Correlation Studies of three different F$_2$ Population in Rice (*Oryza sativa* L.)

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ABSTRACT

This study was performed to determine the assosiation between seventeen agronomic traits of three F$_2$ population viz; Dhanrashi x Wita-12, Dhanrashi x Shyamala and Sahbhagidhan x Birsamati in rice at Birsa Agricultural University , Kanke, Ranchi, Jharkand in 2019. Sixteen characters were assessed in this study viz days to flowering, plant height, panicles per plant, panicle length, primary branches per panicle, secondary branches per panicle, spikelets per panicle, grains per panicle, 100 grain weight, total yield per plant, grain yield per plant, unfilled grains per plant, grains per plant, spikelets per plant, grain length and grain breadth. Results showed that all the characters except days to flowering and 100 grain weight were positively and significantly correlated with grain yield per plant and grains per panicle in all F2 populations. grain yield per plant was negatively and less assosiated with grain length and L/B ratio in both Dhanrashi x Wita-12 and Sahbhagidhan x Birsamati where as in Dhanrashi x Shyamala grain yield is negatively associated with only L/B ratio.

Keywords: *assosiation , rice, F$_2$ population, agronomic traits*

INTRODUCTION

Rice [(*Oryza sativa* L.) (2n = 2x = 24)] is second most widely grown cereal crop. It is the staple food of more than half the world's population and grows in a wide range of environments. Worldwide, it is grown on an area of 166.1 million hectares with yield of 745.2 million tonnes (Anonymous, 2013). In India, rice covered an area of 44.2 million hectares during 2017 with production of 106.19 million tones and productivity of 2416 kg per hectare (Directorate of Economics & Statistics). The relationship between yield and its main economic components, in segregating populations of rice, has been studied by several researchers (Yogameenakshi and Vivekanandan, 2010). Selection of promising genotypes, in a breeding program, is based on various criteria, most importantly final crop yield and its quality. Yield is a complex character and composed of several components. Some of which affect the yield directly while others contribute indirectly. Correlation studies provide an opportunity to study the magnitude and direction of association of yield with its direct and indirect components and also among various components. Correlation analysis thus help in identifying suitable selection criteria for improving the yield. So, the present study was undertaken to know the inter-relation among different yield contributing characters and their association with grain yield. This study reveals the possibility of effective selection for improvement of yield and its important components in subsequent segregating populations.

MATERIALS AND METHODS

The present investigation was carried out during *Kharif* 2018 at rice experimental area of the Birsa Agricultural University, Ranchi, India. The experimental material comprised of five parental lines (Dhanrashi, Wita-12, Shyamala, Sahbhagidhan and Birsamati) and F$_2$ population of three crosses involving these parents viz., Dhanrashi x Wita-12, Dhanrashi x Shyamala, Sahbhagidhan x Birsamati and the population size of these crosses were 309, 51 and 115 plants respectively. Each of the crosses represented a separate experiment. The F2 materials were grown in the nursery on 25th June, 2018. Twenty two (22) days old seedlings were transplanted in the puddled field with a spacing of 25cm between rows and 20 cm between plants within a row. Recommended agronomic practices were followed throughout the crop growth period. Data were recorded on individual plants of each crosses for 17 important agronomic traits like days to flowering, plant height, panicles per plant, panicle length, primary branches per panicle, secondary branches per panicle, spikelets per panicle, grains per panicle, 100 grain weight, total yield per plant, grain yield per plant, unfilled grains per plant, grains per plant, spikelets per plant, grain length, grain breadth and L/B ratio .Statistical analyses, including estimation of descriptive statistics and coefficient of correlation was done for all three crosses.

RESULTS AND DISCUSSION

The success of plant breeding programs relies heavily on the existence of genetic variability in crops for a particular trait. Estimates for range, mean and coefficient of variation (CV) for all three F2 populations are shown in Table. 1 . Among all agronomic traits, more phenotypic variations were found in panicles per plant, total yield per plant, grain yield per plant, unfilled grains per plant, grains per plant and spikelets per plant in all three (F2) segregating populations, while days to flowering, panicle length, grain length and grain breadth had very less variations.

Different results was found in F2 populations viz Dhanrashi x

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Table1: Range, Mean and Coefficient of variation for different characters of three F_2 population of rice

Characters	Dhanrashi x Wita12			Dhanrashi x Shyamala			Sahbhagidhan x Birsamati		
	Range	Mean	CV%	Range	Mean	CV%	Range	Mean	CV%
Days to flowering	96-120	109.18	3.94	86-106	94.53	4.55	86-99	94.10	2.87
Plant height(cm)	50-187	106.95	14.07	66-128	102.22	13.42	70-136	109.12	11.52
Panicles per plant	1-19	8.92	40.69	3-21	11.67	37.78	2-20	9.86	41.27
Panicle length (cm)	17-32	27.44	8.03	21-31	26.75	7.94	21-32	27.23	7.71
Primary branches per panicle	8-19	14.51	13.86	7-17	12.59	14.49	8-17	12.13	14.59
Secondary branches per panicle	17-81	52.61	20.49	18-68	44.33	21.95	21-68	40.67	23.64
Spikelets per panicle	87-372	232.05	23.48	99-32	224.49	23.04	58-300	147.73	32.15
Grains per panicle	60-331	181.43	27.56	53-302	177.43	30.32	80-310	191.40	22.67
100 grain weight(g)	1.38-272	2.11	11.22	1.61-2.54	2.21	8.71	1.72-3.21	2.39	10.87
Total yield per plant(g)	3.62-69.66	26.67	49.77	5.73-64.63	32.43	47.08	3.03-67.09	24.53	51.15
Grain yield per plant(g)	2.65-62.08	23.89	52.12	5-60.13	29.61	48.80	2.86-60.15	22.10	52.16
unfilled grains per plant	15-950	320.49	51.93	75-590	300.16	45.38	15-745	244.49	65.46
Grains per plant	163.64-2664	1125.72	51.17	233.64-2811.94	1339.84	48.81	149.91-3105.31	1160.96	47.94
Spikelets per plant	222.92-3437.4	1446.22	46.39	308.64-3135.92	1640.00	45.94	134.91-2475.31	916.47	49.60
Grain length (mm)	5.5-9.5	7.24	9.16	6.5-7.7	7.16	3.87	7.1-11	8.41	10.12
Grain breadth(mm)	1.7-3.3	2.40	9.76	2.3-2.8	2.53	4.48	1.6-2.8	2.33	10.74
L/B ratio	2.07-4.56	3.06	15.73	2.32-3.35	2.84	6.95	2.63-5.75	3.67	18.22

Wita-12, Dhanrashi x Shyamala and Sahbhagidhan x Birsamati were presented in table-2, table-3 and table -4 respectively. In Dhanrashi x Wita-12 days to flowering was highly correlated with only primary branches per panicle and grain length at both genotypic and phenotypic level. Where as plant height, panicle length, primary branches per panicle and secondary branches per panicle were positively and significantly associated with almost all the characters i.e spikelets per panicle, grains per panicle, total yield per plant ,grain yield per plant, unfilled grains per panicle, grains per plant and spikelets per plants except 100 grain weight, grain length, grain breadth and L/B ratio. (Singh *et al.* 2018) reported that the seed yield exhibited positive and significant correlation with plant height, effective tillers per plant and panicle length these characters are major yield contributing characters. Similar findings were also reported by (Sravan *et al.* 2012, Kalyan *et al.* 2017). Spikelets per panicle and grains per panicle was highly correlated with almost all characters viz; total yield per plant ,grain yield per plant, unfilled grains per panicle, grains per plant and spikelets per plants except 100 grain weight and grain breadth.

Correlation was highly correlated between total yield per plant and grain yield per plant with almost all the characters except grain length, grain breadth and L/B ratio. (Kharb *et al.* 2016) reported positive correlation of grain yield with number of grains per panicle. Similar findings were also reported by (Ramya Rathod *et al.* 2017, Patel *et al.* 2018). However in Dhanrashi x Shyamala results was found that positively significant correlation was observed between days to flowering with primary branches per panicle, secondary branches per panicle and spikelets per panicle. It was observed to be negatively correlated with the characters namely panicles per plant, 100 grain weight and grain breadth. Correlation coefficient of all the characters are non significant. Plant height, panicles per plant, panicle length, primary branches per panicle ,secondary branches per panicle, spikelets per panicle and grains per panicle were

highly correlated with almost all characters except 100 grain weight, grain length, grain breadth and L/B ratio similarly (Ramya Rathod *et al.* 2017 and Rachana Bagudam *et al.* 2018) reported this type of results on their work. Panicles per plant was observed to be positively correlated with 100 grain weight, grain length and grain breadth but it was negatively correlated with L/B ratio having low magnitude of correlation coefficient at phenotypic level. In present study non significant correlation coefficient was observed between primary branches per panicle with 100 grain weight, grain length, grain breadth and L/B ratio. The grain yield per plant and total yield per plant was highly correlated with almost all characters except grain length, grain breadth and L/B ratio at phenotypic level which were supported by (Kalyan *et al.* 2017) whereas genotypically grain yield per plant was highly correlated with all characters except unfilled grains per plant, grains per plant and spikelets per plant. whereas in cross Sahbhagidhan x Birsamati days to flowering was significantly and positively correlated with grains per panicle, 100 grain weight, total yield per plant, grain yield per plant ,spikelets per plant and grain breadth at genotypic level but results are different at phenotypic level. Negative correlation for days to flowering with plant height, panicle per plant, unfilled grains per plant and grains per plant was observed. Plant height was observed to be positively and significantly associated with total yield per plant, grain yield per plant and spikelets per plant ,panicle per plant , panicle length, primary branches per panicle, secondary branches per panicle, unfilled grains per plant and grains per plant at phenotypic level , this type of findings was also observed by (Rachana Bagudam *et al.* 2018, Patel *et al.* 2018, Ramya Rathod *et al.* 2017, Kalyan *et al.* 2017, Sameera *et al.* 2016, Basavaraja *et al.* 2013, Sravan *et al.* 2012), Phenotypically primary branches per panicle, secondary branches per panicle, spikelets per panicle and grains per panicle was highly correlated with almost all characters except 100 grain weight, unfilled grains per plant, grain length.

Table 2: Genotypic and Phenotypic Correlation between different characters in Dhanrashi X Wita-12

Characters	G/P	Plant height	Panicles per Plant	Panicle length	Primary Branches per Panicle	Secondary Branches per Panicle	Spikelets per panicle	Grains per Panicle	100 Grain Weight	Total yield per plant	Grain yield per plant	Unfilled grains per plant	Grains Per Plant	Spikelets Per Plant	Grain Length	Grain Breadth	L/B ratio
Days to flowering	G	0.019	-0.182**	0.949**	0.243**	0.261**	0.289**	0.242**	-0.711**	-0.168**	0.066	-0.096	0.205**	-0.346**	0.626**	-0.770**	0.246**
	P	-0.166**	-0.083	0.053	0.119*	0.078	0.021	-0.047	-0.130*	-0.143**	-0.133*	-0.026	0.111*	-0.102	-0.211**	-0.035	-0.106
Plant height	G		0.130*	0.498**	0.379**	0.385**	0.397**	0.734**	0.059	0.174**	0.164**	0.164**	0.166**	0.185**	0.103	-0.097	0.149**
	P		0.278**	0.426**	0.313**	0.340**	0.310**	0.202**	0.033	0.305**	0.297**	0.178**	0.297**	0.299**	0.109	-0.072	0.129*
Panicles per plant	G			0.577**	0.523**	0.506**	0.525**	0.521**	0.327**	0.511**	0.052	0.519**	0.950**	0.999**	0.035	-0.065	0.055
	P			0.339**	0.288**	0.296**	0.299**	0.359**	0.219**	0.823**	0.806**	0.564**	0.791**	0.819**	-0.041	-0.032	-0.004
Panicle length	G				0.921**	0.937**	0.870**	2.342**	0.101	0.367**	0.277**	0.482**	0.340**	0.415**	0.040	0.165**	0.151**
	P				0.789**	0.784**	0.696**	0.601**	0.073	0.460**	0.450**	0.311**	0.458**	0.470**	0.105	-0.108	0.137*
Primary Branches per Panicle	G					0.902**	0.587**	0.948**	-0.047	0.350**	0.355**	0.243**	0.426**	0.430**	0.041	-0.222**	0.176**
	P					0.878**	0.662**	0.640**	0.035	0.410**	0.397**	0.307**	0.413**	0.431**	0.004	-0.095	0.076
Secondary Branches per Panicle	G						0.707**	0.681**	-0.123**	0.297**	0.265**	0.378**	0.388**	0.431**	0.141*	-0.379**	0.326**
	P						0.749**	0.676**	0.005	0.434**	0.423**	0.345**	0.448**	0.471**	0.041	-0.166**	0.141*
Spikelets per panicle	G							0.593**	-0.103	0.369**	0.346**	0.221**	0.461**	0.456**	0.196**	-0.391**	0.380**
	P							0.742**	-0.032	0.435**	0.437**	0.269**	0.472**	0.472**	0.145**	-0.204**	0.228**
Grains per Panicle	G								-0.104	0.742**	0.682**	0.746**	0.845**	0.510**	0.472**	-0.656**	0.972**
	P								-0.006	0.505**	0.503**	0.277**	0.538**	0.531**	0.125*	-0.206**	0.219**
100 Grain Weight	G									0.343**	0.369**	-0.178**	0.086	0.030	0.142**	0.437**	-0.228**
	P									0.272**	0.274**	0.026	0.077	0.072	-0.036	0.481**	-0.351**
Total yield per plant	G										0.961**	0.376**	0.992**	0.954**	0.047	0.027	0.008
	P										0.992**	0.516**	0.968**	0.959**	-0.014	0.027	-0.025
Grain yield per plant	G											0.390**	0.990**	0.956**	0.001	0.056	-0.028
	P											0.455**	0.974**	0.949**	-0.007	0.025	-0.017
Unfilled grains per plant	G												0.476**	0.513**	0.594**	-0.451**	0.574**
	P												0.473**	0.654**	-0.017	0.131**	0.078
Grains per Plant	G													0.958**	-0.034	-0.087	0.051
	P													0.976**	-0.002	-0.081	0.058
Spikelets per Plant	G														0.119**	-0.188**	0.188**
	P														-0.006	-0.102	0.069
Grain Length	G															-0.071	0.347**
	P															0.271**	0.766**
Grain Breadth	G																-0.654**
	P																-0.814**

** indicates significant at 1% and * indicates significant at 5% level

Table 3: Genotypic and Phenotypic correlation between diffferent characters in Dhanrashi x Shyamala

Characters	G/P	Plant height	Panicles per plant	Panicle length	Primary Branches per Panicle	Secondary Branches per Panicle	Spikelets per panicle	Grains per panicle	100 Grain Weight	Total yield per plant	Grain yield per plant	Unfilled grains per plant	Grains per Plant	Spikelets per Plant	Grain Length	Grain Breadth	L/B ratio
Days to flowering	G	0.019	0.213	-0.177	0.012	0.242*	-0.114	0.122	0.451**	0.190	0.195	0.031	0.139	0.115	0.401**	0.006	0.336*
	P	0.013	-0.007	0.026	0.414**	0.378**	0.266*	0.195	-0.250	0.136	0.131	0.047	0.192	0.175	0.123	-0.018	0.061
Plant height	G		0.064	0.201	0.147	0.297*	0.241	0.346*	0.453**	0.079	0.048	0.440**	0.119	0.031	0.355*	-0.358**	0.909**
	P		0.340*	0.650**	0.404	0.483**	0.512**	0.451**	0.075	0.465**	0.444**	0.482**	0.441**	0.470**	0.112	-0.013	0.081
Panicles per plant	G			0.399	-0.823	-0.163	-0.439**	-0.574**	-0.784**	-0.621**	-0.650**	-0.279*	-0.604**	-0.478**	0.577**	-0.284*	0.529**
	P			0.365	0.138	0.371**	0.384**	0.367**	0.159	0.902**	0.896**	0.686**	0.892**	0.899**	0.000	0.103	-0.070
Panicle length	G				-0.482	0.204	0.037	-0.179	0.894**	0.622**	0.596**	0.563**	0.556**	0.391**	0.788**	0.219	0.324*
	P				0.528	0.591**	0.544**	0.482**	0.238	0.601**	0.584**	0.621**	0.546**	0.586**	0.015	0.021	0.000
Primary Branches per Panicle	G					-0.027	-0.550**	-0.908**	0.367*	-0.178	-0.265	0.159	-0.349*	-0.328*	-0.274*	0.497**	0.444**
	P					0.827**	0.671**	0.645**	0.011	0.392**	0.382*	0.378**	0.392**	0.408**	0.076	0.021	0.025
Secondary Branches per Panicle	G						-0.600**	-0.994**	0.572**	-0.231	-0.351*	0.381**	-0.394**	-0.404**	-0.912**	0.512**	0.790**
	P						0.771**	0.706**	-0.036	0.578**	0.564**	0.508**	0.588**	0.602**	0.186	-0.013	0.102
Spikelets per panicle	G							-0.670**	-0.445**	-0.130	-0.146	-0.320*	-0.171	-0.096	-0.218	0.343*	0.409**
	P							0.896**	-0.005	0.538**	0.522**	0.440**	0.546**	0.553**	0.203	-0.078	0.144
Grains per panicle	G								-0.721**	-0.298*	-0.382**	0.124	-0.332*	-0.308*	-0.390**	0.980**	-0.271*
	P								0.007	0.488**	0.480**	0.349*	0.510**	0.505**	0.090	-0.104	0.101
100 Grain Weight	G									-0.796**	-0.527**	-0.047	-0.777**	-0.666**	0.096	-0.606**	0.393**
	P									0.233	0.231	0.154	0.039	0.062	-0.113	0.005	-0.057
Total yield per plant	G										-0.077	0.328*	-0.009	-0.061	-0.951**	0.525**	0.673**
	P										0.993**	0.750**	0.970**	0.978**	0.061	0.037	0.001
Grain yield per plant	G											0.201	-0.058	-0.083	-0.832**	0.537**	0.672**
	P											0.695**	0.977**	0.973**	0.053	0.052	-0.014
Unfilled grains per plant	G												0.486**	0.113	-0.733**	0.537**	0.891**
	P												0.682**	0.773**	0.058	-0.036	0.060
Grains per plant	G													-0.047	-0.193	0.509**	0.652**
	P													0.991**	0.086	0.054	0.001
Spikelets per Plant	G														-0.591**	0.354*	0.420*
	P														0.085	0.041	0.011
Grain Length	G															-0.581**	0.873**
	P															-0.408**	0.806**
Grain Breadth	G																-0.244
	P																0.867**

** indicates significant at 1% and * indicates significant at 5% level

Table–4: Genotypic and Phenotypic correlation between characters in Sahbhagidhan X Birsamati

Characters	G/P	Plant height	Panicles per plant	Panicle length	Primary Branches per Panicle	Secondary Branches Per Panicle	Spikelets Per panicle	Grains per Panicle	100 Grain Weight	Total yield per plant	Grain yield per plant	Unfilled grains per plant	Grains per Plant	Spikelets per plant	Grain Length	Grain Breadth	L/B ratio
Days to flowering	G	0.750**	0.765**	-0.005	-0.656**	-0.464**	-0.137	0.792**	0.432**	0.788**	0.280**	0.653**	0.386**	0.504**	-0.012	0.589**	0.459**
	P	-0.201**	-0.124	-0.057	0.129	0.097	0.079	0.030	-0.111	-0.063	-0.070	-0.042	-0.050	-0.047	0.006	-0.131	0.092
Plant height	G		0.847**	-0.094	-0.539**	-0.276**	-0.558**	0.744**	0.932**	0.822**	0.962**	0.554**	0.067	0.300**	-0.446**	0.459	0.311**
	P		0.231**	0.449**	0.196*	0.257**	0.123	0.160	0.059	0.273**	0.265*	0.208*	0.271**	0.258**	0.038	-0.010	0.040
Panicles per plant	G			-0.132	0.144	0.275**	-0.257**	0.597**	0.803**	0.871**	0.879**	0.565**	0.748**	0.773**	-0.411	0.200*	0.327**
	P			0.226*	0.102	0.156	0.095	0.272**	0.180	0.746**	0.742**	0.476**	0.741**	0.740**	-0.004	-0.118	0.095
Panicle length	G				-0.272**	-0.337**	-0.551**	0.633**	0.784**	0.265**	0.473**	0.677**	0.558**	0.996**	-0.425**	0.212*	0.772**
	P				0.355	0.381**	0.253**	0.334**	0.147	0.379**	0.372**	0.257**	0.378**	0.373**	0.076	0.070	0.005
Primary Branches per panicle	G					0.847**	0.581**	0.749**	0.569**	0.451**	0.498**	0.027	0.351**	0.454**	-0.207**	0.058	-0.166
	P					0.883**	0.678**	0.636**	-0.078	0.245**	0.254*	0.080	0.255**	0.284**	0.157	-0.205*	0.217**
Secondary branches per panicle	G						0.683**	0.616**	0.550**	0.593**	0.646**	0.095	0.503**	0.629**	-0.212*	0.098	-0.191*
	P						0.736**	0.762**	0.034	0.343**	0.348**	0.156	0.336**	0.356**	0.133	-0.143	0.168
Spikelets per panicle	G							0.765**	0.805**	0.354**	0.413*	0.318**	0.104	0.259**	-0.265	0.078	-0.198*
	P							0.661**	0.019	0.296**	0.320*	-0.075	0.246**	0.328**	0.154	-0.200*	0.223*
Grains per panicle	G								-0.296**	0.183*	0.894**	0.838**	0.570**	0.990**	0.764**	-0.232*	0.221*
	P								0.035	0.385**	0.384**	0.201*	0.387**	0.403**	-0.020	-0.108	0.076
100 Grain Weight	G									0.101	0.026	0.774**	0.443**	0.289**	0.833	-0.847**	0.567**
	P									0.327**	0.339*	0.115	0.161	0.156	-0.012	0.396**	-0.251*
Total yield per plant	G										0.939**	0.841**	0.315**	0.307**	0.234**	-0.089	0.202*
	P										0.994**	0.596**	0.968**	0.975**	-0.048	0.097	-0.075
Grain yield per plant	G											0.816**	0.992**	0.998**	0.332**	-0.168	0.308**
	P											0.519**	0.947**	0.977**	-0.031	0.077	-0.053
Unfilled grains Per plant	G												0.866**	0.800**	-0.555**	0.527**	0.639**
	P												0.723**	0.533**	-0.117	0.165	-0.170
Grains per plant	G													1.000**	-0.140	0.130	-0.146
	P													0.970**	-0.067	0.050	-0.058
Spikelets per plant	G														0.028	-0.029	0.051
	P														-0.041	0.003	-0.011
Grain Length	G															0.904**	0.898**
	P															-0.312**	0.762**
Grain Breadth	G																-0.465**
	P																0.840**

** indicates significant at 1% and * indicates significant at 5% level

CONCLUSION

In summary, the results of this study indicated that days to flowering, 100 grain weight and grains per panicle could be considered as critical criteria for yield improvement in segregating generations of rice.

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