



Effect of planting dates on growth, yield and forage quality of two varieties of Triticale.

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Abstract. A field experiment was conducted during the winter agricultural season (2025-2024 AD) in the Al-Bathaa district, located 45 km west of Dhi Qar Governorate, to investigate the effects of two varieties (Farah-Amal 7) and various planting dates (November 1, November 20, December 10, and December 30) on the growth, yield, and quality of forage of triticale. The experiment employed a split-plot design within a randomised complete block design (RCBD) with three replications, where pla The statistical analysis results indicated the superiority of the Farah variety in the chlorophyll index, number of tillers, green forage production, dry forage yield, and protein percentage in both plots, specifically 44.66 and 47.16 (Spad), and 436.2 and 447.1 tillers, respectively. M-2: 10.93 and 11.17 $\mu\text{g h}^{-1}$; 2.36 and 2.42 $\mu\text{g h}^{-1}$; 10.25 and 9.86%. The planting dates surpassed the third date (10/12) in tiller count, yielding 458.4 and 460.8 tillers. M-2 produced green fodder yields of 11.95 and 12.36 $\mu\text{g h}^{-1}$, and dry fodder yields of 3.05 and 3.01 $\mu\text{g h}^{-1}$ in both harvests, respectively.

Keywords: Triticale ,planting dates, varieties ,yield forage.

Introduction

Triticale cross is a cereal crop in the Poaceae family, produced through hybridisation of wheat and Triticum. I perceive L. as both a maternal figure and a rye crop. *Secale cereale* L. serves as the progenitor, and the morphology of this crop resembles that of wheat. The protein

percentage in its grains, along with the lysine amino acid content, is elevated at 4% compared to wheat; however, the quality of the protein and the gluten present, which influence bread quality, is inferior to that of wheat [1] . The cultivation of this crop in Iraq remains constrained due to insufficient awareness among farmers and peasants, as well as the absence of initiatives to promote

its growth. This dual-purpose crop is advantageous for green fodder, exhibiting favourable characteristics such as plant height, tiller count, leaf area, green fodder yield, dry matter content, and tiller production. Furthermore, it generates substantial biomass and demonstrates a remarkable capacity for regrowth after cutting, making it ideal for dual-purpose applications [2].

triticale has emerged as a global crop cultivated in over 35 nations. The worldwide farmed area approximated 3.8 million hectares, with an average production of approximately 3.7 megagrammes¹[3].

Global warming has resulted in a substantial decrease in the yield of all grain crops due to alterations in environmental and climatic conditions. Consequently, scientific investigation into planting dates is a crucial and fundamental aspect for alleviating this problem and minimising its detrimental effects by adjusting to the current conditions [4]. The planting date is a critical aspect of crop management, particularly in light of recent climate changes marked by significant seasonal variability and fluctuations within individual seasons. These factors are interconnected and influence the growth, formation, and development of plant organs, as well as crop quality. Temperature and light, which vary by location and season, significantly impact most physiological processes of the plant.

The inception of the concept of cultivating and evaluating varieties within the regional environment, primarily focussing on growth characteristics and yield in both quantity and quality, necessitates thorough investigation and resolution. It is imperative to assess their compatibility with the local environment and identify the most suitable varieties to address the deficit in fodder

(green fodder and grains), given their significant influence on the advancement of the livestock sector in Iraq, which is marked by a scarcity of fodder resources and a reliance on specific crops with challenging requirements, particularly concerning the availability of irrigation water. The decline in water imports into the country, coupled with the substantial water demands of crops and the limited diversity of fodder crops, constitutes a significant challenge. The introduction of alternative sources would bolster this vital sector, particularly with the triticale crop, known for its minimal requirements, adaptability to environmental conditions, and high yield potential.

The objective of this experiment was to improve and diversify fodder supplies by determining the optimal types and planting dates to maximise vegetative growth (green fodder) and grain output.

2- Materials and method

A field experiment was executed during the winter seasons of 2023-2024 and 2024-2025 in the agricultural fields of a farmer located in the Al-Bathaa district, 45 km west of the Dhi Qar Governorate centre, at coordinates 45.8 longitude and 31.1 latitude, to investigate the impact of planting dates on the growth, yield, and quality of green fodder for two varieties of Shelmi wheat. A factorial experiment was conducted using the split-plot design to investigate two factors: types of Shelmi wheat, specifically Farah (V1) and Amal 7 (V2). The second element comprised four sequential planting dates (1/11, 20/11, 10/12, and 30/12), denoted as D1, D2, D3, and D4. The field allocated for the experiment was prepared by ploughing it twice perpendicularly with a rotary plough,

and the soil was levelled using combs. The disc was thereafter partitioned into three sectors based on the employed design, with each sector further subdivided into panels of $2 \times 2 \text{ m}^2$, maintaining a separation of 0.5 meters between each experimental unit. The seeds of the Shelmi wheat types were sown on the specified dates. Each experimental unit comprised 10 lines, with a distance of 20 cm between each line and a length of 2 m. The experiment was initiated with a seed amount of 120 kg per hectare. Irrigation operations were conducted continually in accordance with the crop's requirements. Nitrogen fertiliser (urea) containing 46% N was applied at a rate of 200 kg ha⁻¹ in three increments: the first after emergence, the second following the initial harvest, and the third after the subsequent harvest[5]. Phosphate fertiliser was applied at a rate of 100 kg P2O5 per hectare, utilising triple superphosphate (20% P)[6], in a single application prior to planting. Manual weeding operations were conducted as needed to eliminate the proliferating weeds in the field, and the subsequent features were examined:

1. Chlorophyll index in foliage (SPAD) subsequent to each mowing
2. Quantity of tillers (m²) subsequent to each mowing
3. Green fodder yield (Mg ha⁻¹)
4. Dry forage production (Mg h⁻¹)
5. Protein proportion (%) with each mowing.

3. Results and discussion

3.1 Chlorophyll index in leaves (SPAD)

The data in Table (1) indicated notable disparities among the varieties concerning

the chlorophyll index in the leaves. The Farah variety excelled, achieving the highest two averages for this trait at 44.66 and 47.16 (SPAD), whereas the Amal 7 variety recorded the lowest two averages at 42.01 and 45.18 (SPAD) for both crops, respectively. The disparities in chlorophyll content among the varieties may stem from variations in their genetic composition. This finding contrasts with the results of [7], who observed no significant differences in the chlorophyll index among the varieties, attributing this to differences in experimental conditions and the varieties employed.

The results demonstrated that the chlorophyll index in the leaves was significantly influenced by the planting date solely during the second harvest. The initial date (11/1) yielded the highest average for this trait, measuring 46.24 (SPAD), thereby substantially surpassing the other dates. Conversely, the subsequent date (11/20) exhibited the lowest average for the trait, at 40.62 (SPAD). The superiority of the initial date may be attributed to the favourable climatic conditions regarding temperature and photoperiod length (Appendix 1), which facilitated enhanced plant growth and expansion of the plant canopy, thereby improving light interception and increasing photosynthetic efficiency, ultimately elevating the chlorophyll index. This outcome concurred with the findings of [8], which demonstrated an augmentation in chlorophyll content in the leaves associated with an earlier planting date.

Table 1. The effect of varieties, planting dates and their interaction on the chlorophyll index in leaves (SPAD .AD (2024-or the two crops for the first season (2023).

The first agricultural season					
varieties	planting dates				Average
	D1	D2	D3	D4	
V1	49.68	45.00	47.20	46.77	47.16
V2	47.65	43.53	44.97	44.57	45.18
Average	48.66	44.27	46.08	45.67	
	Interference		varieties	dates	LSD
	NS		1.65	NS	
The second agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	48.90	42.40	42.47	44.87	44.66
V2	43.58	38.83	43.47	42.17	42.01
Average	46.24	40.62	42.97	43.52	
	Interference		varieties	dates	LSD
	NS		1.72	3.08	

3.2 Number of tillers

Table (2) reveals substantial disparities among the varieties concerning the trait of tiller count, with the Farah variety exhibiting the highest averages of 436.2 and 447.1 tillers per square metre, surpassing the Amal 7 variety, which recorded the lowest averages of 420.9 and 428.8 tillers per square metre for both crops, respectively. The variance in the number of tillers among the kinds may stem from differences in their genetic content, which is seen in their varying capacities to produce tillers per unit area. This result concurred with the findings of [9;10], which demonstrated considerable differences among the kinds in the quantity of plant tillers.

The analysis of planting dates reveals that the third date (10/12) exhibited the highest averages of 458.4 and 460.8 branches m⁻², significantly differing from the first and second dates. Conversely, the fourth date (30/12) yielded the lowest averages of

369.2 and 397.9 branches m⁻² for both crops, respectively. The superiority of the third planting date in terms of branch quantity per plant may be attributed to the favourable environmental conditions in the study area, specifically regarding temperature and photoperiod length (Appendix (1)). These conditions likely extended the branching period and enhanced photosynthetic efficiency, resulting in adequate dry matter production, which stimulated increased branch formation per unit area. This finding aligns with the conclusions of [11]. The interaction effect reveals that the combination (D3XV1) exhibited significant superiority in the initial harvest, achieving the highest two averages for the trait at 461.4 and 464.5 shoots m⁻². In contrast, the combination (D4XV2) recorded the lowest two averages for the trait, with values of 343.9 and 358.4 shoots m⁻² in both harvests, respectively. Analysis of the interaction findings revealed that both types achieved the highest averages for the number of shoots per unit area on the third date (10/12). The behaviour exhibited by

the two varieties, Farah and Amal 7, alongside the variation in yields, illustrates the disparity in their capacity for growth restoration over time. This phenomenon is a natural consequence of the genetic-environmental interaction between the

variety and the planting date, which often alters the nature and direction of the response from a practical standpoint, particularly given the challenges in regulating genetic and environmental variables.

Table 2. For the first ²on the number of seedlings m The effect of varieties, planting dates and their interaction .AD (2024-season (2023

The first agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	437.6	428.3	461.4	417.5	436.2
V2	436.6	447.7	455.3	343.9	420.9
Average	380.7	438.0	458.4	369.2	
	Interference		varieties	dates	LSD
	22.87		11.52	19.33	
The second agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	443.8	442.8	464.5	437.3	447.1
V2	446.6	453.0	457.1	358.4	428.8
Average	445.2	447.9	460.8	397.9	
	Interference		varieties	dates	LSD
	18.93		8.20	17.20	

3.3 Green fodder yield (megagram h⁻¹)

Table (3) presents a notable disparity between the two varieties concerning the green fodder yield trait. The Farah variety exhibited superior averages of 10.93 and 11.17 $\mu\text{g.h}^{-1}$, whereas the Amal 7 variety demonstrated lower averages of 10.55 and 10.70 $\mu\text{g.h}^{-1}$ in both harvests, respectively. The disparity in green fodder yield among the examined varieties can be ascribed to variations in genetic composition, alongside the prolific growth of the Farah variety and its dominance in vegetative growth characteristics, including leaf chlorophyll content (Table 1) and shoot quantity (Table 2), both of which contribute to the overall green fodder yield. This outcome concurred with the findings of references [8;12], which

identified a disparity in green fodder output across the kinds. The analysis of planting dates revealed significant disparities in green fodder yield. The third planting date (10/12) achieved the highest two averages for this trait, measuring 11.95 and 12.36 $\mu\text{g.h}^{-1}$, which were significantly different from the first (1/11) and second (20/11) dates. Conversely, the fourth date (30/12) yielded the lowest two averages, recorded at 18.03 and 17.50 $\mu\text{g.h}^{-1}$ for both harvests, respectively. The preeminence of the third date (10/12) in green fodder yield across both harvests can be ascribed to its superiority in various vegetative growth characteristics, including chlorophyll content (Table 2), the number of tillers per unit area (Table 3), and the area of the flag leaf (Table 10). Collectively, these factors

contributed to the enhancement of green fodder yield, alongside the favourable climatic conditions regarding temperature and photoperiod length (Appendix (1)), which improved the plant's capacity to intercept light. The illumination enhanced

the effectiveness of photosynthesis and the generation of dry matter, resulting in an augmented yield of green feed. This outcome aligned with the findings of [8], who noted the impact of varying planting dates on green fodder yield.

Table 3. ¹ The effect of varieties, planting dates and their interaction on the green fodder characteristic, Mg H For the two seasons AD (2024-First (2023

The first agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	10.43	11.20	12.10	10.01	10.93
V2	10.30	10.36	11.80	9.76	10.55
Average	10.36	10.78	11.95	9.88	
	Interference		varieties	dates	LSD
	NS		0.27	0.26	
The second agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	10.86	11.26	12.53	10.05	11.17
V2	10.31	10.63	12.20	9.68	10.70
Average	10.59	10.95	12.36	9.86	
	Interference		varieties	dates	LSD
	NS		0.44	0.46	

3.4 Dry feed yield (mg h⁻¹)

Table (4) reveals a significant disparity in dry fodder yield between the two varieties, with the Farah variety achieving superior averages of 2.36 and 2.42 megagrammes h⁻¹, while the Amal 7 variety exhibited lower averages of 2.16 and 2.27 megagrammes h⁻¹ for both crops, respectively. The superiority of the Farah variety may be attributed to its enhanced green fodder yield (Table 3), alongside variations in genetic composition that influence dry matter accumulation. This indicates the Farah variety's greater efficiency in developing a leaf area adequate for capturing light energy, thereby augmenting the photosynthesis process and facilitating the production and accumulation of dry

matter [8]. This result concurred with the findings of [8], which demonstrated the variability of Shelmi wheat cultivars in green fodder yield. The findings revealed significant variations in dry fodder yield based on planting dates. The third date (10/12) achieved the highest averages for this trait, recording 3.05 and 3.01 megagrammes h⁻¹, which were significantly different from the first date (11/1) and the second (11/20). Conversely, the fourth date (12/30) yielded the lowest averages for the trait, with values of 1.75 and 1.92 megagrammes h⁻¹ for both harvests, respectively. The advantage of the third date may be attributed to its enhanced green fodder output in both harvests, a finding consistent with the observations of [9].

Table 4. ¹ the dry fodder yield characteristic, mcg h Effect of varieties, planting dates and their interaction on .AD (2024-For the two teams in the first season (2023

The first agricultural season					
varieties	Dates				Average
	D1	D2	D3	D4	
V1	2.15	2.19	3.20	1.90	2.36
V2	2.01	2.13	2.90	1.60	2.16
Average	2.08	2.01	3.05	1.75	
	Interference		varieties	dates	LSD
	NS		0.10	0.23	
The second agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	2.23	2.30	3.06	2.12	2.42
V2	2.10	2.30	2.97	1.73	2.27
Average	2.17	2.30	3.01	1.92	
	Interference		varieties	dates	LSD
	NS		0.14	0.13	

3.5 Protein content per feed

Table (5) reveals a notable disparity between the two varieties regarding the protein percentage in dry fodder. The Farah variety exhibited superior averages for this trait, attaining 10.25% and 9.86%, in contrast to the Amal 7 variety, which recorded lower averages of 10.02% and 9.24% for both crops, respectively. The diversity in protein content among fodder varieties may be attributed to differences in genetic composition. This outcome aligns with the findings of [8], which demonstrated the variation in protein content among different types of green fodder. The analysis of planting dates on this trait reveals that the initial date (11/1)

was markedly superior to the subsequent dates, achieving the highest averages of 10.69% and 10.26% for both harvests. Conversely, the fourth date (12/30) yielded the lowest average of 9.37% in the first harvest, while the third date (12/10) produced the lowest average of 9.25% in the second harvest. The preeminence of this date compared to others is ascribed to the exposure of the cultivated plants to elevated temperatures during their growth stages (Appendix 1), resulting in heat stress that induced the plants to augment their protein content to safeguard their tissues and cells from damage and the adverse effects of high temperatures. This outcome concurred with the findings of [9], who noted that planting dates varied in the protein content of dry fodder.

Table5. The effect of varieties, planting dates and their percentage of protein in dry feed % interaction on the .AD (2024-the two harvests for the first season (2023 for

The first agricultural season		
varieties	dates	

	D1	D2	D3	D4	Average
V1	11.03	10.02	10.61	9.35	10.25
V2	10.36	10.17	10.14	9.40	10.02
Average	10.69	10.10	10.37	9.37	
	Interference		varieties	dates	LSD
	0.48		0.11	0.48	
The second agricultural season					
varieties	dates				Average
	D1	D2	D3	D4	
V1	10.47	9.80	9.49	9.69	9.86
V2	10.06	9.06	9.01	8.85	9.24
Average	10.26	9.43	9.25	9.27	
	Interference		varieties	dates	LSD
	NS		0.38	0.36	

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Appendix1. shows the maximum and minimum temperatures and relative humidity rates for the first month of .AD (2024-the experiment season (2023

Relative humidity	Solar radiation	Average	Minimum temperature	Maximum temperature	The month
54.35	13.00	19.23	13.08	26.07	November
58.46	11.63	15.19	8.60	23.10	December
54.82	13.55	14.20	7.61	21.27	January
56.95	15.76	14.38	7.63	21.19	February
51.01	20.58	18.33	10.66	25.71	March
32.35	26.11	26.63	18.45	34.58	April

*[13]