COMBINING ABILITY EFFECT OF SOME RICE VARIETIES AND THEIR CROSSES FOR BROWN SPOT RESISTANCE AND SOME PHYSIOLOGICAL CHARACTERS IN SALINE SOILS

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Abstract

The present investigation was carried out at the Experimental Farm of Sirw Agricultural Research Station in saline soil conditions and the glasshouse of Rice Research and Training Center, Sakha, Kafr El-Sheikh during 2003 and 2004 rice seasons. Six rice varieties of diverse origins were used in making nine crosses. IRAT 259, Suweon 339 and IET 1444 were used as lines and Sakha 101, Sakha 102 and Sakha 103 were used as testers.

The severity of brown spot infection exhibited significant differences among most of entries tested. Suwenon 339 was more susceptible for brown spot (610 spots / 100 leaves), followed by Sakha 103 (463.3 spots/100 leaves). IET1444 and Sakha 101 were less susceptible for brown spot and showed 190 and 193 spots/100 leaves, respectively.

The highest percentage of discolored grains (34.3%) was obtained from Suweon 339, while IET 1444 showed the lowest percentage (15.3%). Morevoer, the crosses derived from Suweon 339 had more discolored grains compared with those derived from the other varieties.

The parents and the F_1crosses showed highly significant differences for all the studied characters. The most desirable mean values were detected from the parents, IET 1444, Sakha 101, Suweon 339 and IRAT 259, as well as, the F_1 crosses IRAT 259 x Sakh 101, IET 1444 x Sakha 101 and Suweon 339 x Sakha 101. The most pronounced useful heterosis effects relative to the mid-parents were detected in the F_1 crosses of IRAT 259 x Sakha 101 and Swueon 339 x Sakha 101 for brown spot and discolored grains, IRAT 259 x Sakha 103 and Suweon 339 x Sakha 102 for chlorophyll content, Suweon 339 x Sakha 101 for osmotic pressure, Suweon 339 x Sakha 103 for proline content and IRAT 259 x Sakha 101, Suweon 339 x Sakha 101and IET 1444 x Sakha 101 for grain yield/plant.

The best desirable general combiners were Sakha 101 and IET 1444 for brown spot and discolored grains, Sakha 101 and Suweon 339 for chlorophyll content, osmotic pressure and proline content and Sakha 101 and IRAT 259 for grain yield. The highest specific combining ability (SCA) effects were detected from the F_1 crosses of Suweon 339 x Sakha 101 for brown spot and discolored grains. IRAT 259 x Sakha 103 for chlorophyll content and Suweon 339 x Sakha 101 for osmotic pressure and Suweon 339 x Sakha 103 for proline content and IRAT 259 x Sakha 101 and IET 1444 x Sakha 101 for grain yield.

Additive variance ($Ó^2A$) and relative importance of general combining ability (GCA %) for all studied characters was higher than dominance variance ($Ó^2D$) and relative importance of SCA%. The genetic variance ($Ó^2G$) was greater than environmental variance (Ó 2E). Heritability estimates in broad sense were high, while heritability estimates in narrow sense ranged from moderate to high for all studied traits.

INTRODUCTION

Salinity is a widespread and prevalent problem in irrigated agriculture. Genetic improvement for salt tolerance in major crops has become an urgent task in the agricultural production.

Brown spot disease caused by *Helminthosporium oryzae* Breada de Hann (*Cochliobolus miyabeanus*) is considered one of the most common diseases of rice (Ou, 1985), and is widely spread in salt affected soils. The disease can adversely affect the yield and milling quality of the grains. However, the nutritional disorders promote the disease outbreak (Ou, 1985 and Chakrabarti & Chaudhuri 1992). Heavy leaf spotting is an indication of some unfavorable growth factors (Kauraw and Samantaray, 1982).These unfavorable growth conditions include insufficient nitrogen, inability of the plants to use nitrogen because of injury to root system by root rot, or other unfavorable soil conditions. As the plants approach maturity, brown spot becomes more prevalent, and the spots are larger on senescent leaves more than on the younger ones. Maintaining good growing conditions for rice by proper fertilization, crop rotation, land leveling, proper soil preparation and water management can reduce damage from brown spot. Some varieties are less susceptible than others (Mahanty & Chakrabarti 1982 and Chakrabarti & Chaudhuri 1992).

In Egypt, this disease becomes more serious under conditions of nutritional imbalances due to shortage or excess of nitrogen, deficiency of silica, manganese and zinc /or excess of phosphorus. These nutritional disorders promote the disease outbreak (Ismunadji, 1976, Osman, 1985, El-Wahsh, 1997 and Sehly,*et al* 2001). Oku (1967) reported that brown spot disease has been known to be associated with soil deficit in nutritional elements or with soils in a much-reduced condition.

The deficiency of some elements like potassium, phosphorous and zinc increases severity of brown spot (Ou, 1985 Fompa & Singh, 1991). Sehly *et al* (2001) mentioned that disease incidence was higher in case of leaching of nutrients from soil and lower oxidation- reduction potential (Eh) value.

The present investigation aims to evaluate some of rice genotypes for brown spot disease and other physiological characters in saline soil conditions, estimate potentiality of heterosis expression of some physiological characters and brown spot disease, investigate the general and specific combining abilities for all the studied characters and calculate the phenotypic variance, genotypic variance and heritability in the parents and their crosses.

MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of Sirw Agricultural Research Station and at glasshouse of Rice Research and Training Center, Sakha, Kafr El-Sheikh, Egypt, during 2003 and 2004 seasons. Six rice varieties of diverse origins were used in making nine crosses. Three of them were used as lines namely, IRAT 259 and Suweon 339 (salt tolerant), in IET 1444 (moderate salt tolerant). The testers were: Sakha 101 (moderate salt tolerant), Sakha 102 and Sakha 103 (salt sensitive). Origin and main characteristics of the six rice varieties are given in Table (1).

In the 2003 season, seeds of the parental genotype were sown in the glasshouse nursery at three successive dates at 10- day intervals in order to overcome the differences in flowering time. After 25 days from sowing, seedlings of each parent were transplanted in the experimental field. Nine crosses involving three tolerant lines were crossed with each of the three testers in a Lines x Testers set of crosses.

In the 2004 season, the parents and their F_1 crosses were sown in the nursery seedlings were transplanted after 30 days. The parents and their F_1 crosses were grown in a Randomized Complete Block Design (RCBD), with five replications. Each replicate consisted of five rows of parents and F_1, the row measured five meters long , 20 cm apart and contained 25 hills, each of a single plant. The data were recorded after complete heading. At ripening stage, each plant was harvested individually. Twenty plants were taken from the parents and F_1 crosses at random from each replicate to determine the agronomic, yield and its component characters.

Soil analysis:

Four sites were chosen within El-Sirw farm to represent the area under study. Before conducting the experiments, soil samples of each site were taken at a depth of 30 cm. All samples were then air dried and prepared for chemical analysis, using the soil extract 1:5 to estimate the soluble anions, cations and total dissolved salts (TDS). Soil saturation extract was measured according to Jakson (1967). The electrical conductivity (EC) was measured in the extract of the soil saturated paste. The procedure for preparation and measurement of soil adopted was taken according to the method of Black *et al* (1965). Some chemical characteristics of experimental soil and water at El-Sirw location in 2004 season are given in Table (2).

The studied characters:

1 - Disease assessment.

Total number of brown spot lesions was counted in a sample of one hundred leaves collected randomly from each plot during vegetative stage. After harvest, samples of one hundred grains were taken for estimating the discolored grain percentage.

2 - Chlorophyll content (ppm).

The chlorophyll content of rice leaves was assessed using chlorophyll meter (model SPAD- 502).

3 - Osmotic pressure.

It was estimated by transforming the total soluble solids (T.S.S) to osmotic pressure (bar) and multiplied by the factor (1.013) to represent osmotic pressure as a bar. The total soluble solids were determined as the refractive index of the flag leaf using Zeiss refractmeter at room temperature according to the method of Gosive (1960).

4 - Proline content (ppm).

This trait was determined as procedures proposed by Bates (1973).

5 - Grain yield / plant (g).

The grain yield was recorded as the weight of grain yield of each individual plant, and adjusted to 14% moisture content.

Statistical analysis:

Line x Tester analysis was used according to Singh and Chaudhary (1977) to estimate combining ability effects i.e., general and specific combining ability under salt affected soil. Additive ($\tilde{O}^2A$) and dominance ($\tilde{O}^2D$) gene action and heritability were estimated according to method outlined by Singh and Chaudhary (1977). Differences among mean values of parental genotypes and crosses were tested using multiple range test (Duncan, 1955).

Estimation of heterosis:

The amount of heterosis was expressed as the percentage deviation of F1 mean performance from the mid-parent values according to Mather (1949) and Mather and Jinks (1971), applying the following equation:

Heterosis over mid-parent (%) = F1 – M.P. / M.P. x 100

Where:

F_1 = Mean value of the first generation.

M.P. = Mean value of mid-parent calculated by using average mean of the two parents.

Appropriate L.S.D. values were calculated to test the significance of these heterotic effects .

RESULTS AND DISCUSSION

Data in Table (3) show that severity of brown spot (number of spots / 100 leaves) infection exhibited significant differences among most of tested entries. Concerning the tested parents, Suweon 339 was the highest susceptible variety (610 spots /100 leaves), followed by Sakha 103 (463.3 spots /100 leaves). IET1444 and Sakha 101 were less susceptible for brown spot and gave 190 and 193.3 spot/100 leaves, respectively. On the other hand, the lines derived from Suweon 339 were highly susceptible for brown spot,with 583.3, 383.3 and 213.3 spots /100 leaves for Suweon 339 x Sakha 103, Suweon 339 x Sakha102 and Suweon 339 x Sakha101, respectively.The infection severity for brown spots was reduced with lines obtained from IRAT 259 x Sakha 101 or Sakha 102 or Sakha 103 which gave 160, 296.9, and 286.6 spots/100 leaves, respectively. Lines derived from IET1444 x Sakha 101 or Sakha 102 or Sakha 103 gave 180, 246.7 and 296.7 spots, respectively (Table 3). Kauraw and Samantaray (1982) reported that brown spot occurrences was most severe in soils with high P^H, low organic carbon percentage, low nitrogen and potash levels. El-Wahsh (1997) evaluated seven rice varieties after clover and barley and found that Kanto-51, Toride-1, and Giza 171were highly infected with brown spot while Reiho was the lowest infected either after clover or barley crops. Sehly et al (2001) reported that degree of infection varied between cultivars Sakha 101showed the least number of spots followed by Giza 176, both of them were lower in this respect than Giza 177 and Sakha 102.

Concerning the tested parents, the percentages of discolored grain were 34.3, 30.0, 14.0 and 15.0 for cvs.Suweon 339, Sakha 103, Sakha 101 and IET1444, respectively. The lines derived from Suweon 339 had more discolored grains compared with the other varieties IET1444 and IRAT. The percentage of discolored grains for Suweon 339 x Sakha 102 was higher (60.3%) followed by Suweon 339 x Sakha 103 which gave 41.6% discolored grains. The lines derived from crossing with Sakha 101 were less susceptible for brown spot, compared with the lines derived from Sakha 102 or Sakha 103. These results are in agreement with the finding of El-Wahsh (1997) who mentioned that percentage of discolored grains differed from one cultivar to another Giza 171 had the highest percentage of discolored grains, followed by Giza 176, while Giza 177 was the least infected. Moreove, this crosse showed insignificant negative heterosis with their parents (- 48.93 and - 6.07) for IRAT 259 x Sakha101 and IET1444 x Sakha101 respectively. Also, the cross Suweon 339 x Sakha 101 gave a high negative heterosis (-46.89).

1 - Mean performance and heterosis:

The genotype mean values for all studied characters are presented in Table (3). Concerning brown spot, the parents IET 1444, Sakha 101 and the crosses IRAT 259 x Sakha 101, IET 1444 x Sakha 101 expreased the lowest mean values. Six crosses showed negative values of heterosis. The most desirable crosses were IRAT 259 x Sakha 101 (- 48.93), Suweon 339 x Sakha 101 (- 46.89) that could be used in rice breeding program for improving this trait, and SK.101 showed a good combining for resistance to brown spot .

As for discolored grains, rice genotypes Sakha 101 and IET 1444 and the crosses IRAT 259 x Sakha 101, IET 1444 x Sakha 101 showed the lowest mean values. Heterosis percentage was highly significant and negative in six crosses, which ranged from - 8.09 to - 31.43. The highest negative values were estimated for three hybrid combinations, i.e. IRAT 259 x Sakha 101 (- 31.43), Suweon 339 x Sakha 101 (-24.22) and IET 1444 x Sakha 101 (-18.09). These results indicate that the breeding for brown spot and discolored grain can be done in simultaneous.

For chlorophyll content, the entries, Sakha 101 and the cross Suweon 339 x Sakha 101 showed the highest mean that ranged from 41.730 to 47.500 (ppm). Moreover, five crosses had highly significant and positive heterosis, which ranged from 4.49 to 8.19, while the cross Suweon 339 x Sakha 103 exhibited highly significant negative heterotic effect (-3.95). Similar results were obtained by El-Refaee (2002).

For osmotic pressure, the mean values ranged from 4.389 to 9.286. The genotypes Suweon 339 and the cross Suweon 339 x Sakha 101 showed the highest mean values. While, the three hybrid combinations i.e. IRAT 259 x Sakha 101 (1.7), Suweon 339 x Sakha 101 (31.58) and IET 1444 x Sakha 101 (1.98) showed highly significant and positive heterosis.

Regarding the proline content, the most desirable mean values were found in IET 1444 and the crosses Suweon 339 x Sakha 101 and IET 1444 x Sakha 101. The mean values ranged from 1.320 to 3.700 ppm. Six hybrid combinations showed highly significant and positive heterotic effects, which ranged from 5.14 to 38.24. The remaining crosses had highly significant and negative heterotic effects, which varied from - 19.08 to - 2.94. The most desirable crosses were IRAT 259 x Sakha 101 (33.33), Suweon 339 x Sakha 101 (33.33) and Suweon 339 x Sakha 103 (38.24). These findings are in line with results of Shehata (1991) and Soliman *et al.* (1993).

Regarding grain yield, the entries, IRAT 259, Suweon 339 and the crosses IRAT 259 x Sakha 101 and Suweon 339 x Sakha 101 expressed the highest mean values .The values ranged from 11.180 to 26.892. The crosses IRAT 259 x Sakha 101 (27.86), Suweon 399 x Sakha 101 (27.6) and IET 1444 x Sakha 101 (15.59) had highly significant and positive heterotic effects, the values were found to vary from -18.16 to 27.86. Similar results were reported by El-Mowafy (2001) and El-Refaee (2002).

2- Analysis of variance:

Highly significant differences were detected among genotypes for all studied characters (Table 4). These results indicate that genotypic differences between entries are present. Mean square values of parents and crosses were found to be highly significant for all studied characters. These results could be used as an indication to average heterosis overall crosses and therefore could be used through hybrid breeding technology to improve such traits (Wilfred and Palanisamy 1989). The differences between mean square values for Lines x Testers were highly significant for all studied characters, except chlorophyll content and osmotic pressure which were significant, indicating that non additive (dominance or epitasis) genetic variance were of great importance in the inheritance of these characters. The mean square values for lines were highly significant for osmotic pressure and proline content, but was significant for chlorophyll content. In addition, mean square values for testers were highly significant for osmotic pressure, proline content and grain yield/plant, and significant for brown spot and chlorophyll content. These results revealed that additive and additive x additive gene action were more important in the inheritance of these characters. Similar results were found by Sarathe and Singh (1986)and El Mowafy (2001).

3- Combining ability effects:

a- General combining ability (GCA) effects:

Estimates of general combining ability of parental lines for all studied characters are presented in Table (5).

Concerning brown spot, IRAT 259, IET1444 and Sakha 101 showed highly significant and negative values of GCA effects, indicating that these varieties could be considered as good resistance combiners for brown spot. On the contrary, high positive and significant GCA effects were estimated for Suweon 339and Sakha 103 varieties. With regard to discolored grains, the rice varieties IRAT 259, IET 1444 and Sakha 101 showed highly significant negative GCA effects, revealing that these varieties are good combiners for reducing this character. On the other hand, Suweon 339, Sakha 102 and Sakha 103 cultivars showed highly significant and positive estimates of GCA effects.

Suweon 339 and Sakha 101 showed highly significant positive effects of GCA for chlorophyll content, whereas IRAT 259 had significant positive GCA effects for this character, indicating that these three varieties could be considered as excellent combiners for increasing the chlorophyll content, while the varieties IET 1444 and Sakha 103 showed highly significant negative GCA effects.

Regarding osmotic pressure, rice cultivars Suweon 339 and Sakha 101 showed highly significant positive GCA effects proving to be good combiners for these characters. IET 1444, Sakha 102 and Sakha 103 exhibited the highest negative estimates of such effect.

With respect to proline content, Suweon 339 and Sakha 101 showed highly significant positive GCA effects. Meanwhile, highly significant negative GCA effects were determined for IRAT 259 and Sakha 103 cultivars. These results suggested that Suweon 339 and Sakha 101cultivars could possess favorable genes for proline content.

For grain yield / plant, the rice varieties IRAT 259 and Sakha 101 had significant and highly significant positive GCA effects, respectively, indicating that IRAT 259 and Sakha 101 could be used as good combiners for increasing this character.

In general, the three rice varieties, IRAT 259, IET 1444 and Sakha 101 showed the highest mean performance and significant negative of GCA values for brown spot severity and grain discoloration. Similarly, Suweon 339 and Sakha 101 showed the highest mean performance and significant positive of GCA values for chlorophyll content, osmotic pressure and proline content, while IRAT 259 and Sakha 101 for grain weight, indicating their importance as good general combiners in breeding programs for these characters. Hence, selection could be practiced in parents, either based on mean performance or on general combining ability effects (GCA) with the same efficiency.

b - Specific combining ability effects (SCA):

Estimates of the specific combining ability effects (SCA) of the parental combination are given in Table (6).

With respect to brown spot, highly significant negative estimates of SCA effects were found for the crosses IRAT 259 x Sakha 103, Suweon 339 x Sakha 101 and IET 1444 x Sakha 103. Thes findings lead to the conclusion that high estimates of specific combining ability effects, in any cross combination, might not be necessarily dependent upon the general combining ability effects in the involved parents. With regard to discolored grains, highly significant negative SCA effects were found in three crosses, IRAT 259 x Sakha 102, Suweon 339 x Sakha 101, and IET 1444 x Sakha 102,while highly significant or significant SCA effects were found in the crosses, Suweon 339 x Sakha 102 ,IET 1444 x Sakha 101and IRAT 259 x Sakha 103.

Table (5) reveals the occurrence of positive SCA effects in one cross namely Suweon 339 x Sakha 101 for osmotic pressure, whereas insignificant negative or positive specific combining ability effects were detected for this character in all other crosses.

With respect to chlorophyll content, significant positive SCA effects were found in the cross IRAT 259 x Sakha 103. It is considered as the best cross for this character. Highly significant and significant negative SCA effects were found in the crosses Suweon 339 x Sakha 103 and IET 1444 x Sakha 102, respectively.

For the proline content, three crosses IRAT 259 x Sakha 102, IET 1444 x Sakha 101 and IET 1444 x Sakha 102 showed insignificant positive SCA effects, which indicates that these crosses could be utilized for increasing the proline content through breeding programs.

Concerning grain yield/plant, highly significant positive SCA effects were found in one cross namely, IET 1444 x Sakha 101. On the other hand, non-additive effects of undesirable types could be found in these combinations.

4-Estimation of the genetic parameters and heritability:

Data on additive variance ($Ó^2A$) and relative importance of GCA %, indicated that they were largely governed by non-additive gene action, while dominance variance ($Ó^2$ D) and relative importance of SCA% are defined as the non-additive genetic portion of total genetic variance arising largely from dominance and epistatic deviation. The estimates of genetic parameters, additive variance ($Ó^2A$), dominant variance ($Ó^2D$), environmental variance ($Ó^2E$), genotypic variance ($Ó^2G$), phenotypic variance ($Ó^2P$), broad sense heritability (h^2_b %), narrow sense heritability (h^2_n %) , relative importance of GCA % and relative importance of SCA % for all studied parameters are presented in Table (7) .

It is clear that the additive variance value ($Ó^2A$) and relative importance of GCA % for all characters studied were higher than dominance. Similar results were obtained by Shehata (1991).

Normal value of environmental component was estimated for all characters studied but different in its magnitude, indicating that these characters are affected by the environmental component at different degrees. These findings suggest that early generation breeding population must be large and replicated, and selection for tolerance must be made in a later generation and under controlled conditions to minimize environmental effects.

Heritability estimates in the broad sense were high for all studied characters. While heritability estimates in the narrow sense was relatively low ranging from medium to high. This result further suggested that a major part of the total genotypic variance is due to additive and environmental effects for all characters.

From the previous results, it could be concluded that the varieties IRAT 259, IET 1444 and Sakha 101 could be used for breeding on the basis of brown spot and discolored grain values under saline soil. Suweon 339 and Sakha 101 could be used for breeding to salt tolerance on the basis of chlorophyll content, osmotic pressure and proline content, and IRAT 259 and Sakha 101 for grain yield/plant.

The lowest infected crosses with brown spot were IRAT 259 x Sakha 103 followed by IET 1444 x Sakha 103 and Suweon 339 x Sakha 101. For discolored grains, the most desirable crosses were IRAT 259 x Sakha 101,and IET 1444 x Sakha 101(12%), followed by IET 1444 x Sakha 102 and followed by IET 1444 x Sakha 101 which showed 17.6 and 18.3% recpectively.For chlorophyll content, the cross IRAT 259 x Sakha 103 is appropriate. For osmotic pressure, the best cross was suweon 339 x Sakha 101,whereas Suweon 339 x Sakha 103 was the best for proline content. Finally, for grain yield, the cross IET 1444 x Sakha 103 was appropriate for grain yield.

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Table 1. Parentage, origin and type of the tested rice cultivars.

No	Entry	Parentage	Origin	Type	Salinity tolerance
1	IRAT 259 (P1)	IRAT 112 / GUAPECATETO	Colombia	*.Indica*	*High*
2	*Suweon 339(P2)*	SR 9373-71 / IRI 346	Korea	Japonica	*High*
3	IET 1444(P3)	T N 1 /Co 29	India	Indica	Moderate
4	Sakha 101(P4)	Giza 176 / Milyang 79	Egypt	Japonica	Moderate
5	Sakha 102(P5)	GZ 4096-7-1 /Giza 177	Egypt	Japonica	Low
6	Sakha 103 (P6)	Giza 177 /Suweon 349	Egypt	Japonica	Low

Table 2. Some chemical characters of experimental soil, mixed water, drainage and ground water at El-Sirw location in 2003 season.

Type of sample	EC ds/m	Anions meq/l				Cations meq/l				PH 1:2.5	O.M%	SAR	C.E.C	ESP	Soil texture	Water table depth (cm)
		CO_3^{--}	HCO_3^-	CL^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+							
Soil	14.75	-	2.5	160.0	11.15	7.9	18.7	146.0	1.05	7.96	1.86	34.52	40.43	39.60	Clay	70
Mixed water	2.02	-	5.0	11.00	1.16	5.3	1.84	9.7	0.32			5.13				
Drainage water	4.04	-	6.0	29.0	6.04	5.3	8.89	26.25	0.60			9.83				
Ground water	25.10	-	5.3	249.8	38.1	25.8	79.2	176.0	2.2			23.22				

Table 3. Mean performance and heterosis of parental lines, testers and nine cross combinations for some physiological characters, brown spot severity and grain discoloration.

Entry	*Brown spot number/100 leaves*		Discolored grain (%)		Chlorophyll content (ppm)		Osmotic pressure		Proline content		Grain yield/plant	
	Mean	Heterosis	Mean	Heterosis	Mean	Heterosis	Mean	Heterosis	Mean	Heterosis	Mean	Heterosis
IRAT 259	216.700 efg		21.00 de		42.130 de		8.273 b		1.400 e		23.596 bc	
Suweon 339	610.000 a		34.300 c		44.970 bc		8.442 ab		3.020 b		21.304 d	
IET 1444	190.000 fg		15.300 efg		42.000 de		6.247 cd		3.500 a		22.720 cd	
Sakha 101	193.300 fg		14.000 fg		45.200 bc		5.672 def		2.530 c		18.454 e	
Sakha 102	286.670 de		23.000 d		41.730 e		4.389 g		1.980 d		12.400 ij	
Sakha 103	463.300 b		30.000 c		44.000 cd		4.896 efg		1.320 e		11.180 j	
IRAT259 x Sakha 101	160.000 g	-48.93	12.000 g	-31.43**	45.100 bc	6.65**	7.091 c	1.70**	2.620 c	33.33**	26.892 a	27.86**
IRAT 259 xSakha102	296.000 d	17.62	18.700 def	-15.0**	46.570 ab	7.56**	5.740 de	-9.33**	2.120 d	8.16**	16.460 f	-8.55
IRAT259 x Sakha 103	286.670 de	-15.68	30.000 c	17.65	45.000 bc	4.49**	4.896 efg	-25.64**	1.320 e	-2.94**	14.348 gh	-17.48
Suweon339 x Sakha 101	213.300 efg	-46.89	18.300 def	-24.22**	47.500 a	5.36**	9.286 a	31.58**	3.700 a	33.33**	25.260 ab	27.6**
Suweon 339 x Sakha102	383.3 c	-14.49	60.300 a	110.47	46.900 ab	8.19**	6.456 cd	0.63	2.900 b	16.00**	15.612 fg	-7.35
Suweon339 x Sakha 103	583.3 00a	8.69	41.600 b	29.39	42.730 de	-3.95**	6.078 d	-8.86**	3.000 b	38.24**	13.292 hi	-18.16
IET1444 x Sakha101	180.000 fg	-6.07	12.000 g	-18.09**	43.600 cde	0.00	6.078 d	1.98**	3.170 b	5.14**	23.800 bc	15.59**
IET1444 x Sakha 102	246.700 def	3.52	17.600 def	8.09**	42.070 de	0.49	4.727fg	-11.11**	2.520 c	-8.03**	16.620 f	-5.35
IET1444 x Sakha 103	296.700 d	9.17	20.670 de	8.74**	42.400 de	1.39	4.896 efg	-12.11**	1.950 d	19.08**	15.660 fg	-7.61
L.S.D: 0.05		61.68		4.38		1.66		0.97		0.23		1.45
0.01		83.22		5.91		2.24		-1.08		0.31		2.07

Table 4. Analysis of variance for some physiological characters, brown spot severity and grain discoloration.

Source of variation	d.f.	Brown spot	Discolored grains	Chlorophyll content	Osmotic pressure	Proline content	Grain yield/plant
Rep	2	1762.22	5.60	1.5387	0.5686	0.0847	1.6783
Genotypes	14	60942.22 **	512.25 **	11.2019 **	6.6159**	1.7762**	76.204**
Parents	5	89466.67 **	192.72 **	7.4246 **	8.7833**	2.3309**	85.2796**
Parents Vas Crosses	1	11472.60 *	82.22 **	18.61778 *	0.305	0.9422**	3.0794*
Crosses	8	49298.15 **	765.70 **	12.6359 **	6.0502**	1.5337**	79.6673**
Lines	2	66603.71	1427.81	26.0637 *	9.5777**	3.1629**	3.1332
Testers	2	95525.93 *	911.81	14.1971 *	12.5706**	2.6256**	306.3891**
Lines x testers	4	17531.48 **	361.52 **	5.1415 *	1.0262*	0.1732**	4.5735**
Error	28	1814.60	9.15	1.3044	0.3009	0.0256	1.1181

* Significant at 5 % probability level

* * Significant at 1 % probability level

Table 5. General combining ability effects of lines and testers for some physiological characters, brown spot severity and grain discoloration.

Entry	Brown spot	Discolored grain	Chlorophyll content	Osmotic pressure	Proline content	Grain yield/plant
<u>Lines</u>						
IRAT 259	- 46.296 **	- 5.481**	0.9037*	-0.2251	-0.5703**	0.7529*
Suweon339	99.259 **	14.408**	1.0529**	1.1255**	0.6130**	-0.6057
IET 1444	- 52.963 **	-8.926**	-1.9630**	-0.9005**	-0.0426	0.0329
<u>Testers</u>						
Sakha 101	- 109.629 **	-11.593**	1.2369**	1.3506**	0.5741**	6.6569**
Sakha 102	14.819	6.519**	0.0369	-0.5065**	-0.0759	-2.4297**
Sakha 103	94.815 **	5.074**	-1.2741**	-0.8442**	-0.4981**	-4.2271**
L.S.D						
0.05	29.0804	2.0649	0.7797	0.3744	0.1092	0.7219
0.01	39.2329	2.7859	1.0519	0.5051	0.1473	0.9739

* Significant at 5 % probability level

* * Significant at 1 % probability level

Table 6. Specific combining ability (SCA) of hybrids for some physiological characters, brown spot severity and grain discoloration.

Entries	Brown spots	Discolored grains	Chlorophyll content	Osmotic pressure	Proline content	Grain yield/plant
IRAT 259 X Sakha 101	21.85	3.374	-0.2259	-0.1688	-0.016	1.5051*
IRAT 259 X Sakha 102	34.07*	-8.066**	-0.4926	0.3376	0.144	-0.3403
IRAT 259 X Sakha 103	- 55.93**	4.724*	1.7185*	-0.1688	-0.203*	-0.6546
SUWEON 339 X Sakha 101	- 70.37**	-10.186**	0.5519	0.6754*	-0.073	0.5484
SUWEON 339 X Sakha 102	- 24.82	13.704**	1.1519	-0.3376	-0.223*	-0.0130
SUWEON 339 X Sakha 103	95.22**	-3.516	-1.7037*	-0.3376	0.297**	-0.5353
IET 1444 X Sakha 101	48.52**	6.814**	-0.3259	-0.5064	0.057	1.1941**
IET 1444 X Sakha 102	-9.26	-5.626**	-1.8592**	-.0.0067	0.057	0.3564
IET 1444 X Sakha 103	- 39.26**	-1.186	0.9852	0.5066	-0.093	-1.5504*
L.S.D : 0.05	29.0804	3.5766	1.3504	0.6486	0.1892	1.2503
0.01	39.2329	4.8253	1.8219	0.8750	0.2553	1.6868

* Significant at 5 % probability level

* * Significant at 1 % probability level

Table 7. Genetic parameters of some physiological characters, brown spot severity and grain discoloration.

Parameters	Brown spot	Discolored grains	Chlorophyll content	Osmotic pressure	Proline content	Grain yield/plant
Additive variance (σ2 A)	14118.52	179.6049	3.3309	2.2329	0.6047	33.3751
Dominant variance (σ2 D)	5238.96	117.4809	1.2790	0.2418	0.0492	1.1518
Environmental variance(σ2 E)	1814.6	9.15	1.3044	0.3009	0.0256	1.1181
Genotypic variance(σ2 G)	19357.48	297.0858	4.6099	2.4747	0.6539	34.5269
Phenotypic variance(σ^2 P)	21172.08	306.2358	5.9143	2.7756	0.6795	35.6450
Broad sense heritability (h^2_b)%	0.9143	0.9701	0.7794	0.8916	0.9623	0.9686
Narrow sense heritability(h^2_n)%	0.6668	0.5865	0.5632	0.8045	0.8899	0.9363
Relative importance of gca % *	0.7293	0.6046	0.7226	0.9023	0.9248	0.9666
Relative importance of sca % **	0.2706	0.3954	0.2774	0.0977	0.0752	0.0334

تأثير قدرة الائتلاف لبعض أصناف الأرز وهجنها للمقاومة لمرض التبقع البنى و بعض الصفات الفسيولوجية تحت ظروف الأراضي الملحية

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أجري هذا البحث بمحطة البحوث الزراعية بالسرو ، خلال عامي ٢٠٠٣ و ٢٠٠٤ بهدف دراسة قيم المتوسطات و قوة الهجين و القدرة العامة و الخاصة علي الائتلاف و تقدير مكونات التباين الوراثي لبعض الصفات الفسيولوجية و المرضية و كمية المحصول في الأرز تحت ظروف الأراضي الملحية .

كانت المواد المستخدمة عبارة عن ستة آباء مختلفة فيما بينها في تحملها للملوحة و درجة تحملها للإصابة بالتبقع البني علي الأوراق و الحبوب .

اختبرت الأصناف RAT 259 Suweon 339 وIET 1444 كسلالات بينما Sakha 101 Sakha 102, Sakha 103 (كشافات) و الهجن الناتجة منها باتباع نظام السلالة × الكشاف و عددها تسعة هجن.

و يمكن تلخيص أهم النتائج المتحصل عليها فيما يلي:

أظهرت شدة الإصابة بمرض التبقع البني أن هناك فرقا معنويا بين الأصناف والسلالات المختبرة. فبالنسبة للآباء المختبرة كان الصنف Suweon339 أعلى الآباء إصابة (٦١٠ بقعة /١٠٠ ورقة) يليه الصنف Sakha103 (٤٦٣,٣). بينما كانت الأصناف IET1444و Sakha101 أقل إصابة. أما النسبة المئوية للتلون في الحبوب فقد اتفقت مع النتائج السابقة لشدة الإصابة على الآباء، والسلالات الناتجة من الصنف Suwean 339 كانت اكثر إصابة بالمقارنة بالسلالات الأخرى.

وقد أظهر تحليل التباين بالنسبة للصفات المدروسة ، وجود تباينات عالية المعنوية بالنسبة للتراكيب الوراثية ، والآباء ،والهجن تحت ظروف الأراضي الملحية .

وقد تم الحصول علي أفضل قيم للمتوسط في التراكيب الوراثية ، IET 1444 (أربع صفات) يليه كل من Sakha 101 ، Suweon 339 (ثلاث صفات) و أخيراً IRAT 259 (صفتان فقط) ، و في الهجن التالية :- Sakha101 × IRAT 259 (خمس صفات) يليه Sakha 101 × IET 1444 ، Sakha 101 × Suwean 399 (أربع صفات) و كانت قوة الهجين معنوية أو معنوية جداً و ذلك عند قياسها كانحراف عن متوسط الأبوين و ذلك بالنسبة للهجن التالية :-101 × IRAT 259, Sakha 101، × Suweon 339 يملكان معنوية عالية سالبة لصفتي التبقع البني علي الأوراق و علي السنابل، وعالية المعنوية و موجبة لصفة كمية محصول النبات الفردي.

وSakha 101 × IRAT 259، Sakha 102 × Suweon 33 أظهرا معنوية موجبة عالية لصفة محتوي الكلوروفيل.

و Sakha 101 × Suweon 339 أظهر معنوية موجبة عالية لصفة الضغط الأسموزى .

Sakha 103 × Suweon 339 أظهر معنوية موجبة عالية لصفة محتوي البرولين .

Sakha 101 × IET 1444 أظهر معنوية موجبة عالية لصفة كمية محصول النبات الفردي .

وبالنسبة للقدرة العامة علي الائتلاف :-

أظهرت التراكيب الوراثية التالية معنوية موجبة عالية لكل من الصفات التالية :-

Sakha101 محتوي الكلوروفيل – الضغط الاسموزي – محتوي البرولين – كمية محصول النبات الفردي ، كما أظهر IET 1444 معنوية سالبة لصفتي التبقع البني علي الأوراق و الحبوب .

Suwean399 لصفات محتوي الكلوروفيل – الضغط الاسموزي – محتوي البرولين .

IRAT 259 معنوية موجبة عالية لصفة كمية محصول النبات الفردي .

والقدرة الخاصة علي الائتلاف :-

أظهر الهجين Sakha 101 × Suwean 399 معنوية سالبة لصفتي التبقع البني علي الأوراق و علي الحبوب و معنوية موجبة لصفة الضغط الاسموزي .

الهجين Sakha 103 × IRAT 259 أظهر معنوية موجبة لصفة محتوي الكلوروفيل .

الهجين Sakha 103 × Suwean 399 أظهر معنوية موجبة عالية لصفة محتوي البرولين .

أظهر الهجين Sakha 101 × IRAT 259 و الهجين Sakha 101 × IET 1444 معنوية موجبة لصفة كمية محصول النبات الفردي .

ولمكونات التباين الوراثي :-

أظهرت مكونات التباين الوراثي للصفات تحت الدراسة ، أن الفعل الجيني المضيف كان هو السائد في وراثة كل الصفات .كانت درجة التوريث بالمعني الضيق متوسطة لثلاث صفات و هي التبقع البني علي الأوراق – التبقع البني علي الحبوب – و محتوي الكلوروفيل بالأوراق بينما وجدت عالية لباقي الصفات المدروسة .