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EVALUATION OF SOME RICE (*Oryza sativa* L.) GENOTYPES UNDER WATER STRESS CONDITIONS

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ABSTRACT

Laboratory experiment was conducted at Seed Technology Research Unit in Mansoura, Dakahlia Governorate, Field Crop Research Institute Agricultural research center to evaluate germination and seedling growth of fifty-one rice genotypes under water stress conditions induced by 20% of polyethylene glycol 6000. Also, Field experiments were carried out at Sakha Farm Station, Kafr El-Sheikh Governorate during 2009 and 2010 seasons to evaluate the same fifty-one rice genotypes under flashing water irrigation every 12 days. The results indicated that 20% of PEG solution inhibited all seedling characters in the most of rice genotypes. Giza 178, Sakha 104, Sakha 101, Sakha 102, Rb 10, IET 353, Bala, Cica 4 Giza 172, Giza 181, Bl 1, Mizuho, Yabani M 52, Suweon 351, Suweon 353, BG 367 and Co 39 were superior than IET 1444 (control) in root , shoot lengths and seedling weight. The aforementioned rice genotypes not more affected by PEG therefore, more resistance to water deficit. Also, the highest number of panicles/plant, 100-grain weight, grain yield/plant, the lowest values of panicle length and sterility % were resulted from Giza 178, Sakha 101, Sakha 102, Sakha 104, IET 353, Cica 4, Bala, Giza 181 and Co 39. Genotypic and phenotypic coefficients of variation (GCV and PCV) were found to be high for most of studied characters. Broad- sense heritability estimates ranged from moderate to high for all studied characters. High expected genetic advance was associated with high heritability. High heritability values coupled in number of filled grains/panicle, plant height, germination %, days to 50% heading and grain yield/plant. These characters showed to be highly heritable, points to the predominance of additive gene effect, easily fixable and can be taken as unit characters for effective selection. Also, high genetic advance with high heritability, lead to conclude that effectiveness of selection of most studied traits, might be practiced in the advanced generations. Grain yield/plant was strongly phenotypic positively correlated with germination %, root and shoot lengths, seedling vigor index and seedling weight. The results showed that the amount of added water to the genotypes studied ranged from 4012.63 to 4819.17 m^3/fed. The m^3 of water gave the highest of grain yield in Bala, Giza 178, Sakha 104, Sakha 101, Yamgdoeg, Giza 181, Sakha 102, Sakha 103, IET 353, TKY 104, Co 39, Bl 1, Yabani M55, GZ2447-5-7 and Cica 4 followed by IET 1444(780, 770, 760, 740, 710, 710, 700, 700, 690, 690, 680, 650, 630, 610, 580 and 580 g/m^3, respectively). It could be concluded that rice genotypes under study is considered the best parents for drought recovery ability and could be considered as a donor in crossing with drought tolerance to cover the growing rice area which affected by water shortage in the terminal of irrigation canal.

Keywords: Rice, germination, seedling vigor, Genotypes, water deficit, Genetic variability, yield.

INTRODUCTION

The problem of water deficit is fundamental big problem for rice growing in Egypt. Approximately of one-third of rice area affected by water shortage, this area is located in North Nile Delta or in the terminal of irrigation canals. One of the pertinent avenues for over come this problem is screening of some rice genotypes under water deficit to make new crosses with desirable characters related to drought tolerance to cover more than one-third of rice growing area in Egypt.

Rice is one of the most important cereal crops in Egypt. Rice is a semi aquatic crop plant that requires high amount of water in the field for proper growth and development. Its impact on economy lies within the fact that it occupies about 22% of the planted area in Egypt during the summer season. Moreover, rice is an important export crop. The amount exported was 500.000 tons. The rice area is increased during the last five years to about one million and half feddans (Badawi and Draz, 2004). In Egypt, the success in releasing new rice varieties suitable for drought conditions will not only increase the rice production but also, maximum the farmer's income. Recently, water of the river Nile is not sufficient for irrigation of both old and reclaimed areas. Therefore, water saving becomes argent demand to face this problem through either prolong irrigation intervals without any drastic effect on the grain yield, or growing drought tolerant varieties, which have a capability to grow under shortage of water (Nour, 1989 and Mady,2004). Therefore, efforts are needed to develop improved rice cultivars with early maturity and higher grain yield potential. Saving rice food in Egypt is challenged by increasing rice demand and threatened by declining water availability. More than 6 million ton of paddy rice were produced from 1.5 million feddans of irrigated (0.63) million hectares area which largely depends largely on the irrigated system of rice production. However, the water use efficiency of rice is low, and growing rice requires large amounts of water. Rice transplanting usually requires a large amount of labor usually at critical time for labor availability, which often results in shortage and increasing labor costs. Alternate methods of establishing crops, especially rice crop that require less labor and water without sacrificing productivity are needed. A fundamental approach to reduce water inputs in rice is to grow the crop like an irrigated upland crop such as wheat or maize. Upland crops are grown in non-puddle aerobic soil without standing water (Mujataba *et al.*, 2007). Less water requirement is a set of characteristics that should be incorporated into future rice cultivars to meet the needs of various environmental and water regimes. Balch *et al.* (1996) found that seed germination and plant growth were significantly inhibited by polyethylene glycol (PEG) imposed water deficit in Sinaloa, IR 10120 and Chiapas cultivars which were more tolerant to water stress. Lian *et al.* (2004) Studied different morphological and physiological responses of upland rice (*Oryza sativa* L. spp indica cv. Zhonghan 3) and lowland rice (*Oryza sativa* L. spp japonica cv. Xiushui 63) to water deficit (20% polyethylene glycol (PEG) 6000 treatment). They observed that yong leaf rolling decline of cumulative transpiration in the upland rice. Soil moisture deficit significantly reduces rice yield (Farooq *et al.*, 2006). Jiang and Lafitte (2007) Studied fifteen rice cultivars with different drought resistant ability (7.8 x 10^6 mol/L ABA and 30% PEG 1500 (-101Mpa) which used to culture the germinated seeds for 5 days compared with normal condition (distilled water). PEG applied could inhibit the growth of plumule

J. Plant Production, Mansoura Univ., Vol. 2 (2): 307 - 326, 2011

and radicle and significant differences existed among genotypes in the reduction rate of plumule and radicle. Estimates of variability in respect of yield and its heritable components in the material with the breeder is working are prerequisites for any breeding program. Hence, it is also necessary to spill the phenotypic variability into heritable and non-heritable components by helping of certain genetic parameters such as genotypic (GCV) and phenotypic (PCV) coefficients, heritability and genetic advance.

The objectives of this study are: (1) screening some of rice genotypes under water stress conditions using water deficit induced by PEG in the seedling stage and flashing water irrigation every 12 days in the field, (2) making new crosses with desirable characters related to drought tolerance in rice and (3) over coming the water shortage area cultivated by rice.

MATERIALS AND METHODS

Laboratory and field experiments were used to evaluate fifty one rice genotypes. The laboratory experiment was conducted at Seed Technology Research Unit, Mansoura, Dakahlia Governorate, Field Crop Research Institute, Agricultural Research Center to evaluate germination and seedling growth characters under water stress conditions induced by 20% of polyethylene glycol (PEG) 6000. The field experiments were carried out at Sakha Farm Stations during 2009 and 2010 seasons using flashing water irrigation every 12 days to study the screening some of rice genotypes under water deficit to make new crosses with desirable characters related to drought tolerance such as seedling, yield and its component. Also, estimates genetic variance, heritability and genetic advance to dissolve the water deficit in the terminal of irrigation water canal in the future to low new recompilation and importance genotypes. Fifty one rice genotypes namely, Sakha 101, 102, 103 and 104, Yamgdeog, Sangiu, Giza 159, 170, 171, 172, 175, 176, 177, 178, 181 and 182, Riho, Agami M1, Mizuho, IET 353, Rb 10, Bala, GZ 2447-5-7, Tky 104, Co 39, Yabani M 52, Yabani M55, Shinrei, RD, Nishihomari, Cica 4, Milyang 54, Milyang 80, Milyang 85, Milyang 95, Milyang 97, Milyang 109, Suweon 332, Suweon 346, Suweon 349, Suweon 351, Suweon 353, Suweon 375, Suweon 381, BG 367-4, BG 35-2, Hexi 5, Pi no 4, BL 1, Toride 1 and IET 1444 as the (control). These rice genotypes were taken from the pure genetic stock of Rice Research and Training Center (RRTC).

Laboratory experiment:

Seeds of widely grown fine rice were obtained from pure stock of RRTC. The initial seed moisture content and germination percentage were 14.87 and 99%, respectively. Seeds of each rice genotype were sown and subjected to standard germination test as the rules of International Seed Testing Association (ISTA, 1985). The filter paper welted with 20% of PEG 6000 solution used to impose water stress in rice seeds. A completely randomized design with four replicates was used. At the end of standard germination test after 14 days from sowing the following characters were determined: Germination percentage was expressed by the percentage of the total number of normal seedlings. Shoot and root lengths (cm) were determined from 10 normal seedlings taken at random from each replicate, then seedling weight (mg). Seedling vigor index was calculated by the following equation of ISTA Rules, 1985:

Seedling vigor index = Seedling length (cm) × germination percentage.

Field experiments:

In the summer seasons of 2009 and 2010, seeds of rice genotypes were sown in dry seedbed. Thirty days old seedlings from each genotype were individually transplanted in 10 rows/replicate. Rows were 5 m in length and the plant geometric distribution was 20 x 20 apart between rows and hill. Each row was contained 25 hills. A randomized complete block design with three replicates was used. The normal cultural practices for growing rice crop were followed according to the recommendation of RRTC. Flash water irrigation was used every 12 days. The depth of water was 5 cm above the soil surface approximately. Weeds were chemically controlled by adding dose of 4.76 liters/ha of Saturn in the fourth day after transplanting. Leaf rolling and leaf damage were recorded according to standard evaluation system for rice (IRRI, 1996).

These plants were individually harvested and threshed separately to determine the grain yield and its components. The grain yield and its related studied characters {days to 50% heading, plant height (cm), panicle length (cm), number of panicles/plant, number of filled grains/panicle, 100 grain weight (g), sterility % and grain yield (g/plant)} were studied. The main effect of genotype was tested as suggested by Cochran (1951) with effective degree of freedom according to Satterthwaite (1946). Phenotypic and genotypic coefficients of variability (PCV and GCV), broad –sense heritability and expected genetic advance at 5 % selection were estimated by using formula suggested by Johanson *et al.* (1955). Phenotypic correlation coefficients were estimated by the method of Dewey and Lu (1959).

Soil physical properties:

Physical properties of the experimental field were determined, according to FAO (1976) and Black (1965) as shown in (Table 1).

Table 1: Soil physical properties of the experimental site

Soil depth (cm)	Particle size distribution			Bulk density (g/cm^3)	Soil texture
	Sand (%)	Silt (%)	Clay (%)		
0-20	10.32	21.19	68.94	1.08	Clayey
20-40	14.39	22.54	63.07	1.24	Clayey
40-60	18.62	25.12	56.26	1.35	Clayey

Monitoring soil moisture:

Soil samples were collected two days before and after each irrigation treatment from three successive layers (20 cm each) to determine soil moisture content (Table 2).

Table 2: Soil moisture contents of the experimental site

Soil depth (cm)	Field capacity (F.C) %	Permanent wilting point (PWP) %	Available water (AW) (cm)

0-20	42.27	21.14	21.13
20-40	39.89	19.95	19.94
40-60	33.36	16.68	16.68

Climatologic elements:

Values of the climatologically elements were obtained from The Meteorological Station at El Karada, Kafr El-Sheikh, Governorate (Table 3), situated at 30 to 47 north latitude and 31 longitude and 15 m altitude. It represents the circumstances and conditions of the North Delta. Average values of temperature (°C), air relative humidity (RH %**)** and pan evaporation (mm/day) were recorded daily during two studying seasons. Values of the other climatologically elements, wind speed (kem/day), solar radiation (cal/cm^2 /day) were obtained as the normal values of 20 years from 1962-1982 (FAO. 1984).

Table 3: Monthly of meteorological data over two seasons

Months	Temperature (°C)	RH (%)	Solar radiation (cal/cm^2/day)	wind velocity (Km/day)
June	25.82	68.63	585	112.00
July	26.73	70.25	598	101.00
August	29.62	69.74	600	96.00
September	26.84	81.62	588	98.00

Estimation of the potential evapotranspiration (ETp):

ETp was estimated for four months from June until September in two seasons and used.

Modified penman:

$$ET_p = C \{(W. R_n + (1- w). f(u) (ea - ed)\} \text{ (FAO, 1990).}$$

Where: ET_p **=** potential crop evapotranspiration in (mm/day), **C =** adjustment factor to compensate for the effect of day and night weather conditions, W **=** temperature – related weighting factor, R_n = net radiation in equivalent evaporation in (mm/day), f (u) **=** wind – related function and (ea – ed) = difference between the saturation vapor pressure at mean air temperature and the mean actual vapor pressure of the air, both in mbar.

Radiation method:

$$ETp = C \times (W. Rs)$$

Where: ETp = potential crop evapotranspiration (mm/day), C = adjustment factor which depends on mean humidity and daytime wind conditions, W = weighting factor which depends on temperature and altitude and Rs = the solar radiation expressed in equivalent evaporation (mm/day).

Pan evaporation method:

Potential evapotranspiration (ETp) can be obtained from the following equation:

$$ETp = Kp. Epan \text{ (mm/day).}$$

Where: Kp **=** pan coefficient depends on type of pan conditions of humidity, wind speed and pan environmental conditions and Epan **=** pan evaporation (mm/day) and represent the mean daily value of the period considered.

Estimation of crop coefficient (KC):

Crop coefficient was estimated according to FAO (1990) as follows:

$$\mathbf{ETc = ETp \times Kc}$$

Where: ETc = Actual evapotranspiration (mm/day) and ETp = Potential evapotranspiration calculated by the modified penman equation (mm/day), and Kc = Crop coefficient.

The amount of water needed for land preparation for nursery or permanent field was recorded, beside the amount of water needed for raising the nursery or through the first nine days after transplanting (seedling establishment period), as well as the amount of water used for replenish the plots. Water depth at every irrigation, was kept at 5 cm as water head.

Soil water relations:

Total of water applied i.e. the amount of water delivered each plot plus amount of water applied in both nursery and permanent field for applying three water treatments was measured for each genotype.

Water consumptive use:

Soil moisture content was determined before and after each irrigation to calculate water consumptive use according to Iseraelson and Hansen (1962) as follows:

$$Cu = \sum_{i=I}^{n=1} \frac{\theta_2-\theta_1}{100} \times Bd \times D \times 4200\ m^2$$

Where: Cu = water consumptive use in each irrigation (cm^3), θ_2 = soil moisture percent after irrigation (%), θ_1 = soil moisture percent before irrigation (%), Bd = soil bulk density in (g/cm^3), n = number of irrigation, I = number of soil layer, D = depth of soil layer of the soil (cm) and 4200 m^2 = area of feddan.

Crop water use efficiency (CWUE):

It was calculated according to Hansen *et al.* (1980) equation:

$$\text{CWUE (kg/m}^3\text{)} = \frac{\text{Yield (kg/fed)}}{\text{Water consumptive use (m}^3\text{/fed)}}$$

Field water use efficiency (FWUE):

It was calculated according to Michael (1978) equation:

$$\text{FWUE (kg/m}^3\text{)} = \frac{\text{Yield (kg/fed)}}{\text{Water applied (m}^3\text{/fed)}}$$

Statistical analysis:

Statistical analysis was performed using analysis of variance technique (ANOVA) by means of "MSTAT-C" computer software package (Nissen *et al.*, 1985) as published by Gomez and Gomez (1984). Using the least significant difference test (LSD) compared differences among treatment means at the level of 5% and 1% of probability.

RESULTS AND DISCUSSION

Laboratory experiment:

Germination ability of 51 rice genotypes were shown in Table 4. The results revealed that germination %, root and shoot lengths, seedling vigor index and seedling weight of all rice genotypes significantly affected by concentration of 20% PEG. However, differential tolerance of rice genotypes was observed. Germination % ranged from 32% to 89% for Milyang 109 and Giza 178, respectively. The highest values of germination percentage (89, 86, 85, 83, 83, 82, 82, 81, 81, 79, 79, 79,79 and 78%) were recorded from Giza 178, Sakha 104, Bala, Rb 10, Sakha 101, Giza 172, Giza 181, IET 353, BL 1, Mizuho, Co 39, Pi no 4, PG35-2 and IET 1444, respectively as compared with the control. While, the lowest germination percentage (56, 55, 54, 52, 52, 51, 49, 47, 43, 33 and 32%) were recorded from Milyang 85, Milyang 97, Milyang 80, TKY104, Milyang 54 Suweon 381, Suweon 375, Suweon 332, Hexi 5, Milyang 95 and Milyang 109, respectively. Root length significantly differed among rice genotypes and ranged from 3.1 to 16.5 cm for Hexi 5 and IET 1444, respectively. The maximum root length (16.5, 15.0, 14.6, 14.2, 14.2, 13.6, 13.2, 12.4 and 12.1 cm) produced from IET 1444, Cica 4, Yabani M 52, Sakha 104, Bl 1, Suweon 353, Suweon 351, BG 367-4, Bala and Shinrei, respectively. On the other hand, Giza 171, Suweon 346, Milyang 95, Giza 175, Riho, Suweon 375, Giza 176, Milyang 109 and Hexi 5 were more negatively affected and had the shortest root length (6.2, 6.1, 5.8, 5.6, 5.3, 5.1, 4.8, 4.1, and 3.1 cm, respectively) under water stress imposed by PEG. Shoot length was differently inhibited by treatment of 20% of PEG and ranged from 4.1 to 12.5 cm for Hexi 5 and Bala, respectively. The lowest shoot length (5.6, 5.6, 5.4, 5.2, 5.2, 5.1, 4.6, 4.4, 4.2 and 4.1 cm) were obtained from Milyang 80, BG 35-2, Giza 175, IET 353, Suweon 346, Suweon 381, Milyang 109, Suweon 375, Giza 176 and Hexi 5 , respectively. Whilst, the highest shoot length 12.5, 12.4, 12.2, 12.1, 11.6, 10.8, 10.6, 10.3, and 9.8 cm) were recorded from Bala, Mizuho, Sakha 104, Giza 172, Giza 181 , Sakha 101, Yabani M 52, Co 39, and IET 1444, respectively. Polyethylene glycol (PEG) has been used to induce water stress in hydroponics culture and was found effective way for screening drought tolerance at early growth stage (Bhupinder *et al.*, 1998 and Jing and Chang, 2003). Osmotic stress could affect cell elongation by cell division and cell enlargement (Cleland, 1981 and Taiz, 1984).Similar results have been reported by Balch *et al.*, 1969 and Jiang and Lafitte, 2007.

Seedling vigor index significantly differed among rice genotypes and ranged from 2.8 to 22.7 for Milyang 109 and Sakha 104, respectively (Table 4). The highest seedling vigor index(22.7, 20.9, 20.5, 19.1, 18.9, 18.8, 18.6, 17.5, 17.2, 17.1, 16.7, 16.4, 16.4, 15.7, 15.6, 15.0 and 14.5 were resulted from Sakha 104, Bala, IET1444, Giza 172, BI 1, Giza 181, Cica 4, Sakha 101, Pi no 4, Mizuho, Suweon 353, Co 39, Yabani M52, Giza 178, Bg 35-2, Suweon 351 and Shirei, respectively. Vice versa, the lowest seedling vigor index was obtained from the other genotypes under study. Concerning to seedling weight, mean values of seedling weight was ranged from 2.2 to 8.2 mg for Hexi 5 and Sakha 104, respectively. The heaviest seedling weight (8.2, 7.6, 7.4, 7.3, 7.1, 6.9, 6.8, 6.7 and 6.5 mg) were resulted from Sakha

104, Bala, Giza 172, Mizuho, Giza 181, Co 39, Cica 4, Sakha 101 and IET 1444, respectively. On the contrary, the lightest seedling weight (3.4, 3.4, 3.3, 3.3, 3.2, 3.1, 3.0, 2.9, 2.8 and 2.2 mg) were recorded from Giza 171, BG 35-2, Giza 159, Milyang 80, Sakha 103, Sakha 102, Giza 175, Giza 176, Milyang 109 and Hexi 5, respectively. These results are in agreement with those reported by Takaki (1990), Eugenio *et al.* (1996), ChiBuu and Lang (2003) and Mujataba *et al.* (2007).

Table 4: Germination % and seedling vigor characters of 51 rice genotypes under water stress conditions (PEG 6000)

Characters Genotypes	Germination %	Root length (cm)	Shoot length (cm)	Seedling vigor index	Seedling weight (mg)
Sakha 101	83	10.3	10.8	17.5	6.7
Sakha 102	59	5.3	6.1	6.7	3.1
Sakha 103	68	7.8	6.6	8.9	3.2
Sakha 104	86	14.2	12.2	22.7	8.2
Yamgdeog	73	9.6	10.1	14.4	6.1
Sangiu	69	7.2	7.5	10.1	4.2
Giza 159	62	6.6	6.1	7.9	3.3
Giza 170	60	7.3	9.2	9.9	5.8
Giza 171	58	6.2	6.9	7.6	3.4
Giza 172	82	11.2	12.1	19.1	7.4
Giza 175	62	5.6	5.4	6.8	3.0
Giza 176	53	4.8	4.2	4.8	2.9
Giza 177	63	6.3	6.2	7.9	3.1
Giza 178	89	8.3	9.3	15.7	5.6
Giza 181	82	11.3	11.6	18.8	7.1
Giza 182	75	6.6	7.8	10.8	4.5
Riho	63	5.3	6.3	7.3	3.2
Agami M1	77	8.1	7.9	12.3	5.1
Mizuho	79	9.2	12.4	17.1	7.3
IET 353	81	6.6	5.2	9.6	3.4
Rb 10	83	7.5	8.4	13.2	5.5
Bala	85	12.1	12.5	20.9	7.6
GZ 2447-5-7	63	8.8	9.4	11.5	5.8
TKY 104	52	7.3	6.2	7.0	3.6
Co 39	79	10.4	10.3	16.4	6.9
Yabani M52	65	14.6	10.6	16.4	5.7
Yabani M55	63	8.5	6.3	9.3	4.1
Shinrei	72	12.0	8.1	14.5	5.6
Rd	73	10.14	7.3	12.7	3.7
Nishihomari	53	7.2	6.4	7.2	4.1
Cica 4	77	15.0	9.2	18.6	6.8
Milyang 54	52	9.1	7.3	8.5	4.3
Milyang 80	54	7.6	5.6	7.1	3.3
Milyang 85	56	8.9	6.1	8.4	4.2
Milyang 95	33	5.8	5.3	3.7	4.7
Milyang 97	55	8.8	6.2	8.3	3.9
Milyang 109	32	4.1	4.6	2.8	2.8
Suweon 332	47	7.8	6.1	6.5	4.1
Suweon 346	42	6.1	5.2	4.7	3.9
Suweon 349	53	8.4	6.1	7.7	4.1
Suweon 351	70	13.2	8.2	15	5.5
Suweon 353	75	13.6	8.6	16.7	5.9
Suweon 375	49	5.1	4.4	4.7	2.7
Suweon 381	51	7.0	5.1	6.2	3.1
BG 367-4	79	12.4	7.3	15.6	4.9
BG 35-2	62	8.3	5.6	8.6	3.4
Hexi 5	43	3.1	4.1	3.1	2.2
Pi no 4	79	13.7	8.1	17.2	5.7
Bl 1	81	14.2	9.1	18.9	5.9

Toride 1	69	8.3	5.7	9.7	4.2
IET 1444 (control)	78	16.5	9.8	20.5	6.5
Range from	32	3.1	4.1	2.8	2.2
To	89	16.5	12.5	22.7	8.2
LSD at 5%	3	2.4	2.0	2.8	1.4
1%	7	5.3	3.5	5.0	3.0

Finally, from the results obtained, we could be mentioned that 20% of PEG inhibited germination %, root and shoot lengths, seedling vigor index and seedling weight for all rice genotypes. While, the response of genotypes to water deficit was different from genotype to other. The rice genotypes Giza 178, Sakha 104, Sakha 101, Sakha 102, Rb 10, IET 353, Bala, Cica 4, Giza 172, Giza 181, Bl 1, Mizuho, Yabani M52, Suweon 351, Suweon 353, BG 367 and Co 39 were superior to IET 1444 genotype (control) for root, shoot lengths and seedling weight. These rice genotypes mentioned above not more affected by 20% of PEG therefore, more resistance to water deficit. Genetic variations in water deficit offer the differences in phonology, morphology, physiology and biochemical. The differences of water deficit return to unique opportunity to compare changes in metabolic processes by crossing and a commutation to desirable genes resistance to water deficit. The detailed knowledge of these mechanisms may by important for the application of specific strategies in genetic improvement for water stress in rice genotypes.

Field experiments:

Yield and its related characters:

Yield and its related characters for rice genotypes are presented in Table 5. Mean values of leaf rolling and leaf damage was ranged from zero to 8.9 and 8.7, respectively. Sakha 101, Sakha 102, Giza 170, Giza 178, Giza 181, Agami M1, Mezuho, Bala, GZ 2447-5-7, Co 39, Yabani M 52, Shinrei, Cica 4, Suweon 351, Suweon 353, Pi no 4, Bl 1 and IET 1444 slight affected by water stress condition in the field and recorded zero mean values for leaf rolling and damage. While, the remaining rice genotypes were differed for resistance to water deficit depended on differed in rice germoplasm which resulted to different in phonology, morphology, physiology and biochemical among the rice genotypes. Similar findings were stated by lian *et al.*, 2004.

A wide range of days to 50% heading was detected and ranged from 92.2 days in Yabani M 52 to 115.1 days in TKY 104. Yabani M52, Suweon 381, Suweon 346, Pi No. 4, Suweon 375, BL 1, Suweon 353, Milyang 97, Hexi 5, Suweon 332, and Giza 181 were found to be earlier than the others. The values were 92.2, 92.6, 95.1, 95.5, 95.6, 97.2, 97.4, 98.5, 98.8, 99.3 and 99.8, respectively.

Table 5: Grain yield and its related characters of 51 rice genotypes under drought conditions (combined data)

Characters Genotypes	Leaf rolling	Leaf damage	Days to 50% heading	Plant height (cm)	Panicle length (cm)	No. of panicles/ plant	No. of grains/ panicle	100 -grain weight (g)	Sterility %	Grain yield (g/plant)
Sakha 101	0	0	108.2	89.7	18.7	11.3	100.3	2.3	32.2	25.8
Sakha 102	0	0	103.1	72.3	11.5	10.5	112.5	2.5	35.4	25.6
Sakha 103	5.7	5.5	107.3	79.5	18.8	10.8	123.3	2.2	19.3	21.4
Sakha 104	8.9	8	111.4	62.8	10.9	17.5	98.5	2.5	13.5	26.4
Yamgdeog	7	6.5	103.2	72.9	11.7	9.4	109.6	1.4	12.6	21.7
Sangiu	8.9	5.7	100.3	69.7	10.9	6.1	85.5	2.2	13.5	15.6
Giza 159	7.9	8.9	105.6	75.4	10.8	8.2	99.8	2.5	15.9	18.5
Giza 170	0	0	110.7	70.9	18.5	7.5	89.9	2.4	10.8	16.4
Giza 171	8.9	8.7	104.3	88.6	13.2	9.4	119.3	2.4	17.4	19.3
Giza 172	3.3	3.5	111.4	76.3	12.6	11.2	99.4	2.1	10.7	23.4
Giza 175	8.5	8.7	110.6	93.4	13.7	8.3	105.5	1.5	19.2	12.3
Giza 176	0	7.2	109.5	75.5	11.4	5.1	110.5	2.7	10.5	10.7
Giza 177	5.3	4.1	108.7	70.5	12.5	7.2	98.8	2.4	9.5	16.4
Giza 178	0	0	110.6	72.5	13.7	14.5	97.1	2.3	8.5	31.3
Giza 181	0	0	99.8	70.1	14.4	9.3	84.5	2.5	15.3	24.6
Giza 182	5.2	5.9	101.8	65.3	10.5	6.3	84.4	2.6	8.6	16.8
Riho	4.9	5.2	105.4	62.5	13.8	6.1	94.6	2.4	9.5	15.5
Agami M1	0	0	100.8	74.2	10.5	8.3	85.2	2.2	13.4	18.9
Mizuho	0	0	100.6	70.4	11.3	7.4	89.5	2.2	16.5	20.6
IET 353	4.6	5.1	100.4	81.6	8.6	10.3	132.3	2.1	9.8	25.5
Rb 10	5.3	4.2	104.5	85.5	10.4	8.5	133.9	2.2	14.5	14.5
Bala	0	0	113.6	75.3	19.5	12.4	125.4	2.1	17.4	24.8
GZ 2447-5-7	0	0	109.3	73.2	15.5	10.2	115.6	2.4	13.3	23.6
TKY 104	3.5	2.4	115.1	91.4	12.4	11.3	111.3	2.0	11.6	22.6
Co 39	0	0	101.5	75.5	19.3	13.4	108.3	1.6	15.5	24.5
Yabani M52	0	0	92.2	76.2	11.6	7.5	94.1	2.3	20.9	16.3
Yabani M55	6.4	5.4	106.3	92.1	15.5	8.3	113.3	2.4	16.8	19.9
Shinrei	0	0	103.4	70.7	16.8	8.1	62.2	1.5	10.7	10.8
Rd	3.1	3.6	100.1	75.8	12.7	7.4	53.8	2.4	9.5	15.5
Nishihomari	6.8	6.1	110.4	68.9	12.7	6.2	50.7	2.3	25.4	9.5
Cica 4	0	0	100.2	65.6	10.4	10.8	110.2	2.2	36.6	24.9
Milyang 54	5.3	4.2	102.4	59.3	13.2	9.1	82.5	2.2	32.5	18.6
Milyang 80	6.1	6.4	100.6	68.2	13.9	8.3	121.4	2.1	19.4	16.8
Milyang 85	4.1	5.8	104.3	72.2	18.6	9.5	101.3	1.9	12.5	15.7
Milyang 95	5.8	6.7	100.8	75.3	11.4	5.4	104.6	1.9	13.2	9.3
Milyang 97	4.9	5.2	98.5	79.4	9.5	7.6	90.5	1.8	10.5	13.5
Milyang 109	7.9	8.7	100.2	82	9.2	10.2	110.4	2.1	12.5	19.4
Suweon 332	6.1	6.9	99.3	65	10.7	8.6	100.3	2.2	17.4	18.6
Suweon 346	6.9	7.1	95.1	80	14.9	5.3	99.8	2.1	19.6	9.5
Suweon 349	4.3	5.8	101.4	69.3	13.8	5.5	110.3	2.2	29.8	10.4
Suweon 351	0	0	100.6	68.5	10.5	6.4	92.5	2.5	18.6	15.2
Suweon 353	0	0	97.4	65.2	9.3	6.6	89.2	2.6	19.4	16.3
Suweon 375	7.2	8.6	95.6	73.4	13.7	4.5	70.1	2.5	39.1	8.6
Suweon 381	6.9	6.1	92.6	70.6	10.8	7.4	132.4	1.5	30.5	10.5
BG 367-4	2.5	3.2	108.4	62.5	14.9	10.8	108.5	1.6	20.8	15.9
BG 35-2	3.1	4.9	100.3	59.4	13.6	6.4	70.2	2.0	15.7	11.8
Hexi 5	7.4	8.3	98.8	87.8	11.5	4.5	73.2	2.2	30.5	8.7
Pi no 4	0	0	95.5	73.6	12.2	10.3	119.5	2.1	18.5	22.2
Bl 1	0	0	97.2	74.5	8.4	9.4	114.9	2.4	18.5	10.6
Toride 1	5.8	6.9	100.6	70.3	13.3	7.4	92.3	2.3	25.6	15.9
IET 1444 (control)	0	0	100.3	89.3	14.5	10.3	101.4	2.3	10.4	24.5
Range: from	0	0	92.2	59.3	8.4	4.5	50.7	1.4	8.6	8.6
To	8.9	8.7	115.1	93.4	19.5	17.5	133.9	2.7	36.6	31.3
LSD at 5%	2.0	1.8	7.4	6.2	1.6	4.7	9.6	1.62	2.8	4.6
1%	2.8	3.5	16.3	9.9	3.0	8.4	11.3	3.26	3.3	8.5

Hence, it could be concluded that such genotypes might be valuable in breeding for earliness and shortness under drought conditions. The mean values in plant height ranged from 59.3 to 93.4 cm in Milyang 54 and Giza 175, respectively. Giza 175 (93.4 cm), Yabani M 55 (92.1 cm), TKY 104 (91.4 cm) and Sakha 101 (89.7 cm) were more resistance to water deficit and taller than IET 1444 (control) under water stress conditions.

The panicle length ranged from 8.4 cm to 19.5 cm in Bl 1 and Bala, respectively. The tallest panicles were recorded from Bala (19.5 cm), Co 39 (19.3 cm), Milyang 85 (18.6 cm), Shinrei (16.8 cm), Yabani M 55 (15.5 cm), and Suweon 346 (14.9 cm). Moreover, number of panicles/plant varied from 4.5 in Hexi 5 to 17.5 in Sakha 104. The mean values of number of filled grains/panicle ranged from 50.7 in Nishihomari to 133.9 in Rb 10. While, 100-grain weight ranged from 1.4 g in Yamgdeog to 2.7 g Giza 176. High weights of 100-grain were detected in Suweon 353 and Giza 182 (2.6 g), Suweon 375, Sakha 102, Sakha 104, Giza 159, (2.5 g), Giza 170, Giza 171 and Riho (2.4 g). In addition, the lowest estimates of sterility % were 8.5% in Giza 178, 8.6% in Giza 182, 9.5% in Riho and Rd, 9.8% in IET 353, and 10.4% in IET 1444. The highest estimates of sterility % were observed for all remaining studied genotypes. The lowest sterility % indicated to high yielding and superior rice genotypes compared with other rice genotypes.

According to high number of panicles/plant, 100-grain weight and lowest mean values for panicle length, sterility % in Giza 178, Sakha, 104, Sakha 101, Sakha, 102, IET 353, Cica 4, Bala, Giza 181 and Co 39. These genotypes had high grain yield/plant (31.3, 26.4, 25.8, 25.6, 25.5, 24.9, 24.8, 24.6 and 24.5 g/plant).

Genetic parameters:

Variance components, genetic variability, broad sense heritability and genetic advance are presented in Table 6. The (σ^2g) was greater than that of (σ^2e) in all the studied characters for yield and its component. While, high estimates of phenotypic (σ^2ph) and genotypic (σ^2g) variances (69.63 and 67.68) were recorded for number of filled grains / panicle followed by 61.35 and 52.89 for days to 50% heading, 53.17 and 48.33 for plant height indicating better scope for the genetic improvement in these characters. These results indicated that days to 50% heading was more affected by the environmental condition than number of filled grains/panicle and plant height. On the other hand, the extent of coefficient of variation showed that high estimates of genotypic (GCV) and phenotypic (PCV) were located for germination%, root and shoot lengths, days to 50 % heading, plant height, number of filled grains/panicle and grain yield/plant except for sterility % which was high estimate of PCV. The data indicated that these characters confirmed to be high variable, while a moderate influence of environment was indicated by nearly moderate estimates of abroad-sense heritability in most of them. Low values of G.C.V. for the remaining studied traits showed lack of inherent variability and limited scope for improvement through selection for these characters. Moreover, convenient estimates of G.C.V. coupled with high broad sense heritability and high genetic advance for number of filled grains/panicle, days to 50% heading, plant height, and germination %. These characters showed to be highly heritable, points to the predominance of additive gene effect, easily fixable and can be taken as unit characters for effective selection. Also, high genetic advance with high heritability, lead to conclude that effectiveness of selection of most the studied traits, might be practiced in the advanced generations. Similar results were reported by Sarawgi *et al.* (2000), El-Abd (2003), Hammoud (2004) and Hammoud, *et al.* (2006).

Table 6: Variance component, genotypic (GCV), phenotypic (PCV) coefficient of variability, broad sense heritability (H %) and genetic advance (GS %) for seedling and grain yield and associated traits of 51 rice genotypes

Characters	Component of variance			Genetic variability		H^2B	Genetic advance	
	σ^2ph	σ^2g	σ^2e	GCV	PCV		GS	GS %
Germination %	40.62	35.81	4.82	54.9	62.46	0.88	44.68	0.69
Root length (cm)	4.54	4.15	0.39	55.18	60.17	0.91	5.12	0.68
Shoot length (cm)	4.32	3.84	0.48	47.94	53.93	0.88	8.81	1.09
Seedling vigor index	2.26	1.69	0.57	17.28	23.29	0.74	2.09	0.21
Seedling weight (mg)	0.16	0.09	0.07	1.82	3.35	0.56	0.11	0.02
Leaf rolling	0.28	0.22	0.06	5.15	7.31	0.78	0.27	0.07
Leaf damage	0.46	0.37	0.09	1.16	12.71	0.81	0.46	0.12
Days to 50% heading	61.35	52.89	8.46	51.8	60.14	0.86	66.51	0.65
Plant height (cm)	53.17	48.33	4.84	64.91	71.78	0.91	59.81	0.80
Panicle length (cm)	8.41	7.14	1.27	55.28	70.09	0.85	8.93	0.69
No. of panicles/plant	10.37	8.75	1.62	48.3	57.02	0.84	10.88	0.58
No. of filled grains/ panicle	69.63	67.68	1.95	66.93	68.08	0.97	84.42	0.83
100-grain weight (g)	0.13	0.09	0.04	4.64	5.82	0.69	0.11	0.05
Sterility (%)	13.62	12.64	0.98	5.91	70.2	0.92	15.66	0.86
Grain yield (g/plant)	10.64	9.18	1.46	62.11	54.11	0.86	11.39	0.65

Phenotypic correlation coefficient:

Phenotypic correlation coefficient was observed for seedling characters, yield and its related characters (Table 7). Positive highly significant phenotypic correlation coefficient was recorded for germination% with plant height (0.41), number of filled grains/panicle (0.36), 100 grain weight (0.31) and grain yield/plant (0.48). Also, root length with plant height (0.45), number of filled grains/panicle (0.34), and grain yield/plant (0.51). On the other hand, shoot length was highly significantly correlated with plant height (0.39), panicle length (0.38), number of panicles/plant (0.41), number of filled grains/panicle (0.38) and grain yield/plant (0.43). While, highly significant phenotypic correlation was observed also between seedling vigor index with plant height (0.40) and grain yield/plant (0.39). On the other hand, highly significant phenotypic correlation was recorded between seeding weight with plant height (0.44), panicle length (0.35) and grain yield/plant (0.46). These results are in agreement with those obtained by Abd –El-Lattef (2004), Abd –El-Lattef *et al.* (2006), Abd –El-Lattef and Badr (2007**)** and El-Abd *et al.* (2007).

Table 7: Estimates of phenotypic correlation coefficient among seedling and grain yield and its related characters

Characters	Plant height (cm)	Panicle length (cm)	No. of Panicles/ plant	No. of filled grains/ panicle	100- grain weight (g)	Grain yield (g/ plant)
Germination %	0.41**	0.29	0.22	0.36**	0.30*	0.48**
Root length (cm)	0.45**	0.25	0.24	0.34**	0.29	0.51**
Shoot length (cm)	0.39**	0.38**	0.41**	0.38**	0.25	0.43**
Seedling vigor index	0.40**	0.28	0.12	0.25	0.22	0.39**
Seedling weight (mg)	0.44**	0.35**	0.25	0.29	0.28	0.46**

***, ** = Significant at 0.05 and high significant at 0.01 probability levels, respectively**

Finally, from these results the most desirable mean values were detected from the genotypes, Giza 178, Sakha 104, Sakha 101, Sakha 102, Rb 10, IET 353, Bala, Cica 4 Giza 172, Giza 181, Bl 1, Mizuho, Yabani M 52, Suweon 351, Suweon 353, BG 367 and Co 39 under water stress conditions. According to mean values, for the above mentioned genotypes, these genotypes considered the best parents for drought recovery ability, and could be considered as a donor in crosses with drought tolerance. Grain yield/plant character was strongly phenotypic correlated positively with all seedling studied characters as germination%, root and shoot lengths, seedling vigor index and seedling weight.

Water relations:

Estimates of amount of water applied, water consumptive use m^3/fed and actual evapotranspiration in (ETc mm/day) are presented in Table 8. The results indicated that total water applied and water consumptive use was 4819.17 and 4012.63 m^3/fed, respectively. While, the highest water applied and water consumptive use values were 1371.62 and 1164.52 m^3/fed in August, respectively. On the other hand, the lowest values were 957.62 and 832.73 m^3/fed in September, respectively. Also, the highest values of ETc were recorded in August, July and followed by June (8.48, 8.43 and 7.26 mm/day), respectively. While, in September, was 6.27 mm/day. Concerning, potential evapotranspiration {ETp (mm/day)}, three methods were used for estimation it. The data showed insignificant differences among them in pre-harvest period; e.g., months June, July and August value for ETp. ETp decreased in emergence stage, while, it gradually increased with increasing the age of plant, but decreased with pre-harvest period in September, after that ETp was increased in July (6.92 mm/day) and June (6.71 mm/day). The highest value was recorded by radiation and Pan Evaporation were 7.46 and 5.53 mm / day in July, respectively.

Table 8: Water applied, water consumptive use, actual crop evapotranspiration (mm/day), modified penman (M.P), radiation and Pan Evaporation methods

Months	Water applied (m^3/fed)	Water consumptive use (m^3/fed)	Etc (mm/day)	ETp (mm/day)	Radiations	Pan Evaporation
June	1163.51	963.27	7.26	6.71	7.21	5.21
July	1326.41	1052.11	8.43	6.92	7.46	5.53

August	1371.62	1164.52	8.48	5.93	6.91	5.00
20 September	957.63	832.73	6.27	5.35	5.82	4.61
Total	4819.17	4012.63	30.44	24.91	26.4	20.35

Concerning crop coefficient values (Kc %) in Table 9, it is clear that the effect of crop characteristics on crop water requirements was observed by crop coefficient, which represented the relationship between reference potential (ETp) and actual crop evapotranspiration (ETc). The values of crop coefficient for irrigation pattern (kc) showed slight increase after transplanting, but decreased again at the end of growth season. It could be noticed that the nearest values to average (kc) was that of radiation equation. These results lead to recommend using radiation, followed by modified-penman methods for estimating water consumptive use in rice. Similar results were reported by Nasir *et al.* (2002), Hussain *et al.* (2003) and Azam *et al.* (2005).

Table 9: Means of crop coefficient (kc)

Months	Modified penman	Radiation	Pan Evaporation	Means
June	1.05	1.01	1.40	1.15
July	1.25	1.14	1.53	1.31
August	1.44	1.22	1.70	1.45
20 September	1.12	1.08	1.36	1.19
Means	1.22	1.11	1.50	1.27

Estimates of grain yield (Kg/fed), crop water use efficiency (CWUE %) and field water use efficiency (FWUE %) are tabulated in Table 10. The results indicated that the average of grain yield was significantly affected by breeding. The average grain yield was (2065.82 Kg/fed) for all rice genotypes. Maximum values (3286.12, 2772.63, 2709.35, 2688.47, 2677.34, 2614.53, 2604.25, 2593.62, 2583.41 and 2573.62 Kg/fed) were found for Giza 178, Sakha 104, Sakha 101, Sakha 102, IET 353, Cica 4, Bala, Bl 1, Giza 181 and Co 39 followed by IET 1444 (2572.41). While, the minimum values (998.63, 997.24, 976.45, 913.82 and 903.17, kg/fed) was recorded by Suweon 346, Nishihomari, Milyang 95, Hexi 5 and Suweon 375.

Crop and field water use efficiency (CWUE %):

Data in Table 10 illustrated that crop water use efficiency was significantly affected by water stress. The data showed that the highest crop water use efficiency (kg/m^3) 0.77, 0.76, 0.74, 0.71, 0.70, 0.65, 0.63, 0.59, were recorded for Giza 178, Sakha 104, Sakha 101, Yamgdoeg and Giza 181, Sakha 102, and Sakha 103, Bala, Bl 1, IET 353, Cica 4 and Co 39 followed by IET 1444 (0.58). While, the minimum values 0.25, 0.24, 0.22, 0.21, 0.20 recorded from one m^3 water irrigation was observed for Suweon 346, Nishihomari, Milyang 95, Suweon 375 and Hexi 5, respectively. Data obtained indicated also that significant effect of irrigation conditions on FWUE %. The maximum FWUE % was recorded for Giza 178, Sakha 104, Sakha 101, Yamgdoeg, Giza 181, Sakha 102, and Sakha 103, Bala, Bl 1, IET 353, Cica 4 and Co 39. Vice versa, the minimum value was recorded for Suweon 346, Nishihomari, Milyang 95, Suweon 375 and Hexi 5. These results are in harmony with those obtained by Ahmed *et al.* (2002), Akbar *et al.* (2002), Yasin *et al* (2003), Mady, (2004) and Ahmed and Karube (2005).

Characters Genotypes	Grain yield (kg/fed)	CWUE (%)	FWUE (%)
Sakha 101	2709.35	0.74	0.62
Sakha 102	2688.47	0.70	0.60
Sakha 103	2247.11	0.70	0.60
Sakha 104	2772.63	0.76	0.65
Yamgdeog	2278.12	0.71	0.61
sangiu	1638.21	0.53	0.45
Giza 159	1942.13	0.50	0.40
Giza 170	1722.51	0.42	0.36
Giza 171	2026.46	0.52	0.53
Giza 172	2457.38	0.06	0.59
Giza 175	1291.21	0.39	0.32
Giza 176	1123.42	0.32	0.30
Giza 177	1722.16	0.40	0.35
Giza 178	3286.12	0.77	0.67
Giza 181	2583.41	0.71	0.60
Giza 182	1764.12	0.43	0.35
Riho	1627.36	0.44	0.37
Agami M1	1984.23	0.46	0.39
Mizuho	2163.25	0.52	0.41
IET 353	2677.34	0.69	0.50
Rb 10	1522.24	0.49	0.32
Bala	2604.25	0.78	0.59
GZ 2447-5-7	2478.11	0.61	0.51
TKY 104	2373.16	0.69	0.50
Co 39	2573.62	0.68	0.49
Yabani M52	1711.52	0.41	0.35
Yabani M55	2089.31	0.63	0.44
Shinrei	1134.23	0.45	0.36
Rd	1627.24	0.41	0.35
Nishihomari	997.24	0.34	0.27
Cica 4	2614.53	0.58	0.49
Milyang 54	1953.11	0.44	0.37
Milyang 80	1764.54	0.43	0.36
Milyang 85	1648.23	0.45	0.38
Milyang 95	976.45	0.22	0.25
Milyang 97	1417.24	0.41	0.35
Milyang 109	2037.18	0.49	0.40
Suweon 332	1953.27	0.45	0.40
Suweon 346	998.63	0.25	0.26
Suweon 349	1092.19	0.29	0.27
Suweon 351	1596.21	0.40	0.32
Suweon 353	1711.19	0.41	0.33
Suweon 375	903.17	0.21	0.22
Suweon 381	1102.25	0.31	0.30
BG 367-4	1669.34	0.40	0.31
BG 35-2	1239.18	0.39	0.33
Hexi 5	913.82	0.20	0.21
Pi no 4	2331.18	0.45	0.66
Bl 1	2593.62	0.65	0.40
Toride 1	1669.15	0.47	0.38
IET 1444	2572.41	0.58	0.49

Table 10: Crop and field water use efficiency of 51 rice genotypes under drought conditions

CWUE = Crop water use efficiency and FWUE = field water use efficiency

Finally, rice genotypes Bala, Giza 178, Sakha 104, Sakha 101, Yamgdoeg, Giza 181, Sakha 102, Sakha 103, IET 353, TKY 104, Co 39, Bl 1, Yabani M55, GZ2447-5-7 and Cica 4 followed by IET 1444 could be recommended for growing under drought conditions to obtain the highest rice grain yield and the highest value of saving water at the same time. Moreover, it could be used to make new crosses with desirable characters related to drought tolerance to cover the one third of growing rice area which affected by water shortage in the Northern Nile Delta in the terminal of irrigation canal.

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تقييم بعض التراكيب الوراثية للأرز تحت ظروف الإجهاد المائى

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*****المركز القومى لبحوث المياه بالقاهرة – معهد بحوث إدارة المياه وطرق الرى – القاهرة**

أجريت تجربة معمليه بوحدة بحوث تكنولوجيا البذور بالمنصورة - محافظة الدقهلية - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية لتقييم 51 تركيب وراثى للأرز من خلال الإنبات ونمو البادرات وذلك باستخدام 20% بولى إثيلين جليكول 6000 والتى تعمل على رفع الضغط الإسموزى مما يقلل من إمكانية حصول البادرة على القدر الكافى من المياه. وأجريت التجارب الحقلية بمحطة البحوث الزراعية بسخا - محافظة كفر الشيخ - معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية خلال الموسمين 2009 و2010 وذلك لدراسة تقييم نفس التراكيب الوراثية تحت ظروف الإجهاد المائى وذلك من خلال الرى السطحى كل 12 يوم فقط بعد إجراء عملية الشتل. أشارت النتائج إلى تفوق الأصناف جيزة 178، سخا 104، سخا 101، سخا 102، Rb 10، IET 353، بالا، سيكا 4 ، جيزة 172 ، جيزة 181 ، Bl 1 ، ميزوهو ، يابانى M52، سون 351 ، سون 353، BG 367 وCo39 فى تحمل نقص المياه فى طور البادرة حيث أعطت أعلى قيم لصفات البادرة المدروسة متفوقة على الصنف IET1444 المتحمل للجفاف. سجلت الأصناف جيزة 178، سخا 101، سخا 102، سخا 104، IET 353، سيكا 4، بالا، جيزة 181 وCo39 أعلى قيم لصفات المحصول ومكوناته خاصة صفة محصول النبات. كما أوضحت النتائج أن أعلى قيم لكل من معامل الإختلاف الوراثى والبيئى قد سجلت لمعظم الصفات المدروسة. حيث تراوحت درجة التوريث فى المدى الواسع من متوسطة إلى عالية فى عدد الحبوب الممتلئة بالدالية وطول النبات والنسبة المئوية للإنبات وعدد الأيام حتى 50% تزهير ومحصول الحبوب/نبات كما إختلفت بإختلاف الصفات المدروسة. كما تراوحت النسبة المئوية للتحسين الوراثى المتوقع من الانتخاب من منخفضة إلى عالية فى معظم الصفات المدروسة لإرتباطها بدرجة التوريث. كما أشارت النتائج إلى وجود ارتباط معنوى جداً لمحصول النبات الفردى مع كل صفات البادرة المدروسة. كما أوضحت النتائج أن كمية المياه المضافة للتراكيب الوراثية المدروسة تراوحت بين 4012,63 إلى 4819,17 متر مكعب للفدان.أوضحت النتائج إختلاف محصول الحبوب بإختلاف الصنف فى المتر المكعب من المياه. حيث أعطى المتر المكعب من المياه أعلى كمية من محصول الحبوب فى الأصناف بالا، جيزة 178، سخا 104، سخا 101، يامجدج، جيزة 181، سخا 102، سخا 103 ، IET 353، TKY104 ، Co39، Bl 1 ، يابانى M55، GZ 2447-5-7 وسيكا 4 ويتبعه IET 1444 (780، 770، 760، 740، 710، 710، 700، 700، 690، 690، 680 ، 650، 630، 610، 580 و 580 جم حبوب/متر مكعب). لذا يمكن التوصية بزراعة التراكيب الوراثية السابقة واستخدامها كآباء مبشرة يمكن الحصول من نسلها على نباتات أكثر تحملا للجفاف لزراعتها فى المساحات المتأثرة بنقص المياه فى نهاية الترع.

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