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GENETIC VARIABILITY OF SOME QUANTITATIVE CHARACTERS AND BLAST INHERITANCE IN RICE UNDER DROUGHT CONDITIONS

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ABSTRACT

Six populations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of three rice crosses namely Zonghoa $_2$ x BL1 (cross I); Zonghoa$_2$ X Sakha 102 (cross II) and Sakha 102 X Mezoho (cross III) were investigated under drought condition (irrigation every ten days) and artificial infection of blast spores collected from rice fields. The results of revealed that there was a wide range in mean values between parents and also the presence of partial and at over-dominance gene action for all studied characters .Scaling test provided evidences of non- allelic interaction in controlling all the studied characters in all crosses, the additive gene effect (d) was more important in the genetic system controlling no. of days to heading, plant height, 100 grain weight, leaf and panicle blast infections in most of studied crosses. However, dominance gene effects (h) was playing , important role in the inheritance of plant height, panicle length, no. of panicles/plant, no. of grains / panicle, grain yield / plant and leaf and panicle blast resistance. The additive x additive (i) effects were significant and significantly affected the inheritance of no. of days to heading, no. of grains / panicle, 100 grain weight, grain yield and leaf and panicle blast resistance characters. Furthermore, the dominance x dominance (l) epistatic gene action was found to play a remarkable role in the genetic control of no. of days to heading, plant height, panicle length, no. of panicles /plant, no. of grains/panicle, 100 grain weight, and leaf and panicle blast resistance characters. Broad sense heritability (h^2_b) estimates were moderate (52.02%) to high (91.11%) for panicle length and no. of panicles / plant in cross III, respectively. Narrow sense heritability (h^2_b) estimates were differed from low (19.64%) to moderate (38.61%) for 100- grain weight, and no. of grains / panicle in cross III, respectively. The maximum genetic advance of the mean values were found to be 29.76 and 28.51 for sterility (%) in crosses I and II, respectively.

The results reveled that both rice varieties Zounghoa 2 and Mizuho were resistant to rice blast in the three locations (Sakha, Gemmiza and Zarzora. Moreover, Bl 1 was susceptible rice variety in the three mentioned locations. While, Sakha 102 was moderately resistant for rice blast in Sakha and Gemmiza. On the contrary, it was resistant in Zarzora location. The results also demonstrated that the all plants of segregating generations (F_2, BC_1 and BC_2 of crosses II and III were resistant for rice blast in the three locations. On the other hand, the blast reactions among plants of segregating generations of cross I were ranged between resistant and susceptible in the different above locations. Highly significant and positive estimates of phenotypic correlation coefficients were observed between grain yield/plant and each of panicle length, no. of panicles/plant, 100 - grain weight and leaf and panicle blast infection for most of all studied crosses.

Key words: *Six populations, Genetic variability, Quantitative characters, Drought, Rice*

INTRODUCTION

Rice (*Oryza Sativa* L.) is the second most important cereal crop in Egypt after wheat. It covers about 22% of the cultivated area in Egypt in 2002-2003 summer season. Water deficit is a major problem for rice grown under lowland conditions, where water supplies are scarce or unreliable. Developing varieties for drought tolerance are needed to overcome the shortage of irrigation water.

Breeding varieties for drought tolerance has become of high priority in the Egyptian rice breeding program in order to reduce the water requirements on one hand, and also to tolerate the drought conditions in some rice growing areas due to the shortage of irrigate water, on the other hand. The success of developing and releasing new rice varieties suitable for drought conditions may increase the rice production and also increase the farmer's welfare (Funkai *et al*1996). The biotic stress is also a big problem in rice fields, and the blast disease is one of these stresses. Resistance to rice blast (controlled by *Magnaporthe grisea*) is generally governed by a few major genes (Kiyosawa *et al*1986,padmanabhan, 1974, Rosero, 1967and Hsieh *et al* 1967) and resistant cultivars are recognized as the most economic to control blast. Understanding gene type, mode of inheritance and stability of the resistant cultivars are essential to transfer the blast resistance to popular cultivars. The previous studies for exotic and local rice varieties under Egyptian conditions showed that inheritance of blast resistance was dominant in most cases and one to three major genes were controlling the mode of resistance (Omar *et al.* 1970, El-Azizi, 1972, Maximos 1974, Balal *et al* 1977, Aidy 1984, Maximos *et al*1984 and El-Malky 1997). Pan *et al* (1991) investigated the reaction of two Chinese varieties namely Zhonghua 9 and Lijiang to four differential Japanese strains and Chinese strains. Segregating data indicated that both varities, carry two resistance genes which showed a resistant reaction to the fungal strain Zh2-1. Allelism testes indicated that one of the genes in Meng Wanggu-I variety may be a new allele at the Pi-ta locus, the other gene and the genes carried by Dabainuo variety were unknown genes at new loci. Karen *et al* (1992) They concluded that diverse sources of resistance are necessary to avoid genetic vulnerability. Resistance to race IC-17 and IB-49 was simply inherited and should be relatively easy to incorporate into rice cultivars. Ise (1993) studied three parental lines and their F_1 and F_2 generations which they inoculated by spraying with aqueous spore suspension (3 x 105/ ml) BI *Magnaporthe grisea* isolate A179- 192 which is a virulent to the Pi- ta2 gene. Inoculated seedling was clearly segregated into susceptible and resistant classes and F_2 derived from Pi- 4 x 87 F5-19 showed a 3:1 ratio for resistant susceptible reaction to BL variety and for normal mutant leaf spot character. Tabien (1996) estimated the number of resistance genes in the populations derived from five cultivars, genetic analysis using F_1 and F_2 populations showed that Lemont and A-301 have at least two major genes each, while Teqing and Jasmin 85 have four and five major genes for resistance, respectively. Because yield and its components characters are considered very important to increase yield under water stress, the present study aimed to estimate heterosis, degree of dominance, genetic variance, heritability and genetic advance as percent of means among yield and to evaluate in three crosses for leaf and panicle blast infection and/or resistance under drought conditions.

MATERIALS AND METHODS

The present investigation was carried out at the greenhouse and the farm of the Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh,Gover norates Egypt during two successive rice growing seasons; i.e. winter and summer seasons of 2004 and 2005summer season to study the inheritance of some characters related to drought tolerance and blast resistance in rice. Four rice varieties namely, Zonghoa $_2$ (drought tolerant variety), Sakha102 (susceptible to drought), BL1 (tolerant) and Mizuho (moderate) were crossed to produce three crosses;namely, (Zhonghoa$_2$ x Sakha 102), (Zhonghoa$_2$ x BL1) and (BL1 x Mizuho). Six populations P_1, P_2, F_1, F_2, BC_1 and BC_2 for each cross were utilized to estimate the genetic parameters of each studied character. In the winter season of 2004, four parents were grown at greenhouse in three dates of planting at a 10-day interval in order to overcome the differences in their flowering time Thirty - day old seedlings of each parent were individually transplanted in the permanent field in ten rows. Each row was 5 m long and contained 25 hills. At flowering time, artificial hybridization among parents was done to produce the above mentioned crosses, following the technique proposed by Jodon (1938) and modified by Butany (1961).

In 2004 summer season, parents and F_1 hybrid seeds of the three crosses were planted for F_2 seed production .Furthermore, the simultaneously crossing between F_1 and the recurrent parent to produce BC_1 and BC_2 hybrid seeds were done.

In 2005 season, seeds of the parents and F_1, F_2 , BC_1 and BC_2 were sown in dry seedbed. Thirty day old seedlings were transplanted in the field plots. Sixteen genotypes belong me to different generations (4 parents, 3 F_1, 3F_2, 3 BC_1 and 3 BC_2) were transplanted in a randomized complete block design with three replications. Each replicate comprised 5 rows for each of P_1, P_2 and 4 rows of F_1, BC_1 and BC_2 and 20 rows F_2 generation. Each row was 5- m long with spacing of 20 cm.

All agricultural practices were applied as recommended. Flush irrigation was used every 10 days, and hand weeding was done when needed. Thirty plants from each of P_1, P_2 and F_1, 60 plants from each of BC_1

and BC_2 and 150 plants from F_2 populations were taken at random. These plants were individually harvested and threshed separately to determine the grain yield and its components.

The studied characters were: no. of days to heading, plant height, panicle length, number of panicles/plant, number of grains/panicle, number of filled grains/panicle, 100-grain weight, sterility % and grain yield/plant,

Evaluation of blast disease resistance

The six populations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of three rice crosses were evaluated for leaf blast resistance at seedling stage under blast nursery condition at Sakha, Gemmiza and Zarzora with two replications for each location in 2004 and 2005 seasons. Seedbed was prepared as 11.5 x 1.5 m after land preparation, leveling and adding 20 m^3 of farmyard manure per feddan to increase blast susceptibility. Seeds were sown in the first week of July. Each seedbed was planted with five rows of the tested genotypes and with plants of the susceptible checks variety Giza 159 at the two ends of each seedbed. Also, each two rows of the tested genotypes were followed alternatively by resistant / susceptible check. The test was replicated four times and the highest scores were recorded after 30 – 35 days from sowing. The typical blast lesions were scored according to the International Rice Research Institute (IRRI) scale (1996).

In the field, the same six populations of the three rice crosses with their control were evaluated for leaf and panicle blast reaction. Samples of rice leaves were taken twice, beginning from thirty days after transplanting. Each samples consisted of one hundred leaves randomly taken from each cross to determine leaf blast infection. Severity of infection was estimated by counting the total number of typical blast lesion /100 leaves. Panicle infection was estimated from one hundred panicles at each plot. The severity of neck rot infection was calculated using the formula adopted by Townsend and Heuberger (1943).

Statistical analysis

Heterosis, degree of dominance, inbreeding depression, phenotypic coefficient of variation, genetic variance and phenotypic correlation coefficient were estimated according to Burton (1952) and Mather and Jinks (1971).

RESULTS AND DISCUSSION

Mean Performance

The mean values of the studied characters for the three studied crosses are presented in Table (1). The results showed that the parents differed significantly in all characters studied and the F_1 mean values were higher than the highest parent for no. of days to heading and panicle blast resistance, in cross III, plant height, panicle length and number of panicles

Table 1. Mean performance (M) and standard error (SE) for the studied characters of the three studied three crosses.

Character	Cross	Mean Performance and standard error					
		P_1	P_2	F_1	BC_1	BC_2	F_2
		M SE	M SE	M SE	M SE	M SE	M SE
No. of days to heading (days)	I	95.71±0.44	97.81±0.47	96.01±0.41	99.95±0.99	100.17±0.89	100.97±0.71
	II	95.71±0.44	98.41±0.71	98. 11±0.41	98.14±0.98	99.14±0.92	96.12±0.68
	III	98.22±0.71	96.94±0.47	103.8±0.73	95.61±1.59	93.96±1.49	84.01±1.24
Plant height (cm)	I	91.61±0.51	86.33±0.51	155.91±0.51	133.41±1.34	112.96±1.63	113.25±1.01
	III	91.61±0.53	82.65±0.59	122.91±0.44	155.15±0.98	104.46±0.92	109.18±0.74
	III	82.65±0.51	81.51±0.68	121.01±0.45	122.23±1.05	110.11±1.12	105.97±0.72
Panicle length (cm)	I	22.04±0.27	20.11±0.34	24.45±0.32	21.05±0.53	20.51±0.53	21.91±0.32
	II	22.04±0.27	20.16±0.28	23..57±0.27	20.95±0.54	21.46±0.53	20.74±0.31
	III	20.16±0.28	20.41±0.35	20..55±0.25	20.46±0.99	20.95±0.51	19.09±0.31
No. of panicles/plant	I	19..52±0.53	14.75±0.53	20.11±0.45	19.25±1.04	17.23±1.07	18.65±0.45
	II	19..52±0.53	15.06±0.38	21.36±0.36	18.22±0.59	16.53±0.63	16.67±0.37
	III	15.06±0.38	15.71±0.52	18.91±0.42	16.01±0.67	12.26±0.86	15.65±0.42
No. of grains/panicle	I	132.38±0.56	120.54±0.4	132.48±0.47	124.97±1.22	123.56±1.22	120.72±0.92
	II	132.38±0.56	129.78± 0.8	128.61±0.82	124.65±1.38	121.48±1.72	121.93±0.97
	III	129.78±0.84	116.36±.97	118.32±0.81	122.23±2.51	117.24±2.48	118.04±1.43
Sterility (%)	I	14.49±0.41	21.51±0.47	13.34±0.43	16.56±1.05	14.32±1.03	16.99±0.75
	II	14.49±0.41	18.99±0.52	15.84±0.55	13.06±0.81	20.69±0.77	17.22±0.49
	III	18.99±0.52	16.61±0.44	20.93±0.51	21.11±0.62	17.19±0.65	17.41±0.42
100 grain weight (g)	I	2 .19±0.02	1.85 ± 0.03	2.37 ± 0.03	2.41 ± 0.04	2.39 ± 0.04	2.12 ± 0.02
	II	2.19 ±0.02	1.97 ± 0.02	2.18 ± 0.02	2.39 ± 0.11	1.81 ± 0.11	2.01 ± 0.07
	III	1 .97±0.02	1.91 ± 0.04	1.71 ± 0.02	1.65 ± 0.13	1.82 ± 0.13	1.81 ± 0.11
Grain yield/plant	I	37.75±0.62	26.43±0.65	39.87±0.61	34.93±0.67	33.68±0.66	33.37±0.38
	II	37.75±0.62	31.58±0.38	38.63±0.31	36.75±0.61	28.71±0.68	32.33±0.41
	III	31.58±0.38	26.51±0.37	30.16±0.45	30.01±0.72	27.46±0.72	27.36±0.42
Leaf blast resistance	I	1.25±0.31	4.91±0.61	4.82±0.31	3.56±0.81	4.62±0.51	5.94±0.65
	II	1.25±0.31	2.24±0.29	2.61±0.29	2.94±0.63	2.71±0.82	4.13±0.91
	III	2.24±0.29	1.36±0.46	2.31±0.43	1.94±0.43	1.3±0.74	2.93±0.87
Panicle blast resistance	I	1.72±0.46	4.54±0.63	2.63±0.94	1.86±0.45	2.31±0.45	2.94±0.82
	II	1.71±0.85	2.13±0.59	1.86±0.72	1.35±0.63	1.92±0.38	2.46±0.52
	III	2.13±0.46	1.86±0.84	2.31±0.54	1.73±0.41	1.83±0.27	1.82±0.69

plant, for all studied crosses, number of grains / panicle and 100 grain weight in crosses I and II and leaf blast resistance, in cross III. While, it was lower than the lowest parent for sterility % in cross I and 100 grain weight in cross III indicating that over- dominance was important in the inheritance of these traits verified by values of potence ratio, Moreover, the F_2 mean values, approximately, were nearer to the mid- parent with few exceptions such as sterility % and grain yield in cross II. The performance of backcross populations tended towards the means of recurrent parent and varied somewhat among yield and its major components. These results agree with those reported by El-Hity (1993), Abd-allah (2000) and Abd El-Aty et al (2002).

In continuation, the crosses I and II could offset the hazard effect of drought stress and exerted the value of yield reduction as compared with others under normal and drought conditions. Thus, crosses I and II could be recommended for growing under drought stress as drought tolerant crosses.

Genetic Parameters

Estimates of heterosis, degree of dominance, scaling test, gene action, genetic variance, heritability and genetic advance percentages are presented in Tables (2 through 5) .The percentage of heterosis as a deviation from mid- and better- parent were significant and highly significant and positive in all studied crosses for grain yield and its components in the present investigation, except no. of days to heading, number of grains/ panicle, 100 grain weight and leaf blast resistance in crosses I and II, panicle length in cross III as a deviation from a mid and better parent and 100 grain weight and panicle blast resistance in cross III as a deviation from better parent. It is noteworthy that heterotic effect for grain yield was larger in magnitude than that for any of its major components which is logically expected. Also, the results indicated that the no. of panicles/plant was the main contributing factor for increasing heterosis in grain yield, followed by no. of grains/panicles and 100-grain weight in the rice crosses under drought stress.

Concerning degree of dominance, it was greater than unity in all studied characters except for no. of day to heading and panicle resistance in crosses I and II, panicle length and grain yield / plant, in cross III, number of grains / panicle in crosses II and III, sterility % and 100 grain weight in cross II, and leaf blast resistance in cross I, which recorded positive or negative values, suggesting that over-dominance was involved in the control of such traits. These results agree with those of Reddy and Nerkar (1995), Mishra (1998), Charngpei *et al* (1999) and Abd-Allah (2000).From the previous results, it can be desserved that cross II was the best cross that showed highest estimates of heterosis for most of studied traits.

Scaling test (A, B and C) for grain yield and its related characters are presented in Table (3). The results revealed the adequacy of additive dominance model to measure the generations mean. Data showed that A,B and C value were not significant for some characters and significant for others in the different crosses. These results indicated the presence of non-allelic interaction of most of these characters in all studied crosses.

As shown in Table (4), the major contribution of the additive gene effects was indicated by the magnitude and the significance of parameter (d) in the three crosses for all studied characters with few exceptions. The majority of significant estimates of additive gene effects were positive. This suggests that additive gene effects had a significant contribution to the inheritance of the characters in these crosses. Thus, the contribution of any effects depend on the cross itself for the studied character. The additive gene effect appeared to be the most important type of gene effects in the

Table 2. Estimates of heterosis as a deviation from mid-parent (MP) and better-parent (BP) and degree of dominance for all studied characters, in the studied crosses

Character	Cross	Heterosis %		Degree of dominance
		MP	BP	
No. of days to heading	I	-0.56	0.73	-0.44
	II	1.76	2.41	0.83
	III	18.29**	5.91*	1.56
Plant height	I	74.85**	78.51**	2.41
	II	41.57**	48.72**	4.64
	III	47.64**	46.41**	3.47
Panicle length	I	16.01**	10.93**	3.12
	II	11.67**	6.89*	2.62
	III	-0.19	0.29	-0.4
No. of panicles/plant	I	17.36**	3.02*	-1.13
	II	23.53**	9.42**	-1.82
	III	22.91**	20.42**	11.01
No. of grains/panicle	I	2.76	0.07	1.65
	II	-1.88	-2.84	-0.47
	III	-3.85*	-8.83**	-0.71
Sterility (%)	I	25.88**	-7.97*	-1.21
	II	-4.29*	9.31**	-0.08
	III	17.58**	26.01**	-2.54
100 grain weight (g)	I	1.96	8.18*	2.01
	II	4.72	-0.51	0.89
	III	11.85**	-13.19**	-7.63
Grain yield/plant (g)	I	25.21**	5.61*	1.37
	II	11.43**	2.99*	1.28
	III	3.83 *	4.49*	0.44
Leaf blast resistance	I	0.56	2.85**	-0.95
	II	0.49	1.08	-1.87
	III	0.28*	0.69	-1.57
Panicle blast resistance	I	0.16*	0.52*	0.36
	II	0.15*	0.058	0.51
	III	0.17*	0.27*	-2.21

Where : * significant at 0.05 % and ** significant at 0.01

Table 3. Scaling test for adequacy of additive and dominance model of studied characters for the three studied crosses.

Character	Cross	A	B	C
No. of days to Heading	I	6.71±2.18*	6.21±1.74	18.98±3.02**
	II	2.31±1.91	3.11±1.93*	-4.61±2.91*
	III	-10.61±3.06**	-13.36±3.24**	-19.12±5.29**
Plant height	I	19.31±2.79**	-7.292±3.36	-27.73±4.21**
	II	15.72±2.03**	3.09±2.08	16.36±3.01**
	III	20.81±2..22**	17.95±2..37**	7.96±3.15
Panicle length	I	-2.41±1.15	-3.56±1.16**	-3.42±1.56*
	II	3.27±1.08**	-0.74±1.13	-6.17±1.44**
	III	0.76±1.05	0.95±1.17	-5.74±1.41**
No. of panicles/plant	I	-1.12±2.17**	-0.37±2.26	0.85±2.13
	II	-4.49±1.31**	-3.63±1.36	-10.64±1.75**
	III	-1. 01±1.46	-10.09±1.78**	-6.12±2.11**
No. of grains/panicle	I	-14.91±2.66**	-5.12±2.55	-14.01±3.91**
	II	-11.69±2.94**	-5.43±3.65	-27.66±4.33**
	III	-4.63±5.16*	-0.21±5.12	5.41±6.12**
Sterility (%)	I	5.28±2.19**	-6.21±2.16**	3.28±3.23
	II	4.81±1.76	7.08±1.72**	4.12±2..29
	III	2.71±1.53	-3.21±1.47	-7.82±2..09**
100 grain weight (g)	I	0.26±0.09	0.56±0.11**	-0.31±0.13
	II	0.39±0.22*	-0.53±0.24	0.45±0.31**
	III	0.07±0.27	0.08±0.32	-0.05±0.43
Grain yield/plant (g)	I	-7.53±1.61**	1.05±1.59	-10.42±2.16**
	II	-2.89±1.2	-12.18±1.45**	-17.28±1.81**
	III	-0.72±1.62	-1.74±1.62	-8.97±2.13
Leaf blast resistance	I	1.02±0.63	-0.52±0.42	7.85±2.31**
	II	2.41±0.23*	-0.57±0.12	7.75±1.34**
	III	-0.75±0.68	-1.07±0.26	3.51±0.94**
Panicle blast resistance	I	-0.73±0.33*	-2.54±0.63**	0.16±0.03
	II	-0.92±0.23*	-0.13±0.02	2.21±0.56**
	III	-0.91±0.16*	-0.42±0.31	-1.12±0.95**

Where * significant at 0.05 % and ** significant at 0.01

Table 4. Genetic components of generation mean for studied characters for the three studied crosses

Character	Cross	Genetic components of generation mean					
		$\overline{M}$	d	h	i	j	l
No. of days to heading	I	100.9**	-0.22	-4.53*	-3.98	1.21	-10.82**
	II	96.12**	-1.12	11.71	10.12*	-0.41	15.41**
	III	81.01**	1.65**	-8.81	43.86**	-8.61	10.83**
Plant height	I	113.25**	20.43**	16.17	39.73	18.29	-41.74**
	II	109.18**	50.68*	38.17**	82.51	26.34**	-21.39
	III	105.57**	12.11**	79.84**	40.79	11.42	-99.54**
Panicle length	I	21.91**	-0.55	-1.81	-4.44	-0.52	2.54
	II	20.74**	-6.48	8.07	1.84	5.76	-26.85**
	III	19.09**	-0.51	6.49**	7.45	0.41	-19.17
No. of panicles/plant	I	18.65**	2.99	1.53	-1.55	0.52	10.74
	II	16.67**	1.33	6.85**	2.78	-3.56	-18.93**
	III	15.65**	3.73	-2.45	-6.92	9.05	0.15
No. of grains/panicle	I	120.72**	1.41	-1.22**	-5.21**	-6.51	-61.39**
	II	121.57**	3.93	-1.22	0.52	-4.73	8.78
	III	118.04**	4.99	-15.98	-9.23	-1.71	71.07
Sterility (%)	I	16.99**	2.23	-	-6.14	5.74	7.09
	II	17.32**	-7.63	10.84**	-	-5.88	11.26
	III	17.44**	3.91**	-1.61	1.614**	2.72	56.06**
				10.04	7.17**		
100 grain weight (g)	I	2.12**	0.02	1.47*	1.12	-0.14	-1.93**
	II	2.01**	0.58*	7.71	-0.81*	0.47	0.95
	III	1.81**	0.05	0.35	0.13	0.01	0.89
Grain yield/plant (g)	I	33.37**	1.86	11.73**	3.95*	-4.79	-13.47
	II	32.33**	8.95	5.54	1.57	-5.03	-1.87
	III	27.36**	2.54	6.62**	5.51	-0.98	-2.03
Leaf blast resistance	I	5.94**	-1.06**	-5.51**	-7.24**	0.77	6.76*
	II	4.12**	0.23	-4.33	-5.13	0.73	-9.48**
	III	2.94**	0.59*	-5.89**	-5.25**	0.16	6.98
Panicle blast resistance	I	2.93**	-0.52*	-3.92**	-3.42**	0.92**	6.64**
	II	2.45**	-0.61*	-3.34**	-3.21*	0.41	4.61*
	III	1.82**	-0.12	0.05	-0.22	0.25	1.72

M = Mean , (d = Additive, h = Dominance gene effect) and (i = Additive × Additive, j = Additive × Dominance, l = Dominance × Dominance gene interaction).

Table 5. Estimates of additive genetic variance (1/2D), dominance genetic variance (1/4 H), broad (h_b^2) and narrow-sense (h_n^2) heritability and genetic advance (G.S) for studied characters, in all studied crosses.

Character	Cross	Genetic variance		Heritability		G. S	G. S
		1/2D	1/4H	h_b^2	h_n^2		%
No. of days to heading	I	24.23	20.15	60.44	28.45	5.12	19.48
	II	13.25	11.26	53.28	30.54	9.45	15.26
	III	10.36	9.22	56.41	22.41	10.25	8.15
Plant height	I	32.14	30.15	67.46	36.24	9.14	7.46
	II	25.13	26.12	59.48	26.43	4.12	18.22
	III	12.52	15.17	72.19	30.28	8.1	19.72
Panicle length	I	9.82	10.45	57.22	27.22	3.40	20.80
	II	13.09	9.52	57.69	35.31	4.51	22.91
	III	8.21	11.21	52.02	22.11	2.71	16.72
No. of panicle/plant	I	117.09	148.73	85.05	37.46	13.64	10.07
	II	84.71	105.92	86.61	38.61	11.79	24.1
	III	115.62	236.11	90.15	29.31	12.05	9.49
No. of grains/ panicle	I	82.71	79.62	80.28	34.12	10.53	8.74
	II	49.16	9.95	77.85	34.42	6.91	8.91
	III	80.93	227.84	91.11	23.86	9.05	8.22
100-grain weight (g)	I	0.04	0.03	59.91	19.91	0.18	8.31
	II	0.04	0.11	69.46	20.36	0.20	9.06
	III	0.42	0.79	73.34	19.64	0.11	4.81
Sterility %	I	14.31	15.01	75.16	35.01	4.51	28.51
	II	20.19	28.98	86.51	35.52	50.52	29.76
	III	10.03	12.85	69.65	30.53	30.61	22.21
Grain yield/plant (g)	I	12.69	14.71	74.25	34.33	4.29	13.22
	II	31.81	30.96	76.50	38.15	7.18	17.35
	III	13.76	9.95	64.16	34.17	4.49	12.82
Leaf blast resistance	I	12.36	13.42	68.26	28.92	6.53	12.36
	II	8.42	9.45	52.48	30.19	8.45	21.63
	III	21.65	20.86	69.35	32.56	9.36	7.15
Panicle plast resistance	I	14.35	15.34	55.24	20.36	4.32	15.63
	II	25.16	22.84	64.28	29.34	5.36	12.36
	III	8.16	9.45	69.24	35.19	9.48	10.32

inheritance of yield and its major components in cross II. Nevertheless, a sufficient amount of additive gene effect appears to be present for successful selections for any of these characters under drought stress.

Dominance gene effects appeared to be the most important gene effects in the inheritance of yield and its related characters except for 100-grain weight in cross I. All estimates of dominance gene effects were positive except for 100-grain weight in crosses II and III and for sterility % in the three crosses which exhibited negative values. The magnitude of dominance gene effects relative to magnitude of the additive gene effects was large for yield and its components, showing that dominance effects were relatively more important in the inheritance of quantitative traits, in the present experiment. Thus, increasing yield performance in rice under drought conditions could be achieved through a breeding procedure which emphasizes the dominance gene effects for such crosses.

With regard to the individual types of digenic epistatic gene effects, the significant additive x dominance gene effects were exhibited more frequency than the two types of digenic epistatis, but estimates of the dominance x dominance gene effects have relatively greater magnitude for all studied characters. Two of these epistatic gene effects apparently counteracted each other. The additive x additive gene effects which were mostly significant and positive indicating enhancing effect in inheritance. The additive x dominance gene effects were exhibited less frequently than the other two types. In contrast, most of the dominance x dominance gene effects were negatively significant suggesting a diminishing effect due to this type of gene effects and undesirable epistasis.

Evidently, epistasis gene effects had a significant contribution in the inheritance of studied characters. At least, one epistasis gene effects was significant for all studied traits in the three crosses. The additive x additive gene interactions appears to contribute more to epistasis gene effects than any other source of epistasis. Also, these findings suggest that genetic effects could be an important major contributor to gene actions in the present genetic materials and character under present investigation.

The importance of both additive and dominance gene action in the expression of yield and its related characters could be seen from Table (5). However, dominance variance was more important than additive genetic variance in most studied traits. The relative magnitude of additive variance to dominance variance may depend upon the cross itself, because there was a wide range of differences among studied crosses in the present investigation. Dominance genetic variance appeared to be most important than the additive genetic variance in crosses II and III for plant height and 100 grain weight, crosses I and III for panicle length and panicle resistance, all studied crosses for number of panicles / plant and sterility %, cross I and II for leaf blast infection, cross I for grain yield / plant and cross III for number of grains / panicle. However, additive variance was more important than dominance e in the other studied characters for all studied crosses. These results were in agreement with those of El-Hissewy and Bastawi (1998) and Achrya *et al* (1999).

Evidently, the additive type of gene action plays a significant role in the genetic control of yield and its related traits in crosses I and II. This finding is in line with that previously found by means of gene action estimates and genetic effects of genes (Table4). These results indicated that the breeder can easily raise the level of yield and related traits by simple breeding methods. Similar results were obtained by El-Hity (1993) and, El-Hissewy *et al.* (1994).

The previous results of genetic variance and heritability estimates for grain yield and its components (Table 5)revealed that the dominance genetic variance played more important role in the inheritance of most of these characters than the additive genetic one, and this finding differs from one character to another and also between crosses. Heritability estimates in broad sense were moderate to high in most cases indicating the effect of the environmental condition on these characters. Meanwhile, heritability estimates in narrow sense were mostly low. This was expected due to the high estimates of dominance genetic variance most characters. This in turn suggests that these characters behave in a quantitative manner, and effective selection could be achieved in late generations. This conclusion may be useful to rice breeders in planning for improving the yield in such crosses, under drought condition. These results agree with that reported by Gwimaraes (1989), Abd-allah (2000) and Abd El-Aty *et al* (2002).

Inheritance of blast disease resistance

The reaction of four parents and three crosses to blast is presented in Table (6). Both parents ; Zounghoa 2 and Mizuho were resistant to blast at the three locations Sakha, Gemmiza and Zarzora . Sakha 102 was moderately resistance at Sakha and Gemmiza, but resistant at Zarzora. On the other hand, BL1 proved to be susceptible to blast at all tested locations. In cross1. Table (6), F_2 gave susceptible reaction at Sakha and Zarzora, but moderate resistant reaction at Gemmiza.The.BC1 was susceptible to blast at Sakha, moderately resistant at Gemmiza, and resistant at Zarzora. However, BC2 was susceptible at all locations. In crosses II and III, F_2, BC1 and BC2 proved to be resistant to blast at all locations. These results are in line with those of Maximos (1974), Karen *et al* (1992), Notteoghem (1993), Wang *et al* (1994) and EL-Malkly (1997).

Phenotypic correlation coefficient between grain yield/plant and its related characters and blast resistance characters are showed in Table (7). Highly significant and positive correlations were found between grain yield and each of no. of days to heading, panicle length and panicle blast resistance in crosses I and II, and highly significant and positive associayion was found between grain yield / plant and number of grains / panicle and 100 grain weight for all studied crosses. While negative and highly significant phenotypic correlation coefficients were found between grain yield / plant and plant height and sterility % in crosses I and II. These results are in agreement with those reported by Sasmal (1987), Loesto and Chang (1994), Funkai *et al* (1996), Satpute (1996), Saravanam and Senthi (1997) and Mishra (1998).

Table 6. Inheritance of blast disease resistance the reaction of different rice entries under natural infection in blast nursery at different locations, season 2005.

Entries	Locations			Mean reaction
	Sakha	Gemmiza	Zarzora	
Parents:				
Zoungha 2	2	1	2	R
Sakha 102	3	3	1	MR
BL_1	4	4	5	S
Mizuho	2	2	2	R
Cross 1:				
F2 (Zoungha 2 x BL_1)	4	3	5	S
BC1 (Zoungha 2 x BL_1) x	4	3	2	S
Zoungha 2	4	5	4	S
BC2(Zoungha 2 x BL_1) x BL_1				
Cross 2:				
F2 (Zoungho 2 x Sakha 102)	2	2	1	R
BC1 (Zoungho 2 x Sakha 102) x	3	2	1	MR
Zoungho 2	2	1	1	R
BC2(Zoungho 2 x Sakha 102) x				
Sakha 102				
Cross 3:				
F2 (Sakha 102x Mizuho)	2	1	1	R
BC1 (Sakha 102 x Mizuho) x	1	1	1	R
Sakha 102	2	1	1	R
BC2(Sakha 102 x Mizuho) x				
Mizuho				

1-2 = Resistant, 3 = Moderately resistant, 4-6 = Susceptible,

Table 7. Phenotypic correlation coefficient (rph) among all possible pairs of studied characters and grain yield in the F_2 generation in the studied crosses.

Character	Cross	No. of days to heading	Plant height	Panicle length	No. of panicle /plant	No. of grains /panicle	Sterility (%)	100grain weight (g)	Leaf blast resistance	Panicle blast resistance
Plant height	I	0.23	—							
	II	0.32								
	III	0.24								
Panicle length	I	0.42*	0.39							
	II	0.22	0.40*	—						
	III	0.55**	0.25							
No. of panicles/plant	I	0.49**	0.66**	-0.45*						
	II	0.27	0.65**	-0.52**	—					
	III	0.39*	0.72**	0.32						
No. of grains/panicle	I	-0.25	-0.22	0.35	-0.45**					
	II	-0.51**	-0.47*	-0.21	-0.59**	—				
	III	-0.37	0.27	0.21	0.24					
Sterility (%)	I	-0.52**	0.18	0.27	0.63**	-0.54**				
	II	-0.81**	0.31	0.42**	0.12	-0.59**	—			
	III	-0.51**	0.21	0.31	0.26	-0.23				
100 grain weight (g)	I	0.18	0.35	0.35	0.25	-0.42*	0.57**			
	II	0.27	0.26	0.32	0.39*	-0.45*	0.49**	—		
	III	0.31	0.27	0.24	0.15	-0.29	0.43*			
Leaf blast resistance	I	0.32	0.43	0.36	0.29	0.28	0.27	0.22		
	II	0.31	0.25	0.21	0.42**	0.26	0.23	0.26	—	
	III	0.21	0.27	0.23	0.12	0.12	0.31	0.31		
Panicle blast resistance	I	0.22	0.21	0.22	0.46*	0.24	0.23	0.26	0.49**	
	II	0.29	0.14	0.11	0.24	0.26	0.41**	0.24	0.29	—
	III	0.31	0.24	0.26	0.21	0.21	0.23	0.36*	0.46**	
Grain yield/plant (g)	I	0.65**	0.59**	0.31	0.46**	0.59**	-0.52**	0.54**	0.49**	0.46**
	II	0.72**	0.62**	0.45**	0.42**	0.47**	-0.49**	0.39*	0.29	0.43**
	III	0.39*	0.31	0.21	0.31	0.46**	-0.43*	0.56**	0.46**	0.29

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التباين فى الصفات الكمية وتوارث مرض اللفحة في الارز تحت ظروف تقسية الرى

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آجري هذا البحث خلال موسم الزراعة2004، 2005 بمركز البحوث والتدريب في الأرز -سخا-كفر الشيخ -حيث تم التهجين بين أربعة أصناف أرز زونجهوا 2 و بى ال 1 و سخا 102 و ميزوهو لتعطى الهجن الثلاثة الاتية الهجين 1 (زونجهوا 2 x بى ال 1) والهجين 2 (زونجهوا 2 x سخا 102) والهجين 3 (سخا 102 x ميزوهو) وذلك لتقدير مكونات التباين الو راثي عن طريق تقدير المتوسطات لستة عشائر هي الآباء

والجيل الأول والجيل الثاني والهجن الرجعية لثمانية صفات تشمل المحصول ومكوناته بالإضافة إلى صفتي إصابة الأوراق والدالية بمرض اللفحة وذلك تحت ظروف الري كل 10 ايام.

أوضحت النتائج وجود فروق معنوية عالية لقيم متوسطات الأباء وخاصة الأب الأول زونجهوا 2 فى معظم الصفات المدروسة مقارنة بباقي الأباء لتحملة للجفاف كما جاءت قيم متوسطات الجيل الأول أعلى من أفضل الأباء في معظم الصفات المدروسة وخاصة طول الدالية وعددها في الهجين الأول والثاني وكذلك عدد الحبوب بالدالية في الهجين الأول والنسبة المئوية للعقم ووزن 100 حبة في الهجين الأول والثالث ومحصول النبات الفردي في الهجين الأول والثاني وإصابة أوراق النبات بمرض اللفحة في ألهجين الثاني والثالث وإصابة الدالية فى الهجين الثالث بينما جاءت باقي القيم للصفات الأخرى وسطا بين الأبوين مما يشير إلى تأثر تلك الصفات بالسيادة الفائقة والجزئية

كما كانت هناك معنوية عالية لقوة الهجين في معظم الصفات المدروسة مقارنة بمتوسط الأباء وأفضل الأباء متأثرة بقيم متوسطات الجيل الأول. كما لعبت مكونات التباين الوراثي دوراً هاماً حيث كانت هناك معنوية عالية لكل من الجزء المضيف والسيادي والتفاعل بينهما في بعض الهجن للصفات المختلفة .

كما لعب الجزء المضيف دوراً هاماً في وراثة معظم الصفات ما عدا ألهجين الأول لصفة ميعاد التزهير وطول الدالية ونسبة العقم ووزن ال100 حبة وكذلك الجيل الثالث لصفة محصول النبات الفردي وإصابة الأوراق والدالية بمرض اللفحة. كما أظهرت النتائج زيادة قيم التباين الوراثى المضيف فى كل من تاريخ التزهير للثلاث هجن المدروسة والهجين الأول لصفة طول النبات ووزن المائة حبة والهجين الثاني لصفة طول الدالية وإصابة الدالية باللفحة والهجين الثاني والثالث لمحصول النبات الفردي والهجين الثالث لإصابة الأوراق بمرض اللفحة.

كما أظهرت النتائج قيما معنوية لدرجة التوريث في كل من المدى الواسع والضيق تراوحت من متوسطة إلي عالية كما لوحظ أن أعلي قيمة للتقدم الو راثي (29.76) كانت للهجين الثاني لصفة النسبة المؤية للعقم.

اما بالنسبة لمرض اللفحة فقد اظهرت النتائج ان كل من الصنفين زونجهوا 2 و ميزوهو كانا مقاومان لمرض اللفحة فى المواقع الثلاثة (سخا والجميزة وزرزوره) فى حين ان الصنف بى ال 1 كان قابلا للاصابة فى جميع المواقع المذكورة. بينما كان الصنف سخا 102 متوسط المقاومة لمرض اللفحة فى كل من سخا والجميزة ومقاوم للاصابة فى زرزوره. كما اشارت النتائج الى ان جميع نباتات الاجيال الانعزالية (الجيل الثانى وكل من الجيل الرجعى الاول والثانى) فى الهجينيين الثانى والثالث كانت جميعها مقاومة لمرض اللفحة فى الثلاثة مواقع. فى حين تباينت الاصابة من مقاوم ومتوسط المقاومة وقابل للاصابة بين نباتات الاجيال الانعزالية للهجين الاول وذلك باختلاف المواقع.

كما كان هناك ارتباط معنوي موجب بين محصول النبات فردي وكل من عدد نورات الدالية/للنبات وعدد الحبوب الكلية بالنورة ووزن الـ 100 حبة كما كان هناك ارتباط معنوي سالب بين محصول النبات الفردي وطول النبات والنسبة المئوية للعقم .

مجلد المؤتمر الخامس لتربيه النبات – الجيزه ٢٧ مايو ٢٠٠٧

المجله المصريه لتربية النبات ١١(٢): ٩٣٥ ـ٩٥١ (عدد خاص)