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# Inheritance of grain yield and its related traits in rice under water deficiency conditions

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## ABSTRACT

Six rice genotypes with different drought tolerance were crossed. Six populations ($P_1$, $P_2$, $F_1$, $F_2$, $BC_1$ and $BC_2$) of three rice crosses namely Giza 177 x Giza 178 (cross I); Sakha 103 x WAB 880 SG 33 (cross II) and Sakha 104 x IET 1444 (cross III) were raised in a randomized complete block design with three replications during the three successive summer seasons from 2010 to 2012 at the Farm of Rice Research and Training Center Sakha, Kafer El-Sheikh, Egypt. This study aimed to determine the heterosis, gene action, heritability, genetic advance and phenotypic correlation response to selection and prediction by the new lines for the traits of days to 50 % heading, plant height, panicle length, and number of panicles / plant, number of filled grains / panicle, 100-grain weight, sterility % and grain yield / plant. Flashing water irrigation was added every 10 days intervals.

The results obtained from the mean of parents, $F_1$ and $F_2$ generations showed wide range in mean values between the parents and the presence of partial and over-dominance were found for all studied characters. Significant and highly significant positive estimates as a deviation from mid and better parents in all crosses for panicle length, number of panicles/ plant and grain yield/ plant, also highly significant positive estimates as a deviation from mid and better parents in the first two crosses for plant height. Scaling test provide evidence of non-allelic interaction in controlling all the characters studied in most crosses, the additive gene effect (d) was more important in the genetic system for all studied characters, dominance gene effects (h) and additive x additive gene effects (i) were played an important role in the inheritance of plant height, panicle length, number of filled grains/ panicle, 100-grain weight, sterility % and grain yield/ plant. The additive x dominance (j) were significant and involved in the inheritance of days to 50 % heading, plant height, number of panicles/ plant, number of filled grains/ panicle, 100-grain weight, sterility % and grain yield/ plant. However, the dominance x dominance (l) were involved in the genetic control of all characters. Heritability estimates in broad sense were high. Meanwhile, heritability estimates in narrow sense were mostly low. The maximum genetic advance of the mean values was found to be high for number of panicles/ plant, plant height and days to 50 % heading characters. Highly significant and positive correlation was found for grain yield/ plant with panicle length, number of panicles/ plant, number of filled grains/ panicle and 100-grain weight in all studied crosses.

From the foregoing results, cross II (Sakha 103 x WAB 880 SG 33) and cross III (Sakha 104 x IET1444) could be recommended for growing under water deficiency to obtain the highest rice grain yield and the highest values of saving water at the same time.

**Keywords:** rice, water stress, six parameters, heterosis, heritability and correlation.

## INTRODUCTION

Rice is one of the most important crops in Egypt after wheat and ranks the second export crop after cotton. Covered about 22 % of the cultivated area in Egypt. But, it highly increased during the last five years to better net return of rice comparing to other summer crops. Water shortage is a major problem for rice grown under lowland conditions. The water of River Nile is not sufficient for irrigation of both old and new reclaiming new lands. Progress in irrigated areas, were supplied are scarce or unreliable. A major reason for the slow progress inbreeding for drought tolerance in rice is the complexity of the drought environment, which often results in the lack of clear identification of the target environments Fukai *et al.* (1996). Developing rice varieties for drought tolerance are needed to overcome the shortage of irrigation water. Mady (2004) reported that, increasing irrigation intervals decreased plant height, panicle length, number of panicles/ $m^2$, number of filled grains/ panicle, 1000-grain weight and grain yield/ plant. But, the opposite was true for sterility %. Upland rice crop is 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. Breeding for drought tolerance varieties is become of high priority in the Egyptian rice breeding program in order to reduce the water requirements in one hand, and also to tolerate the drought conditions which occurred 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 will increase the rice production in Egypt and also increase the farmer's welfare. Yield and its component characters considered very important to increase yield under drought.

The present study aimed to determine the heterosis, degree of dominance, genetic variance, heritability, genetic advance and phenotypic correlation coefficient as percent of means among yield and its component studied characters under water deficiency conditions.

## MATERIALS AND METHODS

The present study was carried out at the Experimental Farm of the Rice Research and Training Center (RRTC), Sakha, Kafer EL-Sheikh, Egypt, during the three successive rice growing seasons of 2010, 2011 and 2012, to study the inheritance of grain yield, its components characters in rice under water deficiency conditions. According to the following data the six genotypes were crossed to produce $F_1$ hybrid seeds of three crosses namely; I- Giza 177 (sensitive) x Giza 178 (moderate). II- Sakha 103 (sensitive) x WAB 880 SG 33 (tolerant). III-Sakha 104 (moderate) x IET 1444 (tolerant). Six populations $P_1$, $P_2$, $F_1$, $F_2$, $BC_1$ and $BC_2$ for each cross were utilized in this study.

**A. Experimental field procedures:**

In 2010 season, the six cultivars were grown at RRTC farm in three successive dates of planting with ten days interval in order to overcome the differences in flowering time between parents. Thirty days old seedlings of each parent were individually transplanted in the permanent field in seven rows. Each row was 5m long and contained 25 hills. At flowering time, hybridization between parents was carried out following the technique proposed by Jodon (1938) and modified by Butany (1961). And the aforementioned three crosses were produced.

In 2011 season, parents and $F_1$ hybrid seeds of the three crosses together were planted under normal conditions. At heading, parents were crossed again to produce the $F_1$ hybrid seeds of three crosses following the same technique. Moreover, some of $F_1$ plants were left to self pollinated in order to produce $F_2$ seeds, while some other $F_1$ plants were crossed with their own parents to produce $BC_1$ and $BC_2$ seeds. At harvest, seeds of different generations were individually harvested to be grown in the next season. Subsequently, in the summer season 2012, seeds of $P_1$, $P_2$, $F_1$, $BC_1$, $BC_2$ and $F_2$ of each cross were sown under drought conditions. Eighteen entries belongs to different generations (6 parents, 3 $F_{1'S,}$ 3 $F_{2'S,}$ 3 $BC_{1,}$ 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 $BC_2$ and 20 rows of $F_2$. Rows were 5 m long and 20 x 20 cm spaceing apart. In all growing seasons of the study, all cultural practices such as field preparations, sowing, transplanting and fertilizers were applied as recommended. The six populations in 2012 season were planted under water deficiency conditions (water deficiency was imposed by using flush irrigation every 10 days without standing water after irrigation). Hand weeding was done when it was needed. Sixty plants from each $P_1$, $P_2$ and $F_{1,}$ 90 plants from each $BC_1$ and $BC_2$ and 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 yield components.

Heterosis was estimated according to Falconer and Mackay (1996). Furthermore, appropriate LSD values were calculated to test the significance of heterotic effects according to the formula suggested by Wynne *et al.* (1970). The relative of potence ratio (P) was used to determine the degree of dominance and its directions according to the formula given by Mather and Jinks (1971). Estimation of gene effects were suggested by Mather (1949) and Hayman (1958). Expected genetic variance of $VBC_1$, $VBC_2$ and $VF_2$ in terms of additive ($^1/_2$ D) and dominance ($^1/_4$ H) are derived by Mather (1949). Heritability in both broad and narrow sense were determined relative to Powers *et al*. (1950) and Warner (1952), respectively. Expected and predicted values of genetic advance (GS and GS %) were calculated according to Johnson *et al.* (1955).The phenotypic correlation coefficient was performed according to the procedure of Dewey and Lu (1959).

## RESULTS AND DISCUSSION

### Mean performance

Table 1 shows mean values of the studied characters for three studied crosses. The results indicated that the parents differed significantly in all the studied characters. The $F_1$ mean values were higher than the highest parent for panicle length, number of panicles/ plant, sterility % and grain yield/ plant in all the studied crosses, number of filled grains/ panicles for crosses II and III; and plant height and 100-grain weight for cross I and days to 50 % heading for cross III. While, the $F_1$ mean values were intermediated between the two parents in plant height and 100-grain weight in crosses II and III, and days to 50 % heading in crosses I and II. While, it was lower than the lowest parent for number of filled grains/ panicle in cross I. These results indicating that over-dominance was important in the inheritance of these traits verified by computed of which were the value of potence ratio. While, partial dominance was recorded for plant height and 100-grain weight in crosses II and III and days to 50 % heading in crosses I and II. Moreover, the $F_2$ mean values approximately nearer to the mid-parents with few exceptions. On the other hand, the transgressive segregation was recorded for plant height in cross III. The performance of backcross populations tended towards the means of recurrent parent varied somewhat among yield and its major components. These results are in agreement with those reported by Abd-Allah (2000) and Abd El-Lattef and Mady (2009).

**Genetic parameters**

The percentages of heterosis as a deviation from mid- and better-parent and degree of dominance were showed in Table 2. Highly significant and significant positive values were recorded in most of all the studied crosses for grain yield and its components in the present investigation. On the contrary, the non significant heterosis as a deviation from mid- parents was recorded for days to 50 % heading in cross I and for plant height in cross III. While, the not significant heterosis as deviations from better- parents were recorded for days to 50 % heading in cross II and for number of filled grains/ panicle in crosses II and III. Degree of dominance was greater than unity in all studied crosses for most of all the studied characters indicating over-dominance for these characters. While, partial dominance was recorded for days to 50 % heading in crosses I and II, and for plant height and 100-grain weight in crosses II and III. These results are in harmony with those of Charngpei *et al*. (1997) and El-Abd *et al.* (2003).

**Table 2: stimates of heterosis as a deviation from mid-parents (MP) and better-parents (BP) and degree of dominance of yield and its component characters, for the three studied crosses under water deficiency conditions.**

| Characters | Crosses | Heterosis % | | Degree of dominance |
|---|---|---|---|---|
| | | MP | BP | |
| No. of days to 50% heading (days) | I | 1.40 | 4.38* | -0.49 |
| | II | -3.59* | 1.33 | 0.73 |
| | III | 3.26* | 3.69* | 7.92 |
| Plant height (cm) | I | 4.56** | 6.00** | -3.37 |
| | II | 5.15** | 14.91** | -0.60 |
| | III | -0.34 | 3.91* | 0.08 |
| Panicle length (cm) | I | 16.31** | 7.55** | -2.00 |
| | II | 12.81** | 6.93** | -2.32 |
| | III | 9.32** | 3.75** | -1.73 |
| No. of panicles/plant | I | 54.28** | 20.06** | -1.90 |
| | II | 66.56** | 41.12** | 3.69 |
| | III | 44.38** | 18.80** | -2.06 |
| No. of filled grains/panicle | I | 26.74** | -38.72** | 1.36 |
| | II | 12.79** | 2.34 | -1.25 |
| | III | 8.48** | 1.33 | -1.20 |
| 100-grain weight (g) | I | 16.29** | 0.49** | 1.03 |
| | II | 1.00** | -15.47** | -0.05 |
| | III | 3.20** | -11.94** | 0.18 |
| Sterility (%) | I | 383.47** | 634.03** | 11.23 |
| | II | 150.50** | 167.99** | 4.52 |
| | III | 118.60** | 137.05** | -15.24 |
| Grain yield/plant (g) | I | 19.65** | 2.96** | -1.21 |
| | II | 18.86** | 16.08** | 7.88 |
| | III | 23.70** | 10.23** | -1.93 |

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

Data in Table 3. Illustrates the scaling test parameters (A, B and C) estimated for yield and its component characters in the three studied crosses.

Most of the computed permeates of scaling test were statistically significant. Thus in turn revealed the presence of non- allelic interaction. These results appeared that the genotype x environment type of gene interaction were important in the inheritance of yield and most its components.

**Table 3: Scaling test for adequacy of additive and dominance model of rice yield and its component characters for the three studied crosses under water deficiency conditions.**

| Characters | Crosses | A | B | C |
|---|---|---|---|---|
| No. of days to 50% heading (days) | I | -3.25±0.80** | -4.83±0.83** | -3.33±12.45 |
| | II | -2.56±0.90** | -6.25±0.79** | -3.78±12.23 |
| | III | -10.27±0.53** | -10.93±0.77** | -24.72±11.89* |
| Plant height (cm) | I | -3.31±0.68** | 0.63±0.80 | 1.68±11.35 |
| | II | -4.63±0.80** | -8.80±0.79** | 0.76±20.06 |
| | III | -1.08±1.10 | -1.33±1.07 | 23.90±27.02* |
| Panicle length (cm) | I | 1.10±0.03** | 0.83±0.045** | 0.48±0.96 |
| | II | -1.58±0.02** | -1.86±0.015** | 0.24±0.68 |
| | III | 0.07±0.02** | 0.15±0.024** | -1.02±0.94* |
| No. of panicles/plant | I | -4.98±0.32** | -5.57±0.25** | -6.09±5.22 |
| | II | -0.16±0.10 | 1.66±0.14 | 6.31±5.13* |
| | III | -3.20±0.20** | -1.97±0.17** | -0.33±5.09 |
| No. of filled grains/panicle | I | -24.38±1.18** | 3.63±1.80* | -132.30±49.90** |
| | II | -0.48±1.30 | 1.41±1.08 | -56.79±26.21* |
| | III | -33.45±1.25** | -11.50±1.58** | -47.25±24.25 |
| 100-grain weight (g) | I | -0.48±0.0009** | -0.11±0.0005** | -0.74±0.01** |
| | II | 0.42±0.0004** | -0.51±0.0004** | -1.70±0.01** |
| | III | -0.60±0.0004** | -0.19±0.0004** | -0.05±0.0004** |
| Sterility (%) | I | 4.30±0.67** | 18.51±0.66** | 51.47±10.76** |
| | II | -20.23±0.23** | -22.47±0.07** | 24.44±3.04** |
| | III | -2.47±0.38** | 0.41±0.35 | -32.90±5.30** |
| Grain yield/plant (g) | I | -6.46±0.04** | -4.32±0.07** | -11.23±2.22** |
| | II | -2.77±0.03** | -3.15±0.05** | -9.47±1.43** |
| | III | -3.25±0.04** | -5.81±0.05** | -18.52±1.27** |

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

Data in Table 4, shown that mean of the parameter effects (m) was highly significant for all the studied traits, suggesting that these traits were expressional as yield and its components inherited traits. Additive gene action (d) played an important role in the inheritance of all the studied crosses for all the studied characters, except days to 50 % heading in cross III and sterility % in cross II. Moreover, dominance gene action (h) played a greater role in all studied crosses for all studied characters, except days to 50 % heading and number of panicles/ plant in all the crosses, and plant height in crosses I and II, panicle length in cross II, number of filled grains/ panicle in cross III and sterility % in cross I. Additive x additive type of gene interaction (i) played an effective role in sterility % for all the crosses, plant height. 100-grain weight and grain yield/ plant for crosses II and III, and panicle length in cross

II and number of filled grains/ panicle in crosses I, II.100-grain weight and sterility % in all the studied crosses, number of filled grains/ panicle and grain yield/ plant in crosses I and III, days to 50 % heading and number of panicles/ plant in cross II and plant height in crosses I, II, were affected by additive x dominance type of gene interaction (j). Dominance x dominance type of gene interaction (l) was played an important role in the inheritance of all the studied crosses for all the studied characters, except plant height and sterility % in cross I, panicle length in cross III, number of panicles/ plant in cross II and grain yield/ plant in crosses II and III. These findings suggests that additive gene effects made a significant contribution to the inheritance of the studied characters in these crosses. The three types of gene interactions were important in the inheritance of the studied traits under drought conditions. These results are in line with those obtained by El-Hissewy and Bastawisi (1998), Acharya *et al*. (1999) and El-Abd *et al*. (2007).

**Table 4: Genetic components of generation mean in rice yield and its component characters for the three studied crosses under water deficiency conditions.**

| Characters | Cr | Genetic components of generation mean | | | | | |
|---|---|---|---|---|---|---|---|
| | | **m** | **d** | **h** | **i** | **j** | **L** |
| No. of days to 50% heading (day) | I | 96.12** | -1.95* | -3.39 | -4.75 | 0.79 | 12.83* |
| | II | 94.57** | -2.88** | -8.51 | -5.02 | 1.84* | 13.83* |
| | III | 97.13** | 0.75 | 6.83 | 3.51 | 0.33 | 17.69** |
| Plant height (cm) | I | 78.80** | -3.01** | -0.85 | -4.35 | -1.97* | 7.03 |
| | II | 81.47** | -4.65** | -10.11 | -14.20* | 2.08* | 27.63** |
| | III | 82.08** | -3.00** | -26.59** | -26.33** | 0.12 | 28.75** |
| Panicle length (cm) | I | 20.80** | -1.42** | 4.56** | 1.45 | 0.13 | -3.38* |
| | II | 21.34** | -0.96** | -1.12 | -3.69** | 0.13 | 7.14** |
| | III | 20.92** | -1.12** | 3.13* | 1.25 | -0.03 | -1.47 |
| No. of panicles/plant | I | 13.39** | -3.05** | 1.90 | -4.46 | 0.29 | 15.02** |
| | II | 12.39** | 0.55* | 0.58 | -4.81 | -0.91** | 3.31 |
| | III | 16.09** | -3.46** | 1.03 | -4.84 | -0.61 | 10.01** |
| No. of filled grains/panicle | I | 62.57** | -35.60** | 82.02** | 111.55** | -14.01** | -90.80** |
| | II | 82.95** | -10.27** | 69.40** | 57.71** | -0.95 | -58.64** |
| | III | 108.74** | -19.13** | 12.12 | 2.30 | -10.97** | 42.64** |
| 100-grain weight (g) | I | 2.15** | 0.15** | 0.50** | 0.15 | -0.18** | 0.44* |
| | II | 2.19** | -0.04** | 1.64** | 1.61** | 0.46** | -1.53** |
| | III | 2.22** | 0.17** | -0.67** | -0.74** | -0.20** | 1.54** |
| Sterility (%) | I | 41.65** | -3.73** | 9.18 | -28.65** | -7.10** | 5.84 |
| | II | 31.78** | 5.03 | -49.42** | -67.15** | 1.11** | 109.87** |
| | III | 17.70** | -2.71** | 50.14** | 30.84** | -1.44** | -28.78** |
| Grain yield/plant (g) | I | 24.32** | -5.07** | 5.30** | 0.45 | -1.06** | 10.33** |
| | II | 23.37** | 0.75** | 7.98** | 3.55* | 0.18 | 2.37 |
| | III | 28.60** | -2.35** | 16.51** | 9.46** | 1.28** | -0.40 |

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

It is clear from Table 5 that additive genetic variance was higher than that of dominance genetic variance for days to 50 % heading, plant height, panicle length, number of panicles/ plant, number of filled grains/ panicle, 100-grain weight, sterility % and grain yield/ plant in all studied crosses.

**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 yield and its component characters for the three studied crosses under water deficiency conditions.**

| Characters | Cr | Genetic variance | | Heritability | | G.S | G.S % |
|---|---|---|---|---|---|---|---|
| | | $^1/_2$ D | $^1/_4$ H | Broad-sense | Narrow-sense | | |
| No. of days to 50% heading (days) | I | 2.31 | -0.96 | 90.60 | 44.54 | 112.02 | 116.54 |
| | II | 2.23 | -0.85 | 92.62 | 49.60 | 124.56 | 131.70 |
| | III | 2.36 | -1.11 | 87.77 | 33.74 | 82.83 | 85.28 |
| Plant height (cm) | I | 2.11 | -0.83 | 92.71 | 46.54 | 112.07 | 142.69 |
| | II | 4.26 | -2.04 | 91.41 | 24.43 | 78.44 | 96.28 |
| | III | 5.71 | -2.94 | 87.66 | 18.99 | 69.48 | 84.65 |
| Panicle length (cm) | I | 0.20 | -0.1 | 88.63 | 24.78 | 17.40 | 83.69 |
| | II | 0.15 | -0.08 | 83.34 | 6.12 | 3.57 | 16.75 |
| | III | 0.21 | -0.12 | 85.10 | 5.78 | 3.97 | 19.01 |
| No. of panicles/plant | I | 1.03 | -0.50 | 86.25 | 32.91 | 53.42 | 398.91 |
| | II | 1.16 | -0.58 | 93.24 | 12.39 | 20.12 | 162.38 |
| | III | 1.10 | -0.59 | 85.41 | 15.46 | 24.66 | 153.29 |
| No. of filled grains/panicle | I | 11.21 | -6.24 | 84.29 | 9.91 | 49.63 | 79.31 |
| | II | 5.51 | -3.05 | 80.47 | 19.66 | 70.84 | 85.39 |
| | III | 4.73 | -2.51 | 80.18 | 28.62 | 98.01 | 90.13 |
| 100-grain weight (g) | I | 0.002 | -0.0009 | 87.79 | 40.83 | 3.09 | 143.52 |
| | II | 0.002 | -0.001 | 89.15 | 24.71 | 1.76 | 80.41 |
| | III | 0.002 | -0.001 | 90.56 | 18.89 | 1.54 | 69.54 |
| Sterility (%) | I | 2.03 | -0.88 | 90.52 | 39.90 | 92.77 | 222.69 |
| | II | 0.61 | -0.26 | 94.10 | 36.17 | 45.54 | 143.30 |
| | III | 0.97 | -0.45 | 83.75 | 42.32 | 68.73 | 388.16 |
| Grain yield/plant (g) | I | 0.27 | -0.13 | 89.88 | 20.37 | 16.44 | 67.59 |
| | II | 0.31 | -0.15 | 90.72 | 18.99 | 16.28 | 69.68 |
| | III | 0.49 | -0.24 | 93.04 | 16.04 | 17.20 | 60.15 |

Heritability in broad sense estimates were larger than their corresponding ones of narrow sense heritability for all the studied traits for all the studied crosses. High broad sense heritability and high genetic advance were estimated for the attendant yield and its component characters. Narrow sense heritability ranged from low to moderate in the three studied crosses. Similar results were reported by Abd-Allah (2000) and Abd El-lattef and Mady (2009).

**Estimates of phenotypic correlation coefficients**

The phenotypic correlation coefficients among the pairs of grain yield components traits are presented in Table 6. Grain yield was positively and strongly correlated with each of panicle length, number of panicles/ plant, number of filled grains/ panicle and 100-grain weight in all the studied crosses. These results indicated that these traits were found to be the principle yield components. Therefore, any selection based on these traits will bring the desired improvement in grain yield. Sterility % showed highly significant negative correlation with grain yield/ plant in cross III. Sterility % was highly significant and negative associated with each of panicle length, number of panicles/ plant, number of filled grains/ panicle and 100-grain weight in the third cross. However, a highly significant and positive estimate of phenotypic correlation coefficient was recorded between panicle length and number of filled grains/ panicle in all the crosses, number of panicles/ plant and 100-grain weight in crosses II, III. Highly significant positive estimates of phenotypic correlation coefficients were recorded between number of panicles/ plant with number of filled grains/ panicles and 100-grain weight. Present findings coincide with the results of Deng, HuiMing *et al.* (2005), Patil and Sarawgi (2005), Satyanarayana *et al*. (2005) and El Abd *et al*. (2008). However, the current results do not coincide with the findings of Islam *et al*. (2002), who reported that grain yield per plant was positively correlated with plant height. The difference in results may be attributed to the difference in genetic material and environmental conditions of the experiment.

**Table 6: Phenotypic correlation coefficient among all possible pairs of yield and its component characters in the $F_2$ generation of the crosses I, II and III under water deficiency conditions.**

| Characters | Cr | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1- No. of days to 50% heading (days) | I | | | | | | | |
| | II | | | | | | | |
| | III | | | | | | | |
| 2-Plant height (cm) | I | -0.108 | | | | | | |
| | II | -0.023 | | | | | | |
| | III | 0.040 | | | | | | |
| 3- Panicle length (cm) | I | 0.007 | 0.117 | | | | | |
| | II | 0.232 | -0.024 | | | | | |
| | III | -0.202 | 0.029 | | | | | |
| 4- No. of panicles/plant | I | 0.066 | 0.202 | 0.267 | | | | |
| | II | 0.047 | 0.075 | 0.653** | | | | |
| | III | -0.180 | 0.159 | 0.600** | | | | |
| 5-No.of filled grains/plant | I | 0.063 | 0.200 | 0.279* | 0.985** | | | |
| | II | 0.056 | 0.093 | 0.636** | 0.979** | | | |
| | III | -0.177 | 0.151 | 0.584** | 0.990** | | | |
| 6- 100-grain weight (g) | I | 0.082 | 0.183 | 0.268 | 0.975** | 0.965** | | |
| | II | 0.054 | 0.092 | 0.671** | 0.956** | 0.960** | | |
| | III | -0.179 | 0.130 | 0.587** | 0.982** | 0.981** | | |
| 7- Sterility (%) | I | -0.206 | 0.023 | 0.017 | -0.227 | -0.216 | -0.211 | |
| | II | -0.206 | 0.229 | 0.048 | 0.231 | 0.210 | 0.228 | |
| | III | 0.108 | 0.063 | -0.428** | -0.479** | -0.480** | -0.489** | |
| 8- Grain yield/plant (g) | I | 0.099 | 0.200 | 0.314* | 0.956** | 0.962** | 0.958** | -0.219 |
| | II | 0.053 | 0.092 | 0.643** | 0.963** | 0.970** | 0.952** | 0.205 |
| | III | -0.105 | 0.158 | 0.575** | 0.982** | 0.977** | 0.974** | -0.477** |

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

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## وراثة المحصول ومكوناته فى الأرز تحت ظروف ندرة المياه

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أقيمت هذة التجربة بالمزرعة البحثية لمركز البحوث والتدريب فى الأرز – سخا – كفرالشيخ – مصـــر وذلك خلال مواسم زراعة الأرز ٢٠١٠، ٢٠١١ و٢٠١٢ وذلك بهدف دراسة وراثة المحصول ومكوناته فى الأرز تحت ظروف ندرة المياه وذلك باستخدام العشائر الستة (الأب الأول، الأب الثانى، الجيل الأول، الجيل الثانى، الهجين الرجعى الأول والهجين الرجعى الثانى) لثلاثة هجن من الأرز هى جيزة ١٧٧ X جيزة ١٧٨ (الهجين الأول)، سخا ١٠٣ X واب ٨٨٠ إس جى ٣٣ (الهجين الثانى) وسخا ١٠٤ X أى إى تى ١٤٤٤ (الهجين الثالث). أجريت التجربة فى تصميم القطاعات الكاملة العشوائية فى ثلاثة مكررات تحت ظروف ندرة المياه وذلك باستخدام الرى السطحى كل ١٠ أيام، وتم تقدير كل من قوة الهجين كإنحراف عن متوسط وأفضل الأبوين، الفعل الجينى المضيف والسيادى، درجة التوريث بالمعنى العريض والضيق، التحسين المتوقع من الإنتخاب وكذلك معامل الإرتباط المظهرى بين جميع الأزواج الممكنة لصفات المحصول ومكوناته (عدد الأيام حتى ٥٠ % تزهير، طول النبات، طول الدالية، عدد الداليات/ نبات، عدد الحبوب الممتلئة/ دالية، وزن ١٠٠ حبة، النسبة المئوية للعقم ومحصول النبات الفردى).

وأشارت النتائج المتحصل عليها من الأباء والجيل الأول والأجيال الإنعزالية إلى وجود مدى واسع بين متوسطات القيم وبعضها، وكذلك وجد تأثير كل من السيادة الجزئية والسيادة الفائقة لهذة الصفات. كذلك أوضحت النتائج أن النسبة المئوية لقيم قوة الهجين عند قياسها كإنحراف عن قيم متوسط وأفضل الأبوين كانت عالية المعنوية موجبة فى كل الهجن لصفات طول الدالية، عدد الداليات/ نبات ومحصول النبات الفردي ، كذلك كانت قوة الهجين عالية المعنوية موجبة كإنحراف عن قيم متوسط وأفضل الأبوين لصفة طول النبات فى الهجين الأول والثاني.

وأوضحت النتائج أيضاً أن إختبار إسكالينج أظهر تأثير التفاعل بين الجينات الغير أليلية فى معظم الهجن للصفات المدروسة. كذلك أظهرت النتائج أن التأثير المضيف للجين لعب دورًا هامًا فى وراثة معظم الصفات المدروسة لجميع الهجن، كذلك لعب كل من التأثير السيادى والتأثير المضيف X المضيف للجين دورًا هامًا فى وراثة كل من صفة طول النبات ، طول الدالية ، عدد الحبوب الممتلئة/ دالية ، وزن ١٠٠ حبة ، النسبة المئوية للعقم ومحصول النبات الفردى ، بينما لعب الفعل الجينى المضيف X السيادى دورًا أساسيًا فى وراثة كل من صفة عدد الأيام حتى ٥٠ % تزهير، طول النبات، عدد الداليات/ نبات، عدد الحبوب الممتلئة/ دالية، وزن ١٠٠ حبة، النسبة المئوية للعقم ومحصول النبات الفردى، كذلك لعب الفعل الجينى السيادى X السيادي دورًا هامًا فى وراثة كل الصفات المدروسة.

أوضحت النتائج أن درجة التوريث بالمعنى العريض كانت عالية لكل الهجن فى كل الصفات المدروسة، بينما كانت درجة التوريث بالمعنى الضيق معظمها منخفض إلى متوسطة ، أما التحسين الوراثى المتوقع فقد تم الحصول على أعلى القيم لصفة عدد الداليات/ نبات متبوعا بصفات طول النبات وعدد الأيام حتى ٥٠ % تزهير.

كذلك سجلت النتائج أيضاً أن محصول الحبوب قد تلازم تلازمًا قويًا وموجبًا مع كل من طول الدالية ، عدد الداليات/ نبات ، عدد الحبوب الممتلئة/ دالية ووزن ١٠٠ حبة فى كل الهجن المدروسة.

وتوصى الدراسة بأن الهجين الثاني (سخا ١٠٣ X واب ٨٨٠ إس جى ٣٣) والهجين الثالث (سخا ١٠٤ X أي إى تى ١٤٤٤ ) هما أفضل الهجن التي نستطيع أن نوصى بهما للنمو تحت ندرة المياه وذلك للحصول على أعلى محصول وأعلى القيم لتوفير المياه في نفس الوقت.

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