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Path Coefficient Analysis for Grain Iron and Zinc contents and others traits in Rice Genotypes

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ABSTRACT
The objective of this study was to estimate the direct and indirect effects of iron and zinc contents and agronomic traits on grain yield in 37rice genotypes. Correlations between traits were estimated and decomposed into direct and indirect effects using path analysis. Path coefficient analysis revealed that number of effective tillers per plant exerted highest positive direct effect on grain yield followed by no.of filled grains per panicle, no.of grains per panicle,1000grain weight,panicle length,plant height and grain zinc content. The negative direct effect was noticed on grain yield by days to 50% flowering and grain content.
***Keywords**: Biofortification, correlation, grain iron, grain zinc, path analysis.*

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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. Biofortificationis 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. The most important of these is the genetic correlation, which may be due to pleiotropy or genetic linkage (Falconer and Mackay 1996). If the genetic correlations cannot be estimated, the estimates of the path coefficients derived from phenotypic correlations are also quite informative.

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). In this context, path analysis is one of the methods to explain the causes involved in inter-trait relations, partitioning the correlation in direct and indirect effects of explanatory variables on a principal variable (Kurek et al. 2001).The aim of this study was to estimate the direct and indirect effects of agronomic traits on the iron and zinc levels in grains of ricegenotypes through path analysis.

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. The direct and indirect effects of individual characters on grain yield were estimated(table.1)

RESULTS AND DISCUSSION

Path coefficient analysis allows separation of the direct effect and their indirect effects through other attributes by partitioning the correlations (Wright, 1921). Hence, the path coefficient analysis (dewey and lu,) was done to know the direct and indirect effects of yield components on yield. This Path analysis helps us to know the stable associations among the traits for use in future selections by plant breeders. The characters *viz.,* days to 50% flowering, plant height, panicle length, no.of productive tillers per hill, no.of grain per panicle, no. of filled grains per panicle, 1000 grain weight, grain iron content and grain zinc content were included estimation of correlation.

1 Days to 50 % flowering

Days to 50 percent flowering showed negative effect but low direct effects on grain yield per plant. It had indirect positive effects on yield through panicle length, no. of grains per panicle, 1000 grain weight , Grain Iron content and Grain Zinc content and negative indirect effect shown by plant height and no. of productive tillers per hill. By and large, days to 50% flowering had very little impact on yield and yield components in the material studied.
The direct negative effect of days to 50 per cent flowering on grain yield per plant was reported by Yadav*et al.* (2010), PankajGarge*et al*. (2010), Rajamadhan*et al*. (2011) and RavindraBabu*et al*. (2012), Yadav*et al*.(2012) and Panday (2012).

2. Plant height (cm)

Plant height had positive direct effect on grain yield per plant. It has positive indirect effect *via* all characters except days to 50% flowering and 1000 grain weight. Similar results were reported by PankajGarge*et al.*(2010), Nandan*et al.*(2010), Yadav*et al.* (2010), Padmaja*et al.* (2011) and MulugetaSeyoum*et al*. (2012), Pandey*et al*.(2012) and Yadav*et al*.(2012).

3. Panicle length (cm)

Panicle length has direct positive effect on grain yield per plant. Positive Indirect effect for yield contribution was mainly through all characters except day to 50% flowering, plant height and 1000 grain weight. It's indirect through other characters, both negatively and positively was also neglisable. Results reported by Sathish Chandra *et al*.((2009), Nandan*et al*.(2010), Abdul Fiyaz*et al*.(2011) and Padmaja*et al.* (2011) were in agreement with the results obtained..

4. Number of productive tillers per plant

The direct contribution of this character to grain yield was positive and very high in addition to its significant association with grain yield per plant, which indicated productive tillers played significant role in hybrids productivity. All characters has indirect positive effect except plant height and grain weight.
The indirect effects through other characters were found to be very low. PankajGarge*et al*.(2010), Basavaraja*et al.*(2011), Abdul AbdulFiyaz*et al.*(2011), Padmaja*et al.*(2011), Babu*et al.*(2012), Pandey*et al.*(2012), Yadav*et al.*(2012) and Bhadru*et al.*(2012) reported a high positive direct effect of number of productive tillers per plant on grain yield per plant as was observed in the present investigation.

5. Number of grains per panicle

This trait had positive direct effect on seed yield per plant was observed. Its contribution to yield was attributed to positive indirect effect through all characters except days to 50% flowering, 1000 grain weight and plant height as was reported by Yadav*et al.* (2010).

6. Number of filled grains per panicle

Number of filled grains per panicle had direct positive influence on grain yield was reported by Sathish Chandra *et al.*(2009), Nandeshwar*et al.*(2010), Pandey*et al.*(2012), Yadav*et al.*(2012) and Bhadru*et al.*(2012). While it had indirect negative influence through days to 50% flowering, 1000 grain weight and plant height and remaining traits contributes indirect positive effect.

7. 1000–grain weight (g)

The yield component, 1000-grain weight exhibited the direct positive effect on grain yield per plant. However, it revealed indirect positive influence through all characters except 1000 grain weight and plant height.
The results reported by Panwar*et al.*(2007), sathish Chandra *et al.*(2009),Nandeshwar*et al.*(2010), Bhadru*et al.*(2012) also indicated that 1000 seed weight plays greater role for higher grain yield per plant. This component had very high impact on seed yield per plant, which is evident from highly significant correlation coefficients followed by direct effects at all the locations.

8.Grain iron content

Grain iron content had direct negative influence on grain yield.The similar results were reported by nagesh*et al*(2012)and Rajamadhan*et al.*(2011).
While it had indirect positive influence through plant height, grain zinc content, days to 50% flowering and 1000 grain weight. Indirect negative through panicle length,no.of productive tillers,no. of filled grains per panicle and no of grains per panicle.

9.Grain zinc content

Grainzinc content had direct positive influence on grain yield at all The similar results were reported by nagesh*et al* (2012)and Rajamadhan*et al.*(2011).
While it had indirect negative influence through plant height, grain iron content, days to 50% flowering and 1000 grain weight. Indirect positivethrough panicle length,no.of productive tillers,no.of filled grains per panicle and no. of grains per panicle.
Path coefficient analysis revealed that number of effective tillers per plant exerted highest positive direct effect on grain yield followed by no.of filled grains per panicle, no.of grains per panicle,1000grain weight,panicle length,plant height and grain zinc content. The negative direct effect was noticed on grain yield by days to 50% flowering and grain content. The results were in conformity with PankajGarge*et al.*(2010), Rajamadhan*et al.*(2011) RavindraBabu*et al.* (2012), Pandey*et al.*(2012) for days to 50% flowering, RavindraBabu*et al.* (2012), Bhadru*et al.*(2012), Pandey*et al.* (2012) plant height, number of productive tillers per plant and panicle length, Yadav*et al.*(2012), Bhadru*et al.*(2012) for number of filled grains per panicle.

Table.1.Phenotypical path coefficients for grain iron and zinc content and other yield traits

character	Days to 50% flowering	Plant height	Panicle length	tillers	No. of grains per panicle	No. of filled grains per panicle	1000 Grain weight	Grain iron content	Grain zinc content
Days to 50%flowering	-0.0122	-0.0026	-0.0010	- 0.0009	-0.0006	-0.0010	0.0016	0.0003	-0.004
Plant height	-0.0290	-0.1371	-0.0981	0.042	-0.0446	-0.0434	-0.0519	0.0230	-0.002
Panicle length	0.0166	0.1484	.2073	0.044	0.0493	0.0595	0.6656	-0.0377	.0002
tillers	-0.075	0.3019	0.2100	0.982	0.9001	0.8964	0.9441	-0.0769	0.2041
No. of grains per panicle	0.007	.0519	.0379	0.1461	0.1593	0.1460	0.1415	-0.0165	0.415
No. of filled grains per panicle	0.0056	.0212	0.0192	0.0610	0.0616	0.00668	0.0584	-0.0042	0.0169

1000 Grain weight	0.053	-0.1537	-0.1288	- 0.3909	-0.3608	-0.3551	-0.4062	0.0662	-0.0643
Grain iron content	0.0020	0.0139	0.0151	0.0065	.0086	0.0052	0.013	-0.0831	-0.0316
Grain zinc content	0.0036	.0162	0.001	0.0206	0.0258	0.0251	0.0157	0.0376	0.0990
Grain yield per plant	-0.028	0.2601	0.260	0.8277	0.7987	0.8003	0.7824	-0.0914	0.2430

Residual effect =0.5238

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