Study of Vegetative Growth Characteristics for Seven Genotypes of Durum Wheat (Triticum Durum L.) Newly Derived Under Three Seeding Rates in The Conditions of Anbar Governorate

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Abstract

A field experiment was carried out in the fields of a farmer in the area of (Zakhikhah) with mixed sandy soil, loam sand, which is one of the rural areas of western Heet district (about 15 kg) affiliated to Anbar Governorate during the season 2020-2021, to study seven newly derived genotypes from durum wheat, including two cultivars. They are registered, accredited, and commonly cultivated in Iraq, under three different seeding rates to select the ones that are suitable for the conditions of Anbar Governorate. The experiment layer was according to the randomized complete block design (RCBD), in the order of split-plots and with three replications. It included seeding rates (140, 160, and 180 kg/ha) main plots. As for the sub-plots, they were occupied by the seven genotypes (Latifa, genotype Babel-30, genotype Babel-31, genotype Babel-32, genotype Babel-86, and the two approved cultivars Dor-29 and Dor-85). The genotype (Babylon-32) outperformed the means number of tillers (573.3 m²) and the biological yield (22.94 mcg ha⁻¹). While the genotype (Babylon-86) was superior to the plant height (113.02 cm). As for the variety (Dor).-85) It was superior in Flag leaf area (58.12 cm²) and the number of days from planting to 50% of physiological maturity (164.67 days). The genotyped plants of wheat grown with different seeding rates showed significant differences among themselves in the characteristics of vegetative growth, where the plants grown at a seeding rate of (180 kg ha⁻¹) recorded the highest means in the trait of plant height (105.20 cm), number of tillers/m² (596.9 tillers) and biological yield (23.31 mega grams ha⁻¹), while planting plants at seeding rates (140 kg/ha) resulted in recording the highest value of Rate flag leaf area (53.85 cm²), while planting plants at seeding rates (160 kg/ha) recorded the highest Mean number of days from planting to 50% and physiological maturity (167.38 days). There was a significant interaction between the genotypes and seeding Rates of the wheat included in the study.

Keywords: Durum wheat, Genotypes, Vegetable densities.

1. Introduction

Coarse wheat, or what is called (durum or hard) wheat, or macaroni wheat, its English name is durum wheat and scientifically (Triticum durum L.) is one of the two main types of wheat in the world. It contains a high percentage of protein and its toughness characteristic, which made it distinguished in its use and suitability for making pastries such as pasta, spaghetti, bulgur, grouts...etc. Wheat cultivation spreads all over the world with large areas of arable land and outperforms other crops in global production and cultivated area [1].

It also has an important and significant role in achieving food security, as it is the main source of energy that humans need due to its good balancing advantage between carbohydrates and proteins in its grains [2]. Because of its strategic importance, many field and genetic studies have focused on it. Globally, the annual production of wheat reached about 761.6 million megagrams, and the area cultivated with this crop reached about 260 million hectares [3]. Wheat has outperformed all cereal crops. Being cultivated within a wide range of environmental differences, it occupies about 17% of the total cultivated area in the world, and the area planted with wheat in Iraq is estimated at about 2.583 million hectares, with a total production of 4.343 million mcg at a yield rate of 2.744 mcg/ha [4]. Therefore, efforts must be combined to develop appropriate plans and programs by stakeholders and specialists in order to obtain varieties with high productivity and good and desirable genetic traits that are appropriate with their cultivation areas to achieve effective productivity and fill the shortage in the future [5,6].

The process of continuous provision of new genetic structures is accompanied by the adoption of modern scientific methods...
in the management of the crop service, starting with the number of land and ending with the harvesting operations. Among those important agricultural operations is the adoption of appropriate Seeding Rate, as determining the appropriate quantities of seeds to give good vegetative growth in the field has a positive effect in intercepting the largest proportion of solar radiation needed to carry out the process of photosynthesis, which is reflected in the yield of the cultivated variety. The first and important step in devising new genotypes is evaluating these genotypes under important management factors, including seed quantities, choosing the best ones, and comparing their performance in relation to the local variety. Therefore, this study aims to:

- Knowing the best of these genotypes in terms of their suitability and response to the conditions of the agricultural area and giving them the highest productivity per unit area.
- Determining the appropriate plant density for each of these genotypes to achieve the highest productivity.

2. Materials and Methods

The field experiment was carried out in the Zakhikha area, which is one of the rural areas west of Heat District (about 15 km) of Anbar Governorate with loam sand mixed soil, for the season 2020-2021. The experiment was layered according to a randomized complete block design (RCBD), with split-plot arrangement and three replications. With the aim of evaluating seven newly derived genotypes of durum wheat, including two registered and approved cultivars commonly cultivated in Iraq, under different Seeding Rate, to select the appropriate ones for the conditions of Anbar Governorate. The genotypes included in the study Latifa, genotype Babel-30, genotype Babel-31, genotype Babel-32, genotype Babel-86, and the two approved cultivars Dor-29 and Dor-85), occupied the sub plots. The seeding Rates(140, 160 and 180 kg.ha$^{-1}$) occupied the main plots. The experimental land was plowed and smoothed and then divided into experimental units, the area of each unit is (2 x 2.5 m), and each installation was planted with ten lines in each experimental unit, the length of each line is 2.5 meters, the distance between one line and another is 0.2 m, and a planting depth of 3-5 cm. The amount of seed per line was calculated according to the following equation.

\[ Q = \frac{D \times L \times R}{10000} \]

Since:

- Q = quantity of seeds per line, D = distance from one line to another, L = length of line, R = seeding rate per hectare

Characteristics that have been studied:

2.1 Characteristics of vegetative growth

2.1.1 Plant height (cm)

It was measured from the base of the plant to the top of the spike of the main stem without the peduncle, and it was measured after flowering stage as an means of ten random readings from each secondary experimental unit.

2.1.2 Number of days from planting to 50% physiological maturity:

This characteristic was determined by calculating the number of days from planting until 50% of the plants for each experimental unit reached the stage of physiological maturity, which is inferred from the observation of yellowing of leaves and ears due to their complete loss of chlorophyll pigment.

2.1.3 The area of the flag paper (cm$^2$)

It is the leaf that appears shortly before the fertilization process takes place, and it is a major source of food energy to fill the grains in cereal crops. According to the following equation:

Flag leaf area = length of the flag leaf x its maximum width x 0.95, for ten random plants from each experimental unit

2.1.4 Number of total tillers (m$^2$)

The number of total tillers was calculated in an area of one square meter taken from the center of each experimental unit.

2.1.5 Biological yield (Mg.h$^{-1}$)

It was estimated from the weight of the harvested plants from the same square meter area taken to study the components of the yield and on the basis of (Mg.h$^{-1}$), which includes the weight of the total dry matter (whole plants) (Sanibel + straw).
3. Results and Discussion

3.1 Plant height cm²

The height of the plant is of great importance because it has a strong relationship with resistance to sleep on the one hand and its role in intercepting light on the other hand, and it has a significant correlation with the harvest guide, as the stems contribute up to 20% of the green area of the plant at the time of flowering. It should be noted that plant breeders seek to obtain varieties of short to medium height, as they are more efficient in grain production, due to their high fertilization tolerance and resistance to dormancy [8]. It is noted from the results of (Table 1) that the genotype (Babylon-86) was superior by giving it the highest means plant height of 113.02 cm, followed by the cultivar Dour-85 with a plant height of 107.17 cm. While the lowest means plant height for the genotype (Babylon-32) was 97.35 cm. Other genotypes were distributed among these means. This difference between the genotypes in the plant height characteristic is due to the genetic susceptibility to the genotypes, which causes the different compositions content of the hormone gibberellin and auxin, which are responsible for the elongation and expansion of plant cells, which may be reflected in the length and numbers of the internodes, especially the upper phalanx, which represents almost half the height of the plant [9,10]. Our results are in agreement with many studies, including [10-13], whose results indicated that there are significant differences between the genotypes for wheat yield in the plant height characteristic.

It is noted from the results of the same table (1) that there are no significant differences between seeding Rates in the characteristic of plant height. The means densities indicate the presence of apparent differences, as the high plant density (180 kg.ha⁻¹) gave the highest means plant height of 105.20 cm, while the lowest means was The plant height of the low plant density (140 kg.ha⁻¹) reached a level of 102.92 cm, and the reason for the increase in plant height with the increase in seeding rates is due to the increased competition among them to obtain sufficient light to carry out photosynthesis. The increase in deception leads to an increase in the level of the plant hormone auxin and gibberellin, which was mentioned above [14,15]. In this regard, the results of [16,17], indicate that there are no significant differences between seeding Rates in the characteristic of plant height. The results of the same table (1) indicate that there are no significant differences for the interaction between the treatment of genotypes and Seeding Rate.

Table 1. The effect of genotypes and seeding Rates on the characteristic of the plant height/cm² of durum wheat for the 2020/2021 season.

| Cultivars | Plant density (kg ha⁻¹) | Mean |
|-----------|-------------------------|------|
| Dour-29   | 101.80                  | 101.92 |
| Dour-85   | 105.55                  | 107.17 |
| Latifia   | 102.28                  | 101.53 |
| Babel-30  | 101.55                  | 101.18 |
| Babel-31  | 105.87                  | 105.97 |
| Babel-32  | 94.20                   | 97.35  |
| Babel-86  | 109.15                  | 113.02 |
| Mean      | 102.92                  | 105.20 |
| LSD 0.05  | Cultivar                | N.S.  |
|           | Plant density           | N.S.  |
| 2.68      | Mean                    | N.S.  |

3.2 The number of days from planting to 50% physiological maturity

The means of the results of Table 2) indicated that there is a significant effect of the genotypes included in this study on the characteristic of physiological maturity. It appears that the cultivar (Dour-85) was the earliest genotyped to reach maturity, taking the least number of days, with an means of 164.67 days. Which did not differ significantly from the Latifia variety, which took 164.89 days, while the variety (Dour-29) recorded the longest period to reach the stage of physiological maturity, taking 172.11 days, which did not differ significantly from the genotype (Babylon-32), whose plants required a period of 171.22 days to reach physiological maturity and the variation of the genotypes in the character of the number of days of cultivation of the 50% physiological maturity is due to the difference in its genetic composition and origin, and this is reflected in the different response to the prevailing environmental conditions, especially the photoperiod and temperature, and these results were in agreement with [18,19]. Who indicated that there were significant differences between the genotypes of wheat crop in the characteristic of the number of days to physiological maturity. As for the seeding Rates included in the study, the same (Table 2) showed that there were significant differences between seeding Rates for this trait, the plant density took 140 kg.ha⁻¹, the highest means number of days amounted to 168.10 days. While it took the plant density 160 kg.ha⁻¹ the least number of days to reach 50% physiological maturity, which reached 167.38 days. Which did not differ significantly from the plant density 180 kg.ha⁻¹, which recorded the means number of days and amounted to 167.48 days. These results are
in agreement with the findings of [13-15], who indicated that there are significant differences between seeding Rates in the characteristic of the number of days from planting to physiological maturity. The results of the above (Table 2) indicate that there are no significant differences for the interaction between the factors of genotypes and seeding Rates for this trait.

### Table 2. The effect of genotypes and seeding Rate on the characteristic of on the number of days from planting to 50% physiological maturity of durum wheat for the 2020/2021 season.

| Cultivars   | Plant density (kg ha\(^{-1}\)) | Mean |
|-------------|---------------------------------|------|
|             | 140                             | 160  | 180  |
| Dour-29     | 172.67                          | 171.33 | 172.33 | 172.11 |
| Dour-85     | 165.67                          | 163.67 | 164.67 | 164.67 |
| Latifia     | 165.67                          | 165.00 | 164.00 | 164.89 |
| Babel-30    | 165.67                          | 167.00 | 166.33 | 166.33 |
| Babel-31    | 167.33                          | 165.33 | 165.33 | 166.00 |
| Babel-32    | 172.33                          | 170.00 | 171.33 | 171.22 |
| Babel-86    | 167.33                          | 169.33 | 168.33 | 168.33 |
| Mean        | 168.10                          | 167.38 | 167.48 |
| LSD 0.05    | Cultivar                        | Plant density | Cultivar* Plant density |
|            | 1.330                           | 0.432 | N.S |

### Table 3. The effect of genotypes and seeding Rate on the characteristic of Flag leaf area cm\(^2\) of durum wheat for the 2020/2021 season.

| Cultivars   | Plant density (kg ha\(^{-1}\)) | Mean |
|-------------|---------------------------------|------|
|             | 140                             | 160  | 180  |
| Dour-29     | 58.36                           | 52.51 | 53.46 | 54.78 |
| Dour-85     | 60.47                           | 58.43 | 55.46 | 58.12 |
| Latifia     | 52.88                           | 52.08 | 46.00 | 50.32 |
| Babel-30    | 47.67                           | 44.27 | 46.76 | 46.24 |
| Babel-31    | 55.06                           | 53.69 | 59.55 | 56.10 |
| Babel-32    | 51.65                           | 45.76 | 48.93 | 48.78 |
| Babel-86    | 50.83                           | 43.93 | 47.19 | 47.32 |
| Mean        | 53.85                           | 50.10 | 51.05 |
| LSD 0.05    | Cultivar                        | Plant density | Cultivar* Plant density |
|            | 4.739                           | N.S | N.S |

3.3 The area of the flag paper (cm\(^2\))

The flag leaf is the important source for the production of nutrients that flow into the spike, and the spike relies heavily on it for the duration of the bean's fullness. This is because it is newly formed and closest to the spike. The results of (Table 3) showed the superiority of the variety (Dour-85) by giving it the highest means area of the flag leaf amounted to 58.12 cm\(^2\), followed by the genotype (Babylon-31) with a leaf area of 56.10 cm\(^2\), while the lowest leaf area for installation genotype (Babylon-30) recorded a means of 46.24 cm\(^2\) and the rest of the genotypes were distributed between these two means. The reason for the difference between the genotypes in this trait may be attributed to the difference in its genetic structure, and this result is consistent with the findings of [19-24]. Their results indicated that there were significant differences between the compositions in the characteristics of leaf area of wheat plant. It is noted from the results of the same (Table 3) that there are no significant differences between plants in the characteristics of Flag leaf area under different Seeding Rate, but the means densities indicate the presence of significant apparent differences, as the low plant density (140 kg. ha\(^{-1}\)) of 53.85 cm\(^2\) while the lowest means leaf area in plant density (160 kg ha\(^{-1}\)) was 50.10 cm\(^2\). These results were identical to what was mentioned by [25,26], who indicated that there were no significant differences between seeding Rates in Flag leaf area. The results of the same table (3) indicate that there are no significant differences for the interaction between the factors of genotypes and Seeding Rate.

### Table 3. The effect of genotypes and seeding Rate on the characteristic of Flag leaf area cm\(^2\) of durum wheat for the 2020/2021 season.

| Cultivars   | Plant density (kg ha\(^{-1}\)) | Mean |
|-------------|---------------------------------|------|
|             | 140                             | 160  | 180  |
| Dour-29     | 58.36                           | 52.51 | 53.46 | 54.78 |
| Dour-85     | 60.47                           | 58.43 | 55.46 | 58.12 |
| Latifia     | 52.88                           | 52.08 | 46.00 | 50.32 |
| Babel-30    | 47.67                           | 44.27 | 46.76 | 46.24 |
| Babel-31    | 55.06                           | 53.69 | 59.55 | 56.10 |
| Babel-32    | 51.65                           | 45.76 | 48.93 | 48.78 |
| Babel-86    | 50.83                           | 43.93 | 47.19 | 47.32 |
| Mean        | 53.85                           | 50.10 | 51.05 |
| LSD 0.05    | Cultivar                        | Plant density | Cultivar* Plant density |
|            | 4.739                           | N.S | N.S |
3.4 Number of Tillers m²

The process of shaving formation in the wheat crop is one of the important physiological activities in the vegetative growth stage and is affected by many factors during the period of plant growth, the most important of these factors is the environmental factor and the genetic factor such as soil service, plant density and bush control that provide the appropriate conditions for the growth and formation of the rims that are related to the most important characteristics of the crop. It is the adjective of the number of spikes. The results of (Table 4) showed that there were significant differences between the genotypes included in the research in the characteristic of the number of tillers m². It appears that the genotype (Babylon-32) recorded the highest means in the number of sporangia and reached 573.3 tiller m⁻², which did not differ significantly from the genotype (Babylon-30), which recorded an means of 572.9 tiller m⁻². While the variety (Dour-85) recorded The lowest means for this trait was 531.6 m². Which did not differ significantly from the genotype (Babylon-86) with an means of 534.4 tiller m⁻², and the reason for the existence of significant differences between the genotypes in this trait may be the difference in the nature of the genotypes and their ability to form buds that determine the number of lateral branches and their ability to produce tillers. This result agreed with the findings of [6,27]. And who confirmed the existence of significant differences between the genotypes of this trait in the wheat plant.

Determining the seed rate is the most prominent and most influential factor in the yield of pup and some other traits, and the appropriate seeding rate gives the highest grain yield for genotypes with a high ability to branch. The results (Table 4) indicated that there were significant differences between the seeding rates entered in the research, and that the high density (180 kg.ha⁻¹) recorded superiority by giving it the highest means for this trait, which amounted to 596.9 tiller m⁻². While the low plant density (140 kg.ha⁻¹) recorded the lowest means for the number of shrub number and reached 509.5 tiller m⁻².

The reason is due to the increase in the number of plants per unit area when the seeding rate is increased and thus the increase in the number of tiller unit area, and these results were similar to what was found by [26-28]. Those who indicated that plants grown with high seeding rate recorded the highest means number of tiller m². Results of the same table (4) indicate that there are no significant differences for the interaction between the factors of genotypes and seeding Rates for this trait.

Table 4. The effect of genotypes and seeding Rate on the characteristic of the number of tiller m² of durum wheat for the 2020/2021 season.

| Cultivars     | Plant density (kg ha⁻¹) | Mean  |
|---------------|-------------------------|-------|
|               | 140         | 160         | 180         |     |
| Dour-29       | 530.0       | 548.0       | 585.7       | 554.6|
| Dour-85       | 482.0       | 535.0       | 577.7       | 531.6|
| Latffia       | 518.0       | 535.0       | 568.3       | 540.4|
| Babel-30      | 521.3       | 571.7       | 625.7       | 572.9|
| Babel-31      | 500.3       | 532.0       | 591.0       | 541.1|
| Babel-32      | 519.7       | 561.0       | 639.3       | 573.3|
| Babel-86      | 495.3       | 517.7       | 590.3       | 534.4|
| Mean          | 509.5       | 542.9       | 596.9       |     |
| LSD 0.05 Cultivar | Plant density | Cultivar* Plant density | N.S |
|               | 17.18       | 11.84       | N.S         |

3.5 Biological yield (Mg.h⁻¹)

Biological yield is a measure of the total dry matter produced by the plant during its different stages of growth, which results from the difference between the process of photosynthesis and respiration. It depends on the various agricultural processes as well as on the environmental factors familiar with the plant and the ability of the vegetative system to exploit the solar rays reaching the mechanism and its efficiency to convert it into useful materials for the plant [20]. It is noted from the results of (Table 5) that there are significant differences between the genotypes of this trait and that the genotype (Babylon-32) was superior by giving it the highest means for the trait of the biological yield and amounted to 22.94 mcg.h⁻¹, followed by the Latffia cultivar, which recorded an means of 22.12 mcg.h⁻¹. While the genotype (Babylon-31) recorded the lowest means for this trait and amounted to 20.15 mcg.h⁻¹, and the reason for the variation of the genotypes in the character of the biological crop is due to its genetic variation as well as the efficiency of the genotype (Babylon-32) in its ability to increase Its vegetative growth and its superiority in the characteristic of the number of tiller m² (Table 4), and thus the increase in the accumulation of dry matter. These results agreed with [26-36]. Who indicated that there were significant differences between the genotypes of the wheat crop in this trait. The results of the same (Table 5) also showed the positive effect of increasing the seed rates used in the study on the biological yield, as the higher seeding rate (180 kg.ha⁻¹) and scored The highest means yield was 23.31 mcg.h⁻¹. While the low plant density (140 kg.ha⁻¹) recorded the lowest means of 19.99 mcg.h⁻¹. The reason for the increase in the biological yield when increasing seed rates is due to the increase in the means height of the plant and...
the number of tiller m$^{-2}$ (Tables, 2 and 5), which leads to the exploitation of a greater amount of nutrients available in the soil and improving the efficiency of the photosynthesis process through the interception of the vegetative total to the largest amount of Solar radiation and thus improve the performance of crop plants for various vital processes, and the increase in the accumulation of manufactured dry matter during the stages of plant growth, and this is reflected positively in the increase in the biological yield of the crop. This result agreed with what was obtained by [25-39]. Who indicated that there were significant differences between seeding Rates in the biological yield of wheat.

The results of the same (Table 5) indicate that there are significant differences for the interaction between the factors of genotypes and seeding Rates for this trait. The highest mean of biological yield trait was achieved when the genotype (Babylon-32) with plant density (180 kg ha$^{-1}$) amounted to 24.72 mcg. ha$^{-1}$. While the lowest means for this trait was recorded (Babel-30) with plant density (140 kg. ha$^{-1}$) with an means of 17.85 mcg ha$^{-1}$.

Table 5. The effect of genotypes and seeding Rate son the characteristic of the biological yield (Mcg ha$^{-1}$) of durum wheat for the 2020/2021 season.

| Cultivars     | Plant density (kg ha$^{-1}$) | Mean    |
|---------------|------------------------------|---------|
|               | 140                          | 160     | 180     |         |
| Dour-29       | 20.40                        | 21.58   | 23.85   | 21.94   |
| Dour-85       | 20.33                        | 20.90   | 22.16   | 21.13   |
| Latitia       | 21.33                        | 20.63   | 24.40   | 22.12   |
| Babel-30      | 17.85                        | 19.47   | 24.02   | 20.44   |
| Babel-31      | 18.73                        | 20.50   | 21.22   | 20.15   |
| Babel-32      | 20.65                        | 23.45   | 24.72   | 22.94   |
| Babel-86      | 20.62                        | 22.38   | 22.83   | 21.94   |
| Mean          | 19.99                        | 21.27   | 23.31   |         |
| LSD 0.05 Cultivar Plant density | 0.806    | 0.315   | 1.310   |

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