

Article

Response of Barley Variety Noor to Different Levels of DAP Fertilizer at Different Planting Dates

Raad Ahmed Hameed¹, Husham Abdul-Rahman Ahmed², Jasim Abdullah Hayawi³, Alaa Younis Dhannoon⁴

1,2. Dep. Agricultural Research, Rashedia Research Station, Iraq

3,4. Dep. Plant Production Techniques, Technical Agricultural College, Northern Technical University, Iraq

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Abstract: Study was conducted at Rashidiya Research Station, Nineveh Governorate, during the 2024–2025 agricultural season to determine the optimal sowing date and DAP fertilizer level for the Noor barley cultivar. Three replications of a factorial experiment were set up in an RCBD design, including three sowing dates (15 Nov., 15 Dec., and 15 Jan.) and three DAP levels (0, 120, and 150 kg ha⁻¹). Results showed that sowing on 15 Nov. significantly outperformed other dates in plant height, biological yield, and grain yield, while 15 November and 15 Dec. were superior in spike number and grains per spike compared with 15 Jan. Fertilizer at 150 kg ha⁻¹ resulted in the tallest plants, whereas 120 kg ha⁻¹ achieved the best performance in most yield components. The interaction on 15 November with 150 kg ha⁻¹ yielded the highest values for growth and yield traits., highlighting the critical role of synchronizing sowing date and fertilization level to maximize barley productivity.

Keywords: Planting Dates, Noor Barley Variety, DAP Fertilizer

Introduction

Selecting a crop that can grow in multiple environments is one of the most important aspects of agriculture [1]. Cereal crops, especially barley, are grown annually in most dry land areas and are one of the most important staple food sources in most parts world. Barley ranks as the fourth most significant cereal crop by total production, following wheat, rice, and maize [2]. Barley straw is considered a good fodder for all ruminant animals [3]. Also one of most important cereal crops, occupying large areas in ancient and modern world civilizations under the dry farming system, or what is known today as conservation agriculture [4]. Barley is widely cultivated due to its adaptability to all types of soil, and is mainly used as human food and farm animal feed [5], [6]. Barley (*Hordeum vulgare* L.) is well adapted to various cool and relatively humid environments and grown under wide range of environmental conditions, with its cultivation extending to subtropical regions with improved varieties [7]. Despite the increase in the area of barley cultivation, its average productivity is relatively low, as there are many factors that affect the growth and yield of barley, including soil type, climatic conditions, planting depth and planting date, as well as fertilizers [8]. For successful barley cultivation, it is essential to determine the appropriate planting date, as some varieties may be sensitive to environmental changes during different growth stages [9]. Planting date, which is one of most important factors affecting barley growth, yield and quality varies according to climatic conditions and environmental diversity. Chaudhary et al. stated that early planting of barley crop may lead to low

yield and poor quality due to the nature of dense growth and long duration of its stay in the soil [1]. Barley is the main food source in many North African countries, including Egypt. Barley can replace wheat as the main crop in the northern coastal region, as well as in newly reclaimed lands with saline soil, thanks to its ability to tolerate drought and salinity, It is also considered to be more productive in harsh environments than other grains [10].

Fertilization is one important factors for success any field crop, in addition to approved varieties with high productivity and adaptation to different environmental conditions [11]. Diammonium phosphate (DAP) fertilizer is one important fertilizers widely used in fertilizing grain crops, Diammonium phosphate contains (18)% of nitrogen, in addition to containing (45)% of (P₂O₅), and it is considered one of the effective fertilizers when used in agriculture [12]. Khan et al indicated during their study of the effect of two planting dates (10/Nov and 17/Nov.) and four levels of DAP fertilizer (0, 1, 2, 4) g. pot⁻¹ that the interaction between the first date (10/Nov.) and the fertilization level (1) g. pot⁻¹ outperformed the rest of the interactions in many growth and yield traits, including leaf area index, dry weight of the plant, number of leaves, and grain yield [13]. Abd El-Hameed stated, during his study of the effect of three levels of nitrogen fertilizer (40, 60, 80) kg.fad⁻¹ on three varieties of barley (Giza 129, Giza 130, Giza 131), that the variety Giza 131, treated with (80) kg.fad⁻¹, significantly outperformed all the interventions [14]. El-Sobky and Desoky added that when studying the effect of three levels of nitrogen fertilizer (25, 50, and 75 kg.fad⁻¹) on rice yield, there was a significant increase in several growth and yield characteristics, including plant height and number of tillers, at the 50 kg.fad⁻¹ fertilizer level compared to the other nitrogen fertilizer levels [15].

Materials and Methods

Research was conducted at Agricultural Research Dep. /Nineveh Research Division/Rashidiya Research Station during the 2024-2025 agricultural season after land preparation by plowing and smoothing, table (1) shows the results of the physical and chemical soil analysis. The research included two factors: first, three planting dates for the Noor barley variety (15/ Nov., 15/ Dec., and 15/Jan.) and the second, 3 levels of fertilizer (0.0, 120, 150) kg ha⁻¹. Thus, number of experimental units became (3 x 3) distributed over three sectors, area of each experimental unit (1 x 2) meters, planted at seed rate of 100 kg. ha⁻¹ and in lines with a distance between each line 25 cm. The experiment was implemented using the factorial experiment system and (RCBD) design with 3 replications [16]. At the conclusion of the season, the following traits were analyzed: plant height, number of spikes per square meter, number of grains per spike, biological yield, and grain yield. Data analysis was conducted using the SAS program, and Duncan's multiple range test was employed to compare means at a 5% probability level [17].

Table 1. Physical and Chemical Soil Analysis

Soil type	%Silt	Sand	%Clay	pH	EC Dc/m	K Ppm	P Ppm	N Ppm
sandy mixture	12.76	72.28	14.95	7.5	1700	33.76	12.5	70.05

Results and Discussion

Plant height (cm):

Results of Table 2 indicate that difference in planting dates for barley crops was accompanied by a difference in average plant height, as first date (15/Nov.) was significantly superior to the second and third dates (15/Dec. and 15/Jan.), in addition to the significant superiority of the second date over the third date, as the height reached (58.33, 53.66, 34.82) cm for three dates, respectively. Reason for this may be attributed to difference in the duration of plants' stay at the three dates, which caused this increase, these results were similar to what was obtained by Shirin and Hamid, who obtained an increase in the height of the plants at early dates compared to late dates [18].

Table 2. Effect of planting dates, DAP fertilizer levels, and their interaction on plant height (cm.)

Planting dates	DAP fertilizer			Average Dates
	0 Kg.ha ⁻¹	120 Kg.ha ⁻¹	150 Kg.ha ⁻¹	
15 / Nov.	52.34 c	60.00 ab	62.67 a	58.33 a
15 / Dec.	51.67 c	56.66 b	52.67 c	53.66 b
15 / Jan.	31.00 e	32.34 e	42.40 d	34.82 c
Average DAP fertilizer	45.00 c	49.66 b	53.17 a	

Similar letters do not exhibit significant differences at the 0.05 probability level.

Results of same table show increasing rate of DAP Fertilizer from (0-150) kg. ha⁻¹ caused gradual significant increase in average plant height trait, and reason for this may be attributed to fact that this type of fertilizer contains nitrogen at a rate of (18%), which works to encourage an increase in vegetative growth traits, including plant height [19]. Results of interaction between two factors showed that the combination of the first date (15/Nov.) and the level of DAP fertilizer (150 Kg.ha⁻¹) caused the highest height of barley crop plants to be recorded, reaching (62.67) cm, thus significantly outperforming the rest of the interactions, while the combination of the third date (15/Jan.) and the level of DAP fertilizer (0 Kg.ha⁻¹) achieved lowest height of plants, which reached (31.00) cm.

Spikes m⁻²:

One crucial characteristic that raises yield is the quantity of spikes per unit area.. This trait is usually linked to several factors, including planting dates. Determining the appropriate planting date for wheat results in achieving good growth characteristics, which is reflected in the characteristics and components of the crop [20]. The results of Table (3) show that the two planting dates (15/Nov. and 15/Dec.), which did not show any significant difference in average number spikes m⁻², were significantly superior to the date (15/Jan.) with an increase rate of (51.35 and 53.91)%. One possible explanation for this is that early planting may give the plants a greater opportunity to grow and form a good vegetative mass, which is later reflected in an increase in the yield [21].

Table 3. Effect planting dates, DAP fertilizer levels and their interaction on number of spikes m⁻²

Plant dates	DAP fertilizer			Average Dates
	0 Kg.ha ⁻¹	120 Kg.ha ⁻¹	150 Kg.ha ⁻¹	
15 / Nov.	694.3 bcd	955.0 a	594.0 cde	747.76 a
15 / Dec.	823.7 abc	866.7 ab	677.7 bcd	789.36 a
15 / Jan.	375.0 ef	494.3 de	222.0 f	363.76 b
Average DAP fertilizer	631.00 b	772.00 a	497.89 c	

Similar letters do not exhibit significant differences at the 0.05 probability level.

Results of same table indicate that fertilizer treatment (120 Kg.ha⁻¹) caused highest number of spikes per unit area to be recorded, as number reached (772.00) spikes.m⁻², thus it was significantly superior to comparison treatment and the fertilizer level (150 Kg.ha⁻¹). Perhaps reason for this that increasing level of fertilization may lead to an increase in vegetative growth at the expense of fruit growth, and this is what was observed in the average plant height characteristic, Table (1), with an increase in the fertilization level to (150 Kg.ha⁻¹). Results of interaction between two factors show that combination planting date (15/Nov.) and fertilization level (120 kg.ha⁻¹) resulted in recording highest number of spikes m⁻², which reached (955.0) spikes m⁻², while the lowest number of spikes was (222.0) spikes m⁻² at the combination of date (15/January) and fertilization level (150 kg.ha⁻¹).

grains .spike⁻¹

Yields consist of several components that interact with each other and with other components to ultimately increase the dry matter content of the grain. This process is the final result of all the

physiological processes and environmental influences experienced by the plant during the various growth stages [22]. The results of Table (4) indicate that the two planting dates (15/Nov. and 15/Dec.), which did not show any significant difference, were significantly superior to the date (15/Jan.) in the average trait of the number of grains per ear, with an increase rate of (33.34 and 30.93)%, respectively. The reason for this may be attributed to planting at late dates, which may lead to not giving the crop plants enough opportunity to pass through the physiological stages naturally, which leads to the production of shriveled grains. In addition, delaying the planting date and the accompanying rise in temperatures at the time of flowering leads to the killing of pollen grains and the failure of the pollination and fertilization process, and thus a decrease in the number of grains in the spike [23], [24].

Table 4. Effect planting dates, DAP fertilizer levels, and their interaction on number of grains per spike (grain . spike⁻¹)

Plant Dates	DAP fertilizer			Average Dates
	0 Kg.ha ⁻¹	120 Kg.ha ⁻¹	150 Kg.ha ⁻¹	
15 / Nov.	30.00 ab	32.00 a	24.00 cde	28.67 a
15 / Dec.	30.00 ab	27.67 abc	25.33 bcd	27.67 a
15 / Jan.	16.00 f	21.00 de	20.33 ef	19.11 b
Average DAP fertilizer	25.33 a	26.89 a	23.22 b	

Similar letters do not exhibit significant differences at the 0.05 probability level.

The results also indicate that the fertilizer level (120 Kg.ha⁻¹), which did not differ from the comparison treatment (0 Kg.ha⁻¹), significantly outperformed fertilizer level (150 Kg.ha⁻¹) in average number of grain. spike⁻¹, as the number of grains per spike reached (25.33, 26.89, 23.22) grains per spike for three fertilizer levels, respectively. Results of interaction between two factors indicate that combination of the date (15/Nov.) and the fertilizer level (120 Kg.ha⁻¹) caused highest number of grains per spike, which reached (32) grains. spike⁻¹, consequently, it was far better than any interaction. The planting date (15/Jan.) produced the fewest grains per spike. and the comparison treatment (0 kg.ha⁻¹) reached (16.00) grains. spike⁻¹.

Bio-yield (gm.m⁻²):

Bio-yield is one of the measures used in agricultural sciences, which can be used to determine the total dry matter accumulation produced by plants at different stages of their growth, It is usually the result of the difference between the two processes of photosynthesis (which largely depend on the vegetative system and its efficiency in intercepting sunlight, adding moisture and nutrients provided by the root system) and respiration [22]. The results of Table (5) show that the difference in planting dates for the barley crop was along with a steady, noticeable change in average characteristic of the biological yield, as the biological yield reached (2146.56, 2011.89, 493.33) g.m⁻² for three dates, respectively. Perhaps reason for this may be attributed to difference in growth period with difference in planting dates, as long period that early date plants were exposed to and their optimal benefit from the factors of the surrounding environment of suitable humidity and exposure to sunlight. In addition to absorbing the nutrients present in the soil, which led to the plants acquiring good vegetative growth characteristics, which led to an increase in the accumulation of dry matter in all parts of the plant, and thus an increase in the biological yield, and these results were consistent with what was obtained by [25], [26].

Table 5. Effect of planting dates, DAP fertilizer levels and their interaction on the biological yield characteristic (g.m⁻²)

Plant Dates	DAP fertilizer			Average Dates
	0 Kg.ha ⁻¹	120 Kg.ha ⁻¹	150 Kg.ha ⁻¹	
15 / Nov.	2115.00 b	2828.67 a	1496.00 c	2146.56 a

15 / Dec.	2176.67 b	2272.33 b	1586.67 c	2011.89 b
15 / Jan.	280.00 e	760.67 d	439.33 e	493.33 c
Average DAP fertilizer	1523.89 b	1953.89 a	1174.00 c	

Similar letters do not exhibit significant differences at the 0.05 probability level.

Results of same table show that difference in fertilization levels was accompanied by a significant difference in the average characteristic the biological yield of the barley crop. We note that increasing the fertilization level to (150 Kg.ha⁻¹) caused the lowest biological yield to be recorded, and that the fertilizer level (120 Kg.ha⁻¹) achieved highest biological yield and thus significantly outperformed the rest of the fertilizer levels, as the biological yield for the three levels reached (1523.89, 1953.89, 1174.00) g.m⁻², respectively. Results of interaction between two factors indicate that combination date (15/Nov.) and the fertilizer level (120 kg.ha⁻¹) achieved highest biological yield, which reached (2828.67) g.m⁻², thus significantly outperforming all interactions. Lowest biological yield was (439.33) g.m⁻² when the date (15/Jan.) and fertilizer level (150 kg.ha⁻¹) were interacted.

Grain yield (g.m⁻²):

Grain yield is the final result of the biological activities occurring within the plant during its various growth stages. Grain yield is affected by external factors, including planting dates, as well as the source's efficiency in providing dry matter through photosynthesis and the down stream's ability to absorb and store this material [27]. The results of Table (6) show that the two dates (15/Nov. and 15/Dec.) did not show any significant effect on the average grain yield trait, and that they were significantly superior to the date (15/Jan.) for the same trait, with an increase rate of (67.88 and 66.58)%, respectively. The reason for this may be attributed to the long period of time at the first and second dates and the accompanying suitable environmental conditions of suitable temperature and humidity, which is reflected positively in many growth characteristics, yield and its components, and thus increases the grain yield [28]. This result is similar to what many researchers have reached, who confirmed the superiority of early dates over late dates in growth and yield traits [29], [30].

Table 6. Effect of planting dates, DAP fertilizer levels and their interaction on the grain yield trait (g.m⁻²)

Plant Dates	DAP fertilizer			Average Dates
	0 Kg.ha ⁻¹	120 Kg.ha ⁻¹	150 Kg.ha ⁻¹	
15 / Nov.	749.67 b	940.00 a	290.67 de	660.11 a
15 / Dec.	695.33 b	765.33 b	442.67 c	634.44 a
15 / Jan.	326.67 d	198.67 ef	110.67 f	212.00 b
Average DAP fertilizer	590.56 a	634.67 a	281.33 b	

Similar letters do not exhibit significant differences at the 0.05 probability level.

The results also show that the comparison treatments (0 Kg.ha⁻¹) and fertilizer level (120 Kg.ha⁻¹) significantly outperformed the fertilizer level treatment (150 Kg.ha⁻¹) in the average grain yield trait, which reached (590.56, 634.67, 281.33) g.m⁻² for three fertilizer levels, respectively. Results of interaction between two factors indicate that combination of planting date (15/Nov.) and fertilizer level (120 kg.ha⁻¹) achieved highest grain yield, which reached (940.00) g.m⁻², thus significantly outperforming all interactions. Lowest grain yield was achieved with combination planting date (15/Jan.) and fertilizer level (150 kg.ha⁻¹), which reached (110.67) g.m⁻²

Conclusion

Based on the results of the study conducted at the Rashidiya Research Station during the 2024–2025 growing season, it can be concluded that planting date and DAP fertilizer level significantly affected the growth and yield of the Noor barley cultivar. Sowing on 15 November consistently

produced superior performance in most growth and yield parameters, including plant height, number of spikes per unit area, number of grains per spike, biological yield, and grain yield, compared with sowing on 15 December and 15 January. Delaying sowing to mid-January markedly reduced all yield components, indicating that the prevailing environmental conditions at this time were less favorable for normal physiological development and yield formation of barley plants. This finding highlights the critical role of proper planting time in synchronizing crop growth stages with optimal climatic conditions.

Regarding fertilization, application of DAP at a rate of 120 kg ha⁻¹ resulted in the best overall performance for most yield components, particularly spike density, grains per spike, biological yield, and grain yield, compared with the control and the higher fertilizer rate of 150 kg ha⁻¹. Although the higher DAP rate enhanced vegetative growth, as reflected by increased plant height, excessive fertilization did not translate into higher grain yield and appeared to reduce fertilizer use efficiency. The interaction between planting date and fertilizer level revealed that the combination of sowing on 15 November with 120 kg ha⁻¹ DAP was the most effective treatment for maximizing barley productivity. Therefore, this study recommends mid-November sowing combined with moderate DAP fertilization as an optimal agronomic practice for improving the yield of the Noor barley cultivar under similar agro-ecological conditions.

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