association with no. of grains per panicle, no. of filled grains per panicle and grain iron content and positive non significant with days to 50% flowering, plant height and panicle length,1000 grain weight and grain yield per plant as observed by Panwar *et al.*[22]

Similar results of significant positive correlation coefficient between grain iron and zinc concentrations was also obtained by Graham and Welch[9] in general, Kumar et al.[12] and Gayathri et al.[7] in sorghum, Nagesh et al.[14] in rice, Feng et al.[6]in wheat, Govindraj et al[8] in pearl millet, Chakraborthi et al.[3] in maize. Highly significant positive correlation between grain iron and zinc concentrations indicated the possibility of simultaneous improvement of both the traits. This might be due to co-segregation of tightly linked genetic stocks governing the physiology of these micronutrients or might be due to the pleiotropic effect of genes.

Seed yield/plant
The seed yield per plant had a significant positive association with the plant height, panicle length, effective tillers/plant, no. filled grains/panicle, 1000 seed weight, Positive association with grain zinc content. Negative non significant association with days to 50% flowering and grain iron content.

Similar kind of association with this trait was observed in finding of Rajamadhan *et al*[23], Bhadru *et al*[1] and Ravindra Babu *et al*[24] for number of productive tillers per plant, Pankaj Garge *et al*[21], Padmaja *et al*[20] for number of filled grains per panicle and Yadav *et al* [25] for 1000 seed weight. Hence, these characters could be considered as criteria for selection for higher yield as they were mostly inter related positively in addition to a positive association with grain yield.

Table 1: Phenotypic correlation co-efficient for the grain iron, zinc content and other yield attributes in rice genotypes

Character	Days to 50%flowering	Plant height	panicle length	Productive tillers per hill	No. of grains per panicle	No. filled grains per panicle	1000 grain weight	Grain iron content	Grain zinc content
Days to 50%flowering	1.00	0.2112*	0.0802	-0.0770	0.0482	0.0831	-0.1313	-0.0236	0.0364
Plant height		1	0.7158	0.3077**	0.3256**	0.3167**	0.3784**	-0.1677	0.1639
Panicle length			1	0.2140*	0.2379*	0.2869**	0.3166**	-0.1820	0.0012
Productive tillers per hill				1	0.9174**	0.9137**	0.9623**	-0.0784	0.2080*
No. of grains per panicle					1	0.9217**	0.8883**	-0.1037	0.2605**
No. of filled grains per panicle						1	0.8743**	-0.0630	0.2534**
1000 grain weight							1	-0.1631	0.1583
Grain iron content								1	0.3798**
Grain zinc content									1
Grain yield per plant	-0.0280	0.2601**	0.2619**	0.8277**	0.7987**	0.8003**	0.7824**	-0.0914	0.2430

REFERENCES

1. Bhadru D, Tirumala Rao V, Chandra Mohan Y, Bharathi D Genetic variability and diversity studies in yield and its component traits in rice (Oryza sativa L.). SABRAO J. *Breed. Gen.* **44 (1)**: 129-137. (2012).
2. Blair MW, Austudillo C, Grusak MA, Graham R and Beebe SE Inheritance of seed iron concentrations in common bean (*Phaseolus vulgaris* L.). *Molecular Breeding* **23**: 197-207. (2009).
3. Chakraborthi, M., Prasanna, B.M., Hossain, F and Anju M.S. Evaluation of single cross Quality Protein Maize (QPM) hybrids for kernel iron and zinc concentrations. *Indian Journal of Genetics and Plant Breeding*. **71 (4):** 312-319 (2011).
4. Cruz CD, Regazzi AJ and Carneiro PCS Modelos biométricos aplicados ao melhoramento genético. Editora UFV, Viçosa, 390p (2004).
5. Falconer, D.C. An introduction to quantitative genetics. Longman, New York. 67-68 (1981).
6. Feng, X.Y., Xing, X.H and Guo, A.D. Identification of germplasm with enriched micronutrients of wild emmer and progeny of wild emmer × common wheat. *Chinese Journal of Eco-Agriculture.* **19 (5):** 1205-1209 (2011).
7. Gayathri, S.P.V.L., Radhika, K., Kumar, A.A and Janila, P. Association of grain iron and zinc content with grain yield and other traits in sorghum (Sorghum bicolour L. Moench). *The Journal of Research, ANGRAU*. **40 (3):** 105-107 (2012).
8. Govindaraj, M., Rai, K.N., Shanmugasundaram, P., Dwivedi, S.L., Sharawat, K.L., Muthaiah, A.R and Rao, A.S. Combining ability and heterosis for grain iron and zinc densities in pearl millet. *Crop Science***. 53:** 507-517 (2013).
9. Graham, R.D and Welch, R.M. Breeding for staple food crops with high micronutrient density. Agricultural strategies for micronutrients. Working paper 3. International Food Policy Research Institute, Washington, D.C., USA. (1996).
10. Griffiths AJF, Gelbart WM, Miller JH and Lewontin RC Genética Moderna. Guanabara Koogan, *Rio de Janeiro*, 589p. (2001)
11. Gupta, S.K., Velu, G., Rai, K.N and Sumalini, K. Association of grain iron and zinc content with grain yield and other traits in pearl millet (Pennisetum glaucum (L.) R. Br.). Crop Improvement. **36 (2):** 4-7 (2009).
12. Kumar, A.A., Reddy, B.V.S., Sahrawat, K.L and Ramaiah, B. Combating micronutrient malformation: Identification of commercial sorghum cultivars with high grain iron and zinc. *SAT e Journal*. **8:** 1-5 (2010).
13. Madhavilatha L, Reddi Sekhar M, Suneetha Y, Srinivas T Genetic variability, correlation and path analysis for yield and quality traits in rice (Oryza sativa L.). Res Crops **6(3)**:527-534. (2005).
14. Nagesh, Ravindrababu,V. Usharani, G and Reddy, T.D. Grain iron and zinc association studies in rice (*Oryza sativa* L.) F1 progenies. *Archives of Applied Science Research*. **4 (1):** 696-702. (2012).
15. Nandan, R., Sweta and Singh, S.KCharacter association and analysis in rice(Oryza sativa L.) genotypes. *World J. Agric. Sci.*, **6(2):** 201-206. (2010).
16. Nandeshwar, B.C., Pal, S.,Senapati, B.K. and De, D. KGenetic variability and character association among biometrical traits in F2 generation of some rice crosses. Electronic *J. Pl. Breed.***1:** 758-763 (2010).
17. Nayak A. R. Genetic variability and correlation study in segregating generation of two crosses in scented rice. *Agric. Sci. Digest* **28**: 280–282 (2008).
18. Nayak, A. R., Chaudhary, D and Reddy, J. N. Correlation and path analysis in scented rice (Oryza sativa L). *Indian Journal of Agricultural Research***.** **35(3):** 186-189. (2001).

19. Nestel, P., Bouis, H.E., Meenakshi, J.V and Pfeiffer, W. Biofortification of staple food crops. *The Journal of Nutrition.* **136:** 1064-1067 (2006).
20. Padmaja, D., Radhika, K., Subba Rao, L.V and Padma, V. Correlation and path analysis in rice germplasm. *Oryza*.**48 (1):** 69-72 (2011)
21. Pankaj Garg., Pandey, D.P. and Dhirendra singh. Correlation and Path Analysis for Yield and its Components in Rice (Oryza sativa L.). *Crop Improvement.* **37 (1):** 46-51 (2010).
22. Panwar, A., Dhaka, R. P. S. and Vinod Kumar. Path analysis of grain yield in rice. *Adv. Plant Sci.,* **20:** 27-28 (2007).
23. Rajamadhan R, Eswaran R, Anandan. A investigation of correlation between traits and path analysis of rice (*Oryza sativa* L.) grain yield under coastal salinity. *Electronic Journal of Plant Breeding,* **2(4):** 538-542 (2011).
24. Ravindra Babu V, Shreya K, Kuldeep Singh Dangi, Usharani G, Siva Shankar A Correlation and Path Analysis Studies in 171 Popular Rice Hybrids of India. *Int. J. of Sci. and Res. Publ.* **2(3):** 1-5 (2012).
25. Yadav, S.K, Pandey, P., Kumar, B., Suresh, B.G., Genetic architecture, inter-relationship and selection criteria for yield improvement in rice. *Pak J Biol Sci*.; **14(9):** 540-545 (2011).