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Correlation studies for micronutrients, yield and yield components in F3 population of rice (*Oryza Sativa L.)*

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Abstract: The experimental material comprised two F_3 families one derived from Swarna x Ranbir basmati cross and another from Swarna X BR 2655. These two segregating populations were used as experimental material in present study for estimating grain iron and zinc content during *kharif,* 2012 and 2013 .Correlation studies indicated highly significant and positive correlation of grain yield with number of panicle per plant, panicle weight, test weight, grain breadth, and L/B ratio. Among micronutrients significant positive correlations were observed between iron and zinc content among themselves.

Key words : Rice, Yield, Correlation, XRF, Iron, Zinc

Introduction

Rice is a key food for human nutrition because it supplies starch, protein, and the majority of micronutrients to humans, particularly in Asia (Donald, 2002). Today, over three billion people are afflicted with micronutrient malnutrition and the numbers are increasing (WHO, 1999; World Bank, 1994). Nearly two-thirds of all deaths of children are associated with nutritional deficiencies, many from micronutrients deficiencies, especially of iron and zinc, is a global problem that affects more than one third of the world population in developing as well as in industrialized countries. (Caballero, 2002). Marginal intakes of micronutrients have been shown to contribute to increased morbidity and mortality rates, diminished livelihoods, and adverse effects on learning ability, development, and growth in infants and children (Caballero, 2002). Much of childhood stunting has been attributed to the impact of micronutrient deficiencies on children from early foetal stages of development through the fourth year of life (Branca and Ferrari, 2002). By any measure, micronutrient malnutrition is currently of alarming proportions in many developing nations (WHO, 2002). Selection of promising genotypes, in a breeding pro-gram, is based on various criteria, most importantly final crop yield and its quality. Relation-ships between yield and yield contributing traits also play an important role in plant breeding (Kozak *et al.,* 2008). A positive genetic correlation between two desirable traits makes the job of the plant breeder easy for improving both traits simultaneously. Even the lack of correlation is useful for the joint improvement of the two traits. On the other hand, a negative correlation between two desirable traits impedes or makes it impossible to achieve a significant improvement in both traits. 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 association among micronutrient, grain yield and its component characters.

Materials and Methods

The experimental material comprised two F_3 families one derived from Swarna x Ranbir basmati cross and another from Swarna X BR 2655. Cross 1(Swarna x Ranbir basmati) comprising 214 F_3 families where in one of the parent Swarna is a popular high yielding semi dwarf variety derived from cross between Vasistha x Mahsuri having low iron and zinc content (2.93 mg 100 g^{-1} and 2.28mg 100 g^{-1} respectively).While, Ranbir basmati possess high iron and zinc content of 4 mg/100 g and 5 mg/100 g respectively and is a selection from Basmati 370. Cross 2 (Swarna X BR 2655) comprising 234 F_3 families in which the male parent BR-2655 is high in iron and zinc content (3.50 mg 100 g^{-1} and 3.02 mg 100 g^{-1} respectively) in brown rice with parentage of (BR 10 x BR 4) x (BR7 x Palghar 84-3). In both the crosses Swarna is used as female parent. These two segregating populations were used as experimental material in present study for estimating grain iron and zinc content during *kharif,* 2012 and 2013, at Agricultural Research Station (Paddy) Sirsi. The experiment was laid out in Randomized Block Design with two replications and all the entries were allotted randomly using random number table. Sowing was carried out on 1st July, 2013 in individual row for F_2-01-214 derived F_3 families and another F_2-02-234 derived F_3 family. Observations were recorded in randomly selected five plants per family in each replication. The yield and yield components traits and grain quality characters were recorded in both the crosses (Swarna x Ranbir basmati) and (Swarna x BR-2655). The averages of the observations recorded on these five plants were considered for analysis. The iron and zinc contents of seed samples were estimated by X-ray fluorescence (XRF) spectrometry at M S Swaminathan Research Foundation, Chennai. The analysis was done as per Panse and Sukhatme (1985), Burton and De Vane (1953) and Johnson *et al.* (1955).

Results and Discussion

Association between grain yield per plant and its component characters:

Cross 1: Swarna x Ranbir basmati : The correlation between all the pairs of variable at both locations is shown in the Table 1 to 4. Highly significant and positive correlation was observed for panicle length (0.378G, 0.295P), panicle weight (0.124G, 0.115P), grain breadth (0.224G, 0.182P) and L/B ratio (0.090 G.104 P). This suggests that these characters should be considered while selecting plants for grain yield improvement. These results are in corroboration with Augustina *et al.* (2013) for panicle weight: Nagesh *et al.* (2012) for grain breadth: Kiani and Nematzadeh (2012) for panicle length. Positive non significant correlation was observed for number of panicle per plant (0.092G, 0.092P), number of grains per panicle (0.072G, 0.080P), test weight (0.056G, 0.054P), and grain length (0.079G, 0.009P). Thus, grain yield could be improved considerably through selecting its components characters like plant height, number

Table-1: Genotypic correlation coefficients among yield, yield attributing traits in two hundred fourteen F_3 families in Cross 1 (Swarna x Ranbir basmati)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
X_1	1.000	1.005	-0.023	0.016	0.130**	-0.043	0.066	-0.019	-0.120*	0.029	0.101*	0.145**	-0.082	-0.003
X_2		1.000	-0.025	0.017	0.130**	-0.032	0.064	-0.027	-0.119*	0.016	0.098*	0.130**	-0.095*	-0.009
X_3			1.000	0.272**	-0.102*	-0.062	0.085	0.101*	0.096*	0.118*	0.015	-0.026	-0.010	-0.014
X_4				1.000	-0.098*	0.335**	0.096*	-0.047	0.139**	0.023	0.114*	-0.205**	-0.205**	0.378**
X_5					1.000	-0.244**	-0.211**	0.027	-0.040	0.168**	0.188**	-0.056	-0.022	0.092
X_6						1.000	0.127**	-0.155**	0.004	-0.198**	-0.072	-0.132**	-0.131**	0.124**
X_7							1.000	-0.197**	0.028	-0.141**	-0.106*	0.004	-0.112*	0.072
X_8								1.000	0.296**	0.405**	0.065	-0.063	0.257**	0.057
X_9									1.000	0.200**	-0.323**	-0.310**	-0.158**	0.224**
X_{10}										1.000	0.735**	0.014	0.254**	0.079
X_{11}											1.000	0.107*	0.041	0.090
X_{12}												1.000	0.497**	-0.173**
X_{13}													1.000	-0.172**
X_{14}														1.000

Table-2: Phenotypic correlation coefficients among yield, yield attributing traits in two hundred fourteen F_3 families (Cross 1 Swarna x Ranbir basmati)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
X_1	1.000	0.993**	-0.017	0.013	0.110*	-0.037	0.060	-0.008	0.115*	0.031	0.095*	0.113**	-0.074	-0.002
X_2		1.000	-0.017	0.013	0.108*	-0.023	0.056	-0.016	0.112*	0.028	0.085	0.106*	-0.077	-0.006
X_3			1.000	0.195**	-0.070	-0.045	0.073	0.071	0.071	0.092	0.017	-0.019	-0.009	0.029
X_4				1.000	-0.038	0.289**	0.099*	-0.033	0.139**	0.001	0.115**	-0.097*	-0.108*	0.295**
X_5					1.000	-0.147**	-0.132**	0.049	-0.013	0.147**	0.157**	-0.001	-0.037	0.092
X_6						1.000	0.145**	-0.095*	0.012	-0.157**	-0.044	-0.021	-0.098*	0.115*
X_7							1.000	-0.122*	0.042	-0.142**	-0.078	0.045	-0.080	0.080
X_8								1.000	0.248**	0.308**	0.047	0.003	0.200**	0.054
X_9									1.000	0.191**	-0.291**	-0.158**	0.111*	0.182**
X_{10}										1.000	0.608**	0.015	0.144**	0.009
X_{11}											1.000	0.107*	0.045	0.104*
X_{12}												1.00	0.161**	-0.084
X_{13}													1.000	-0.111*
X_{14}														1.000

Table-3: Genotypic correlation coefficients among yield, yield attributing traits in two hundred thirty four F_3 families of Cross 2 (Swarna x BR2655)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
X_1	1	0.995**	-0.048	-0.012	0.169**	0.078	-0.023	-0.048	-0.203**	-0.113**	-0.013	0.244**	0.127**	-0.067
X_2		1.000	-0.043	-0.011	0.164**	0.070	-0.017	-0.054	-0.196**	-0.111**	-0.019	0.260**	0.123**	-0.062
X_3			1.000	0.677**	-0.0459	-0.021	0.106*	0.070	0.030	0.035	-0.046	-0.082	-0.001	0.027
X_4				1.000	0.134**	0.186**	0.136**	0.028	0.079	0.149**	0.050	-0.058	0.047	0.058
X_5					1.000	0.318**	0.128**	0.013	-0.122**	0.016	0.053	-0.060	-0.025	0.158**
X_6						1.000	0.101*	-0.009	-0.106*	-0.018	0.021	-0.217**	-0.156**	0.099*
X_7							1.000	0.095*	-0.060	0.011	0.062	-0.156**	-0.068	0.072
X_8								1.000	0.023	0.277**	0.146**	-0.107*	-0.043	0.111**
X_9									1.000	0.249**	-0.518**	-0.044	-0.041	0.144**
X_{10}										1.000	0.747**	-0.153**	-0.018	0.088
X_{11}											1.000	-0.226**	-0.052	0.108*
X_{12}												1.000	0.449**	-0.098*
X_{13}													1.000	0.014
X_{14}														1.000

In Table 1 to 3: *Significant at 5%; **Significant at 1%; X_1:Days to 50 per cent flowering; X_2: Days to maturity; X_3: Plant height (cm); X_4: Panicle length (cm); X_5: Number of panicle per plant; X_6: Panicle weight (g); X_7: Grains per panicle; X_8: Test weight (g); X_9: Grain breadth (mm); X_{10}: Grain Length (mm); X_{11}: L/B ratio; X_{12}: Iron content (mg/kg); X_{13}: Zinc content (mg/kg); X_{14}: Grain yield (kg/ha)

of productive tillers per plant, panicle length, panicle weight, number of grains per panicle and test weight. The yield contributing traits like, productive tillers per plant, grains per panicle and test-weight are useful in increasing the grain yield. . Reports of Girish *et al.* (2006), Gangashetty *et al.* (2013), Idris and Khalid (2013) are in conformity with the above results. Grain yield exhibited significant and negative correlation with iron content (-0.173G, -0.084P) and zinc content (-0.172G, -0.110P) both at genotypic and phenotypic levels. Thus, There is no association between grain mineral content with grain yield, hence we can take up separate breeding producer to enhancement of grain mineral content and grain yield.grain The observations are in accordance with the reports of Patil(2008) and Nagesh *et al.* (2012). However for the traits grain L/B ratio (0.104P), there was positive significant association at phenotypic level only.

Cross 2: Swarna x BR2655: Highly significant and negative genotypic and phenotypic correlations were observed for grain yield

Table-4: Phenotypic correlation coefficients among yield, yield attributing traits in two hundred thirty four F_3 families of Cross 2 (Swarna x BR2655)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}
X_1	1	0.979**	-0.032	-0.006	0.151**	0.072	-0.019	-0.027	-0.172**	-0.097*	-0.004	0.165**	0.094*	-0.060
X_2		1.000	-0.038	-0.011	0.145**	0.064	-0.013	-0.027	-0.164**	-0.099*	-0.009	0.172**	0.088	-0.056
X_3			1.000	0.471**	-0.034	-0.012	0.096*	0.022	0.031	0.059	-0.006	-0.041	-0.005	0.020
X_4				1.000	0.110*	0.151**	0.127**	0.023	0.082	0.191**	0.107*	-0.004	0.041	0.048
X_5					1.000	0.309	0.147**	0.091*	-0.073	0.043	0.113*	-0.036	0.029	0.144**
X_6						1.000	0.122**	0.072	-0.077	0.021	0.078	-0.132**	-0.096*	0.102*
X_7							1.000	0.097*	-0.022	0.049	0.132**	-0.104*	-0.028	0.069
X_8								1.000	0.062	0.222**	0.161**	0.043	0.038	0.052
X_9									1.000	0.213**	-0.373**	0.015	-0.051	0.117**
X_{10}										1.000	0.688**	-0.112*	0.011	0.079
X_{11}											1.000	-0.138**	0.030	0.101*
X_{12}												1.000	0.249**	-0.070
X_{13}													1.000	0.009
X_{14}														1

*Significant at 5%; **Significant at 1%; X_1:Days to 50 per cent flowering; X_2: Days to maturity; X_3: Plant height (cm); X_4: Panicle length (cm); X_5: Number of panicle per plant; X_6: Panicle weight (g); X_7: Grains per panicle; X_8: Test weight (g); X_9: Grain breadth (mm); X_{10}: Grain Length (mm); X_{11}: L/B ratio; X_{12}: Iron content (mg/kg); X_{13}: Zinc content (mg/kg); X_{14}: Grain yield (kg/ha)

kg/ha with days to 50% flowering (-0.067 G, -0.06P), days to maturity (-0.062G, -0.05P), On the other hand highly significant and positive correlation was observed for number of panicles per plant (0.158G, 0.144P), panicle weight (0.099G, 0.102P), test weight (0.111G, 0.052P), grain breadth (0.144G, 0.117P) and L/B ratio (0.108G, 0.101P). These traits may indirectly contribute for increased grain yield, by way of accommodating more number of grains per panicle. Studies made by Swain and Reddy (2006), Panwar and Mashiat Ali (2007), Eradasappa *et al.* (2007), Nagesh *et al.* (2012) and Gangashetty *et al.* (2013), are in conformity with the above results.

Positive correlation and non significant correlation observed for plant height (0.027G, 0.020P), panicle length (0.058G, 0.048P), number of grains per panicle (0.072G, 0.069P) and Grain length (0.088G, 0.079P). Significant and negative correlation was observed for grain yield with iron content (-0.098G, -0.070P) both at genotypic and phenotypic levels. However, yield with zinc content, grain recorded significant positive correlation at both at G and P levels. This is a important bottleneck in improving micronutrients like iron and zinc coupled with grain yield. Thus, grain yield could be improved considerably through selecting its components characters like plant height, number of productive tillers per plant, panicle length, panicle weight, number of grains per panicle and test weight. These results are accordance with Patil (2008), Nagesh *et al.* (2012). Among yield attributing traits, positive significant association of plant height was observed with panicle length, number of panicle per plant; panicle length with number of panicle per plant, panicle weight, grains per panicle, grain length, test weight with grain length, L/B ratio. This suggests that inter relation among the traits should be considered while breeding genotypes for different purposes. These results are in confirmation with the findings of, Idris and Khalid (2013).

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