Morphological characterization and its relation with yield traits of *Oryza sativa* L. genotypes in Iraq

Balqees Hadi Al-Musawi* and Mohammed A. Al-Anbari

1Department of Biology, College of Science, Kerbala University, Iraq.
2Department of Field crops, College of Agricultural, Kerbala University, Iraq.

*E-mail: balqees.hadi@uokerbala.edu.iq

**Abstract.** In the current study we reported for agronomic traits and yield of fifteen rice genotypes in season during 2018 and investigated at the field experimental of Al-Mashkab research station (AMRR), Najaf, Iraq. The experiment was conducted following Randomized Complete Block Design (RCBD) with having three replications. These data related days to 50% flowering and heading, plant height (cm), leaf area index (LAI), panicle length (cm), number of tiller per panicle, 1000 grain weight (g) and biological yield, harvest index and grain yield (kg ha\(^{-1}\)) were evaluated. The results indicated that the rice genotypes differed in plant growth characteristics and yield and yield components. 1000 grain weight and grain yields both were highest in Gohar genotype. Shiroudi genotype required shorter days to maturity and Anber33 longest days to maturity. Some of the rice genotypes particularly (Gohar) showed high promise with grain yield. Recommended, intensification of introducing more genotypes to select the best rice genotype for Iraqi condition could maximize the benefits of genotype cultivation. Agronomic data collected in the current study would be significant to realize the suitability of an individual rice genotypes of the farmer field, also were found more appropriate of the agro-climatic status of Iraq.

**Keywords.** *Oryza sativa* L., Field experiment, Yield traits.

1. Introduction

Rice (*Oryza sativa* L.) is the serves as the staple food for more than half of the globe’s population, belongs to family Gramineae (Poaceae) [1]. More than 90 percent of the world’s rice is mature and used in Asia, where 60 percent of the earth’s people and two thirds of world’s needy live [2]. Different morphological characters play very significant role for most rice production with new plant type characteristics related with the plant yield [3]. Morphological property of rice also related with the yield possibility of the different rice genotypes for the selection of the best genotypes that further interested in rice breeding program [4]. Thousand rice genotypes have been developed by selection from the cultivated material many centuries ago, which are well proper to the local climate, grain yield regard a complex trait, quantitative in nature and a collective function of a number of constitutive traits. Thus, chosen for yield present may not be much pleasing unless other yield complex traits are possessed into discernment [5]. Grain yield of rice is a quantitative polygenic trait and much influenced by climate. Range and importance of
combination of yield with yield components should be believed, while determining the chosen criteria of germplasm on the basis of available genetic diversity [6]. The success of breeding program also consist onto the value of genetic variability current in the population and range to which the desired traits are heritable. Maintenance in the current search entitled of assessment of different rice (*Oryza sativa* L.) genotypes for agronomic traits and yield traits to fulfil the following objective and to detect appropriate high yielding genotype for Iraqi regions.

2. Materials and Methods

2.1. Plant materials

Current search included 15 genotypes of rice, were collected of the Al-Mushkab Rice Research Station (AMRR), Najaf, Iraq. The source of this genotypes as given in (Table 1).

2.2. Methods

This search was carried at the experimental field of Al-Mushkab research station during rice growing season from 2018. The trial was prepared in a Randomized Complete Block Design (RCBD) with three replications, the date of planting was 17/06/2018, and the seedlings were planted after 22 days old. Cultivated of the seedlings were at spacing of 20 x 20 (cm) line. Whole cultivation exercise were used approving to the proceedings recommended of rice crop in research. The recommended amount of chemical fertilizer (CF) were used : 280 kg ha\(^{-1}\) of urea and 120 kg ha\(^{-1}\) of NP as DAP fertilizer 18-46 [7].

2.3. Genetic parameters

The following genetic parameters were studied during trial which traits: days to 50% heading, days to heading , plant height (cm), Leaf area index, panicle length (cm), number of panicles/plant, number. of filled grains/panicle, sterility (%), 1000-grain weight (g), biological yield, harvest index and grain yield/plant (kg ha\(^{-1}\)).

| Genotypes’ name   | Pedigree                                  | Breeding Institute |
|-------------------|-------------------------------------------|--------------------|
| 1. Amber 33       | Local (Iraqi)                             | AMRRRS             |
| 2. Amber al-Baraka | Introduced from India                     | AMRRRS             |
| 3. Amber Furat    | Technology & Science Ministry / Baghdad    | AMRRRS             |
| 4. Amber Baghdad  | Technology & Science Ministry / Baghdad    | AMRRRS             |
| 5. Amber Menathera| Technology & Science Ministry / Baghdad    | AMRRRS             |
| 6. Sumar          | Technology & Science Ministry / Baghdad    | AMRRRS             |
| 7. Dijlah         | Introduced from China                     | AMRRRS             |
| 8. Ghadeer        | Introduced from IRRI (Philippines).        | AMRRRS             |
| 9. Brnamge -4     | Introduced from IRRI (Philippines).        | AMRRRS             |
| 10. Dorfak        | Sepidrood/Salari- Iran                    | AMRRRS             |
| 11. Gohar         | Pusa1238-1/Pusa1238-81-6-Iran             | AMRRRS             |
| 12. Khazar        | IR2071-625-1-52/TANU7456-Iran             | AMRRRS             |
| 13. Shiroudi      | Khazar / Deylamani – Iran                 | AMRRRS             |
| 14. Neda          | Amol3/Hassansarayee/sangetarom-Iran       | AMRRRS             |
| 15. Nemat         | Amol3/sangetarom - Iran                   | AMRRRS             |

AL-Mashkhab Rice Research Station (AMRRS).
2.4. Statistical analysis

The data famed on several genetic parameters were presented to the analysis of variance (ANOVA) method to detect the difference among all genotypes. In states where difference were begin important, averages were identified for differences employ least significant variance (LSD) test, \((P \leq 0.001\%). The software (Genstat) was utilized for calculated both LSD and the ANOVA [8]. Variability for all the agronomic traits as shown in (Table 2).

3. Results and Discussion

3.1. Analysis of variance

The results presented in this manuscript were acquired of an trial carried during 2018 in AMRRS, the literal of this trial was to study the estimation of selected rice genotypes for agronomic traits and yield traits under ecological situation of Iraq. These results related for days to 50% flowering and heading, plant height, leaf area index, panicle length, number panicle/plant, sterility, 1000 grains weight and grain yield are given and discuss. These genotypes for the studied 12 quality as current in Table 2.

Table 2. Summary mean squares (M.S.) and analysis of variance of collective data for agronomic & yield traits in fifteen genotypes from rice grown in the field at Rice Research Station, Najaf-Iraq.

| S.O. V. Traits          | Reps. | Genotypes   | Error |
|-------------------------|-------|-------------|-------|
| Df                      | 2     | 14          | 28    |
| Days to 50% heading     | 15.76 | **150.66**  | 3.68  |
| Days to heading         | 7.62  | **128.80**  | 5.36  |
| Plant height            | 8.16  | 663.31**    | 50.16 |
| Leaf area index         | 9.63  | **107.83**  | 7.72  |
| Panicle length.         | 5.64  | 19.87       | 11.31 |
| No .of tiller/panicle   | 0.59  | 11.63**     | 0.62  |
| No of panicles          | 455.3 | **10657**   | 761.3 |
| No. of filled grains/panicle | 1447 | **7655** | 412 |
| Sterility (%)           | 50.61 | **98.21**   | 29.07 |
| 1000 grain weight       | 7.27  | **21.13**   | 0.81  |
| Biological yield        | 4453129 | **9730076** | 812724 |
| Harvest Index (%)       | 51.72 | **129.51**  | 7.79  |
| Grain yield/plant       | 719796 | **2426113** | 243672 |

**significantly at 0.01 probability level.

3.2. Plant growth characteristics

3.2.1. Days to panicle initiation

The vegetative growth parameters of the different genotypes and the data related days to panicle initiation included day number to 50% flowering and day number to physiological maturity are presented in (Table 3). Analysis of the data exhibited that all genotypes studied are significantly several with relate to days 50% flowering and heading. The number of days required to 50% flowering stage differed significantly among the rice genotypes studied. The lowest number of days required to 50% flowering was observed in 86.33 days with Neda, while the maximum number of days required to 50% flowering was for Anber33 was 105.67 days, also days to physiological maturity
stage also varied significantly among the genotypes studied. Shiroudi, Dorfak and Neda took the lowest duration for maturity days, while Anber33 took the longest duration days.

**Table 3.** Day numbers to 50% flowering, and physiological maturity stages, plant high and leaf area index per plant.

| Genotypes          | Day number to 50% flowering | Day number to physiological maturity | Plant height (cm) | Leaf area index |
|--------------------|-------------------------------|--------------------------------------|-------------------|-----------------|
| Amber 33           | 105.67                        | 142.67                               | 139.33            | 19.05           |
| Amber al-Baraka    | 100.00                        | 136.67                               | 124.67            | 5.93            |
| Amber Furat        | 104.33                        | 141.67                               | 139.00            | 17.01           |
| Amber Baghdad      | 104.00                        | 140.67                               | 142.00            | 22.43           |
| Amber Menathera    | 105.67                        | 142.67                               | 135.67            | 14.27           |
| Sumar              | 93.67                         | 127.33                               | 103.67            | 5.81            |
| Dijlah             | 105.33                        | 140.67                               | 112.00            | 6.70            |
| Ghadeer            | 98.00                         | 137.33                               | 119.33            | 6.49            |
| Brnamege -4        | 96.00                         | 137.00                               | 108.00            | 7.48            |
| Dorfak             | 88.00                         | 127.33                               | 103.33            | 3.63            |
| Gohar              | 93.00                         | 130.67                               | 123.00            | 6.05            |
| Khazar             | 98.67                         | 138.00                               | 116.00            | 5.11            |
| Shiroudi           | 89.00                         | 125.00                               | 109.00            | 4.47            |
| Neda               | 86.33                         | 127.67                               | 100.33            | 5.44            |
| Nemat              | 88.00                         | 127.00                               | 101.00            | 5.73            |
| LSD 0.01           | 3.21                          | 3.87                                 | 11.84             | 4.65            |

The breeding efforts are underway to develop short plant cycle with high yield potential. The variation in the plant growth characteristics between rice genotypes are due to variability in their genotype composition. Similar result was reported by [9, 10].

3.2.2. **Plant height (cm), leaf area index per plant**

variation between genotype of rice were significant presented in (Table 3). There plant height, Leaf area index per plant was higher in Anber33 compared with the other genotypes which also differed among themselves in this parameter as shown in above. It is apparent from the table 3 that the plant height was lead significantly several between the genotypes. The result display that highest (142.00cm) plant height was showed in Amber Baghdad genotype directed significantly by Amber33, Amber Furat and Amber Menathera genotype having (139.33cm, 139.00 and 135.67) respectively in plant height on record, whereas least (100.33cm) plant height was showed in Neda genotype. Also differences in leaf area index among genotype of rice are given in Table 3. It was found significantly several between them. The result show that highest (22.43) leaf area index was found in Amber Baghdad genotype follow significantly by Amber33 genotype have (19.05) recorded. The difference among genotypes in plant height is may be referred to variation climatic requirements of among genotypes, also accomplished that there is different climatic requirements of each genotype. Yet, it has been notified that plant height was influenced by numerous factors such as plant density, fertilizer employments and plantation method, [11, 12]. The yield indices for number of tiller per panicle, filled grain number per panicle, sterility ratio (%), Table 4.
Table 4. Panicle length (cm), number tillers of panicle, number panicles, filled grain number/panicle, sterility ratio (%).

| Genotypes         | Panicle Length (cm) | Number Tillers/panicle | Number of panicles | Filled Grain number/panicle | Sterility Ratio (%) |
|-------------------|---------------------|------------------------|--------------------|-----------------------------|---------------------|
| Amber 33          | 29.07               | 10.43                  | 333.3              | 160.2                       | 19.96               |
| Amber al-Baraka   | 26.30               | 9.43                   | 361.0              | 75.2                        | 21.69               |
| Amber Furat       | 29.43               | 10.00                  | 246.0              | 165.2                       | 15.51               |
| Amber Baghdad     | 23.30               | 9.90                   | 370.3              | 171.4                       | 19.18               |
| Amber Menathera   | 28.92               | 9.96                   | 363.0              | 154.6                       | 14.10               |
| Sumar             | 23.10               | 10.47                  | 372.3              | 133.4                       | 18.88               |
| Dijlah            | 31.80               | 15.77                  | 268.7              | 275.2                       | 9.24                |
| Ghadeer           | 29.17               | 11.40                  | 350.0              | 183.6                       | 17.97               |
| Brnamge -4        | 26.97               | 12.83                  | 362.0              | 184.9                       | 9.90                |
| Dorfak            | 25.13               | 8.90                   | 388.3              | 79.9                        | 30.37               |
| Gohar             | 27.83               | 11.37                  | 396.0              | 174.6                       | 14.61               |
| Kazmar            | 25.10               | 13.77                  | 197.0              | 152.1                       | 30.09               |
| Shiroudi          | 28.60               | 9.20                   | 329.3              | 107.5                       | 14.86               |
| Neda              | 23.87               | 9.20                   | 412.7              | 188.6                       | 8.75                |
| Nemah             | 25.73               | 9.07                   | 371.0              | 100.9                       | 18.46               |
| LSD 0.01          | N.S.                | 1.31                   | 46.15              | 33.94                       | 9.02                |

3.2.3. The Panicle length (cm), number tiller/panicle, filled grain number and sterility ratio (%)

The results in this (table 4) indicated that the panicle length was count of the all rice genotype no differed significantly between them at (p = 0.01). The number tillers per panicle was significantly, the highest in Dijlah reached to 15.77, while the lowest in Dorfak reached to 8.90. Filled grain number per panicle was significantly highest in the Dijlah (275.2), while recorded the lowest in the Amber al-Baraka genotype (75.2). The results in this table showed that the significant variation in sterility ratio among genotypes, the Dorfak genotype showed significantly highest ratio, and the lowest in Neda genotype. Number of tillers/panicles and number of reproductive tiller/panicle supply valuable information for the rice breeders and these traits have direct influence on yield/plant [13].

3.3. Yield components

3.3.1. 1000 grain weight (g), biological yield, Harvest Index and grain yield (kg.ha⁻¹)

This analysis of the data shows in table 5 that 1000 grain weight are significantly different among genotypes. The highest (29.33g) 1000 grain weight was on record in Amber al-Baraka genotype while recorded lowest weight reached to (19.67 g) in Sumer and Brnamge-4 genotypes. 1000 weight was influenced by agriculture methods. According to [12, 14, 15] notified that agriculture methods didn’t have this influence on 1000-grain weight. The genotypes also showed significant differences in the biological yield was highest reached to 17860 kg.ha⁻¹ Amber33 genotypes while other genotypes Sumer in biological yield. The harvest index showed significant differences among genotypes, the Sumer gave highest index reached to 49.29 % followed by Dijlah, Gohar and Shiroudi while the Amber33 gave the lowest index reached to 27.57%. Variations among genotype of rice in grain yield are given in Table 5. The apparent from that table was found significantly several among genotypes in grain yield (kg. ha⁻¹). There result shows Gohar genotype reached to maximum (7553.33) kg.ha⁻¹ with producing the highest paddy yield followed by Ghadeer and Dijlah while other genotype Kazmar had lowest paddy yield reached to 4116.67 kg. ha⁻¹. The variation in the yield and yield components between rice genotypes are due to variability in their genotype composition, and differed adapted to current environmental conditions. Similar result was reported by [16, 17, 18, 19, 20].
Table 5. 1000-grain weight (g), biological yield, harvest index (%) and grain yield (kg ha\(^{-1}\)).

| Genotypes         | 1000 Grain Weight (g) | Biological yield | Harvest Index (%) | Grain Yield (kg ha\(^{-1}\)) |
|-------------------|-----------------------|------------------|-------------------|-----------------------------|
| Amber 33          | 21.00                 | 17860            | 27.57             | 4930.00                     |
| Amber al-Baraka   | 29.33                 | 14337            | 37.52             | 5383.33                     |
| Amber Furat       | 21.67                 | 14097            | 43.51             | 6113.33                     |
| Amber Baghdad     | 21.33                 | 16247            | 34.08             | 5530.00                     |
| Amber Menathera   | 21.00                 | 17747            | 33.66             | 5930.00                     |
| Sumar             | 19.67                 | 12590            | 49.29             | 6190.00                     |
| Dijlah            | 23.33                 | 14140            | 48.73             | 6856.67                     |
| Ghadeer           | 22.33                 | 17210            | 42.05             | 7226.67                     |
| Baramge -4        | 19.67                 | 17617            | 33.97             | 5976.67                     |
| Dorfak            | 24.00                 | 13787            | 37.94             | 5220.00                     |
| Gohar             | 26.67                 | 15790            | 47.81             | 7553.33                     |
| Khazar            | 23.33                 | 12700            | 32.42             | 4116.67                     |
| Shiroudi          | 21.33                 | 14357            | 45.93             | 6456.67                     |
| Neda              | 25.33                 | 15557            | 42.38             | 6590.00                     |
| Nemat             | 22.00                 | 13960            | 39.95             | 5593.33                     |
| LSD 0.01          | 1.51                  | 1507.8           | 4.67              | 825.60                      |

4. Conclusion

The advancement grain yield for rice is the major objective of breeding program to improve genotypes. Grain yield regard is a complex trait, controlled through many genes and very influenced by climate. Supplement, grain yield as well attached to other traits like as growth duration, plant kind and yield compound [21]. Traits like as number of reproductive tillers and number of tiller / panicle are immediately responsible for the ultimate yield while trait like as plant height, leaf area index and numbers of total tillers are not very important as yield determinants. All these traits are possessed in to seeing when the rice genotypes are choose for the commercial cultivation. However, some of rice genotypes particularly (Gohar) showed high promise with grain yield and Integrating the promising genotype into the farming system could boost rice productivity and provide the basis for national food security as well as generate sustainable income. Further, intensification of introducing more genotypes to select the best rice genotype for Iraqi condition could maximize the benefits of genotype cultivation. In the current search gives average values for each genetic parameter and these data can be employed when different genotypes are screened for future breeding programs.

5. Acknowledgement

Al-Musawi, well thanks to Al-Mashkhab Rice Research Station (AMRRS).Najaf-Iraq of provided that rice grain specimen and experiment managed in field.

6. References

[1] Khan AS, Imran M and Ashfaq M 2013 Estimation of Genetic Variability and Correlation for Grain Yield Components in Rice (Oryza sativa L.) American-European J. Agric. Environ. Sci. 6 585.
[2] Khush GS and Virk PS 2000 Rice breeding achievements and future strategies Crop Improv. 27 115.
[3] Yu HG, Zhu FQ and Wang CL 2008 Preliminary report of the application of the high-yielding techniques of SRI in single cropping hybrid rice Hybrid Rice. 19 33.
[4] Shahidullah SM, Hanaf MM and Ashrafuzzaman M 2009 Phenological characters and genetic divergence in aromatic rice's African J. Biotech. 8 3199.
[5] Satheeshkumar P and Saravanan K 2012 Genetic variability, correlation and path analysis in rice (Oryza Sativa L.) Int. J.Curr. Res. 4 082.
[6] Habib SH, Bashar MK and Khalequzzaman M 2005 Genetic analysis and morpho-physiological selection criteria for traditional biroin Bangla desh rice germplasm J. Biol. Sci. 5 315.
[7] Al-Musawi BH and Al-Anbari MA 2019 Comparative study of new rice genotypes (Oryza sativa L.) Introduced in middle of Iraq Biochem. Cell. Arch. 19 2453.
[8] Steel RG and Torrie JH 1984 Principle and Procedure of Statistics, A biometrical Approach Seconded Mc Claw-Hill Book Co. Inc., New York. 633pp.
[9] Sudha RM and Jayalakshm V 2008 Evaluation of rice (Oryza sativa L.) genotypes in saline soils of Krishna delta of Andhra Pradesh Agric. Sci. Digest. 28 225.
[10] Vange T and Obi IU 2006 Effect of planting date on some agronomic traits and grain yield of upland rice varieties at Makurdi, Benue State, Nigeria. J. Sustain. Develop. Agric Enviro. 2 0794.
[11] Beser N and Genctan T 1999 Effects of different plantation methods on some agricultural features and productivity in the rice (Oryza sativa L.) Turk. 3rd Field Crop Cong. 1 462.
[12] Aide M and Beighley D 2006 Hyperspectral reflectance monitoring of rice varieties grown under different nitrogen regimes. Transact. Missouri Acad. Sci. 40 6.
[13] Sadeghi SM 2011 Heritability, Phenotypic correlation and path coefficient studies for some agronomic characters in Landrace rice varieties J. W. Applied Sci. 13 1229.
[14] Surek, H. and Beşer N 1996 A Research to Determine the Suitable Rice (Oryza Sativa L.) Harvesting Time J. Agric. Forestry 22 391.
[15] Manzoor Z, Ali RI Awan TH, Khalid N and Mushtaq A 2006 Appropriate time of nitrogen application of fine rice (Oryza sativa ) J. Agric. Res. 44 261.
[16] Akram M, Rehman A and Cheema AA 1982 Correlation between yield and yield attributing characters in some induced dwarf mutants of rice (Oryza Sativa L.) Pak. J. Agric. Res. 3 141.
[17] Asad MA, Bughiio HR, Odhano MA and Bughiio MS 2009 interactive effect of genotype and environment on the paddy yield in sindh province Pak. J. Bot. 4 1775.
[18] Khalifa AABA 2009 Physiological evaluation of some hybrid rice varieties under different planting dates Aust. J. Crop Sci. 3 178.
[19] Steven D, David L, Ann B and Ryan P 2004 Rice response to planting date differs at two locations in Louisiana Crop Manag.
[20] Vange T and Obi IU 2009 Influence of sowing date on rice grain yield in Benue State of Nigeria Crop Manag.
[21] Yoshida S 1981 Fundamentals of Rice Crop Science IRRI, Los Banos, the Philippines. 269.