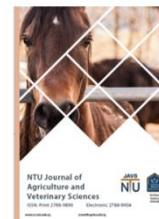




P-ISSN: 2788-9890 E-ISSN: 2788-9904

NTU Journal of Agricultural and Veterinary Sciences

Available online at: <https://journals.ntu.edu.iq/index.php/NTU-JAVS/index>



Response of *Triticum durum* Desf varieties to different sowing dates under climate change

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Article Informations

Received: 21-10- 2025,
Accepted: 02-03-2026,
Published online: 28-03-2026

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Key Words:

Duram wheat, ,
sowing dates
wheat varieties

A B S T R A C T

Field experiment was carried out in Nineveh Governorate in 2024 agricultural season. study aimed to determine response of some Duram wheat varieties used to best sowing date in terms of productivity under climate change conditions Supplemental irrigation was used. experiment included two factors, first factor was sowing dates and included three dates (25 November, 10 December, 25 December), and second factor included three varieties of coarse wheat (Um Rabie, Ou hassan, Alwaha). Experiment was implemented according to a randomized complete block design (R.C.B.D.), according to factorial experiment system, with three replications. results indicated that sowing dates of 25 November and 10 December was superior in recording the highest significant values for plant height, which amounted to 91.31 cm and 90.46 cm, respectively. sowing dates of 10 December also excelled in recording the highest significant value for flag leaf area, which amounted to 46.98 cm². Likewise, grain yield was 428.91 kg. Dunam⁻¹. Ou hassan variety was also significantly superior in terms of spike length, 6.86 cm, and grain yield, 420.34 kg. Dunam⁻¹. and did not differ significantly with Alwaha variety in plant height and with Um Rabie variety in flag leaf area. best significant binary interaction was for grain yield when planting Ou hassan variety on sowing dates of 10 December, which amounted to 592.28 kg. dunam⁻¹ and protein % was 16.06%.



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How to Cite: Response of *Triticum durum* Desf varieties to different sowing dates under climate change. (n.d.). *NTU Journal of Agriculture and Veterinary Science*, 6(1).

Introduction

[1] concluded that in a study of four sowing dates (15 November, 22 November, 19 November, and 4 December), first date, 15 November, was superior in giving the highest significant values for grain yield traits, which amounted to 4.90 tons. Hectare⁻¹, weight of 1000 grains was 45.65 grams, while length of spike did not differ significantly. [2] found in a study the effect of different sowing dates on growth traits and components of bread wheat yield. sowing dates were (20 October, 10 November and 30 December). results showed that sowing dates was superior to November 10 by giving highest yield. Grains reached 4.96 and 5.21 tons. Hectare⁻¹, and most of its components are number of spike. m⁻² were 403.3 and 408.6, and spike length was 15.84 and 14.39 cm, for both seasons of study respectively, while sowing dates of 20 October was higher by giving highest weight for 1000 seed trait, reaching 42.94 and 43.72 grams for two seasons respectively, and this is what led to Until researchers concluded from their study that planting on 10 October is best date for central region of Iraq to obtain the highest grain yield, and that planting early or later than this date causes a decrease in yield, even though effect of early planting is greater than effect of late planting on traits. Thoughtful. In study of [3] when using four sowing dates for soft wheat (1 November, 15 November, 1 December, 15 December), first sowing dates, 1 November, led to a significant increase in plant height, which reached 90.25 cm. And number of spikes. m⁻² 324.1, weight of 1000 grains reached 40.24 grams and the amount of yield was 6.231 tons. Hectare⁻¹, while third sowing dates, 1 December, gave highest number of grains per spike, which reached 75.75 grains. [4] observed when studying effect of early and late sowing dates for four durum wheat varieties, that higher yields were obtained at early planting compared to late sowing dates. results obtained by [5] in a study that included effect of three sowing dates for several varieties of bread wheat (1 October, 10 October, and 20 October), indicated that there were no significant differences in the effect on grain yield, as yield ranged between 6750 kg. Hectare⁻¹ and 6840 kg. hectare⁻¹. [6] reported that grain yield decreased by 82-87 kg. Hectare⁻¹ for each day of delay from sowing dates of 30 November. [7] showed, when studying effect of four sowing dates (1 November, 20 November, 10 December, and 30 December) on different varieties of bread wheat, that some varieties planted by second date, November 20, excelled in giving highest grain yield of 5.148. Tons. hectare⁻¹, and highest percentage of grain protein content is 10.67% . [8] mentioned in their study that early sowing dates of November 14 recorded a significant increase in grain yield, biological yield, plant height of 87.00 and 104.58 cm, and number of spikes. M², which was 362.25 and 371.83, as well as the number

of grains per spike, which were 53.91 and 50.91 for both experimental seasons, respectively, compared to late sowing dates of November 28 for coarse wheat. [9] also found in their study, to evaluate effect and dates of planting on traits of bread wheat, where study included four dates (10/11, 25/11, 10/12 and 25/12), that maximum number of days until flowering is 107. day, which was when planting early on 10/11. Also, highest grain yield was obtained, which amounted to 4717 kg. hectare⁻¹ when planting on early date of 10/11. which amounted to 11,602 kg. hectare⁻¹. and in description of height plant, which was 102.84 cm, and in description of number of spike. M⁻² 323, harvest index is 41.1%, and weight of 1000 seeds is 38.82 grams. In light of this, researchers concluded that best sowing dates is when planting from November 10 to 25. results obtained by [10] through a study to determine effect of two sowing dates (23 November and 23 December) on yield and its components for fourteen varieties of fine wheat, showed that first sowing dates, 23 November, was superior in studied traits, namely plant height. grain yield, number of grains per ear, and the number of spikes.M⁻² on second sowing dates. [11] reported that highest biological yield of 11585 kg was obtained. Hectare⁻¹, and highest grain yield is 5461 kg. Hectare⁻¹, and the highest harvest index reached 47.37%, when planting bread wheat on 10 November compared to the late date of 15 December. In a study of effect of three sowing dates for soft wheat, which included (November 20, 30November, and 10 December), [12] found that first sowing dates, November 20, was superior to rest of sowing dates in terms of plant height, 93.4 cm, and flag leaf area. number of days until 50% of the field flowers, and the number of spikes. m⁻² 466.3, and harvest index 41.97%. [13] was They found in their study applied results indicated to significantly superiority of early date only in traits of biological yield and grain yield. and this date did not differ significantly from the average date in the traits of the number of grains per spike and weight of 1000 grain while sowing dates did not significantly affect traits of number of tillers.m⁻². Recording to varieties, Ouhasan, Atlhagy, and Nano showed exceed in number of grains per spike, Atlhagy outperformed in the biological yield and Ouhasan in the grain yield, while the Uramy exceeded in weight of 1000 grains. interactions of early and medium sowing date with different seeding rates outperformed all trait. All interactions were significant in effecting studied trait.[14] concluded, through a field study that included two factors, first of which was seed rates and four varieties of bread wheat (Pikaflore, Tay, Gassay and Dinknesh), that best growth and highest significant values for yield traits and its components were obtained when two-way interaction between Pikaflore variety and seed rate was 100 kg. Hectare⁻¹ is highest yield in experimental area. [15] found, when carrying out an experiment to determine

response of yield and its components to three varieties of bread wheat (Kana, Dande, and Ncema) under influence of six different seed rates, that cultivars had a significant effect on most of traits studied, such as plant height, beginning of flowering time, and number of spikes per crop. Unit area, and highest value for grain yield was 2927.5 kg. Ha⁻¹ when interfering between Kana variety and the seed rate (80 kg. ha⁻¹). **aim of study** is to determine best sowing dates for some varieties of *Triticum durum* Desf.

materials and methods.

field experiment was carried out in 2024 agricultural season in an area almost guaranteed by rain (Mosul). Three varieties of durum wheat, *Triticum durum* Desf, were used in this study. These varieties were grown under a conservation agriculture system, where lines were opened with seed and then planted manually. Experiment was implemented according to a randomized complete block design (R.C.B.D.), according to factorial experiment system experiment included two factors. first factor: sowing dates. This factor included three sowing dates: first date was early, before plow fell on 25/11, second was medium, after plow fell on 10/12, and third was late, on 25/12. (25 November, 10 December, 25 December) second factor included three varieties of durum wheat (Um Rabie, Ouhasan, Alwaha). experiment included 27 experimental units, each with an area of one square meter. traits were studied which are: Plant height, leaf flag area, spike length, 1000 grain weight, grain yield and protein % were studied.

Results and discussion

plant height (cm): results of study in Table 1. showed that Ouhasan and Alwaha varieties were significantly superior in plant height to Um Rabie variety, which amounted to 89.70 cm and 87.91 cm, respectively. reason for this may be due to genetic factors of each variety and the extent of their interaction with environmental factors, and this is consistent with what He found it [12],[16]. Sowing dates also showed a significant effect on plant height, as the first and second dates gave the highest significant values for this trait compared to late date, which amounted to 91.31 cm and 90.46 cm, respectively. reason for this may be due to speed and strength of plants planted at same time. Early, which enhances and strengthens germination and seedlings due to suitable environmental conditions, especially temperatures, which decrease when planting at late dates, causing slow and weak seedling growth and thus delaying and weak vegetative growth, and this is consistent with what was mentioned [17], [18],[19] as they confirmed that the height of wheat plants decreased gradually due to lates owing dates , and they explained this to fact that late planting exposes the plants to negative impact of high

temperatures during branching and elongation stages, which leads to plants accelerating cessation of vegetative growth. trend is towards flowering, which leads to a reduction in the elongation period and thus a decrease in the height of plant. Table (1) indicates that there is a significant bilateral interaction between experimental factors, as highest significant values were when planting both varieties Ouhasan, Alwaha, and first and second sowing dates compared to late planting for all varieties.

flag leaf (cm²): results in Table .2 indicate that there is a significant effect of varieties used in experiment on trait of flag leaf, as both Um Rabie and Ouhasan varieties excelled in giving the highest significant values for this trait, which amounted to 40.25 cm² and 44.66 cm², respectively. reason for this may be due to difference is due to genetic nature of each accession or variety, as leaf area varies from one accession to another when environmental conditions are ideal, and this is consistent with what was found [16], [15]. results in same table indicate that there is a significant effect of sowing dates on leaf area trait, as first sowing dates was superior in giving highest significant values for this trait, which amounted to 46.98 cm² compared to the other sowing dates. reason for this may be attributed to the early sowing dates may give A longer time for plant cells to build, elongate, and grow well, and this reflects positively on area of the flag leaf, and this is consistent with what was confirmed by [12], [1], [16]. results also indicate that there is a significant binary interaction between experimental factors in influencing trait of area of knowledge heirs, as the highest significant value for this trait was when planting Um Rabie variety on first date of planting, which amounted to 56.82 cm², while lowest significant value for this trait was when planting on third date. For agriculture and for everyone Wheat varieties.

spike length (cm): results in Table .3 indicate that there is no significant effect of sowing dates on spike length. While there was a significant effect of difference between varieties in trait of spike length, as both Um Rabie variety and Ouhasan variety excelled in giving highest significant values for trait of spike length, which amounted to 6.24 cm and 6.86 cm, respectively. reason for this difference may be due to difference in varieties used in experiment, which is reflected in on plant behavior, varieties may differ in length of period from beginning of formation of spikes until 100% total flowering, and this causes a difference in length of spike, and this is consistent with what was indicated by [19]. results also did not show a significant effect of experimental factors.

Weight of 1000 seeds: results in Table .4 results indicated there was no significant difference between varieties used in experiment regarding weight of 1000 grain. While showed that first and second sowing dates were significantly superior in giving highest weight for weight of 1000 seeds, which amounted to 45.59 grams and 44.84 grams,

respectively. reason for this may be due to plant taking sufficient time for vegetative growth, which was reflected in It positively increases weight of grains through increasing efficiency of photosynthesis, manufacturing food materials, and storing them in estuaries for the longest possible period, and this is consistent with [1], [20]. binary interaction between experimental factors was significant, as highest significant value was obtained for weight of 1000 seeds when planting Um Rabie variety on sowing dates of 25 November, which amounted to 47 grams.

grain yield kg. dunam⁻¹: Table .5 shows that there is a significant effect of difference in sowing dates on grain yield, as sowing dates of 10 December was significantly superior in recording the highest grain yield, which amounted to 428.91 kg. dunam⁻¹, and reason for this may be due to providing ideal conditions for the plant in terms of temperatures and periods of lighting, which led to an increase in efficiency of photosynthesis and the exploitation of available nutrients, which led to an increase in manufactured materials and their storage in estuaries, and this is consistent with [8, 12] Ouhasan variety was significantly superior in giving highest grain yield, which amounted to 420.34 kg. dunam⁻¹. reason for this may be due to the genetic traits of this variety and its response to environmental conditions prevailing in region, and this is consistent with [8], [12],[21], [22]. dual interaction also had a significant effect on weight of 1000 grains, as highest significant value for this trait was obtained when planting Ouhasan variety on 10 December, which amounted to 592.28 kg. dunam⁻¹.

protein %: Table 6. indicates that there is a significant effect of differences in varieties used in study on percentage of protein in grains, as variety Ouhasan was superior in giving highest significant value for this trait, which amounted to 14.60% over rest of varieties. reason for this may be due to genetic factor of each variety and extent of its response to surrounding environmental conditions, and this is consistent with [13, 24] same table also indicates that there is a significant effect of difference in sowing dates on protein percentage in grains, as an increase in protein percentage was observed later sowing date was, as dates of 10 December and 25 December were superior in giving highest significant percentage of protein, which amounted to 14.23%, 14.31% respectively. This may be due to coincidence of grain filling periods with high temperatures, which led to transfer of nitrogen from leaves to grains, which led to accumulation of protein in grains. This is consistent with what was stated by [13, 23] Secondary interaction also had a significant effect on the protein percentage in the grains, as highest percentage could be obtained significantly when planting the Ouhasan variety on two planting dates of 10 December and 2December, which reached 15.06%, 14.66% respectively.

Conclusion

- Based on results obtained, we conclude that the best sowing date is 10 December for planting variety Ouhasan in order to obtain highest yield.

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Table .1 effect of Sowing dates and varieties *Triticum durum* Desf on plant height (cm).

Varieties	Sowing dates			Effect of Varieties
	November25	10 December	25 December	
Um Rabie	89.73ab	82.20bc	74.60 c	82.18b
Ouhassan	95.33a	93.83a	79.93 c	89.700a
Alwaha	88.86ab	95.33a	79.53c	87.91a
Effect of Sowing dates	91.31a	90.46a	78.02 b	

Values followed by identical letters do not differ significantly from each other at probability level 5%.

Table .2 Effect of sowing dates and varieties of *Triticum durum* Desf on flag leaf area cm².

Varieties	Sowing dates			Effect of Varieties
	November25	10 December	25 December	
Um Rabie	36.78 cd	56.82 a	27.16 e	40.25 a
Ouhassan	50.47 ab	45.97 bc	37.54 cd	44.66 a
Alwaha	34.68 de	38.14 cd	32.06 de	34.96 b
Effect of Sowing dates	40.64 b	46.98 a	32.25c	

Values followed by identical letters do not differ significantly from each other at probability level 5%.

Table .3 Effect of sowing dates and varieties of *Triticum durum* Desf on spike length, (cm).

Varieties	Sowing dates			Effect of Varieties
	November25	10 December	25 December	
Um Rabie	6.42 a	6.63 a	5.68 a	6.24ab
Ouhassan	7.06 a	7.06 a	6.47 a	6.86a
Alwaha	5.94 a	5.91 a	5.67 a	5.84b
Effect of Sowing dates	6.48a	6.53a	5.94 a	

Values followed by identical letters do not differ significantly from each other at probability level 5%.

Table .4 Effect of sowing dates and varieties of *Triticum durum* Desf on weight of 1000 grams (gm).

Varieties	Sowing dates			Effect of Varieties
	25 November	10 December	25 December	
Um Rabie	47.00 a	44.47 ab	41.50 b	44.32a
Ouhassan	44.67 ab	44.63 ab	41.12 b	43.47a
Alwaha	45.09 ab	45.41 ab	42.27 ab	44.26 a
Effect of Sowing dates	45.59a	44.84a	41.63b	

Values followed by identical letters do not differ significantly from each other at probability level 5%.

Table .5 Effect of sowing dates and varieties of *Triticum durum* Desf on grain yield kg. dunam⁻¹.

Varieties	Sowing dates			Effect of Varieties
	November25	10 December	25 December	
Um Rabie	312.61 e	348.39 c	193.11g	284.70c
Ouhassan	418.02 b	592.28 a	250.70 f	420.34a
Alwaha	335.14 d	346.04 c	248.97 f	310.05c
Effect of Sowing dates	355.56 b	428.91 a	230.93c	

Values followed by identical letters do not differ significantly from each other at probability level 5%.

Table .6 Effect of sowing dates and varieties of *Triticum durum* Desf on protein %.

Varieties	Sowing dates			Effect of Varieties
	November25	10 December	25 December	
Um Rabie	13.27 c	14.12 b	14.17 b	13.85 b
Ouhassan	14.08 b	15.06 a	14.66 a	14.60 a
Alwaha	13.43 c	13.51 c	14.11 b	13.68 b
Effect of Sowing dates	13.59 b	14.23 a	14.31 a	

Values followed by identical letters do not differ significantly from each other at probability level 5%.