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# Yield potential and correlation analysis of some rice hybrids for yield and its component traits

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**Key word:** Correlation analysis, heterosis, *oryza sativa,* yield.

## 1 ABSTRACT

**Eleven hybrid combinations developed by three line systems with two standard check varieties were evaluated in two rice growing seasons in 2014 and 2015 at the experimental farm of the Rice Research and Training Center (RRTC), Kafr El-Sheikh, Egypt to find out best heterotic hybrids and interrelationships of yield and yield components of rice. Analysis of variance revealed significant differences for all traits studied, indicating the presence of high genetic variability among the genotypes. Two hybrids yielded significantly better than the higher-yielding check variety Giza 179 over the two seasons. The results revealed that the degree of standard heterosis varied from trait to trait. All of the hybrids showed superiority over standard check Sahel 108 for grain yield also showed significant heterosis for majority of other traits. While, two out of 11 hybrids significantly exceeded the respective check Giza 179.The interrelationships study showed positive and significant correlations in most of the cases. The highest value was found between flag leaf area and panicle length (0.788). Grain yield showed significant correlation and positive with number of panicles plant$^{-1}$ (0.565).**

## 2 INTRODUCTION

Rice (*Oryza sativa* L.) is an important crop, which supplies staple food for nearly 50% of the global population (Garris *et al*., 2005). Among the most cultivated cereals in the world, rice ranks as second to wheat (Abodolereza and Racionzer, 2009).Rice crop plays a significant role for sustaining the food self-sufficiency and for increasing the export in Egypt. Rice provides 20 per cent of the world's dietary energy, while wheat supplies 19 per cent and maize 5 per cent (FAO, 2004). Rice production should increase by about 60% by the year 2025 to feed the additional rice consumers (Duwayri *et al.,* 1999). Though during past two and half decades, a few high yielding rice varieties have been released, rice productivity in the valley has reached a plateau in the recent years and chances of further yield enhancement are scanty due to low genetic variability in hill rice cultivars (Sanghera and Wani, 2008). To meet the demand of ever-growing human population in valley, it is thus imperative to find alternative means for increasing the yield potential of rice cultivars in a sustainable manner. With limited resources, hybrid rice technology provides an opportunity to boost the yield of rice as hybrid rice varieties have a yield advantage of 15-20% over the conventional high yielding varieties (Virmani and Kumar, 2004). The associations among different traits can be evaluated by correlation analysis [8].The path co-efficient partitions the correlation co-efficient of the yield within its contributing traits into direct and indirect effects (Ahmadizadeh *et al.*, 2011). The availability of morpho-genetic variation in agronomic characteristics of a crop would be of considerable importance in determining the best method to improve the yield of that crop. It is necessary to have a good knowledge of those characteristics that have significant association with yield because the characteristics can be used to direct selection criteria or indices to enhance performances of varieties in a new plant population. The objectives of the study are (i) to evaluate twelve rice hybrids for adaptation and yield in two seasons, (ii) to estimate the heterosis for earliness, grain yield and yield components, and (iii) to discuss the interrelationships among the examined agronomic traits.

## 3 MATERIALS AND METHODS

The present investigation was carried out at the farm of Rice Research and Training Center (RRTC), Sakha, Kafr El- Sheikh, Egypt during two summer seasons 2014 and2015. The study was included 11 released $F_1$ hybrids in rice developed by RRTC and Africa Rice Center (ARC). The evaluation of hybrids were done along with two check varieties, one high yielding Egyptian variety Giza 179 and another check was Sahel 108 developed by ARC. These combinations collected according to the collaborative research program between RRTC and ARC (Table 1).

**Table 1:** Details about the 11 developed rice hybrids and two checks

| Hybrids | Parentage | Origin |
|---|---|---|
| **HER 1** | IR69625A/Giza 178 | Egypt |
| **HER 2** | IR69625A/Giza 179 | Egypt |
| **AR009 H** | Exotic hybrid | ARC |
| **AR081 H** | Exotic hybrid | ARC |
| **AR105 H** | Exotic hybrid | ARC |
| **AR133 H** | Exotic hybrid | ARC |
| **AR138 H** | Exotic hybrid | ARC |
| **AR042 H** | Exotic hybrid | ARC |
| **AR039 H** | Exotic hybrid | ARC |
| **AR108 H** | Exotic hybrid | ARC |
| **AR028 H** | Exotic hybrid | ARC |
| **Giza 179 (ck)** | GZ1368/GZ6296 | Egypt |
| **Sahel 108 (ck)** | Exotic variety | ARC |

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Genotypes were grown in five meter long as individual plants 20 x20 cm and applied all the recommended cultural practices for rice was applied. Nine agronomic characteristics were studied i.e. days to heading (day), plant height (cm), flag leaf area ($cm^2$), number of panicles/plant, panicle length (cm), panicle weight (g), 1000-grain weight (g), spikelet fertility percentage and grain yield (t $ha^{-1}$).

**Statistical analysis:** The data were subjected to analysis of variance (Steel *et al.*, 1996) to determine the significant differences among genotypes for all the characters evaluated by the IRRISTAT program for pooled data. The heterosis of an individual cross for each trait was determined as the increase of the $F_1$ hybrid mean over check varieties, these proposed by Mather (1949), and Mather and Jinks (1982). Phenotypic correlation was estimated using the standard procedure suggested Kashiani and Saleh (2010).

# 4 RESULTS AND DISCUSSION

**4.1. Evaluation of mean performance of hybrid varieties:** The analysis of variance for the mean performance of genotypes (hybrids and check varieties) is presented in Table 2. Results showed that mean squares due to genotypes were highly significant, revealed that sufficient genetic variability existed in the genotypes for all characters studied. Mean performance of genotypes (hybrids and check varieties) for the studied traits is presented in Table (3). Results indicated that there were highly significant differences in all studied traits among 11 $F_1$ rice hybrids. This was an indication of variation created. Early maturing hybrids are desirable as they produce more yield/day and fit well in multiple cropping systems (Neelam *et al.*, 2009). Days to heading ranged from 90.0 to 111.4 days in F1 hybrids compared to the earlier check, which gave 93.3 days. Two hybrids (AR039H and AR108H) were significantly earlier in heading than the earlier check, which gave 90.0 and 90.7 days, respectively. While five hybrids were significantly later than the late check (Sahel 108). Plant height trait ranged from 96.0 cm to 122.0 cm. All African hybrid varieties were taller than the Egyptian hybrid variety EHR2 and the Egyptian check variety Giza 179. The highest plant height was observed in AR108H (122.0 cm) and the lowest in EHR2 (96.0 cm). Flag leaf area is very important trait because it plays significant role in grain filling period. All hybrids except EHR2 exhibited a significant increase in this trait than the two check varieties ranging from 32.9 to 45.0 $cm^2$. Concerning number of panicles $plant^{-1}$, the mean values of hybrids ranged from 16.7 to 25.0 panicles. Furthermore, only one hybrid had significantly superior number of paniclesplant$^{-1}$ over the best check variety Giza 179. Hybrids are generally characterized by having longer panicles indicating their efficiency in partitioning of assimilates to reproductive parts (Neelam *et al.*, 2009). For panicle length, seven hybrids were significantly better than the best check and ranged from 29.2 to 31.5 cm, while no hybrid was lower than the low check. Panicle weight ranged from 4.9 to 7.8 gm in hybrids compared to the two check varieties, which were 4.6 and 4.3 gm. Nine hybrids had significantly superior panicle weight over the best check variety Giza 179. Spikelet fertility percentage ranged from 70.2 to 96.4%. The rice hybrids EHR2 and AR108H gave the maximum mean value of 95.1 and 93.8%, respectively. On the other hand, AR039H recorded the lowest value of 70.2%.Weight of 1000-grain was significantly heavier than the better check in three hybrids ranging from 28.5 to 29.7 g. Regarding grain yield per plant, the mean values of hybrids ranged in grain yield from 8.0 to 11.0 t $ha^{-1}$ compared to the two check varieties, which gave 10.0and 7.3 t $ha^{-1}$, respectively. Only two hybrids produced higher grain yield than the better check variety, which were 11.0 and 10.2 t $ha^{-1}$, respectively (Figure 1). From these results, it was observed that some hybrids performed well and gave high grain yield and yield traits comparing with the better check variety. All rice hybrids included in study were performed better yield than check Sahel 108. Higher yield of hybrids resulted from their increased spikelet fertility percentage and to some extent increased grain weight, which enhanced the sink capacity (Ponnuthurai *et al.*, 1984).

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**Table 2:** Analysis of variance for studied traits of thirteen rice genotypes

| Source of variation | | Days to heading (day) | Plant height (cm) | Flag leaf area (SPAD) | No. of panicle/ Plant | Panicle length (cm) | Panicle weight (g) | 1000- grain weight(g) | Spikelets fertility % | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Replications** | 2 | 0.57 | 9.54 | 0.31 | 0.33 | 0.88 | 0.20 | 0.02 | 0.04 | 0.18 |
| **Genotypes** | 12 | 165.55** | 243.21** | 117.06** | 27.38** | 20.12** | 3.20** | 15.70** | 255.01** | 2.97** |
| **Error** | 24 | 1.09 | 3.34 | 7.23 | 1.82 | 0.64 | 0.38 | 0.10 | 0.98 | 0.02 |

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

**Table 3:** Mean performances of agronomic traits for thirteen rice genotypes over two seasons

| No. | Variety | Days to heading (day) | Plant height (cm) | Flag leaf area (SPAD) | No. of panicle/ Plant | Panicle length (cm) | Panicle weight (g) | 1000- grain weight(g) | Spikelets fertility % | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **HER 1** | 105.7 | 110.3 | 32.9 | 25.0 | 26.2 | 5.1 | 25.0 | 93.4 | 11.0 |
| 2 | **HER 2** | 95.0 | 96.0 | 25.3 | 23.3 | 24.5 | 4.9 | 28.5 | 95.1 | 10.2 |
| 3 | **AR009 H** | 101.0 | 119.0 | 45.0 | 19.0 | 31.5 | 6.3 | 26.6 | 76.6 | 9.3 |
| 4 | **AR081 H** | 111.4 | 121.3 | 42.0 | 23.3 | 30.5 | 6.1 | 24.8 | 88.6 | 9.6 |
| 5 | **AR105 H** | 102.4 | 119.7 | 36.6 | 15.0 | 30.1 | 7.8 | 26.5 | 93.6 | 9.8 |
| 6 | **AR133 H** | 110.0 | 121.3 | 36.1 | 20.7 | 28.3 | 5.8 | 29.7 | 85.5 | 9.1 |
| 7 | **AR138 H** | 107.7 | 111.0 | 39.0 | 21.7 | 29.2 | 5.7 | 25.4 | 77.0 | 9.2 |
| 8 | **AR042 H** | 105.7 | 112.3 | 35.7 | 18.7 | 30.5 | 6.4 | 23.6 | 77.5 | 8.8 |
| 9 | **AR039 H** | 90.0 | 105.7 | 38.0 | 20.0 | 30.1 | 6.8 | 22.4 | 70.2 | 8.0 |
| 10 | **AR108 H** | 90.7 | 122.0 | 35.6 | 17.3 | 30.9 | 6.5 | 28.9 | 93.8 | 9.2 |
| 11 | **AR028 H** | 103.0 | 119.3 | 42.9 | 21.0 | 28.3 | 6.1 | 24.7 | 80.7 | 9.0 |
| 12 | **Giza 179 (ck)** | 93.3 | 99.0 | 27.0 | 22.0 | 23.6 | 4.6 | 27.5 | 96.4 | 10.0 |
| 13 | **Sahel 108 (ck)** | 103.0 | 112.0 | 29.4 | 16.7 | 28.0 | 4.3 | 24.2 | 92.6 | 7.3 |
| **Grand mean** | | 101.4 | 113.0 | 35.8 | 20.3 | 28.6 | 5.9 | 26.0 | 86.2 | 9.3 |
| **Range of hybrids** | | 90.0-111.4 | 96.0-122.0 | 25.3-45.0 | 15.0-25.0 | 23.6-31.5 | 4.3-7.8 | 22.4-29.7 | 70.2-96.4 | 8.0-11.0 |
| **LSD 0.05 %** | | 1.47 | 2.56 | 3.77 | 1.89 | 1.13 | 0.87 | 0.44 | 1.39 | 0.22 |
| **0.01 %** | | 2.14 | 3.75 | 5.50 | 2.76 | 1.64 | 1.27 | 0.64 | 2.02 | 0.32 |

**4.2 Estimates of standard heterosis for rice hybrids:** Standard heterosis computed over check varieties (Giza 179 and Sahel 108) for nine traits revealed that heterosis varied from trait to trait, and from hybrid to hybrid (Table 4). Since earliness is an important objective for rice breeding, the negative values of heterosis for days to heading are considered desired values. Only two hybrids were significantly earlier than the respective Giza 179 (-3.54 and -2.79%). Five hybrids were significantly later than their respective the check Sahel 108 (2.62 to 8.16%), while four hybrids were significantly earlier than respective the check Sahel 108 (-1.94 and -12.62%). Concerning plant height, ten out of eleven crosses showed highly significant and positive heterosis relative to over check variety Giza 179 ranging from 6.77 to 23.23% as well as only six crosses to over check variety Sahel 108 ranging from 6.25 to 8.93%. Regarding flag leaf area is considered an important parameter for genetic improvement of genotypes. Ten crosses exhibited a significant increase of heterosis in this trait than the check variety Giza 179 ranging from 21.85 to 66.67% and nine crosses than the check variety Sahel 108 ranging from 21.09 to 53.06%. Furthermore, number of panicles plant$^{-1}$ is believed to be closely associated with high yield potential. Only one cross showed highly significant and positive heterosis relative to the check variety Giza 179 (13.64%), while highly significant and positive heterotic effects were obtained in nine crosses (11.98 to 49.70%) for the check variety Sahel 108. For panicle length, all crosses showed highly significant and positive heterosis relative to over check variety Giza 179 as well as seven crosses to over check variety Sahel 108. Generally, large panicle length is associated with high number of grains per panicle, thus results in higher production. Therefore, positive heterosis for panicle length is desirable (Saidaiah *et al.*, 2010). Weight of panicle showed significant heterosis over both the check varieties except EHR1 and EHR2. The per cent of heterosis for these hybrids ranged from 23.91 to 69.57% over check variety Giza 179, and 32.56 to 81.40% over check variety Sahel 108. Earlier rice scientists (Tiwari *et al.*, 2011) have also reported significant heterosis for this trait. Besides these yield-contributing traits, heterosis was manifested by entire hybrids for 1000-grain weight. Only three hybrids were significantly heavier than the respective Giza 179 (3.64 to 8.00%). Nine hybrids were significantly heavier than respective the check Sahel 108 (2.07 to 22.73%).

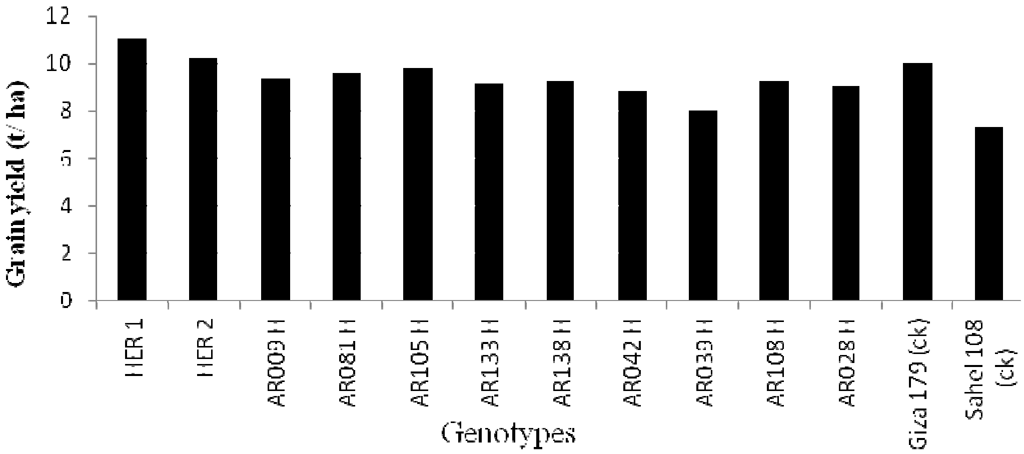


**Fig. 1:** Grain yield for rice hybrids and standard check varieties.

Spikelet fertility percentage is the important trait, which directly influences the ultimate grain yield. Most of the hybrids showed significant and negative heterosis for this trait. While positive significant heterosis was observed only in one case (2.70 %). Saidaiah *et al.* (2010) concluded that standard heterosis in yield was primarily due to increased number of spikelets panicle$^{-1}$. For grain yield, two out of eleven hybrids significantly exceeded the respective check Giza 179 values (2.00 and 10.00%). For the check Sahel 108 heterosis, highly significantly positive heterosis was obtained in all hybrids, which exceeded it check values (9.59 to 50.68%). Tiwari *et al.* (2011) also reported more than 25% yield increase of hybrids over standard rice varieties. A high level of heterosis in rice is a prerequisite for the development of commercial hybrid rice. It is worthy to note that the hybrids (HER 1 and HER 2) showed the highest useful heterosis for grain yield (t ha$^{-1}$). Therefore, these crosses offer good possibility for improving grain yield in rice. It could be concluded that the level of heterosis expressed in this study reflects a high degree of genetic diversity among the parents. The acceptable amount of heterosis for yield and other yield contributing traits indicates that hybrids can be commercially exploited after screening of $F_1$'s.

**4.3 Estimates of phenotypic correlation coefficient:** Yield is a complex product being influenced by several interdependable quantitative characteristics. Thus developing a breeding protocol for yield improvement may not be effective unless the other yield components influencing it directly or indirectly are taken into consideration. When selection pressure is exercised for improvement of any trait highly associated with yield, it simultaneously affects a number of other correlated characteristics. Hence, knowledge regarding association of character with yield and among themselves provides guideline to the plant breeder for making improvement through selection and provides a clear understanding about the contribution in respect of establishing the association by genetic and non-genetic factors (Rahman *et al.*, 2012). The correlation coefficient values among all traits tested are presented in Table 5. The results indicated positive correlations among all traits tested in most of the cases. The highest value was found between flag leaf area and panicle length (0.788), while the lowest one was observed between days to heading and panicle weight (0.009). Grain yield showed significant correlation and positive with number of panicles plant$^{-1}$ (0.565). Results showed presence of positive and significant correlation between flag leaf area and each of panicle height (0.732), panicle length (0.788), panicle weight (0.644) and spikelet fertility percentage (0.661). Plant height showed significant and positive association with both panicle length (0.752) and panicle weight (0.572). The thousand-grain weight showed significant correlation and positive with spikelet fertility percentage (0.537). It means increase of one trait will cause increase in the correlated trait also. However, significant negative correlations were found between panicle length and each of number of panicles plant$^{-1}$ (-0.533) and spikelet fertility % (-0.562). Similar trends were found by Hammoud *et al.* (2012) and Anis *et al.* (2016a, b).

**Table 4:** Estimation of heterosis (%) for eleven hybrids over standard checks for various agro- morphological traits in rice

| Hybrids | Days to heading (day) | | Plant height (cm) | | Flag leaf area (SPAD) | | No. of panicle/Plant | | Panicle length (cm) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 |
| **HER 1** | 13.29** | 2.62** | 11.41** | -1.52 | 21.85** | 11.90 | 13.64** | 49.70** | 11.02** | -6.43** |
| **HER 2** | 1.82* | -7.77** | -3.03* | -14.29** | -6.30 | -13.95* | 5.91 | 39.52** | 3.81** | -12.50** |
| **AR009 H** | 8.25** | -1.94* | 20.20** | 6.25** | 66.67** | 53.06** | -13.64** | 13.77** | 33.47** | 12.50** |
| **AR081 H** | 19.40** | 8.16** | 22.53** | 8.30** | 55.56** | 42.86** | 5.91 | 39.52** | 29.24** | 8.93** |
| **AR105 H** | 9.75** | -0.58 | 20.91** | 6.88** | 35.56** | 24.49** | -31.82** | -10.18 | 27.54** | 7.50** |
| **AR133 H** | 17.90** | 6.80** | 22.53** | 8.30** | 33.70** | 22.79** | -5.91 | 23.95** | 19.92** | 1.07 |
| **AR138 H** | 15.43** | 4.56** | 12.12** | -0.89 | 44.44** | 32.65** | -1.36 | 29.94** | 23.73** | 4.29* |
| **AR042 H** | 13.29** | 2.62** | 13.43** | 0.27 | 32.22** | 21.43** | -15.00** | 11.98* | 29.24** | 8.93** |
| **AR039 H** | -3.54** | -12.62** | 6.77** | -5.63** | 40.74** | 29.25** | -9.09* | 19.76** | 27.54** | 7.50** |
| **AR108 H** | -2.79** | -11.94** | 23.23** | 8.93** | 31.85** | 21.09** | -21.36** | 3.59 | 30.93** | 10.36** |
| **AR028 H** | 10.40** | 0.00 | 20.51** | 6.52** | 58.89** | 45.92** | -4.55 | 25.75** | 19.92** | 1.07 |

**Table 4:** (Continued)

| Hybrids | Panicle weight (g) | | 1000- grain weight (g) | | Spikelets fertility % | | Grain yield (t/ha) | |
|---|---|---|---|---|---|---|---|---|
| | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 | Giza 179 | Sahel 108 |
| **HER 1** | 10.87 | 18.60 | -9.09** | 3.31** | -3.11** | 0.86 | 10.00** | 50.68** |
| **HER 2** | 6.52 | 13.95 | 3.64** | 17.77** | -1.35 | 2.70** | 2.00* | 39.73** |
| **AR009 H** | 36.96** | 46.51** | -3.27** | 9.92** | -20.54** | -17.28** | -7.00** | 27.40** |
| **AR081 H** | 32.61** | 41.86** | -9.82** | 2.48* | -8.09** | -4.32** | -4.00** | 31.51** |
| **AR105 H** | 69.57** | 81.40** | -3.64** | 9.50** | -2.90** | 1.08 | -2.00* | 34.25** |
| **AR133 H** | 26.09* | 34.88** | 8.00** | 22.73** | -11.31** | -7.67** | -9.00** | 24.66** |
| **AR138 H** | 23.91* | 32.56** | -7.64** | 4.96** | -20.12** | -16.85** | -8.00** | 26.03** |
| **AR042 H** | 39.13** | 48.84** | -14.18** | -2.48* | -19.61** | -16.31** | -12.00** | 20.55** |
| **AR039 H** | 47.83** | 58.14** | -18.55** | -7.44** | -27.18** | -24.19** | -20.00** | 9.59** |
| **AR108 H** | 41.30** | 51.16** | 5.09** | 19.42** | -2.70** | 1.30 | -8.00** | 26.03** |
| **AR028 H** | 32.61** | 41.86** | -10.18** | 2.07* | -16.29** | -12.85** | -10.00** | 23.29** |

**Table 5:** Estimates of phenotypic correlation coefficients among each pair of studied traits

| Traits | Days to heading | Plant height(cm) | Flag leaf area (SPAD) | No. of panicle /plant | Panicle length(cm) | Panicle weight (g) | 1000-grain weight (g) | Spikelets fertility % | Grain yield (t/ha) |
|---|---|---|---|---|---|---|---|---|---|
| **Days to heading (day)** | 1.00 | | | | | | | | |
| **Plant height(cm)** | 0.474 | 1.00 | | | | | | | |
| **Flag leaf area (SPAD)** | 0.365 | 0.732** | 1.00 | | | | | | |
| **No. of panicle/plant** | 0.198 | -0.406 | -0.121 | 1.00 | | | | | |
| **Panicle length(cm)** | 0.198 | 0.752** | 0.788** | -0.533* | 1.00 | | | | |
| **Panicle weight (g)** | 0.009 | 0.572** | 0.644** | -0.483 | 0.767** | 1.00 | | | |
| **1000- grain weight (g)** | -0.114 | 0.070 | -0.286 | 0.010 | -0.282 | -0.132 | 1.00 | | |
| **Spikelets fertility %** | -0.096 | -0.152 | 0.661** | 0.047 | -0.562** | -0.414 | 0.537* | 1.00 | |
| **Grain yield (t/ha)** | 0.089 | -0.167 | -0.160 | 0.565** | -0.421 | -0.061 | 0.420 | 0.463 | 1.00 |

## 5 CONCLUSION

The overall results indicated that, The Egyptian rice hybrids EHR1 and EHR2 were the higher agronomic performance for grain yield, than the remaining introduced hybrids. This indicated that these exotic hybrids not complete adapted under Egyptian conditions due to the genetic background for these hybrids. In addition, the Egyptian check variety Giza 179 was higher than Sahel 108 as introduced check for grain yield. Therefore, the environmental factors are played a major role for appearance the differences.

## 6 REFERENCES

Abodolereza A and Racionzer P: 2009. Food Outlook: Global market analysis.23-27.

Ahmadizadeh M, Nori A, Shahbazi H and Aharizad S: 2011.Correlated response of morpho physiological traits of grain yield in durum wheat under normal irrigation and drought stress conditions in greenhouse. Afr. J. Biotechnol., 10(85): 19771-19779.

Anis G, EL Sabagh A, Ghareb A, EL-Rewainy I: 2016b.Evaluation of promising lines in rice (*Oryza sativa L.*) to agronomic and genetic performance under Egyptian conditions. International Journal of Agronomy and Agricultural Research, 8(3), 52-57.

Anis G, El-Sabagh A, El-Badry A, Barutçular C: 2016a.Improving Grain Yield in Rice (*Oryza Sativa* L.) by Estimation of Heterosis, Genetic Components and Correlation Coefficient. International Journal of Current Research, Vol. 8(01):25080-25085.

Duwayri M, Tran DV and Nguyen VN: 1999.Reflection on yield gaps in rice production. Intr.Rice Commission Newsletter. FAO, Rome. (48): 13-25.

FAO: 2004. The State of Food and Agriculture 2003-2004. Agricultural Biotechnology: Meeting the Needs of the Poor? (1 June 2005).

Garris AJ, Tai TH, Coburn J, Kresovich S and McCouch S: 2005. Genetic structure and diversity in *Oryza sativa* L. Genetics, 169: 1631-1638.

Hammoud SAA, Sedeek SEM, El-Rewainy IOM and El-Namaky RA: 2012. Genetic behavior of some agronomic traits, blast disease and stem borer resistance in tow rice crosses under two N-levels. J. Agric. Res. Kafr El-Sheikh Univ. 38(1): 83-105.

Kashiani P and Saleh G: 2010. Estimation of genetic correlations on sweet corn inbred lines using SAS mixed model. American J. Agril. Biol. Sci., 5(3): 309-314.

Mather K: 1949.Biometrical Genetics.3rd ed. Cambridge Univ. Press, London, NY, USA. p.158.

Mather K and Jinks JL: 1982.Biometrical Genetics.3rd ed. Cambridge Univ. Press, London, N.Y.

Neelam S, Ramesha M, Dayakar Reddy T and Siva Sankar A: 2009.Study of heterosis by utilizing male sterility-restoration system in rice (*Oryza Sativa* L.). J. Rice Res., 2(2): 93-98.

Ponnuthurai S, Virmani SS and Vergara BS:(1984). Comparative studies on the growth and grain yield of some $F_1$ rice (*Oryza sativa* L.) hybrids. Philip. J. Crop Sci. 9(3): 183-193.

Rahman MM, Syed MA, Adil M Ahmad H and Rashid MM: 2012.Genetic Variability, Correlation and Path Coefficient Analysis of Some Physiological Traits of Transplanted Aman Rice (*Oryza sativa* L.). Middle-East J. Sci. Res. 11(5): 563-566.

Saidaiah P, Kumar SS and Ramesha MS: 2010. Combining ability studies for development of new hybrids in rice over environments. J. Agric. Sci. 2: 1-5.

Sanghera GS and Wani SH: 2008. Innovative approaches to enhance genetic potential of rice (*Oryza sativa* L.) for higher productivity under temperate conditions of Kashmir. J. Pl. Sci. Res. 24: 99-113.

Tiwari, D.K., P. Pandey, S.P. Giri and J.L. Dwivedi: 2011. Heterosis studies for yield and its components in rice hybrids using CMS system. Asian J. Pl. Sci. 10: 29-42.

Virmani SS and Kumar H: 2004.Development and use of hybrid rice technology to increase rice productivity in the tropics. International Rice Res. Notes, 29: 10-19.