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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 hadstrong positive significant association with grain zinc content.
keywords: Zn, Fe, Rice genotype

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 (Blair *et al*. 2009).

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 is a genetic approach which aims at biological and genetic enrichment of food stuffs with vital nutrients (vitamins, minerals and proteins). 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. 2001). For breeding, the phenotypic, genetic and environmental correlations between two traits can be estimated. (Falconer, 1981).

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. 2004). 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 2012 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 37Genotypes (Table 1).
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 byNandeshwar*et al.(*2010) for grain yield per plant*,* Yadhav*et al.*(2012) for kernel length, seed yield per plant, Badhru*et al.*(2012) for 1000 seed weight.
2 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.*(2004), Garge *et al.*(2010), Ravindra Babu*et al.*(2012), Yadhav*et al.*(2010), Rajamadhan*et al.*(2011) for panicle length, Badhru*et al.*(2012) for effective tillers per plant and 1000 seed weight, kernel length, breadth and seed yield per plant.
3 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.* (2011) and Ravindra Babu*et al.*(2012) for 1000 seed weight, Yadav*et al.*(2010), Rajamadhan*et al.*(2011) and Bhadru *et al.*(2012) for seed yield per plant.
4   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.*(2007), Pankaj Garge *et al.*(2010) Padmaja *et al.*(2011), Rajamadhan *et al.*(2011), Bhadru *et al.*(2012) and RavindraBabu*et al.*(2012) also reported a strong association between productive tillers and grain yield per plant.

Table1. 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

*Significant at 5% probability level
**significant at 1% probability level

5   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.*(2012) reported positive significant correlation with 1000 seed weight, Yadhav*et al.*(2010) for 1000 seed weight and seed yield per plant and Nandeshwar *et al.*(2010), Ravindrababu*et al.*(2012) for seed yield per plant as observed in the present study.

6. 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 positiveand 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.* (2010) also observed positive   association between filled grains per panicle and 1000 seed weight, Padmaja*et al.* (2011) for seed yield per plant, Pankaj Garge *et al.* (2010) for seed yield per plant, 1000 seed weight reported same kind of association with filled grains per panicle.

7. 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*. (2011) for 1000 seed weight, seed yield per plant.

8.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 andsignificant association with grain zinc content.

9.Grain zinc iron content

This trait exhibited positive significant association with no.of grains per panicle,no.of filled grainsper 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 PankajGarge*et al.* (2010).

Similar results of significant positive correlation coefficient between grain iron and zinc concentrations was also obtained by Graham and Welch (1996) in general, Kumar et al. (2010) and Gayathri et al. (2012) in sorghum, Nagesh et al. (2012) in rice, Feng et al. (2011) in wheat, Govindraj et al. (2013) in pearl millet, Chakraborthi et al. (2011) 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.

10. 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 on 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.*(2011), Bhadru*et al.* (2012) and RavindraBabu*et al.*(2012) for number of productive tillers per plant, PankajGarge*et al.*(2010), Padmaja*et al.*(2011), for number of filled grains per panicle and Yadav*et al.* (2010) 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.

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