GENETIC ANALYSIS FOR SOME ROOT CHARACTERS IN SOME RICE VARIETIES AND ITS RELATION TO DROUGHT

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Abstract

Four rice genotypes with different drought tolerance were crossed to produce three main crosses [IET 1444 X GZ 5688-10-3-4-1 (cross I), IET 1444 X Cica 4 (cross II), Cica4 X Sakha102 (cross III)] grown at the farm of Rice Research and Training Center (RRTC) during 2000,2001 and 2003 seasons. Six populations P1, P2, F1, F2, BC1and BC2, for each cross were benefit in the genetic study.

The most desirable mean values were detected from the parents "IET 1444 and Cica4" and their crosses for all studied characters. On the other hand, the most pronounced useful heterotic effects relative to the mid-parent and better – parent were also detected in the cross "IET 1444 X Cica4" for all studied characters. The results obtained from the mean of parents, F1 and F2 generations showed the presence of partial and over-dominance for the studied root characters .

Most of the computed parameters of scaling test were significant for all root characters, indicating the effect of non-allelic and the genotypes X environment interaction .

Additive types of gene action were of greater importance in the inheritance of most of root characters studied [especially in crosses I (IET 1444 X GZ 5688-10-3-4-1) and II (IET 1444 X Cica4)]. On the other hand, dominance genetic variance was more important than additive one in the inheritance of most studied characters. The root length, root number and root/shoot ratio could be used as a selection criteria for selecting drought tolerance cultivars under drought conditions.

Heritabillity estimates in broad and narrow senses were moderate to high and moderate to low indicating the high to low estimates of expected genetic advance, respectively. Significant and highly significant phenotypic correlation coefficient of variation were found between all root characters and grain yield /plant especially in crosses IET 1444 x GZ5688-10-3-4-1 and IET 1444 x Cica4.

From the foregoing results, it could be concluded that there is a good chance to breed for improving drought tolerance in high yielding genotypes.

INTRODUCTION

Rice is the preferred food by most Egyptians because it contributes about 20 % to the per capita cereal consumption, it consumes about 18% of the total water resources. Moreover, rice is also grown in very limited areas in the Southern Delta and middle Egypt. The rice area is annually supposed to be one million feddans, but it highly increased during the last five years due to better net return of rice comparing to other summer crops.

The importance of root system morphology especially root length, root number / plant, root fresh weight, root dry weight and root/ shoot ratio, in ensuring water capture under drought, is established for rice in drought tolerance (Price *et al.* 1997). To improve the efficiency of the root system, the inheritance of these characters that affect plasticity of the root system must be emphasized, as well as genetic factors (Mishra *et al.* 1998). We need to understand further genetic and environmental effects on morphological characteristics of roots in rice in relation to their function in water uptake. From the previous results, root length and root numbers are important in determining the water extraction rate across layers in the soil profile. The limited water capacity of rice under severe stress can be attributed to limited water absorption rate per length in the deep soil layer (reddy *et al.* 1995).

The present study aimed to determine the inheritance of some root characters which can be used as a selection criterion in selecting drought tolerance varieties.

MATERIALS AND METHODS

The present investigation was carried out at the farm of the rice Research and Training Center (RRTC), Sakha, kafr El-sheikh, Egypt, during three successive rice growing seasons,. i.e 2000, 2001and 2002. to study the inheritance behavior of some rice root characters related to drought tolerance and its relation with yield and yield components. Four rice genotypes with different drought tolerance namely, IET 1444 (Indicia type), Cica4 (Indicia type), Sakha102 (Japonica type), and GZ 5688-10-3-4-1 (Japonica type), were used in this study. These rice genotypes were taken from the pure genetic stock of the rice Research and Training Center, Field Crops Research Institute, Agricultural Research Center, Egypt. In 2000, the four genotypes were grown at RRTC farm in three dates of planting with ten- day intervals in order to overcome the differences in flowering time between the parents. Thirty days 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, hybridization between each two parents was made following the technique proposed by Jodon (1938) and modified by Butany (1961).

In 2001, parents and F_1 hybrid seed of the three crosses were planted in the nursery for F_2 seed production and simultaneously crossing between parents were made to reproduce F_1 hybrid seed and at the same time, crossing to produce BC_1 and BC_2 hybrid seed were also made during the same season. Subsequently, in the summer season of 2002, seeds of the parents and of F_1, F_2, BC_1 and BC_2 were sown in dry seedbed. Thirty- day old seedlings were transplanted in field plots. Sexteen entries belong to different generations (4 parents, 3 F_1's,3F_2's,3 BC_1 and 3 BC_2) were included in a randomized complete block design experiment with three replications. Each replicate contained 10 rows of each p_1,p_2 and 5 rows of each F_1, BC_1 and BC_2 as well as 20 rows of each F_2. Row was 5 long and 20x20 cm apart were maintained between rows and seedlings .

In all growing seasons of study, all cultural practices such as field preparation, sowing, transplanting and fertilizers were applied as recommended. Concerning irrigation water, the six populations were sown in 2002 season under drought condition after transplanting (irrigated every 10 days only). The amount of water irrigated was to 5 cm above the soil surface approximately). Weeds were chemically controlled by adding dose of 2 liters Saturn /feddan four days after transplanting. Samples for root characters study were taken at maximum tillering stage for all populations (P_1, P_2, F_1,BC_1,BC_2, F_2).

Sixty plants from each P_1, P_2 and F_1's, 90 plants from each of $BC_1$and BC_2 as well as 200 plants from each F_2 populations were taken at random.

These plants were individually harvested and threshed separately to determine the grain yield/plant and its components.

The following data for the root characters were taken:

1. Root length (cm): It was determined as the length of the root from the base of the plant to the tip of the main axis of primary root.
2. Root volume (cm3): volume of all the root system per plants was determined in cubic centimeters.
3. Root number: number of all developed secondary and tertiary root per plant was counted.
4. Root fresh weight (g) : weight (g) of the fresh root/plant.
5. Root dry weight (g) : weight (g)of the dried root/plant.
6. Root /shoot ratio (%) : Ratio of the root dry weight (g) to the shoot dry weight.

Statistical and Genetic Analysis :

The data under field condition of the present study were subjected to the proper Statistical analysis of Randomized Complete Block Design as described by Snedecor and Cochran (1967).

Significance of the genetic effects is tested in a similar manner as done in case of scaling tests.

The relative of potence ratio (p) was used to determine the nature of dominance and its directions according to the formula given by Wigan (1944) and Mather and Jinks (1971).

The amount of heterosis expressed in individual cross was determined by comparing the F_1 mean performance to the mid-parent or better- parent average values and it was estimated according to the formula by Mather (1949) and Mather and Jinks (1971).

Expected genetic variance of VBC_1, VBC_2 and VF_2 in terms of additive by Mather (1949).

Phenotypic correlation between root characters and grain yield were determined by Burton (1995).

RESULTS AND DISCUSSION

I. Mean values:

The mean values of rice root characters in the six populations for the three crosses are shown in Table (1). The date revealed that there are high differences among the four parents for all root characters . IET 1444 gave the highest mean values for all root characters, while the lowest values were recorded for Sakha 102. The F_1 means were higher than the means of the two parents in cross I and II while the lowest F_1 means were obtained in cross III. Furthermore, the F_2 mean estimates were lower than those of F_1 means in all studied crosses for all root characters except for root number / plant in cross I . In addition, BC_1 and BC_2 mean values tended towards the mean values of the recurrent parents with some exceptions . It is well known that higher root characters enable plant to grow safely under water shortage. So , IET 1444 rice cultivar and crosses I and III could be recommended under drought stress. However, Sakha 102 and its cross fail to grow well under water stress .

From the results presented in Table (1), the F_1 mean was higher than both mid- parent and high parent in the crosses I and II for root length, root number/plant, root volume, root fresh weight and root / shoot ratio, indicating the presence of partial and over-dominance for these traits which were verified by the computed values of potence ratio, heterosis and heterobeltiosis. On the other hand, the F_2 population mean was lower than the F_1 mean for all studied characters, indicating the existence of significant inbreeding depression in F_2 generation for these characters. Meanwhile, transgressive segregation was observed in the F_2 population for crosses I and III in number of roots / plant.

From the previous results, it could be indicated that, for most traits, the expression of heterosis in the F_1 might be followed by considerable inbreeding depression in F_2 performance, indicating that the non-additive gene effects governed the inheritance of such traits. This is logic and expected since there is a tendency towards homozygosity which is accelerated by 50% for each selfed generation.

The most desirable genotypes for root characters studied were the parents IET 1444 and Cica4 and their cross , proving to be useful genotypes in breeding drought tolerance program.

The results are in agreement with those reported by Sasmal (1987), EL-Hity (1993), Loresto and Chang (1994), Suframanan *et al.* (1997) and Abdallh (2000).

2. Genetic Parameters :-

2.1. Estimates of heterosis and nature of dominance

It is evident from Table (2) that highly significant and positive estimates of heterosis as a deviation from mid-parent and better-parent were exhibited in all studied crosses for all root characters. Root dry weight and root shoot ratio in cross III exhibited highly negative significant heterosis comparing to parent, while the better crosses I and III as a mid and better parents for root length, root number and root fresh weight gave insignificant heterosis. In the attendant representation, as shown in Table (2), degrees of dominance values in crosses I and II were greater than ± 1.0, offering over –dominance for all studied characters. Meanwhile, the degree of dominance in cross III ranged between zero and unity, for root length and root dry weight indicating the rate of partial dominance.

From the foregoing results in Table (2), the most desirable cross for root length, number of roots/plant, root dry weight and root /shoot ratio was that of cross II (IET 1444 x Cica4). For root volume and root fresh weight, all studied crosses showed highly significant positive heterotic effects , proving that these could be useful hybrids for improving these characters in the drought tolerance breeding program. These findings also indicated the existence of over-dominance and was ascertained again by the respective value of potence ratio which exceeding unity.

These results are similar to those reported by Bashar (1987), El-Hity (1993), El-Hissewy *et al.* (1994), Price *et al.* (1997) and Abd EL-Aty *et al.* (2002).

2.2. Estimates of gene action and genetic effects of genes

Table (3) presents the scaling test parameters (A, B and C) estimated for root characters in the three crosses. Most of the computed parameters of scaling test were statistically significant. This in turn indicates the presence of non-allelic interaction. These results showed that genotype x environment interactions were important in the inheritance of root characters.

Additive gene effects were significant in 6,3 and 1 of the 6 root characters for crosses I,II and III, respectively. This suggests that additive gene effects had a significant contribution to the inheritance of the root characters in these crosses especially in crosses I and II. (Table 4) .

In this study, the dominance gene effects appeared to be the most important one in the inheritance of most root characters with few exceptions. The magnitude of the dominance gene effects relative to the magnitude of additive gene effects were large for most root characters in the studied crosses. With regard to the individual types of digenic epistatic gene effects, the three types of gene interaction were very important in the inheritance of root characters specially root length and number of root /plant under drought stress.

These results are in agreement with those of Hong and Ichii (1996), Acharya *et al.* (1999), Abdallah (2000) and Abd EL-Aty *et al.* (2002).

2.3. Estimates of genetic variance , heritability and predicted genetic advance

Additive genetic variance, dominance genetic variance, broad and narrow-sense heritabilities and genetic advance estimates of some root characters studied for all studied crosses were shown In Table (5). The additive genetic variance estimates were higher than the dominance genetic variance in crosses I and II for root length and root /shoot ratio, while equal values of both additive and dominance genetic variance were estimated for cross III. This results indicate that additive genetic variance played an important role in the inheritance of these characters in most of the studied crosses.

Heritability estimates in broad sense were moderate to high for all studied characters. On the other hand, narrow-sense heritability were moderate to low in the three studied crosses, indicating that the selection for these characters will be more effective in late generations. Moderate to high values of predicted genetic advance were estimated for all studied crosses, These values ranged between 29.6 for root dry weight to 3.8 for number of roots /plant in cross I.

Finally, dominance genetic variance was more important than the additive genetic one , especially in crosses I and II for the studied root characters. Moreover, the dominance genetic variance was more important than the additive genetic variance in crosses III for root volume and root/shoot ratio, all three crosses for root fresh weight, crosses II and III for root dry weight . These findings proved that the dominance type of gene effects appeared to be the most effective in the genetic control of the studied root characters in the present investigation.

The role of additive genetic variance was more pronounced than the dominance one in crosses I and II for root length and for root/shoot ratio, cross I for number of roots / plant, and root dry weight. Thus, the additive type of gene action played a significant role in the genetic control of the studied root character especially in crosses I and II.

Both additive and dominance genetic variances played an important role in the inheritance of studied root characters and role of each variance type differs according to the characters in one hand and the involved cross in the other hand. Furthermore, it could be recognized that heritability estimates in broad sense were moderate to high for all studied characters, while in narrow sense, such estimates were moderate to low. These estimates are in line with those for different types of genetic variance. This in turn leads to the conclusion that these characters could be improved by the traditional breeding methods and selection could be effective mostly in late generation. This was proved by the entire values of the predicted genetic advance which were low to moderate in most cases. Different results were obtained by several investigators, moderately high to high heritability estimates in broad sense and moderately low to low narrow-sense estimates for root dry weight and root /shoot ratio were found for root length by Ekanayake *et al.* (1985), Bashar *et al.* (1993), EL-Hity (1993), EL-Hissewy *et al.* (1994), and Abd El-Aty *et al.* (2002).

Table (6). shows that significant phenotypic correlations were recorded among all yield and passable bares of rice root characters especially root length, root number, root volume and root /shoot ratio with grain yield/plant.

From the foregoing results, it could be concluded that the most desirable crosses for most of root studied characters were IET 1444 x GZ5688-10-3-4-1 and IET 1444 x Cica4 and it can be useful in breeding program for drought tolerance.

Table 1. Means and standard error of the six populations for rice root characters in the three studied crosses

Character	Crosses	Mean Performance and standard error					
		P_1	P_2	F_1	BC_1	BC_2	F_2
Root length (cm)	I	29.16± 0.38	21.70± 0.41	29.53± 0.29	28.63± 0.47	25.33± 0.48	26.21±0.39
	II	29.16± 0.38	22.20± 0.44	30.30± 0.42	27.90± 0.57	25.61± 0.57	22.72 ± 0.49
	III	22.20± 0.44	19.07± 0.41	20.91± 0.43	22.80± 0.74	21.54± 0.73	20.40± 0.58
No. of roots/plant	I	185.16± 1.32	120.36± 1.35	199.30± 1.34	168.86± 2.28	205.16± 2.18	204.00±1.73
	II	185.16± 1.32	151.13± 1.59	274.93± 1.53	162.96± 2.18	153.23± 2.20	142.26±1.68
	III	151.13± 1.58	139.54± 1.48	153.61± 1.39	173.26± 2.24	185.48± 2.11	118.19±1.69
Root volume (cm^3)	I	67.26± 1.29	21.55± 1.25	81.16± 1.27	89.03± 1.74	50.96±1.72	52.51±1.36
	II	67.26±1.29	59.62± 1.39	96.92± 1.38	72.13± 2.19	68.71± 2.10	64.91±1.61
	III	59.62±1.39	31.56± 0.70	76.51± 1.21	48.96± 1.79	52.78± 1.73	43.60±1.39
Root fresh weight (g)	I	78.63± 0.67	29.60± 0.84	80.46± 0.91	61.46± 1.25	36.50± 1.28	35.55±1.08
	II	78.63± 0.67	45.53± 1.01	8793± 0.63	55.93± 2.03	49.29± 0.84	48.25±1.51
	III	45.53± 1.01	22.99± 0.77	49.90± 0.88	23.01± 1.25	23.48± 1.29	34.98±1.05
Root dry weight (g)	I	8.85± 0.12	3.03± 0.13	8.91± 0.12	5.86± 0.29	3.50± 0.28	4.08±0.23
	II	8.85± 0.12	3.62± 0.11	9.71± 0.07	6.69± 0.07	6.34± 0.59	5.51±0.67
	III	3.62± 0.11	2.91± 0.11	3.33± 0.09	3.64± .26	3.07± 0.28	2.60±0.41
Root-Shoot ratio (%)	I	0.47± 0.01	0.27± 0.02	0.41± 0.01	0.38± 0.02	0.23± 0.02	0.37±0.02
	II	0.47± 0.01	0.29± 0.04	0.49± 0.03	40.2± 0.08	0.46± 0.60	0.38±0.07
	III	0.29± 0.04	0.31± 0.02	0.28± 0.01	0.29± 0.04	0.26± 0.02	0.26±0.04

Crosses I : IET 1444 x GZ 5688-10-3-4-1
II : IET 1444 x Cica4
III : Cica4 x Sakha 1o2

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

Character	Crosses	Heterosis %		Degree of dominance
		MP	BP	
Root length (cm)	I	16.13**	1.28	1.10
	II	17.91**	3.91**	1.47
	III	1.42	5.72**	0.16
	LSD 5 %	2.06	2.38	
	LSD 1 %	2.81	3.24	
No. of roots/plant	I	30.46**	7.67**	1.43
	II	66.53**	48.46**	3.12
	III	5.35**	1.32	1.34
	LSD 5 %	3.34	3.85	
	LSD 1 %	4.54	4.77	
Root volume (cm^3)	I	84.66**	21.87**	1.64
	II	52.68**	44.11**	8.78
	III	67.72**	28.18**	2.19
	LSD 5 %	3.30	3.82	
	LSD 1 %	4.50	5.19	
Root fresh weight (g)	I	48.61**	2.32	1.23
	II	41.65**	11.83**	1.56
	III	45.71**	9.49**	1.38
	LSD 5 %	2.77	3.20	
	LSD 1 %	3.78	4.36	
Root dry weight (g)	I	50.84**	1.13**	1.03
	II	56.41**	10.22**	1.39
	III	2.02**	-8.01**	0.18
	LSD 5 %	0.69	0.79	
	LSD 1 %	0.94	1.09	
Root-Shoot ratio (%)	I	10.86**	12.76**	0.14
	II	81.57**	46.81**	3.44
	III	6.64**	-9.62**	-1.40
	LSD 5 %	0.09	0.10	
	LSD 1 %	0.12	0.14	

Crosses I : IET 1444 x GZ 5688-10-3-4-1
II : IET 1444 x Cica4
III : Cica4 x Sakha 1o2

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

Character	Crosses	A	B	C
Root length (cm)	I	-2.43±0.61	-1.36±1.07	-5.08±1.77**
	II	-3.66±2.87	3.03±1.30*	-21.16±2.27**
	III	-1.53±0.61	0.92±0.15**	-1.40±2.54
No. of roots/plant	I	-46.74±30.91	90.60±24.70	112.10±17.63**
	II	-33.36±29.11	-119.60±20.90**	-317.20±27.81**
	III	42.20±28.77	78.16±14.61**	53.60±16.71**
Root volume (cm^3)	I	28.96±3.93**	-1.48±3.87	-24.46±3.93**
	II	-19.70±0.04**	-19.03±12.61	-60.76±7.52**
	III	-38.20±4.04**	-2.50±1.73	-69.15±6.28**
Root fresh weight (g)	I	-36.20±22.80	-37.11±29.84	-127.10±24.85**
	II	54.70±14.27**	-35.89±31.89	-107.10±16.47**
	III	-47.43±22.64*	-21.89±21.98	-28.38±21.17
Root dry weight (g)	I	-598±0.58**	-4.93±0.58**	-13.28±9.96
	II	-5.31±0.05**	0.71±1.41	-9.80±2.78**
	III	0.33±0.29	-0.11±0.03	-2.77±1.67*
Root-Shoot ratio (%)	I	-0.12±0.06*	-0.22±0.15	-0.08±0.15
	II	-0.32±0.15*	-0.06±0.13	-0.66±0.27*
	III	0.02±0.01	0.22±0.08**	-0.14±0.13

Crosses I : IET 1444 x GZ 5688-10-3-4-1
II : IET 1444 x Cica4
III : Cica4 x Sakha 1o2

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

Character	Crosses	Genetic components of generation mean					
		M	d	h	i	J	L
Root length (cm)	I	0.77*	3.30**	7.17**	3.08*	-0.43	1.07
	II	-2.96**	2.29**	20.18*	16.14**	-1.19*	-11.30**
	III	-0.23**	1.26	7.83*	7.08*	-0.30	-12.53
No. of roots/plant	I	51.42**	-36.30**	-22.07	-67.96**	-68.73**	24.14
	II	-25.88**	9.73**	80.14**	63.34**	-7.28*	190.73**
	III	12.85**	-12.21**	92.61**	84.72**	-18.01**	-205.20**
Root volume (cm^3)	I	8.11*	38.07**	107.31**	-69.94**	15.21**	-96.90**
	II	1.47**	3.41	56.20**	-22.04**	-0.40	-17.50
	III	-2.01**	-3.81	59.65**	-29.08**	-14.36**	11.70*
Root fresh weight (g)	I	-18.56*	24.97**	79**	53.72**	0.45	19.50**
	II	-18.83**	6.64**	43.25*	17.44**	-9.91**	72.14
	III	0.72**	-0.49	-31.30**	-46.94**	-11.77**	122.28**
Root dry weight (g)	I	-1.86**	2.37**	2.24**	2.41*	-0.54	36.18**
	II	-0.72**	0.36	7.13	4.02*	-2.25	52.60**
	III	-0.66**	0.57	3.07*	3.02	0.21	-3.26
Root-Shoot ratio (%)	I	0.01**	0.14*	-0.22	-0.26	0.04	0.61*
	II	0.11**	0.04	0.59**	-0.21	-0.13	0.11
	III	0.04**	0.04	0.07*	0.06	0.05	-0.04

I : IET 1444 x GZ 5688-10-3-4-1

II : IET 1444 x Cica4

III : Cica4 x Sakha 1o2

*and **: Significant at 5% and 1% levels of probability, respectively .

where: mid-parent value (m), additive (d) and dominance (h) gene action, additive x additive (i), additive x dominance (J) and dominance x dominance (L) type of gene interaction.

Table 5. Estimates of additive genetic variance (1/2 D),dominance genetic variance (1/4 H) ,broad and narrow-sense heritability and genetic advance (G .S %) for rice root characters, for the three studied crosses

Character	Crosses	Genetic variance		Heritability		G.S	G.S %
		½ D	¼ H	Broad-sense	Narrow-sense		
Root length (cm)	I	3.60	1.81	54.54	63.36	2.48	8.90
	II	6.51	1.39	59.50	49.59	3.67	16.21
	III	7.69	7.99	52.51	25.15	2.39	11.21
No. of roots/plant	I	51.54	70.22	64.32	29.64	7.14	3.80
	II	48.65	53.82	60.76	28.85	7.72	5.42
	III	45.74	58.70	61.09	26.76	7.21	4.56
Root volume (cm^3)	I	34.83	27.60	56.28	31.40	6.81	12.08
	II	52.81	55.65	65.41	31.52	8.39	12.92
	III	23.61	32.53	53.42	22.41	4.74	10.86
Root fresh weight (g)	I	15.32	16.61	57.17	27.44	7.22	11.88
	II	30.22	78.90	79.85	22.11	5.33	11.04
	III	14.98	17.67	58.46	26.79	4.12	11.81
Root dry weight (g)	I	0.43	1.71	84.62	26.54	5.23	13.13
	II	1.34	1.01	85.34	48.68	1.64	29.60
	III	0.82	5.31	94.61	21.39	6.31	24.48
Root-Shoot ratio (%)	I	0.51	0.24	87.54	62.21	0.36	9.84
	II	0.13	0.09	88.86	52.54	0.54	11.12
	III	0.06	0.08	91.66	24.19	0.17	6.63

Crosses I : IET 1444 x GZ 5688-10-3-4-1
II : IET 1444 x Cica4
III : Cica4 x Sakha 1o2

Table 6. Phenotypic correlation coefficient (rph) among all possible pairs of rice root characters and grain yield in the F_2 generation of three studied crosses

Character	Crosses	1	2	3	4	5	6
Root length (cm)	I	-					
	II						
	III						
No. of roots/plant	I	0.425*					
	II	0.227	-				
	III	0.558**					
Root volume (cm^3)	I	0.496**	0.665**				
	II	0.279	0.652**				
	III	0.399*	0.792**				
Root fresh weight (g)	I	-0.225	-0.212	0.355			
	II	-0.561**	-0.457*	-0.216	-		
	III	-0.377	0.277	0.217			
Root dry weight (g)	I	-0.552**	0.318	0.267	0.632**		
	II	-0.801**	0.301	0.462**	0.121	-	
	III	-0.581**	0.241	0.319	0.261		
Root-Shoot ratio (%)	I	0.186	0.352	0.305	0.215	0.472**	
	II	0.271	0.266	0.329	0.399*	-0.107	-
	III	0.316	0.279	0.224	0.125	0.466**	
Grain yield	I	0.651**	0.594**	0.311	0.416*	0.399*	0.425*
	II	0.721**	0.622**	0.415*	0.420*	0.411*	0.412*
	III	0.413*	0.341	0.216	0.317	0.296	0.315

Crosses I : IET 1444 x GZ 5688-10-3-4-1
II : IET 1444 x Cica4
III : Cica4 x Sakha 1o2

REFERENCES

1. Abd-Allah, A. A. 2000. Breeding study on rice (*Oryza sativa* L) Ph.D. Thesis, Fac. Of Agric., Menoufiya University, Shibin El-Kom, Egypt.
2. Abd El-Aty, M.S., A.B. Elabd and A.A. Abdallah 2002. Genetic analysis of quantitative traits in rice. 1-Yield and its related characters. J. Agric. Sci., Mansoura Univ., 27 (7):4399-4408.
3. Acharya, B.,B. Swain and K. Pande 1999. Variation in drought tolerance, its anatomical basis and inheritance in lowland rice. India Central Rainfed Lowland Rice Research Station. *Oryza.,* 36 (A): 378-379.
4. Bashar, M.D.K. 1987. Genetic studies of rice root xylem vessels and related characters in relation to drought avoidance mechanisms M.SC. Thesis. Fac. of the Grraduate School, Unv. of the philippines at los Banos.
5. Burton, G.W. 1995. Quantitative inheritance in pearl millet (penniseetum glaucum). Agron. J. 43 (9): 409-417.
6. Butany, W.T. 1961. Mass emasculation in rice. In ster. Rice Comm. Newsletter,.9:9-13.
7. EL-Hity, M.A. 1993. Estimates of genetic parameters for grain yield and some of its components in three rice crosses. Alex. J. Agric. Res. 38 (3): 335-350.
8. Ekanayake, I.J,J.C.O. Toole, D.P.Garrity and Masajo 1988. Inheritance of root characters and their relations to drought resistance in rice. Crop. Sc. Vol. 25, November- December. 1181-1186
9. El-Hissewy, A.A., A. M. El-Serafy and S.A.Ghanem 1994. Genetic variability of some root characters of rice associoated with drought resistance. Egypt. J.App.Sci., 9(6) : 431-438.
10. Hong.D.L. and M.Ichii 1996. Genetic analysis of short root in rice (*Oryza sativa* L.). Chinese Journal of Rice. 8(4):200-204.
11. Jodon, N.E. 1938. Experiments on artificial hybridization of rice.J. Amer. Soc. Agron., 30:249-305.
12. Loresto, G.C. and T.T. Chang 1994. Genetic control of rice root system associated with drought resistance. Proceeding of the 7th International Congress in Asia and Oceania. PP:77-83.
13. Mather,K. 1949. Biometrical Genetic Dover publication. Inc. London.
14. Mather,K. and J.L. Jinks 1971. Biometrical Genetic. Cornell Univ. Press Ithaca, N.Y., 231 pp.
15. Mishra, D.K. C.B. Singh and M.S. Baghel 1998. Heterosis in rice under different environments. Annals of Agric Res. 1998, 19:2.

16. Price, A.H., A.D.Tomos and D.S. Virk 1997. Genetic dissection of root growth in rice. I: Ahydroponic screen. Theoretical and Applied genetics. 95(1-2):,132-142.

17. Reddy, C.D.R. and Y.S.Nerkar 1995. Heterosis and inbreeding depression in upland rice crosses. Indian Journal of Genetic and Plant Breeding. 55(4): 389-393.

18. Savrmn, R. and N. Senthi 1997. Genotypic and phenotypic variability, heritabilirty and genetic advance in some important traits in rice. Madras Agricultural Journal. 84 (5): 276-277.

19. Sasmal, B. 1987. Relationship of root /shoot in parents F_1 and F_2 populations of rice Journal of Agronomy and Crop Science, 159 (4) : 260-263.

20. Souframanian, J., P. Rangasmy , P. Vaidyathan and M.C.Thangaraj 1997. Combining ability for drought resistance characters in hybrid rice. Indian Journal of Agric. Sci. 68(10): 687-689.

21. Sanedecor, G.W. and W.G. Cochran 1961. Statistical Methods. 5th ed. Iowa state Univ.

22. Wigan, L.G. 1944. Balance and potence in natural (populations. J. Genet. 46: 150-160.

التحليل الوراثي لبعض صفات الأرز في بعض أصناف الأرز وعلاقتها لتحمل العطش

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٢ مركز *البحوث والتدريب في الأرز-معهد بحوث المحاصيل الحقلية-مركز البحوث الزراعية-مصر*

أجريت هذه الدراسة بمزرعة مركز البحوث والتدريب في الأرز- سخا-كفر الشيخ خلال ثلاث مواسم زراعية متعاقبة هي٢٠٠٠، ٢٠٠١ ، ٢٠٠٢ . حيث تم التهجين بين ثلاثة أصناف أرز هي أي إي تي١٤٤٤ ، سيكا ٤ ، سخا ١٠٢ بالإضافة إلي سلالة مبشرة هي جي زد ٥٦٨٨-١٠-٣-٤-١ وكانت هذه التراكيب الوراثية متباينة في قدرتها علي تحمل الجفاف وتمت الدراسة بهدف تقدير مكونات التباين الوراثي عن طريق تقدير متوسطات ست عشائر هي الأباء والجيل الأول والجيل الثاني والهجن الرجعية وذلك لست صفات من الجذور وهي :-

طول الجذر-عدد الجذور- حجم الجذر-الوزن الرطب- الوزن الجاف- نسبة المجموع الجذري إلي المجموع الخضري

وكانت النتائج المتحصل عليها كالآتي :

اعطت الآباء أي إي تي ١٤٤٤و سيكا ٤ أعلي قيم مقارنة بباقي التراكيب الوراثية كما أن الهجين الناتج منهما أعطى قيم أعلي من الآباء وكان افضل الهجن المدروسة في معظم صفات الجذر خصوصاً طول الجذور وعددها وحجمها ونسبة المجموع الجذري إلي المجموع الخضري كما أعطي هذا الهجين معنوية عالية لقوة الهجين مقارنة بأفضل الآباء كما تراوحت درجة السيادة من سيادة فائقة إلي سيادة جزئية بناءاً علي المتوسطات المتحصل عليها لمعظم الصفات المدروسة. كانت هناك قيم هجن كبيرة لكل من التأثير الإضافي والسيادي لكل من طول الجذر وعدد الجذور والوزن الغض للمجموع الجذري ونسبة المجموع الجذري إلي المجموع الخضري في معظم الهجن المدروسة.

كما كان هناك دور كبير للتفاعل الإضافي × الإضافي للهجين رقم ١، ٢ لصفة الوزن الجاف للجذر ونسبة المجموع الخضري .

كما كان للتفاعل الإضافي × السيادي دور هام في كل الهجن المدروسة لصفة عدد الجذور والهجن (١،٣) لصفة حجم الجذر والهجن (٢،٣) لصفة الوزن الغض للجذر كما كان هناك دور فعال للتفاعل السيادي × السيادي للهجين الثاني لصفة طول الجذر والهجن أرقام (٢،٣) لصفة عدد الجذور والهجن أرقام (١،٣) لصفة حجم الجذر والهجن أرقام (١،٢) لصفة الوزن الجاف للجذر.

وجد أيضاً أن قيمة التباين الوراثي المضيف أعلي من التباين الوراثي السيادي للهجين الأول لصفة طول الجذر-حجم الجذر- نسبة المجموع الجذري إلي المجموع الخضري وفي الهجين الثاني لصفة طول الجذر والوزن الجاف للجذور ونسبة المجموع الجذري إلي المجموع الخضري وتراوحت مقدار الزيادة من ضعيفة إلي متوسطة فأكثر كما تراوحت قيمة درجة التوريث في المعني الواسع من معتدلة إلي عالية بينما تراوحت نسبة التحسين المتوقع من الانتخاب من منخفضة إلي عالية وأعطي الهجين الثاني أعلي قيم بالنسبة للتحسين المتوقع من الانتخاب مقارنة بباقي الهجن المدروسة.

كان هناك ارتباط معنوي بين صفة محصول النبات الفردي لكل من طول الجذر وحجم الجذر و نسبة المجموع الجذري إلي المجموع الخضري وخاصة الهجين الثاني .

وجد من الدراسة أن الهجين رقم ١(أي إي تي ١٤٤٤ / جي زد ٥٦٨٨-١٠-٣-٤-١) والهجين رقم ٢(أي إي تي ١٤٤٤ / ، سيكا ٤) كانت افضل الهجن في معظم الصفات تحت الدراسة وبالتالي يمكن الاستفادة منهما في برامج التربية لتحمل العطش في محصول الأرز.