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COMBINING ABILITY ANALYSIS FOR YIELD AND ITS COMPONENT CHARACTERS IN RICE

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ABSTRACT

This investigation was carried out at the Farm of the Rice Research & Training Center, Sakha Kafr El-Sheikh, Egypt during 2012 and 2013 rice growing seasons to estimate the general combining ability (GCA) and specific combining ability (SCA) effects for yield and its component characters at the two years and their combined data. The characters were panicles plant^{-1}, filled grains panicle^{-1}, panicle weight, sterility %, 100-grain weight and grain yield plant^{-1}. The results revealed that the parents Giza 178, , IR 65600-38-1-2 and the crosses Giza 178 x BG-35-2, Giza 178 x IET1444, Giza 178 x IR 6560-38-1-2 and BG35-2 x IET 1444 were found to have the most desirable mean values for yield and its components characters under the two years and their combined data. Genotypes, parents and the resultant crosses mean squares were found to be highly significant for all the characters studied. Highly significant positive GCA effects were found from the parents Giza 178, IET 1444 and IR 65600-38-1-2 for filled grain/panicle^{-1}, BG35-2, Nishihomare , RD-25 and IR 65600-38-1-2 for 100-grain weight; Giza 178, IET 1444 and IR 65600-38-1-2 for grain yield plant^{-1}. the most pronounced crosses over the two years and their combined data were Giza 178 x RD-25, Giza 178 x IR 65600-38-1-2 and RD-25 x IR 65600-38-1-2 for grain yield plant^{-1}; Giza 178 x Nishihomare ,Giza178 x IR65600-38-1-2 and RD-25 x IET1444 for panicle weight; Giza 178 x IR65600-38-1-2 RD-25 x IET1444 and IET1444 x Nishihomare for the number of panicles plant^{-1}

INTRODUCTION

Rice (*Oryza sativa* L.) is considered as one of the most important field crops in Egypt. Annually, more than one million feddans (more than 0.42 million hectare) are cultivated with rice, producing about 4-5 million tons of paddy with an average of 4 tons/fed. (10. Tons/ha) which is considered the highest productivity per unit area average in the world (Badawi, 1999). However, rice is very important for local consumption, and some amount for exportation. In the near future, this production will not be sufficient because of the dramatic increase in local population, which is expected to be 100 million individuals by the year of 2025.

In self-pollinated crops like rice, the goal of a breeder is to develop true breeding homogenous population with superior agronomic and other desirable characteristics. Accomplishment of this objective would depend on the suitable choice of the parental materials, nature of gene action controlling characters under consideration. Combining ability analysis helps in identifying superior parents and cross combinations to be followed in a breeding program. Hence, the present study aims to assess both general and specific combining abilities and their interaction with two years for yield and its components.

MATERIALS AND METHODS

The present investigation was carried out at the Farm of Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Egypt, during 2012 and 2013 rice growing seasons. Six rice genotypes utilized in this study, namely, Giza 178, BG35-2, RD-25, IET 1444, Nishihomare and IR 65600-38-1-2 were grown during 2011 seasons in three successive dates of planting at ten days intervals in order to overcome the differences in flowering time of each parent. After thirty days from sowing, seedlings were individually transplanted in the permanent field in seven rows. At flowering, the seven parents were diallel crossed, i.e. in all possible combinations (excluding reciprocals) to produce F_1 hybrid seeds. Bulk emasculation method was done by using the hot water technique proposed by Jodon (1938) and modified by Butany (1961).

In both 2012 and 2013 seasons, seedlings of the six parents and their fifteen F_1 crosses, of 30 days old, were individually transplanted in a Randomized Complete Block Design(RCBD) with three replications. Each replicate consisted of 105 rows of 5 m long and 5 rows for each parent of F_1 and 25 cm part plants. In all growing season of study, all cultural practices such as field preparation, sowing, transplanting, fertilizers and weed control were applied as recommended. The data were recorded on an individual plant basis for parents and F_1 generation for six yield trails, i.e. panicles plant^{-1}, filed grain panicle^{-1}, panicle weight (g), sterility %, 100-grain weight (g) and grain yield plant^{-1}. The data were analyzed by using the ordinary analysis of variance to test the significance of differences between the twenty one genotypes. If the genotypes mean squares are found to be significant, there is need to proceed for further analysis; i.e. Griffing (1956) analysis (method 2, model 1). The combined analysis was calculated over the two years to test the interaction of the different genetic components with the two years, as two different environmental conditions.

RESULTS AND DISCUSSION

The ordinary analysis of variance (Table 1) showed highly significant differences between genotypes for yield and its components in both 2012 and 2013 seasons and their combined data.

Mean performance:

The genotypes mean performance of yield and its components are given in Table (2).

For the panicles plant^{-1} (Table 2), the most desirable mean values towards this trait were obtained from the parents, Giza 178, IET 1444 and Nishihomare and the crosses, Giza 178 x Nishihomare (24.66 panicles), Giza 178 x IR65600-38-1-2 (23.58 panicles) and BG 35-2 x IET1444 (23.10 panicles). Concerning panicle weight, the parents, Giza 178 and IR 65600-38-1-2 and the crosses, Giza 178 x IR 65600-38-1-2, BG 35-2 x IET 1444, RD-25 x IET 1444 and RD-25 x IR 65600-38-1-2, gave the highest mean values which ranged from 4.54-5.58 grams.

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Table (2):The genotypes mean performances under the two years and their combined data for yield and yield components characters.

Genotypes	Panicles plant^{-1}			Panicle weight(g)			filled grains panicle^{-1}		
	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.
Giza 178	21.960	22.530	22.245	4.540	4.570	4.555	193.600	193.660	193.630
BG-35-2	17.030	17.560	17.295	4.020	4.060	4.040	161.000	163.000	162.000
RD-25	16.160	18.130	17.145	4.320	4.420	4.370	170.000	172.650	171.325
IET 1444	19.800	19.530	19.665	4.510	4.570	4.540	179.300	180.600	179.950
Nishihomare	18.200	20.130	19.165	4.190	4.420	4.305	156.300	157.000	156.650
IR 65600-38-1-2	16.030	14.460	15.245	5.570	5.590	5.580	202.000	197.660	199.830
Giza 178 x BG-35-2	18.230	20.900	19.565	4.510	4.870	4.690	176.500	153.600	165.050
Giza 178 x RD-25	18.030	23.100	20.565	4.490	4.640	4.565	158.800	158.200	158.500
Giza 178 x IET 1444	18.130	18.600	18.365	4.670	4.520	4.595	179.400	170.300	174.850
Giza 178 xNishihomare	22.200	27.130	24.665	3.860	4.260	4.060	181.000	186.000	183.500
Giza 178 x IR 65600-38-1-2	21.860	25.300	23.580	5.520	5.510	5.515	197.600	204.000	200.800
BG-35-2 xRD-25	21.600	22.800	22.200	4.440	3.610	4.025	143.600	154.000	148.800
BG-35-2 xLET 1444	22.600	23.600	23.100	5.510	5.410	5.460	152.000	156.000	154.000
BG-35-2 xNishihomare	21.100	24.900	23.000	4.160	5.820	4.990	161.000	168.000	164.500
BG-35-2 x IR 65600-38-12	15.600	15.600	15.600	4.020	3.920	3.970	203.660	191.000	197.330
RD-25 x LET 1444	19.500	25.100	22.300	5.350	5.690	5.520	173.000	183.300	178.150
RD-25 xNishihomare	19.960	19.400	19.680	2.970	2.990	2.980	61.200	65.300	63.250
RD-25 x IR 65600-38-1-2	16.600	18.600	17.600	5.060	5.060	5.060	151.000	163.000	157.000
IET 1444 x Nishihomare	25.800	28.600	27.200	3.470	3.790	3.630	105.000	74.500	89.750
LET 1444 x IR 65600-38-1-2	16.360	21.100	18.730	4.920	4.770	4.845	181.300	184.000	182.650
Nishihomare x IR 65600-38-1-2	21.560	22.900	22.230	4.960	4.790	4.875	179.000	187.600	183.300
L.S.D. (0.05)	1.500	1.240	1.370	0.161	0.171	0.166	1.050	1.070	1.060
L.S.D. (0.01)	2.060	1.280	1.670	0.190	0.204	0.197	1.120	1.180	1.150

Table (2):Continued.

Genotypes	Sterility %			100-grain weight (g)			Grain yield/plant^{-1} (g)		
	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.
Giza 178	12.14	12.18	12.16	2.36	2.37	2.37	36.26	38.93	37.60
BG-35-2	9.15	10.00	9.58	2.39	2.39	2.39	33.60	36.60	35.10
RD-25	6.34	8.17	7.26	2.62	2.62	2.62	24.26	29.76	27.01
IET 1444	8.72	9.94	9.33	2.27	2.26	2.27	38.93	40.60	39.77
Nishihomare	8.33	10.71	9.52	2.69	2.72	2.71	29.26	29.46	29.36
IR 65600-38-1-2	8.14	10.04	9.09	2.99	2.99	2.99	29.26	31.93	30.60
Giza 178 x BG-35-2	18.43	22.04	20.24	2.39	2.51	2.45	36.60	38.20	37.40
Giza 178 x RD-25	14.56	15.19	14.88	2.73	2.81	2.77	33.93	36.60	35.27
Giza 178 x IET 1444	7.57	8.45	8.01	2.92	2.76	2.84	38.26	44.76	41.51
Giza 178 xNishihomare	10.06	10.28	10.17	2.66	2.71	2.69	28.60	31.93	30.27
Giza 178 x IR 65600-38-1-2	14.68	17.85	16.27	2.54	2.56	2.55	38.26	43.93	41.10
BG-35-2 xRD-25	30.25	31.44	30.85	3.21	3.36	3.29	25.93	26.26	26.10
BG-35-2 xLET 1444	22.64	19.51	21.08	2.46	2.42	2.44	35.26	39.60	37.43
BG-35-2 xNishihomare	19.44	15.56	17.50	3.26	3.41	3.34	28.76	30.60	29.68
BG-35-2 x IR 65600-38-12	24.18	25.39	24.79	2.49	2.51	2.50	31.43	38.60	35.02
RD-25 x LET 1444	17.99	15.80	16.90	2.83	2.71	2.77	34.76	35.93	35.35
RD-25 xNishihomare	67.78	6.60	37.19	2.64	2.64	2.64	25.26	28.23	26.75
RD-25 x IR 65600-38-1-2	48.87	34.35	41.61	2.72	2.81	2.77	33.26	32.60	32.93
IET 1444 x Nishihomare	42.72	68.05	55.39	2.84	2.76	2.80	31.60	33.43	32.52
LET 1444 x IR 65600-38-1-2	16.68	21.13	18.91	2.83	2.81	2.82	34.60	38.76	36.68
Nishihomare x IR 65600-38-1-2	11.88	10.34	11.11	2.33	2.36	2.35	32.10	32.60	32.35
L.S.D. (0.05)	0.62	0.65	0.64	0.16	0.12	0.14	2.51	3.01	2.76
L.S.D. (0.01)	0.68	0.70	0.69	0.18	0.14	0.16	3.22	3.85	3.54

Y_1 = 2012 Y_2 = 2013 Comb. = Combined data.

Regarding the filled grains panicle^{-1}, the genotypes Giza 178, IET 1444, IR 65600-38-1-2 and the crosses, Giza 178 x Nishihomare, Giza 178 x IR 65600-38-1-2 and BG 35-2 x IR 65600-38-1-2, recorded the highest mean values which ranged from 179.950-200.800 grains panicle^{-1}. For sterility %, the most desirable mean values towards lower sterility % were observed by the genotypes RD-25, IET 1444, IR 65600-38-1-2, Giza 178 x IET 1444, Giza 178 x Nishihomare and Nishihomare x IR 65600-38-1-2, these values were ranged between 7.26 to 11.11%. For the 100-grain weight character, the genotypes IR 65600-38-1-2, Nishihomare, RD-25 and the crosses, BG 35-2 x RD-25 and BG 35-2 x Nishihomare gave the highest values which ranged from 2.62 to 3.34 grams. With respect to grain yieldplant^{-1} (Table 2), the most desirable mean values were detected by the genotypes Giza 178, BG 35-2, IET 1444, Giza 178 x BG 35-2 and the crosses combinations Giza 178 x IET 1444 and Giza 178 x IR 65600-38-1-2, where the values ranged from 35.10-41.51 g. It is worth to note that the parents Giza 178, IR 65600-38-1-2 and the crosses Giza 178 x IET 1444 and Giza 178 x IR 65600-38-1-2 were found to have the most desirable mean values for yield and its component characters under the years and their combined data.

Variation and interactions:

The ordinary analysis of variance and combining ability analysis for yield and its components characters of the two years and their combined data are presented in Table (1).

Year's mean squares were detected to be highly significant for grain yield and its components. Genotypes, parents and the resultant crosses mean squares were found to be highly significant for grain yield and its components characters at the two years and their combined data, which would indicate overall wide differences among these populations. Parents vs. crosses mean squares estimates, as an indication to average heterosis overall crosses, were found to be highly significant for grain yield and its component characters at the two years and heir combined data. The interactions of genotypes, parents, crosses and parents vs. crosses with the two years were detected to be highly significant for grain plant^{-1} and its component characters studied at the two years and their combined data. These results were in agreement with those obtained by Virmani *et al.* (1982), Anandakumar and Rangasamy (1986), Mandel *et al.* (1990), Ram (1992) and El-Abd (1995).

Combining ability:

Both general and specific combining ability variances (Table 1) were found to be highly significant for grain yield and its components characters at the two years and their combined data, indicating the importance of both additive and non-additive genetic variances in determining the performance of these traits.

General combining ability/specific combining ability ratio was used to clarify the nature of the genetic variance involved. GCA/SCA ratios were found to be greater than unity for grain yield plant^{-1}, panicle weight(g), panicles plant^{-1} and sterility percentage, indicating that additive and additive x additive types of gene action were of great importance in the inheritance of these traits. The obtained results are in harmony with those previously obtained by El-Hissewy (1985), Sarathe and Singh (1986), Peng and Virmani (1990) and Hammoud (1996). For sterility % and 100-grain weight, GCA/SCA ratios were less than unity, indicating the prevalence of non-additive gene actions (i.e. dominance and epistasis) in the inheritance of both traits. Therefore, improvement of such traits could be achieved through crossing followed by selection. The obtained results are in harmony with those obtained by Kim *et al.* (1981), Murai *et al.* (1987) and Hammoud (1996).

The interaction of years with general and specific combining ability variances (Table 1) were found to be highly significant for grain yield and its components which would indicate that both additive and non-additive genetic variances tended to interact with environments. Therefore, selection for these traits would be not effective in a single environment, but more environments would be required.

General combining ability(GCA) effects:

Estimates of the general combining effects (GCA) of individual parental lines for grain yield and its components characters at the two years and their combined data, are presented in
Table (3).

Table (3):Estimates of general combining ability (GCA) effect for the parental varieties evaluated under two years and their combined data for yield and its component characters.

Genotypes	Panicles plant^{-1}			filled grains panicle^{-1}			Sterility %		
	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.
Giza 178	0.756	1.235	1.235	15.613	13.109	14.405	6.353-	3.716-	5.426-
BG-35-2	0.325-	0.845-	0.845-	0.462	0.710-	0.174-	0.829-	0.822	0.464-
RD-25	1.006-	0.586-	0.586-	15.983-	10.664-	13.328-	6.499	0.989-	3.590
IET 1444	0.741	0.764	0.764	0.771-	3.139-	1.976-	1.887-	3.149	0.206
Nishihomare	1.353	1.639	1.639	19.458-	19.893-	19.653-	3.533	0.561	2.901
IR 65600-38-1-2	1.519-	2.207-	2.207-	20.137	21.297	20.727	0.963-	0.172	0.806-
LSD at 0.05 (gi)	0.576	0.582	0.582	0.558	0.510	2.925	0.488	0.488	0.460
LSD at 0.01 (gi)	1.131	1.143	1.143	1.095	1.002	5.745	0.958	0.958	0.908
LSD 0.05 (gi-gi)	0.892	0.901	0.901	0.864	0.791	4.532	0.756	0.756	0.716
LSD 0.01 (gj-gj)	1.752	1.770	1.770	1.697	1.553	8.900	1.485	1.485	1.406

Table (3):Continued.

Genotypes	Panicle weight (g)			100-grain weight (g)			Grain yield plant^{-1}		
	Y1	Y2	Comb.	Y1	Y2	Comb.	Y1	Y2	Comb.
Giza 178	0.039	0.036	0.067	0.145-	0.137-	0.148-	2.675	3.316	3.060
BG-35-2	0.093-	0.046-	0.119-	-	0.042	0.031	0.149-	0.031	0.105-
RD-25	0.092-	0.211-	0.160-	0.081	0.081	0.033	3.122-	3.418-	3.276-
IET 1444	0.157	0.101	0.142	0.021-	0.084-	0.049-	3.196	3.433	3.293
Nishihomare	0.486-	0.237-	0.357-	0.048	0.067	0.085	2.758-	3.829-	3.296-
IR 65600-38-1-2	0.475	0.356	0.428	0.038	0.031	0.047	0.158	0.467	0.325
LSD at 0.05 (gi)	0.536	0.575	0.125	0.415	0.462	0.138	0.609	0.552	0.578
LSD at 0.01 (gi)	1.052	1.130	0.245	0.815	0.907	0.272	1.195	1.083	1.136
LSD 0.05 (gi-gi)	0.830	0.891	0.194	0.643	0.715	0.214	0.943	0.855	0.896
LSD 0.01 (gj-gj)	1.630	1.750	0.380	1.262	1.405	0.421	1.852	1.678	1.760

Y_1 = 2012 Y_2 = 2013 Comb. = Combined data.

Table (4):Estimates of specific combining ability (GCA) effects for the crosses evaluated under the two years and heir combined data for yield and its component characters.

Genotypes	Panicles plant^{-1}			filled grains panicle^{-1}			Sterility %		
	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.
Giza 178 x BG-35-2	1.675-	0.949-	0.949-	4.660-	23.735-	14.167-	5.554	6.663	6.510
Giza 178 x RD-25	1.195-	0.992	0.992	5.915-	9.180-	7.564-	5.644-	1.624	2.904-
Giza 178 x IET 1444	2.842-	4.858-	4.858-	0.528-	4.605-	2.566-	4.247-	9.254-	6.383-
Giza 178 xNishihomare	0.616	2.798	2.798	19.760	27.849	23.928	7.178-	4.836-	6.918-
Giza 178 x IR 65600-38-1-2	3.148	4.814	4.814	3.235-	4.659	0.682	1.938	3.123	2.882
BG-35-2 xRD-25	3.590	2.905	2.905	5.831-	0.572	2.685-	4.656	13.469	8.105
BG-35-2 xLET 1444	2.842	2.355	2.355	12.644-	4.953-	9.003-	5.432	2.599-	1.719
BG-35-2 xNishihomare	0.730	2.780	2.780	15.044	23.668	19.341	3.189-	3.961-	4.550-
BG-35-2 x IR 65600-38-12	1.897-	2.673-	2.673-	18.109	5.478	11.791	6.047	6.258	6.440
RD-25 x LET 1444	0.423	3.596	3.596	24.668	32.168	28.417	6.546-	4.498-	6.515-
RD-25 xNishihomare	0.138	3.112-	3.112-	68.444-	69.078-	68.756-	37.690	11.243-	21.177
RD-25 x IR 65600-38-1-2	0.350-	0.066-	0.066-	18.239-	12.568-	15.385-	23.276	16.896	19.210
IET 1444 x Nishihomare	4.230	4.738	4.738	39.857-	67.403-	53.625-	21.016	46.069	32.664
LET 1444 x IR 65600-38-1-2	2.337-	1.084	1.084	3.152-	0.907	1.087-	0.528-	0.462-	0.110-
Nishihomare x IR 65600-38-1-2	2.250	2.010	2.010	13.236	21.261	17.240	10.749-	8.664-	10.598-
L.S.D. (0.05)	1.582	1.598	1.598	1.532	1.402	8.035	1.340	1.340	12.694
L.S.D. (0.01)	3.106	3.138	3.138	3.008	2.753	15.778	2.632	2.632	24.929
L.S.D. at 0.05 (S_{ii} - S_{jj})	1.784	1.803	1.803	1.728	1.581	9.064	1.512	1.512	14.321
L.S.D. at 0.01 (S_{ii} - S_{jj})	3.504	3.540	3.540	3.394	3.105	17.800	2.969	2.969	28.123
L.S.D. 0.05 S_{ij} - S_{ki})	2.360	2.385	2.385	2.286	2.092	11.991	2.000	2.000	18.945
L.S.D. 0.01 S_{ij} - S_{ki})	4.635	4.684	4.684	4.490	4.108	23.547	3.928	3.928	37.204

Table (4):Continued.

Genotypes	Panicle weight(g)			100-grain weight(g)			Grain yield plant^{-1} (g)		
	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.	Y_1	Y_2	Comb.
Giza 178 x BG-35-2	0.018	0.329	0.171	0.196-	0.136-	0.081-	1.773	0.397-	0.637
Giza 178 x RD-25	0.002-	0.131	0.086	0.063	0.125	0.430-	2.077	1.452	1.728
Giza 178 x IET 1444	0.071-	0.300-	0.183-	0.355	0.240	0.389	0.045-	2.761	1.349
Giza 178 xNishihomare	0.239-	0.223-	0.220-	0.025	0.039	0.098	3.751-	2.807-	3.286-
Giza 178 x IR 65600-38-1-2	0.461	0.434	0.448	0.084-	0.074-	0.003	2.993	4.897	3.903
BG-35-2 xRD-25	0.212	0.683-	0.435-	0.531	0.629	0.572	3.100-	5.469-	4.331-
BG-35-2 xLET 1444	1.033	0.805	0.866	0.117-	0.146-	0.190-	0.088-	1.020	0.434
BG-35-2 xNishihomare	0.326	1.552	0.895	0.613	0.694	0.570	0.634-	0.718-	0.727-
BG-35-2 x IR 65600-38-12	0.908-	0.940-	0.910-	0.146-	0.170-	0.226-	0.880-	2.986	0.985
RD-25 x LET 1444	0.740	1.250	0.964	0.172	0.105	0.138	2.385	0.798	1.518
RD-25 xNishihomare	0.998-	1.246-	1.074-	0.221-	0.249-	0.126-	1.294-	0.227	0.490-
RD-25 x IR 65600-38-1-2	0.131	0.232	0.221	0.003	0.043-	0.035	3.790	0.301	2.072
IET 1444 x Nishihomare	0.747-	0.757-	0.725-	0.214	0.170	0.116	1.272-	1.424-	1.292-
LET 1444 x IR 65600-38-1-2	0.257-	0.370-	0.294-	0.215	0.256	0.121	1.188-	0.390-	0.747-
Nishihomare x IR 65600-38-1-2	0.425	0.013-	0.231	0.354-	0.345-	0.436-	2.266	0.712	1.512
L.S.D. (0.05)	1.472	1.580	0.343	1.140	1.268	0.380	1.672	1.515	1.589
L.S.D. (0.01)	2.890	3.103	0.674	2.238	2.490	0.746	3.283	2.975	3.120
L.S.D. at 0.05 (S_{ii} - S_{jj})	1.660	1.783	0.387	1.286	1.431	0.429	1.886	1.709	1.792
L.S.D. at 0.01 (S_{ii} - S_{jj})	3.260	3.500	0.760	2.525	2.810	0.842	3.704	3.356	3.520
L.S.D. 0.05 S_{ij} - S_{ki})	2.196	2.358	0.512	1.701	1.893	0.567	2.495	2.261	2.371
L.S.D. 0.01 S_{ij} - S_{ki})	4.313	4.631	1.006	3.340	3.717	1.114	4.900	4.440	4.656

For grain yield plant^{-1}, the three rice genotypes Giza 178, IET 1444 and IR 65600-38-1-2, showed highly significant positive GCA effects at the two years and their combined data, proving to be excellent combiners for this trait. For the 100-grain weight, BG-35-2,Nishihomare, RD-25 and IR 65600-38-1-2 showed highly significant positive GCA effects at the two years and their combined data and proved to be good general combiners for this trait. Concerning the panicle weight, Giza 178, IET 1444 and IR 65600-38-1-2 exhibited highly significant positive GCA effects at the two years and their combined data, proving to be good combiners for this trait. Giza 178, IET 1444 and Nishihomare showed highly significant positive GCA effects for the panicles plant^{-1}, proving to be good combiners for this trait. For filled grains panicle^{-1}, Giza 178 and IR 65600-38-1-2 showed highly significant positive general combining ability effects at the two years and their combined data, proving to be good combiners for this trait. Concerning the sterility %, Giza 178,BG-35-2 and IR 65600-38-1-2 showed highly significant negative values of GCA effects in the two years and heir combined data, indicating that both genotypes could be considered as excellent combiners for this trait.

Specific combining ability (SCA) effects:'

As shown in Table (4), five crosses out of the fifteen cross combinations studied exhibited highly significant desirable SCA effects for grain yield plant^{-1} at the two years and their combined data. The most desirable crosses for this grain yield plant^{-1} were Giza 178 x RD-25, Giza 178 x IR 65600-38-1-2 and RD-25 x IR 65600-38-1-2. It could be concluded that these superior cross combinations would be of practical interest in breeding program for developing hybrid rice materials. For 100-grain weight; nine out of the twenty one cross combinations showed highly significant and positive SCA effects in the two years and their combined data. The highest SCA effects were detected from the crosses BG 35-2 x RD-25 and BG 35-2 x Nishihomare for 100-grain weight character. For panicle weight, six crosses showed highly significant and positive specific combining ability effects at the two years and their combined data. For the panicles plant^{-1}, seven crosses showed highly significant and positive SCA effects for this trait in the two years and their combined data. The highest SCA effects were detected for the crosses Giza 178 x Nishihomare ,Giza178 x IR65600-38-1-2 and RD-25 x IET1444. Six out of the fifteen hybrid combinations studied showed highly significant and positive specific combining ability effects for filled grains panicle^{-1} at the two years and their combined data. Concerning the sterility percentage, six out of the fifteen crosses studied exhibited significant negative SCA effects at the two years and their combined data.

From the previous results, it could be concluded that the most pronounced crosses over the two years and their combined data were Giza 178 x RD-25, Giza 178 x IR 65600-38-1-2 and RD-25 x IR 65600-38-1-2 for grain yield plant^{-1}; Giza 178 x Nishihomare ,Giza178 x IR65600-38-1-2 and RD-25 x IET1444 for panicle weight; Giza 178 x IR65600-38-1-2 RD-25 x

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دراسات على تربية الأرز القدرة على التألف بالنسبة لصفات المحصول ومكوناته فى الأرز

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أجريت هذه الدراسة بمركز البحوث والتدريب فى الأرز - سخا - كفرالشيخ - مصر خلال موسمي الزراعة ٢٠١٢ ، ٢٠١٣ لتقدير تأثيرات القدرة العامة والقدرة الخاصة على التآلف بالنسبة لصفات المحصول ومكوناته في الارز على مستوى السنتين والتحليل المشترك لهما. وكانت الصفات المدروسة عدد السنابل/نبات ، عدد الحبوب الممتلئة/سنبلة ، وزن السنبلة ، النسبة المئوية للعقم ، وزن ١٠٠ حبة ومحصول النبات الفردى.

وأظهرت النتائج أن التراكيب الوراثية جيزه ١٧٨ ، آى آر ٢-١-٣٨-٦٥٦٠٠ والهجن جيزه ١٧٨ × بي جي ٣٥-٢ ، جيزه ١٧٨ × آى اي تي ١٤٤٤ ، جيزه ١٧٨ × آى آر ٢-١-٣٨-٦٥٦٠٠ تحتوى على أعلى متوسطات للقيم بالنسبة لصفات المحصول ومكوناته التى تم دراستها على مستوى السنوات والتحليل المشترك لهما.

أظهرت كل التراكيب الوراثية والآباء والهجن تباينات عالية المعنوية بالنسبة لكل الصفات المدروسة. كانت تأثيرات القدرة العامة على التآلف موجبة وعالية المعنوية بالنسبة للتراكيب الآتية: جيزه ١٧٨ ونشيوهومارى بالنسبة لعدد السنابل/نبات ، جيزه ١٧٨ ، آى آر ٢-١-٣٨-٦٥٦٠٠ بالنسبة لعدد الحبوب الممتلئة/سنبلة ، نشيوهومارى ، آر دى ٢٥ ، آى آر ٢-١-٣٨-٦٥٦٠٠ بالنسبة لوزن ١٠٠ حبة ، جيزه ١٧٨ ، آى إى تى ١٤٤٤ ، آى آر ٢-١-٣٨-٦٥٦٠٠ بالنسبة لمحصول النبات. أحسن الهجن بالنسبة للسنوات والتحليل المشترك لهما كانت جيزه ١٧٨ × بى جى ٣٥-٢ ، آى إى تى ١٤٤٤ × آى آر ٢-١-٣٨-٦٥٦٠٠ لصفة محصول النبات ، نشيوهومارى × بى جى ٣٥-٢ ، آر دى ٢٥ × بى جى ٣٥-٢ لوزن ١٠٠ حبة وجيزه ١٧٨ × بى جى ٣٥-٢ ونشيوهومارى × آى إى تى ١٤٤٤ لصفة عدد السنابل/نبات.

قام بتحكيم البحث

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Table (1):Mean squares estimates of ordinary analysis and combining ability analysis for yield and its components under both 2012 and 2013 seasons and their combined data.

Source of	Df		Panicle weight(g)			100-grain weight(g)			Grain yield/plant (g)		
Variance	single	combined	Y_1	Y_2	Combined	Y_1	Y_2	Combined	Y_1	Y_2	combined
Years (Y)	--	1	-	-	11.764**	-	-	0.024	-	-	0.220
Replicates within years	2	4	4.176**	10.903**	0.227	0.520**	8.218**	0.063	1.029	0.191	0.101
Genotypes	20	20	2.496**	4.523**	6.337**	0.153*	0.177**	0.298**	357.30**	410.868**	748.869**
Parents	7	5	1.283**	1.762**	3.960**	0.072	0.064	0.188**	78.063**	63.389**	196.997**
Crosses	14	14	2.614**	4.119**	6.077**	0.182*	0.221**	0.358**	442.738**	523.981**	939.534**
Parents Vs. crosses	1	1	4.352**	20.470**	21.849**	0.001	0.002	0.001	401.410**	437.917**	838.930**
Genotypes x years	-	20	-	-	0.683**	-	-	0.033	-	-	19.308**
Parents x years	-	5	-	-	0.303	-	-	0.001	-	-	1.037*
Crosses x years	-	14	-	-	0.655**	-	-	0.046*	-	-	27.185**
Parents Vs. cross X Y	-	1	-	-	2.973**	-	-	0.001	-	-	0.397*
G.C.A	5	5	10.205**	17.158**	0.419**	0.808**	0.385**	0.600**	2,923.542**	1,832.360**	1,927.850**
S.C.A.	15	15	6.645**	12.465**	0.300*	0.354**	0.627**	0.409**	1.029	1,032.340**	855.920**
G.C.A. x years	-	5	-	-	26.944**	-	-	0.592**	-	-	2,828.052**
S.C.A. x years	-	15	-	-	18.809**	-	-	0.573**	-	-	177.449**
Error	40	80	1.123	1.146	0.679	0.972	1.120	1.370	1.053	0.882	3,371.698
G.C.A./S.C.A.	-	-	1.536	1.377	1.396	2.279	0.614	1.469	2,840.569	1.775	2.252

***, ** Significant at 0.05 and 0.01 levels, respectively.**

Table (1):Continued.

Source of	Df		no. of panicle/plant			panicle weight(g)			sterility %		
Variance	single	combine	Y_1	Y_2	Combined	Y_1	Y_2	Combined	Y_1	Y_2	combined
Years (Y)	--	1	-	-	16.612**	-	-	0.001*	-	-	14.963**
Replicates within years	2	4	0.903*	0.903*	31.317**	1.903**	1.791**	0.077**	5.803**	10.294**	41.636**
Genotypes	20	20	82.121**	62.815**	106.417**	0.025**	0.029**	0.054**	6.252**	8.632**	14.132**
Parents	7	5	0.857*	0.401	1.642**	0.017**	0.018**	0.048**	6.839**	5.508**	16.780**
Crosses	14	14	91.697**	76.524**	114.233**	0.025**	0.030**	0.053**	5.470**	9.491**	14.071**
Parents Vs. crosses	1	1	352.667**	182.156**	520.869**	0.041**	0.049**	0.090**	0.596	1.213*	1.754**
Genotypes x years	-	20	-	-	38.518**	-	-	0.001*	-	-	0.752**
Parents x years	-	5	-	-	0.119	-	-	0.001*	-	-	0.506**
Crosses x years	-	14	-	-	53.987**	-	-	0.001*	-	-	0.890**
Parents Vs. cross X Y	-	1	-	-	13.955**	-	-	0.001	-	-	0.054
G.C.A	5	5	160.417**	41.151**	82.638**	0.051**	0.063**	0.057**	55.636**	78.954**	67.074**
S.C.A.	15	15	275.272**	237.840**	216.002**	0.106**	0.117**	0.108**	6.469**	8.121**	5.996**
G.C.A. x years	-	5	-	-	118.930**	-	-	0.057**	-	-	67.516**
S.C.A. x years	-	15	-	-	297.110**	-	-	0.115**	-	-	8.594**
Error	40	80	0.806	0.806	547.982	0.583	0.722	0.285	1.255	1.030	63.796
G.C.A./S.C.A.	-	-	0.583	0.173	0.383	0.481	0.543	0.529	8.600	9.723	11.187

*** and **: Significant at 0.05 and 0.01 levels of probability, respectively.**