

Physiological Indicators Of Seven Barley Varieties and the Effect of Planting Dates

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Abstract

This study was carried out in the agricultural season (2023-2024) with the aim of studying the effect of five planting dates on the physiological growth characteristics of seven barley varieties according to the split-plot system and in a completely randomized block design(RCBD) with three replicates, as the planting dates were in the main panels and the barley varieties were in the secondary panels, The physiological growth characteristics were studied and the results were summarized as follows, Planting dates showed significant differences, as the date of September 15 was superior to the crop growth rate, relative growth rate, and absolute growth rate by values of 0.00156 , 0.0533 g.cm-2.day-1, 0.2227g. day-1respectively

While the date of November 15 was superior in terms of net carbon representation and the duration of survival of leaf area recording values of up to 0.000388 g.cm-2.day-1 , 8928,44 cm2. Day-1, While the dates of November 1 and 15 excelled in terms of the duration of dry matter production and recorded the highest values of 79.420 , 77.007 g. day-1. As for the varieties, the variety Rehan was superior in terms of crop growth rate with a value of 0.00142 g.cm-2.day-1, without any significant difference from the two varieties Sameer and Shoa'a. The studied barley varieties did not achieve any significant differences among themselves in terms of net carbon representation and relative growth rate, As for the absolute growth rate, the Sameer variety achieved the highest value, amounting to 0.01682 g. day -1, In terms of the survival period of the leaf area, the variety surpassed Shoa'a and recorded the highest value, amounting to 9119.86 cm2.day-1. In the survival period of dry matter production, the two varieties Shoa'a and Samir excelled and recorded the highest averages, amounting to 86.33 and 84.461 g. day- 1.

Keywords (Physiological indicators, planting dates, barley varieties (

Introduction

Barley (*Hordeum Vulgare* L.) is one of the important strategic grain and fodder crops grown in most parts of the world and in large areas. It ranks fourth in terms of area and productivity after wheat, rice, and yellow corn. The cultivated area in Iraq for the year 2023 was estimated at about 2,344 thousand dunums, with a productivity of 106 thousand tons. Barley is characterized by containing 55.8% carbohydrates, 3.4% fats, 11% crude protein, vitamins, and 3.7% minerals [1]. Barley is used as animal feed in the form

of grains or green fodder. It is also used in some industries such as the manufacture of malt (barley water), in addition to the importance of barley grains in human nutrition because of their important role in reducing the risk of contracting some diseases because they contain phytochemicals that help in treating Chronic heart disease, high blood pressure, colon cancer, and gallstones [2], [3]. Despite the cultivation of barley on a large scale in most regions of Iraq and in the irrigated plains in the central and southern regions and the desolate regions of northern Iraq, the rates of

barley productivity in Iraq are low compared to its productivity in countries of the world, with a decline rate of 21%. This may be attributed to the lack of availability of seeds of improved varieties and the lack of Agricultural technologies here it was necessary to re-examine the issue of planting dates to clarify the effect of the difference in dates on the stages of emergence and growth characteristics that differ in the time of their occurrence or duration according to environmental conditions. This is what recent studies have confirmed when planting varieties of barley with different dates and knowing the extent of the effect of dates on the productivity of the varieties[4]. Here, it

Materials and

A field experiment was carried out in the Al-Dur district of Salah al-Din Governorate in the fields of a farmer in the 2023-2024 seasons with the aim of studying the growth response of some barley varieties to planting dates by arranging split plots according to the randomized complete block design (RCBD) with three replications, The first factor included five planting dates: September 15, October 1, October 15, October 15, November 1, and November 15. The second factor included seven varieties of barley: Arefat, Amal, Ebba 99, Buraq, Shoa, Rehan, and Sameer. Table 1 shows the varieties. included in the study.

The land was ground, then plowed in two perpendicular plows with a flip plow, smoothed using disc harrows, and leveled with a leveling bale. Random samples were taken from the field soil at a depth of 3-30 cm before planting and analyzed in the laboratories of the Soil and Water Resources Department at the College of Agriculture - Tikrit University, the results of which are shown in Table No. 2. The

was necessary to choose varieties registered and approved by the Ministry of Agriculture in order to show the effect of variation in different planting dates on growth stages and field characteristics, as the success of any crop and the quality of its production depends on the interaction between environmental factors and genetic compositions. Therefore, this study was conducted to find out:

The best date to plant each type of barley, The best barley variety in terms of physiological growth characteristics, And the best combination between planting dates and varieties to achieve the best physiological growth standards.

methods

area of the experimental unit was 11 m² (4. [5], and 8 grams per line. The experimental land was fertilized with urea fertilizer (46% N) in the amount of 200 kg N ha⁻¹ in the first batch at planting and the second batch in the elongation stage, and triple superphosphate fertilizer (46% P₂O₅) was added in the amount of 200 kg P ha⁻¹ in one batch after plowing and before planting [6]

Studied attributes

-1 Crop Growth Rate (CGR) (g.cm⁻².day⁻¹.)

It is the increase in the weight of the plant community (g) per unit of land area (cm) per unit of time (day) [7]and according to the equation of [8.]

$$CGR = (1/GA) * (W_2 - W_1 / T_2 - T_1)$$

-2 Net Assimilation Rate (NAR) (g cm⁻² day⁻¹)

It is the increase in net carbon assimilation products (g) per unit leaf area (cm) and time (day) [9] [10]and was estimated according to the equation [8]

$$NAR = (W_2 - W_1 / T_2 - T_1) * (L_2 - L_1 / LA_2 - LA_1)$$

-3 Relative Growth Rate (RGR) (g.g-1 day-1)

It expresses the increase in dry weight in certain periods and its relationship to the initial weight of the plant

$$RGR = (\text{Lin } W_2 - \text{Lin } W_1) / (T_2 - T_1)$$

-4 Absolute Growth Rate (AGR) (g. day-1)

This standard indicates how quickly the crop is growing, whether it is growing faster or slower than usual, expressed in grams of dry matter produced per day.

$$AGR = W_2 - W_1 / T_2 - T_1$$

-5 Duration of residence Duration of leaf area Duration (LAD) (cm². Day-1)

It is an expression of the length of time during which the leaf area is effective during the growth period of the crop and was estimated according to the equation [8.]

$$LAD = (LA_2 + LA_1) / (T_2 - T_1) / 2$$

-6 Biomass Dry Matter Duration BDMD (gm) Day-1

This characteristic represents a function of biomass and temperature and is useful for determining the amount of dry matter at the appropriate time and was estimated according to the equation [8.]

$$BDMD = (W_2 + W_1) / 2 * (T_2 - T_1)$$

GA: the area of land occupied by a plant

W1: The dry weight of the plant when measured at the first appointment

W2: The dry weight of the plant when measured at the second appointment

T2 - T1 : The time period between the first and second measurement appointment

LA1: The leaf area of the plant measured at the first appointment

LA2 : leaf area of the plant measured at the second appointment

Lin A1 : The natural logarithm of the leaf area of the plant measured at the first date

Lin A2 : The natural logarithm of the leaf area of the plant measured at the second date

The data for the studied characteristics were analyzed statistically according to the analysis of variance method using the statistical program SPSS, and the means were compared and the significance was tested using the Duncan multinomial test to compare the levels of independent factors and the least significant difference test L.S. D to compare the interference coefficients [11.]

Results and Discussion

-1 Crop growth rate (g.cm-2.day-1)

The values of (Table 3) indicate the significance of the effect of planting dates for barley varieties on the characteristic of the crop growth rate. Planting on the first date, September 15, caused a significant increase in this characteristic, as it achieved the highest value of 0.00165 g.cm-2.day-1, The other dates recorded the lowest values for this characteristic

,this may be due to the favorable environmental conditions and heat accumulation accompanying plant growth on this day, which contributed to increasing the efficiency of photosynthesis due to increased light interception. This is in line with [12], and [13.]

The barley varieties differed significantly, and from the results shown (Table 7), it is noted observed that the Rehan variety was superior with a value of 0.00142 g.cm-2.day-1 and without a significant difference from the two varieties Sameer and Shoa'a, while the variety Arefat, Amal and Ebbaa 99 recorded the lowest value for this characteristic without recording a significant difference between them. This is due to the genetic variation between the varieties and the extent to which they are affected by the prevailing

environmental factors in the region, such as temperature and rain, and this is consistent with what was confirmed by [13] and [14]. about the difference in crop growth rate values according to the different types of barley.

The planting dates overlapped with the varieties, , which recorded the highest value the first date (September 15 with the variety Rehan) also overlapped, with the highest value 0.002567 gm.cm-2.day-1, while the date (October 1 and Amal variety) overlapped with the lowest value of 0.00029 gm.cm-2.day-1.

-2Net carbon assimilation rate (g cm-2 day-1 (

Table (4) indicates that there is a significant difference in the rate of net carbon construction due to the influence of planting dates varieties .

The fifth (November 15) with a value of 0.00038 g cm-2 day-1, without a significant difference from the fourth date (November 1) compared to the first date (September 15), which recorded the lowest average for this characteristic, amounting to 0.00015 g cm-2 day-1, these results indicated that the efficiency of leaf area per day in the representation Carbon dioxide and dry matter build up by delaying the planting date

As for the varieties without a significant difference among the varieties Barley. This is due to the genetic variation between these varieties, in addition to the differences that appeared between these varieties in the characteristics of Growth.

In the interaction between dates and varieties The November 15, and the variety of Rehan had the highest value, amounting to 0.00042 grams. cm-2 day-1 compared to the date September 15 and the Arefat variety, which recorded the lowest value of 0.00011 g cm-2 day-1

-3Relative growth rate (gm-1 day-1(

Planting at the early date (September 15) caused a significant increase in this trait and achieved the highest value 0.05334 gm-1 day-1. This is due to the prevailing environmental conditions, including ideal temperatures at this date and the occurrence of Accumulating the largest amount of dry matter, activating the process of carbon metabolism and manufacturing nutrients, balancing its distribution among the parts of the plant, and benefiting from it in physiological processes. While the date, the date of October 15 recorded a relatively lower rate of 0.01919 gm-1. day-1.

The behavior of the varieties to respond to planting dates had a non-significant effect, but the interaction between the two factors in this trait had a significant effect., the highest value was recorded at 0.08176 gm-1 day-1 at the date (October 1 and the Shooa variety), while the lowest value was recorded at 0.011812 gm-1 day-1 at the date (November 15 and the Arevat variety. (

-4Absolute growth rate gm. Day-1

The effect of planting dates differed significantly in the absolute growth rate, as planting in 15 September increased the rate of this trait to the highest value amounting to 0.02227 grams. day -1, and the rest of the dates did not differ significantly from each other. The reason for the superiority of the first date is that the environmental conditions are favorable, especially the temperatures, and this enhances the process of carbon metabolism in the plant, which increases the accumulation of dry matter over a period of time, and increases the absolute growth rates. The reason for the lower absolute growth rate at later dates was that increased respiration and premature leaf senescence due to high

temperatures lead to a decrease in dry matter production and accumulation.

A significant difference was found between the barley varieties, , the Sameer variety showed this trait and gave the highest average of 0.01682 g. day⁻¹, without any significant difference from Shoa'a and Rehan, which recorded averages of 0.01493 and 0.01392 g. day⁻¹ in a row .

The two study factors interacted significantly, as the date (September 15 with the Sameer variety) achieved the highest value for the absolute growth rate, reaching 0.03822 g. day⁻¹, while the date (October 1 and the Arevat variety) achieved the lowest value of 0.002398 grams. day⁻¹.

-5 Duration of leaf area (cm², Day-1 (

The results presented in (Table 7) showed that planting dates had a significant effect on the leaf area persistence characteristic, as the date of November 15 recorded the highest average for the trait, amounting 8928.44 cm². day⁻¹ and was not significantly different from the second, third and fourth dates. While the value of this characteristic decreased at the date of September 15 to 6315.569 cm². day⁻¹. The reason for the superiority of the fifth date is that the temperatures were ideal and had a positive effect on the structure of the plant by providing the necessary conditions for division and elongation processes, in addition to increasing the level of carbon metabolism, which prolongs the period of the leaves remaining green and increasing their area. Leaf too. The cultivars showed a significant effect on the duration of leaf area, the variety achieved the highest average Shoa'a of 9119.869 cm². Day-1, while the cultivar Ebaa 99, Amal, and Arefat gave the lowest averages for this trait without distinguishing significantly from each other, This difference may be due to differences in genetic makeup

and its effect on the response and expression of growth traits.

The bilateral interaction between planting dates and varieties was significant, , the date (November 15) with the variety Rehan achieved the highest average of 10823.54 cm². day-1, while the lowest value was recorded at the date (September 15, grade Ebaa 99), it reached 5168.32 cm². Day- 1.

-6 Duration of dry matter production (g. Day-1 (

The results in (Table 8) indicate that planting dates significantly affected the duration of dry matter production, as the dates of November 1 and November 15 recorded the highest averages for the trait, reaching 79.42 and 77.00 g. day⁻¹ compared to September 15, which recorded the lowest average for the trait, amounting to 53.00 g. On day -1, the reason for increasing the duration of dry matter production may be due to the role of environmental elements, especially temperatures, which in turn work to increase the process of carbon assimilation, thus increasing the vegetative growth of the crop, and this will be reflected positively in increasing the duration of dry matter production.

From (Table 8) , it was noted that there were significant differences between the barley varieties in their effect on this trait, , The two varieties Shoa'a and Sameer gave the highest averages for this trait, reaching 86.33 and 84.46 grams. day-1 compared to the Amal variety, which gave the lowest average of 48.2987 g. Day-1, The reason for this superiority may also be due to the genetic differences between the varieties and how they respond to environmental conditions at different stages of plant growth, which creates plant parts that are highly efficient in blocking

sunlight and increasing the deposition of nutrients to all parts of the plant.

It was found that the interaction between planting dates and varieties had a significant effect, , the date (November 15 and the variety

Rehan) exceeded the highest value, amounting to 111.01 grams. day- 1, while the date (September 15 and the cultivar Arefat) recorded the lowest average for the trait, reaching 31.28 grams. day-1.

Table (1) shows the names of barley varieties and their sources

varieties	Sources
Arevat	Atomic Energy Organization
Amal	Atomic Energy Organization
Ebaa99	Abaa Center for Agricultural Research
Boraq	Atomic Energy Organization
Shoaa	Atomic Energy Organization
Rehan	Abaa Center for Agricultural Research
Sameer	Atomic Energy Organization

Table 2. Some chemical and physical characteristics of the experimental soil

Adjective	Value and unity
Soil electrical conductivity (EC)	3.74 Dese Siemensm ⁻¹
Degree of soil interaction PH	7.13
Gypsum	15 %
Ready nitrogen	15.1 ml .kg ⁻¹
Ready phosphorus	22 ml .kg ⁻¹
Ready potassium	27 ml .kg ⁻¹
The sand	41 %
Clay	11 %
Alluvial	47 %
Soil texture	Loam

Table (3) The effect of planting at different dates on the crop growth rate of barley varieties

varieties Planting Date	Arevat	Amal	Ebaa99	Buraq	Shoaa	Rehan	Sameer	Average dates
September15	0.000651	0.000733	0.001529	0.002036	0.001656	0.002567	0.002383	0.001651 a
October1	0.000592	0.000296	0.000795	0.00045	0.001211	0.001325	0.002012	0.000954 b
October15	0.000391	0.000748	0.000727	0.000419	0.001252	0.000387	0.000496	0.000631 b
November1	0.000698	0.000825	0.000419	0.000607	0.000897	0.000875	0.000698	0.000717 b
November15	0.00042	0.000705	0.000683	0.000605	0.001243	0.001949	0.001274	0.000983 b
Average varieties	0.00055 b	0.00066 b	0.00083 b	0.00082 b	0.00125 a	0.00142 a	0.00137 a	

LSD planting× varieties= 0.6106

Table (4) The effect of planting at different dates on the rate of net carbon assimilation of barley varieties

varieties Planting Date	Arevat	Amal	Ebaa99	Buraq	Shoaa	Rehan	Sameer	Average dates
September15	0.000118	0.000127	0.000149	0.000164	0.000176	0.000184	0.000194	0.000159 c
October1	0.000262	0.000225	0.000219	0.000224	0.000252	0.00024	0.000234	0.000237 b
October15	0.000259	0.000266	0.000259	0.000237	0.000276	0.000281	0.000296	0.000268 b
November1	0.000277	0.000302	0.000349	0.000344	0.00035	0.000293	0.000367	0.000326 a
November15	0.000387	0.000356	0.000371	0.000388	0.000409	0.00042	0.000385	0.000388 a
Average varieties	0.000261a a	0.000255 a	0.000269 a	0.000271 a	0.000293 a	0.000284 a	0.000295 a	

LSD planting× varieties= 0.0000281

Table (5) The effect of planting at different times on the relative growth rate of barley

varieties Planting date	Arevat	Amal	Ebaa99	Buraq	Shoaa	Rehan	Sameer	Average dates
September15	0.033026	0.114429	0.024117	0.121195	0.022188	0.027278	0.031115	0.05334 a
October1	0.047753	0.013932	0.015491	0.021551	0.081796	0.025932	0.020117	0.03237 ab
October15	0.021542	0.012479	0.016297	0.017265	0.021753	0.020023	0.024978	0.01919 c
November1	0.036416	0.0261	0.019063	0.012875	0.053283	0.017223	0.023109	0.02687 bc
November15	0.011812	0.042407	0.019151	0.019371	0.019708	0.020512	0.024774	0.02253 bc
Average varieties	0.03011 a	0.04187 a	0.01882 a	0.03845 a	0.03975 a	0.02219 a	0.02482 a	

LSD planting× varieties= 0.0438

Table (6) The effect of planting at different dates on the absolute growth rate of barley varieties

varieties Planting Date	Arevat	Amal	Ebaa99	Buraq	Shoaa	Rehan	Sameer	Average dates
September15	0.008118	0.01071	0.021268	0.018199	0.02503	0.034322	0.03822	0.02227 a
October1	0.002398	0.003988	0.006229	0.005886	0.015592	0.003796	0.021208	0.00844 b
October15	0.003903	0.00638	0.007263	0.004189	0.012531	0.003226	0.004953	0.00606 b
November1	0.006977	0.008252	0.004191	0.005868	0.009082	0.008752	0.006979	0.00716 b
November15	0.004202	0.0069	0.006833	0.006048	0.012435	0.019484	0.012742	0.00981 b
Average varieties	0.00512 b	0.00725 b	0.00916 b	0.00804 b	0.01493 a	0.01392 a	0.01682 a	

LSD planting× varieties= 0.00596

Table (7) The effect of planting at different times on the duration of leaf area of barley varieties

varieties Planting Date	Arevat	Amal	Ebaa99	Buraq	Shoaa	Rehan	Sameer	Average dates
September15	5786.65	5656.157	5168.32	6247.637	6808.323	6548.027	7993.867	6315.569 b
October1	7022.667	6955.733	7004.133	7557.867	9927.2	7874	10112.13	8064.819 a
October15	8825.1	8313.6	8923.95	7873.5	8865.9	7950.9	8776.5	8504.207 a
November1	8942.423	8184.62	7570.877	8844.67	9489.24	8259.87	7351.16	8377.551 a
November15	7378.42	7829.36	7903	8353.24	10508.68	10823.54	9702.84	8928.44 a
Average varieties	7591.052 d	7387.894 d	7314.056 d	7775.383 cd	9119.869 a	8291.267 bc	8787.299 ab	

LSD planting× varieties=193.32

Table (8) The effect of planting at different times on the duration of dry matter production of barley varieties

varieties Planting Date	Arevat	Amal	Ebaa99	Buraq	Shoaa	Rehan	Sameer	Average dates
September15	31.28667	35.08	46.10333	56.05333	52.30667	67.41333	82.77	53.0019 c
October1	44.58667	49.36	57.13333	57.74667	87.32	48.48	95.62667	62.8933 b
October15	63.04333	60.72	70.77	50.23	77.05333	50.14333	45.62	59.6543 bc
November1	69.36667	47.15333	51.56667	95.64333	110.46	75.41667	106.3333	79.4200 a
November15	51.40333	49.18	57.11667	73.85667	104.5147	111.018	91.96	77.0071 a
Average varieties	51.9373 cd	48.2987 d	56.5380 c	66.7060 b	86.3309 a	70.4943 b	84.4619 a	

LSD planting× varieties=6.2644

Conclusions

The results showed that the best planting dates are September 15 and November 15, in order to provide appropriate environmental conditions and achieve the best growth characteristics. Barley varieties responded to

planting dates, as the two varieties Sameer and Shoaa demonstrated their superiority in raising the values of all the studied traits compared to other varieties.

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