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ORIGINAL ARTICLE

EFFECT OF PLANTING DATES ON GROWTH AND YIELD OF SEVERAL EUROPEAN VARIETIES OF TRITICALE (X-TICOSECALE WITTMACK) UNDER ENVIRONMENTAL CONDITIONS OF AL-MUTHANNA DISTRICT, IRAQ

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Abstract: A field experiment was carried out in one of the agricultural fields during the agricultural season 2018/2019 of Al-Rumaitha district 25 km north of Al-Muthanna Governorate to study the effect of planting date on the growth and yield of several European varieties of triticale (X-triticosecale wittmack). The experiment was applied according to arrangement of split plot design, according to it set dates of cultivation in the main plots which included three dates (01.11, 15.11 and 01.12), while varieties were placed in the secondary plots which were five of European varieties (Trapero, Panteon, Rotonda, Fidelio, Dublat) and the sixth one was local variety) were used to the complete random sectors (R.C.B.D) design with three replictes. The results showed that the first date of 01.11 was significantly superior to it, which gave highest values of plant height, spike length, number of spikes.m^2, number of grains per spike, grain yield and the biological yield, with averages (107.12 cm, 13.12 cm, 684 spike.m^2, 62.06 grains. $spike^{-1}$, 12.575 tons.ha^{-1}, 2.578 kg.m^2) in sequence for above features, while the second date 15.11 gave a highest average of 1000 grains weight was 45.91 g. As for the effect of the varieties, Dublat cultivar outperformed of the another varieties, by giving highest average for plant height, flag leaf area, number of spikes.m^2, number of grains per spike, grain yield, and the biological yield reached (113.99 cm, 35.61 cm^2, 707 spike.m^2, 83.00 grains.$spike^{-1}$, 15,574 tons. ha^{-1}, and 2.797 kg.m^2) on a sequence of previous characteristics., while Fidelio variety gave highest average of spike length was 15.33 cm, while Trapero variety gave the highest weight of 1,000 grains an average of 46.43 g. As for the interaction between the studied factors, the combination of the first date 11.11 with the Dublat cultivar was superior by giving it the highest averages for most of studied characteristics.

***Key words*:** Planting dates, European varieties, Triticale (X-ticosecale wittmack), Al-Muthanna district.

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1. Introduction

Triticale (*X-Triticosecale wittmack*), is a cereal crop. It was discovered from human by hybridization between crops of wheat and rye, it is a man-made crop, by multiplying-hybrid chromosomes that carry the characteristics of parents, it looks similar to wheat in appearance, but it exceeds in the size of plant, spike, yield and quality of protein in addition to that it is rich in the amino acid lysine and has acquired the characteristics of durability and resistance to lying, diseases, grain breakage and adaption or coexistence with harsh environmental conditions [EI-Metwally *et al*. (2012)]. The importance of triticale in human nutrition comes because it contains important and necessary amino acids that grain crops lack and produced by its flour after mixing it with certain proportions brown bread, which is a substitute for barley and is also used in pastry industries [Al-Othmahy

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(1996)]. Also, it is used in feeding poultry in diets as an energy source and as a substitute in whole or in part for yellow corn in some stages of growth and production of broiler mothers [Al-Adhari (2000)]. Triticale is grown in many countries of the world as a cereal feed crop, but its cultivation in Iraq is limited because many farmers do not know the importance of this crop physiological and economic. To increasing area planted with this crop, there are many agricultural processes and technologies that must be followed, such as the introduction of new varieties with a high yield and good quality that bear the prevailing environmental conditions in the region, in addition to the interest in studying crop cultivation dates, which is one of the most important factors that depend on it in the stages of plant establishment and field formation of its direct correlation with heat and lighting, which changes according to the location and season, and therefore its effect on the overall biological and physiological processes that takes place within the plant and the extent of this reversal in the negative or positive growth and production of the crop. It has been shown by McDonald (1991) that the early cultivation of the triticale crop resulted in an increase in plant height, number of grains per spike and the weight of 1000 grains. El-Metwally *et al*. (2012) indicated a decrease in the grain yield of 22.9 and 46.7% for the first and second seasons respectively, by delaying the date of planting from 15 November to 15 December. Also, Saleh (2015) found that date of planting on 15 November gave highest averages for plant height, spike length, number of spikes and branches per m^2, while the date of 25 on November exceeded the number of grains per spike, weight of 1000 grains and grain yield, which was 4.97 and 5.22 tons.ha^{-1} for two seasons in succession about effect of varieties on growth and yield of triticale crop. Hassan (1991) and Abdul Karim (1995) indicated that there are significant differences in yield and components of triticale due to the different genotypes of the varieties. Also, Abdel Karim *et al*. (2015) mentioned that genotypes differed in yield of cereals and its components, as the genotype gave 810 the highest grain yield at 5.52 tons.ha^{-1}. Siddiq *et al*. (2019) indicated to the presence of a difference in height of triticale, leafy area, number of spikes, and weight of 1000 grains, due to the difference of varieties studied. The aim of this study is knowing date of planting and appropriate varieties to be grown in study region of triticale crop, which gives the best growth and highest grain yield.

2. Materials and Methods

A field experiment was carried out in one of the agricultural fields during the 2018/2019 agricultural season of the Rumaitha district 25 km north of Al-Muthanna Governorate, to study the effect of planting date on the growth and yield of European varieties of triticale. The experiment was applied according to the arrangement of split plot design, dates of cultivation were put in the main plots which included three dates (01.11, 15.11 and 01.12), a symbol for them (D_1, D_2, D_3) on the sequence, while the varieties were placed in the secondary plots, which were five of European varieties (Trapero, Panteon, Rotonda, Fidelio, Dublat) and the sixth one was local variety) are symbolized (V1, V_2, V_3, V_4, V_5, V_6) sequentially, using the complete random sectors (R.C.B.D) design with three replicates. Soil service operations were carried out by plowing, smoothing and leveling and then divided the field according to the design used for the panels with an area of $2 \times 2 = 4$ m^2, after that the seeds were planted with a seed quantity of 120 kg.ha^{-1}, cultivation was carried out on lines of length 2 m and the distance between one line and another 20 cm. Nitrogen fertilizer was added in the form of urea fertilizer 46% N and according to the fertilizer recommendation in the amount of 120 kg N.ha^{-1} by two batches the first one after 15 days of planting and the second after 45 days from first batch, while the phosphate fertilizer was added in the amount of 100 kg P2O5.ha^{-1} in the form of triple fertilizer of superphosphate (46% P) and weeding and irrigation operations were also carried out whenever required. Studied characteristics were (plant height (cm), flag leaf area (cm^2), spike length (cm), Number of spikes (m^2), weight of 1000 grains (g) and number of grains per spike, grain yield (tons.ha^{-1}) and biological yield (tons.ha^{-1}). Data were statistically analyzed according to the design used by the statistical program (GenStat) and the arithmetic averages were compared according to the L.S.D test under the probability level of 5%. Random samples were taken from the soil of field from different places from each replicate and mixed together to form a complex sample with a depth of 0-30 cm. Table 1 shows physical and chemical characteristics of the experiment field.

3. Results and Discussion

3.1 Plant height (cm)

The results shown in Table 2 that planting dates significantly affected of plant height, the first date of planting D_1 gave highest average reached 107.12 cm,

Table 1: Physical and chemical properties of the field soil before planting.

Characteristic		Value	Unit
pH		7.4	
E.C.		2.8	Desimines M^{-1}
CEC		20.6	Centimeter (+) kg^{-1}
Nitrogen Ready		23	Mg kg^{-1} soil
Phosphorus Ready		8.4	Mg kg^{-1} soil
Potassium ready		180	Mg kg^{-1} soil
Analysis of minute volumes	Sand	210	Kg kg^{-1}
	Silt	495	
	Clay	295	
Texture		Silty clay loam	

Table 2: Effect of planting dates and varieties and their interaction on plant height (cm).

V	D			Mean V
	D_1	D_2	D_3	
V_1	114.00	110.00	102.00	108.67
V_2	108.93	103.93	97.60	103.49
V_3	100.87	95.23	91.53	95.88
V_4	108.87	111.80	102.53	107.73
V_5	119.3	113.80	106.13	112.99
V_6	91.00	97.20	92.67	93.62
Mean D	107.12	105.33	98.74	
$L.S.D_{0.05}$	V	D	D × V	
	2.694	3.365	4.935	

while the third date D_3 recorded lowest plant height at 98.74 cm. The reason may be due to low average height to plants in the elongation stage were exposed to high temperatures and intensity of illumination that destroyed the oxine, which affected to elongation of cells and shortening of the number of days needed for growth. This results was consistent with Saleh (2015). About effect of varieties, the V_5 cultivar gave the highest plant height of 112.99 cm, while the V_6 cultivar gave the lowest average of this trait of 93.62 cm. The reason for this may be due to the genetically varied of varieties, which have a great correlation with the length of the internodes and in particular the upper internode, during which varieties can be distinguished from each other. This result was consistent with Abdel Karim *et al*. (2015) and Seddiq *et al*. (2019). As the effect of interaction between cultivars and planting dates, had a significantly affected the plant height, the combination ($V_5 \times D_1$) gave highest average for this feature reached 119.03 cm, while ($V_6 \times D_1$) gave lowest average as 91.00 cm. This may be due to genetic characteristic of the Dublat variety, in addition to the climatic conditions when planting at the first date were appropriate and encouraging to increase cell division and expansion (Table 2).

3.2 Flag leaf area (cm^2)

Flag leaf is one of the important indicators in plant photosynthesis system and it has a large role and influencing yield as it participates with a rate of up to 83% of the photosynthesis process that arrive to spike [AL-Mousawi (2009)]. Table 3 shows the significantly effect of varieties and interaction in flag leaf area. V_5 variety recorded the highest plant height of 35.61 cm^2, while V_2 variety gave the lowest at 19.07 $cm^{2.}$ This difference is due to the difference of the genetic varieties, which affects this feature. This result was consistent with Seddiq *et al*. (2019). There was significant effect of interaction between cultivars and dates of cultivation on flag leaf area, the inter action between ($V_5 \times D_2$) recording the highest average for this trait reached 37.77 cm^2, while cultivar V_1 with time of cultivation D_2 gave the lowest average 17.12 cm^2. The reason may be that environmental conditions of heat and lighting were appropriate for the variety, which encouraged an increase in the vegetative group and photosynthesis products, and thus an increase in flag leaf area (Table 3).

3.3 Spike length (cm)

Table 4 shows the superiority of date of cultivation D_1 by gaving highest average length of the spike as 13.12 cm, which did not differ significantly with D_2, which gave 13.06 cm, while the date of cultivation D_3 was recorded, the lowest length of the spike at 12.36 cm. The reason for the decrease in the length of the spike was due to the height of temperature and length of the lighting period, which increased from the period of beginning of elongation to 100% flowering. This period is important in determining length of spike and this was negatively reflected on the length of spike. This result was consistent with each of Hassan *et al*. (2009) and Saleh (2015) (Table 4). V_4 cultivar gave the highest spike length of 15.33 cm, while V_6 cultivar gave the lowest mean of this trait at 10.00 cm. This

Table 3: Effect of planting dates and varieties and their interaction on flag leaf area (cm^2).

V	D			Mean V
	D_1	D_2	D_3	
V_1	24.75	17.12	19.11	20.33
V_2	21.01	17.74	18.45	19.07
V_3	26.03	27.19	20.72	24.65
V_4	19.94	27.11	28.22	25.09
V_5	36.56	37.77	32.51	35.61
V_6	29.27	32.32	31.33	30.97
Mean D	26.26	26.54	25.06	
$L.S.D_{0.05}$	V	D	D × V	
	1.930	N.S	3.375	

Table 4: Effect of planting dates and varieties and their interaction on spike length (cm).

V	D			Mean V
	D_1	D_2	D_3	
V_1	11.75	11.17	10.17	11.03
V_2	12.75	13.17	12.75	12.89
V_3	12.75	13.33	12.17	12.75
V_4	15.58	14.92	15.50	15.33
V_5	16.58	15.25	13.24	15.08
V_6	9.33	10.50	10.17	10.00
Mean D	13.12	13.06	12.36	
$L.S.D_{0.05}$	V	D	D × V	
	0.745	0.419	1.213	

may be due to the genetic characteristics of this variety than another cultivars (Table 4). There was a significant effect of interaction between cultivars and cultivation dates on spike length, a combination of (V_5 cultivar × date of planting D_1) recorded the highest average for this feature was 16.58 cm, while (V_6 × D_1) scored the lowest average for this trait at 9.33 cm (Table 4).

3.4 Number of spikes (m^2)

The results in Table 5 showed that there was a significant effect of dates of planting on number of spikes. Date of planting D_1 gave the highest average number of spikes m^2 about 684 spike m^2, which significantly different with date D_3, that gave the lowest mean of spike length was 460 spike m^2. The reason for this is due to the short time required for the growth and formation of sprout, which was reflected negatively in

Table 5: Effect of planting dates and varieties and their interaction on number of spikes (m^2).

V	D			Mean V
	D_1	D_2	D_3	
V_1	695	367	492	518
V_2	627	638	427	564
V_3	747	447	612	602
V_4	833	717	450	667
V_5	912	717	492	707
V_6	289	291	285	291
Mean D	684	531	460	
$L.S.D_{0.05}$	V	D	D × V	
	79.7	84.6	140.2	

the number of spikes per unit area, as is the length of the light period when accumulated cultivation to accelerate flowering, and then the plant stops producing the sprouts and this is consistent with and Saleh (2015) (Table 5). As for the effect of the varieties, the V_5 variety recorded the highest number of spikes was 707 spike.m^2, while the local cultivar V_6 gave the lowest average of this feature at 291 spike.m^2. This difference between the genotypes may be attributed to the genetic differences between these varieties and their capacity to form sprouts fertile activities. This result was consistent with Al-Ubaidi (2013). There was a significant effect of interaction between varieties with dates of planting on this feature. (V_5 × D_1) gave the highest average as 912 spike.m^2, while the lowest mean for this trait reached 285 spike.m^2 with (V_6 × D_3) (Table 5).

3.5 Weight of 1000 grains (g)

The results in Table 6 showed the significant effect of planting dates on the weight of 1000 grains, as it exceeded date of cultivation D_2 by giving the highest average weight of 1000 grains amounted to 45.91g, which did not differ significantly from date D_1, which gave 44.21 g, while the date of cultivation D_3 recorded the lowest weight of 40.45 g. The reason for the low grain weight in late dates may be due to the negative effect of high temperatures and an increase in the length of lighting period, which led to a reduction in length of period of fullness of grains, which negatively affected the weight of grains. This result is consistent with what indicated by Hassan *et al.* (2009) and Saleh (2015). Table 6 indicates the superiority of cultivar V_1 by giving

Table 6: Effect of planting dates and varieties and their interaction on weight of 1000 grains (g).

V	D			Mean V
	D_1	D_2	D_3	
V_1	49.20	50.57	39.57	46.43
V_2	38.87	57.07	38.33	44.76
V_3	52.73	43.65	40.58	45.66
V_4	45.62	35.62	37.08	39.44
V_5	40.15	46.28	46.47	44.30
V_6	38.67	42.32	40.67	40.55
Mean D	44.11	45.91	40.45	
$L.S.D_{0.05}$	V	D	D × V	
	2.176	2.993	4.108	

it highest average at 46.43g, while V_4 gave lowest average for this trait as 39.44g. The reason may be due to nature of variety and its genetic difference in this trait, in addition to the difference of varieties in the period from planting to flowering and the duration of filling the grain. This result is consistent with Abdel Karim *et al*. (2015) and Siddiq *et al*. (2019). As for the effect of the interaction, it was significant in weight of 1000 grains, the combination from (V_2 cultivar with date of planting D_2) gave the highest average for this trait was 57.07 g, while (V_4 cultivar with time of cultivation D_2) recorded the lowest mean at 35.62 g (Table 6).

3.6 Number of grains per spike

It is clear from the results in Table 7 that the date of planting D_1 gave the highest average number of grains as 62.06 grains.spike^{-1}, which did not differ significantly with date D_2, which gave 61.22 grains. spike^{-1}. While date of planting D_3 recorded the lowest number of grains at 54.67 grains. spike^{-1}. This decrease in the number of grains at the third date may be due to high temperatures. This decrease on number of grains at the third date may be due to high temperatures, which reduces production of dry matter during the critical stage which is starting formation of spikes, thereby reducing their number, in addition to the appropriate environmental conditions at the early dates of heat and light. During the period of formation of grains, which led to an increase in photosynthesis products produced from leaves and exported towards grains, which was same what found by Hassan *et al*. (2009) and Saleh (2015). As for the effect of the varieties, V_5 variety outperformed by giving highest average for this feature

Table 7: Effect of planting dates and varieties and their interaction on number of grains per spike (grains. spike^{-1}).

V	D			Mean V
	D_1	D_2	D_3	
V_1	54.00	61.33	51.67	55.67
V_2	61.33	64.00	63.33	62.89
V_3	66.33	57.33	42.67	51.78
V_4	62.67	59.67	64.67	62.33
V_5	96.00	87.67	65.33	83.00
V_6	43.00	37.33	40.33	40.22
Mean D	62.06	61.22	54.67	
$L.S.D_{0.05}$	V	D	D × V	
	4.242	1.797	6.818	

about 83.00 grains.spike^{-1}, while local cultivar V_6 gave lowest average to 40.22 grains.spinal^{-1}, perhaps the reason for the variation of varieties in this trait is due to genetic nature of studied varieties and to variation in both number of spikes and length of spike. This result was consistent with what was indicated by Abdel Karim *et al*. (2015) and Seddiq *et al*. (2019) (Table 7). There was a significant effect of interaction between cultivars and dates of planting to this feature, cultivar V_5 with date of planting D_1 recorded highest average for this characteristic was 96.00 grains.spike^{-1}, while cultivar V_6 recorded at the time of planting D_2, the lowest mean of this feature was 37.33 grains.spike^{-1} (Table 7).

3.7 Grain yield (tons.ha^{-1})

The grain yield is the final result of its three components (number of spikes per unit area, number of grains per spike and the weight of 1000 grains), where the results of Table 8 showed a significantly effect of planting dates, varieties and the interaction between them in the grain yield. Date of cultivation D_1 gave the highest average of grains yield of 12.575 tons.ha^{-1}, while date of cultivation D_3 recorded the lowest average of grain yield at 7.608 tons.ha^{-1}, due to the superiority of the first date in grains yield due to its superiority in each of the number of spikes per square meter (Table 5) and number of grains per spike (Table 7).This result was consistent with the findings of AL-Hassan (2007), Hassan *et al*. (2009) and Saleh (2015). The cultivar V_5 gave the highest grain yield of 15,574 tons.ha^{-1}, while cultivar V_6 gave the lowest average of this feature to 5.015 tons.ha^{-1}. The reason may be due

Table 8: Effect of planting dates and varieties and their interaction on grain yield (tons.ha^{-1}).

V	D			Mean V
	D_1	D_2	D_3	
V_1	12.080	6.463	4.800	7.781
V_2	9.683	13.287	5.258	9.409
V_3	14.997	10.438	8.917	11.451
V_4	13.567	10.733	8.367	10.898
V_5	20.247	13.213	13.262	15.574
V_6	4.875	5.123	5.047	5.015
Mean D	12.575	9.867	7.608	
$L.S.D_{0.05}$	V	D	D × V	
	1.467	1.102	2.446	

Table 9: Effect of planting dates and varieties and their interaction on biological yield (kg.m^2).

V	D			Mean V
	D_1	D_2	D_3	
V_1	2.593	1.783	1.183	1.853
V_2	2.450	1.900	1.183	1.844
V_3	3.250	2.533	1.800	2.528
V_4	2.933	2.550	1.676	2.383
V_5	3.167	2.950	2.275	2.797
V_6	1.077	1.075	1.092	1.081
Mean D	2.578	2.132	1.533	
$L.S.D_{0.05}$	V	D	D × V	
	0.2205	0.1604	0.3364	

to superiority of cultivar V_5 in number of spikes and number of grains in spike (Tables 5 and 7), This result agreed with Abdel Karim *et al*. (2015) and Al-Amiri and Muhammad (2016) (Table 8). There was a significant effect on the interaction for experiment factors, cultivar V_5 with date of cultivation D_1, recording the highest average for this feature was 20.247 tons.ha^{-1}, while cultivars V_1 with date D_3 recorded the lowest average reached 4,800 tons.ha^{-1} (Table 8).

3.8 Biological yield (kg. m^2)

Results in Table 9 show the superiority of date of planting D_1. It gave the highest average of biological yield as 2.578 kg.m^2, while date of cultivation D_3 recorded the lowest yield at 1.533 kg.m^2. The reason amy be due to high grain yield at this date as shown in Table 8. The cultivar V_5 gave the highest biological yield of 2.797 kg.m^2, while V_6 gave the lowest average of this feature was 1.081 kg.m$^{2.}$. The reason may be due to increase achieved by the higher varieties in grains yield in addition to its superiority in the yield components, which provided an better opportunity to increase the efficiency of the photosynthesis process and thus an increase in the rates of production and accumulation of dry matter, which was reflected to increase in the mean of the biological yield. This result was agreed with Abdel Karim *et al*. (2015) and Al-Amiri and Al-Obaidi (2016). Effect of interaction was significant, as the cultivar V_3 at date of planting D_1 exceeded and recorded the highest average for this feature at 3.250 kg.m^2, while V_6 at time of cultivation D_2 recorded the lowest average at 1.075 kg.m^2 (Table 9).

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