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Grain Zinc and Iron Association Studies in Swarna X Type 3 RIL Population of Rice

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A B S T R A C T

The present study was undertaken with the objective to determine the degree of association between yield, yield attributing traits and grain Zinc and Iron concentration in Swarna x Type 3 RIL population of rice. 100 RIL population were evaluated for identifying their efficiency with respect to ten characters. The correlation studies revealed that grain yield per plant showed strong positive significant association with plant height and 1000-seed weight. Positive non- significant association of grain yield per plant was observed with days to 50 per cent flowering, panicle length, number of filled grains per panicle and significant negative correlation was observed for grain iron and zinc concentration.

Introduction

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 cereal 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.

The range of iron and zinc concentration in brown rice is 6.3-24.4 µg/g and 13.5-28.4 µg/g respectively. There is approximately a fourfold difference in iron and zinc concentration, suggesting some genetic potential to increase the concentration of these micronutrients in rice grains.

A scarce scientific literature is available on the association between grain iron and zinc content with grain yield. The present research was taken up to study the association of grain iron and zinc with grain yield.

Materials and Methods

The experiment was conducted at Indian Institute of Rice Research Farm, Ramachandrapuram, Hyderabad, India, during *kharif*, 2017. The experimental material comprised of 100 RILs of F_7 population derived from Swarna and Type 3 along with four checks (Swarna, Type 3, BPT 5204, Chittimutyalu) laid out in Augmented Block Design. All the recommended package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop.

Five representative plants for each population were randomly selected to record observations on the quantitative characters under study. Data on days to 50% flowering (DFF) recorded at flowering stage while, plant height (PH), panicle length (PL), number of productive tillers per plant (NPT) were recorded at harvest and panicle weight, number of filled grains per panicle (FGP), test-weight (TW), grain iron content (Fe), grain zinc content (Zn) and grain yield per plant (GY) were recorded after harvest. Grain Iron and Zinc content were estimated by following recommended standard procedure i.e., X – Ray fluorescence Spectrometry (XRF).

Statistical analysis

Simple correlation coefficients were calculated for grain yield and its components using the formulae given by Webber and Moorthy (1952).

Results and Discussion

Grain yield is a complex character and is dependent on its contributing traits. The 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 100 RIL population of rice (Table 1).

Days to 50 % flowering

The character days to 50 per cent flowering recorded a non-significant positive correlation with grain yield per plant (0.0807), test weight (0.1433), panicle weight (0.1232), number of filled grains per panicle (0.0690). It showed negative and significant correlation with plant height (-0.2523**) and non–significant negative correlation for panicle length (-0.0135), number of productive tillers per plant (-0.0674) and grain iron concentration (-0.0597) and grain zinc concentration (-0.1333). The Similar findings were recorded by Nandan *et al.,* (2010), Sarker *et al.,* (2014) for number of filled grains per panicle, Rao *et al.,* (2014) for 1000 seed weight, Madhavilatha *et al.,* (2005), Chandra *et al.,* (2009), Nandan *et al.,* (2010), Rao *et al.,* (2014) for single plant yield, Rao *et al.,* (2014) for panicle length and Ajmera *et al.,* (2017) for grain iron and zinc concentration.

Plant height (cm)

The trait plant height shown a significant positive correlation with single plant yield (0.2150*).

It had positive non-significant correlation with plant height (0.1145), number of productive tillers per plant (0.0901), panicle weight (0.0103), test weight (0.0233), negative significant correlation with grain iron concentration (-0.2269*), grain zinc concentration (-0.1885*), days to 50 % flowering (-0.2523**) and negative non-significant correlation with number of filled grains per panicle (-0.0247).

The results are in accordance with Rao *et al.,* (2014) for number of productive tillers per plant, Nandan *et al.,* (2010) for number of filled grains per panicle Sala and Geetha (2015) for panicle length, Dhurai *et al.,* (2016) for 1000 seed weight, Rajendra Prasad *et al.,* (2017) for panicle weight. Sala and Geetha (2015) for grain iron concentration, Nagesh *et al.,* (2012) for grain zinc concentration Reddy *et al.,* (2013), Patel *et al.,* (2014), Biswash *et al.,* (2015), Thippeswamy *et al.,* (2016) and Priya *et al.,* (2017) for single plant yield.

Panicle length (cm)

Panicle length registered non-significant positive correlation with plant height (0.1145), number of filled grains per panicle (0.0153), grain yield per plant (0.0306) and non-significant negative correlation with days to 50 % flowering (-0.0135), 1000 grain weight (-0.0399), number of productive tillers per plant (-0.0059), panicle weight, (-0.0874) grain zinc concentration (-0.1104) and grain iron concentration (0.0973).

Similar results were reported by Rao *et al.,* (2014) for days to 50 % flowering, Sala and Geetha (2015) for plant height, Rahman *et al.,* (2014) for number of filled grains per panicle, Ajmera *et al.,* (2017) for grain iron concentration, Nagesh *et al.,* (2012) for grain zinc concentration Dhurai *et al.,* (2016) for 1000 seed weight and number of productive tillers per plant, Madhavilatha *et al.,* (2005), Seyoum *et al.,* (2012) for single plant yield.

Panicle weight

Panicle weight exhibited significant positive correlation with 1000 grain weight (0.2880**), non-significant positive correlation with days to 50% flowering (0.1232), plant height (0.1034), single plant yield (0.1099), non-significant negative correlation with plant height (-0.0874), number of productive tillers per plant (-0.0282), filled grains per panicle (-0.0229), grain iron concentration (-0.0909) and grain zinc concentration (-0.0183). Prasad *et al.,* (2017) also reported similar results for 1000 seed weight and plant height.

Number of productive tillers per plant

Number of productive tillers per plant exhibited non-significant positive correlation with plant height (0.0901), grain yield per plant (0.0378).

It had negative non-significant correlation with days to 50% flowering (-0.0674), panicle length (-0.0059), number of filled grains per panicle (-0.0551), panicle weight (-0.0282), test weight (-0.0406), grain Iron concentration (-0.0578) and grain Zinc concentration (-0.0705).

The results were in conformity with Rao *et al.,* (2014) for plant height, Dhurai *et al.,* (2016) for panicle length, Seyoum *et al.,* (2012), Nikhil *et al.,* (2014), Rahman *et al.,* (2014) for single plant yield, Rao *et al.,* (2014) for 1000 seed weight and Nagesh *et al.,* (2012) for grain iron concentration.

Table.1 Phenotypic correlation co-efficient for yield and yield attributes in RIL population of rice

	DFF	PH	PL	NT	PW	FGP	TW	Fe	Zn	SPY
DFF	1.000	-0.2523**	-0.0135	-0.0674	0.12325	0.0690	0.1433	-0.0597	-0.1333	0.0807
PH		1.000	0.1145	0.0901	0.10340	-0.0247	0.0233	-0.2269*	-0.1885*	0.2150*
PL			1.0000	-0.0059	-0.08740	0.0153	-0.0399	-0.0007	-0.1104	0.0306
NT				1.0000	-0.02825	-0.0551	-0.0406	-0.0578	-0.0705	0.0378
PW					1.0000	-0.0229	0.2888**	-0.0909	-0.0183	0.1099
FGP						1.000	0.0203	-0.1966*	-0.0803	0.1027
TW							1.000	-0.1286	-0.0414	0.3937**
Fe								1.000	0.6691**	-0.4059**
Zn									1.000	-0.4243**
SPY										1.000

*Significant at 5% probability level
**Significant at 1% probability level
DFF = Days to 50% flowering
PH = Plant height (cm)
PL = Panicle length
NT = Number of tillers plant^{-1}
PW = Panicle weight (g)
FGP = Filled grains per panicle
SPY = Single plant yield (g)
TW = Test weight (g)
Fe = Iron
Zn = Zinc

Number of filled grains per panicle

Number of filled grains per panicle exhibited a non-significant positive correlation with days to 50 % flowering (0.0690), panicle length (0.0153), grain yield per plant (0.1027) and 1000 seed weight (0.0203) whereas significant negative correlation with grain iron concentration (-0.1966*) and non-significant negative correlation with plant height (-0.0247), number of productive tillers per plant (-0.0551), grain zinc concentration (-0.0803) and panicle weight (-0.0229).

Similar findings were reported by Nandan *et al.,* (2010), Sarker *et al.,* (2014) for days to 50 % flowering, Nandan *et al.,* (2010) for plant height, Rahman *et al.,* (2014) for panicle length, Biswash *et al.,* (2015), Thippeswamy *et al.,* (2016), Lakshmi *et al.,* (2017) for 1000 seed weight, Rahman *et al.,* (2014), Rashid *et al.,* (2014) for single plant yield, Nagesh *et al.,* (2012) for grain zinc concentration.

1000 grain weight

Thousand grain weight showed highly significant positive correlation with panicle weight (0.2888**), grain yield per plant (0.3937**) and non-significant negative correlation with panicle length (-0.0399), number of productive tillers per plant (-0.0406), grain iron concentration (-0.1288) and grain zinc concentration (-0.0414) and positive non-significant correlation with days to 50% flowering (0.1433), plant height (0.0233), number of filled grains per panicle (0.0203). Basavaraja *et al.,* (2011), Chakraborty and Chaturvedi (2014), Naseem *et al.,* (2014), Patel *et al.,* (2014), Rahman *et al.,* (2014), Rao *et al.,* (2014), Rashid *et al.,* (2014), Anil kumar *et al.,* (2015), Ashok *et al.,* (2016), Kalyan *et al.,* (2017), Lakshmi *et al.,* (2017), Priya *et al.,* (2017) for grain yield per plant and Nagesh *et al.,* (2013) for grain zinc and iron concentrations reported similar results

Grain zinc concentration

Grain zinc concentration showed a negative significant correlation with grain yield per plant (-0.4243**), and positive significant correlation with grain iron content (0.6691**). The results were in accordance with Nagesh *et al.,* (2013) for grain yield per plant and Gangashetty *et al.,* (2013) and Nagesh *et al.,* (2013) for grain iron concentration.

Grain iron concentration

Grain Iron concentration showed a negative significant correlation with grain yield per plant (-0.4059**), significant positive correlation with grain zinc concentration (0.6691**). Similar findings were reported by Nagesh *et al.,* (2013) for grain yield per plant and Gangashetty *et al.,* (2013) and Nagesh *et al.,* (2013) for grain iron concentration.

Grain yield per plant

Grain yield per plant had significant positive association with plant height (0.21500*), 1000 seed weight (0.3937**). The trait recorded a non- significant positive association with days to 50 per cent flowering (0.0807), panicle length (0.0306), number of productive tillers per plant (0.0378), panicle weight (0.1099), number of filled grains per panicle (0.1027) and showed significant negative correlation with grain iron concentration (-0.4059**) and grain zinc concentration (-0.4243**).

Similar kind of association was revealed by Madhavilatha *et al.,* (2005), Rao *et al.,* (2014) for days to 50% flowering, Patel *et al.,* (2014), Biswash *et al.,* (2015), Thippeswamy *et al.,* (2016), Priya *et al.,* (2017) for plant height, Seyoum *et al.,* (2012), Rahman *et al.,* (2014) for number of productive tillers per plant, Madhavilatha *et al.,* (2005), Seyoum *et al.,* (2012) for panicle length, Rahman *et al.,* (2004) for number of filled grains per panicle, Patel *et al.,* (2014), Anil Kumar *et al.,* (2015), Ashok *et al.,* (2016), Lakshmi *et al.,* (2017) and Priya *et al.,* (2017) for 1000 seed weight, Sala and Geetha (2015) for grain iron concentration.

The present study has revealed that grain yield had strong positive significant association with plant height and 1000-seed weight. Grain iron content and zinc content had no correlation with grain yield. Simultaneous selection / breeding can be taken up to enhance grain iron and zinc and grain yield because of absence of correlation.

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