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Determined the Oat (*Avena sativa* L.) genotype sresponding to different planting dates in southern Iraq

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Abstract

Although the oat crop is an important forage crops by many countries to face the problem of lacking forage to feed livestock, it still is not popular in southern Iraq. Establishing oat productivity, especially in southern Iraq needs to limit the best genotypes and planting dates in this area. Thus, factorial experiment arranged in randomized complete block design to understand response of three oat genotype (Wallaro, Carrolup and Wild) in four planting dates (20-10, 1-11, 10-11, and 20-11) at two locations (Thi-Qar and Al-Muthana). Plant height, flag leave area, chlorophyll content (SPAD), period of physiological maturity day^{-1}, wet and dry forage yield t ha^{-1}, grains yield t ha^{-1} and its components (number of panicles m^{-2}, number of grains panicle^{-1}, and weight of 100 grains g^{-1}), and the grains protein percentage observed as crop related measurements. All these traits significantly differed among the genotypes and affected by the planting dates. Significant responding of forage and grains yield to planting date found, and the highest wet and dry forage yield obtained from Wallaro and Carrolup genotypes sowing at the second planting date at both locations. Grains yield was 6.88 and 7.03 t ha^{-1} for Wallaro genotype planted at the second planting date at Thi-Qar and Al-Muthana locations respectively. Thus, adopting oat crop in this area needs to focus on planning date, especially from first to mid-November with using Wallaro genotype for grain production and Carrolupas a forage crop.

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Introduction

Availability of fodder crops is to be a major problem that increasing the livestock productivity. At Iraq, animal production adopted in the fed is on the special fodder crops such as alfalfa (*Medicago sativa* L.) and barely (*Hordeum vulgare* L.). Moreover, lacking of fodder production might be the reason for animal production dropping. Thus, thinking about the diversification of fodder production might help increase animal production. Therefore, beside the oat (*Avena sativa* L.) ranks a fifth crop in the world as a cereal crop, it is an appropriate and adequate to feed livestock countries. Moreover, it is environmentally friendly with temperate and cool sub-tropical and at poor soils, although; it is sensitive to high temperature, especially at the filling stage (Wiggans, 1956; Coffman and Frey, 1961; Hofman, 1995). On the same time, oat crop can respond to temperature during the vegetative stages compared to anthesis (heading) stage in which it is sensitive to high temperature (Taylor, 1967). To avoid heat stress, oat can grow as an early maturing crop in the Midwestern United States (Baltenberger and Frey, 1987). To reach the integrated of oat growth stages should be avoiding the effect of temperature stress, especially from sowing to heading. Thus, manipulating in planting dates or choosing appropriate genotypes is observed in many previous studies in many countries. Therefore, oat growth was affected by the delay in sowing date because of the decreasing in the period to anthesis as well as it might decreased oat forage yield by 35% (Baron *et al.*, 1993; Legere, 1997; Kibite *et al.*, 2002). In addition, grain and its components and forage yield significantly affected in changing planting dates depending upon the genotypes (Hussain *et al.*, 2002). Thus, planting the right genotypes of oat in appropriate planting date might be increased the forage yield by 56.4% (Narimah, 1991; Aydin *et al.*, 2010; Coblentz *et al.*, 2011). Although the environmental conditions highly correlated and effected in forage yield, grain yield and grain starch compared to genotypes (Douglas *et al.*, 2001), there is a significant affect of oat genotypes because of the differences in genetic structure of the genotypes (Salman, 1988). However, there is such a relationship in the fodder yield depending upon the genotypes and environmental conditions (Hussain *et al.*, 1993; Hussain *et al.*, 1998; Zute *et al.*, 2010; Malik *et al.*, 2011). As this is a recently crop in southern Iraq, thus the aim of this scenario is to determine the appropriate planting date and convenient genotypes of oat growing in southern Iraq to produce forage and cereal crop as well.

Materials and methods

Experiments preparation

Three genotypes of oat were Wallaro, Carrolup, and wild oat planted in Oct. 20th, Nov. first, Nov. 10th, and Nov 20th at two locations Garraf city/Thi-Qarprovince and Al-Majad city/Al-Muthana province in southern Iraq during the growing season 2013- 2014. Treatments arranged in a factorial experiment by using a randomized complete block design with three replications. The experimental unit area was (3* 2) m, and each experimental unit had 10 lines. Two meters had left as allay among the experimental units to avoid the nutrients interference. Nitrogen fertilizer as Urea (46 % -N) broadcasted by the rate of 200 kg ha^{-1} and equally separated at emergence, tillering, elongation and booting stages, in addition; tri-super phosphate broadcasted, as type of Phosphorus fertilizer (21% P_2O_5) by the rate of 100 kg ha^{-1}, before planting date (Al-Tahir, 2014). Seed rate was 120 kg ha^{-1}. The amount of fertilizer applied, depending upon the soil nutrient contents.

Studied characters

The traits of, the plant height (cm), flag leave area cm^{-2}by using (leaf area meter/ Li-3100), chlorophyll content by using (the Opti-Sciences CCM-200 chlorophyll meter), physiological maturity period as growth characteristics were determined. Wet and dry forage yield t ha^{-1}, grain yield t ha^{-1}, and grain protein percentage (examined by Crop Scan Li, 2000), were examined, as well as yield components also measured (number of panicles m^{-2}, number of grains panicle^{-1}, weight of 100 grains gram). All these traits collected from the 6-midl lines in each experimental unit.

Data analyzing

The data estimated through the standard procedure of analysis of variance by using SPSS program. Moreover, treatments means compared for significance of difference with the less significant differences Test (L.S.D) at α= 0.05 of confidence level.

Results

Genotypes effectiveness

Analysis of variance (Table 1) showed that the crop related measurements were significantly affected by the genotypes at both locations.

Therefore, plant height was significantly different among the genotypes at Thi-Qar location, but not significant at the other location, and it was about 110.57, 107.75 and 103.18 cm for Wallaro, Carrolup and Wild Oat genotypes respectively. Flag leave area at both locations was not significant. On the other hand, the chlorophyll content (SPAD) was significantly high in Wild genotype at both locations, and the lowest content of chlorophyll recorded by the Wallaro genotype at both locations.

Table 1. Genotypes influence on the related measurements at both locations.

Location	Related measurements	Genotypes			L.S.D value
		Wallaro	Carrolup	Wild oat	
Thi-Qar	Plant hieght cm-1	110.57	107.75	103.18	7.15
	Flag leaf area cm-2	75.32	80.74	75.36	ns
	SPAD	50.97	53.69	55.65	4.12
	Physiological mature day^{-1}	110.75	114.17	113.17	1.96
	Wet forage yield t ha^{-1}	64.76	71.48	46.57	8.81
	Dry forage yield t ha^{-1}	14.60	15.13	12.06	0.79
	Panicles m^{-2}	387.22	417.64	374.25	14.23
	Seeds panicle^{-1}	40.75	32.08	30.33	1.21
	Weight 100 grains g^{-1}	3.70	3.69	3.50	0.2
	Grains yield t ha^{-1}	5.76	5.04	4.01	0.40
	Grain protein (%)	11.67	11.63	12.01	0.29
Al-Muthana	Plant height cm^{-1}	109.68	108.75	103.50	ns
	Flag leaf area cm^{-2}	75.14	80.65	75.25	ns
	SPAD	50.04	52.95	53.69	3.24
	Physiological mature day^{-1}	110.62	114.31	112.56	1.95
	Wet forage yield t ha^{-1}	66.51	71.67	48.90	7.98
	Dry forage yield t ha^{-1}	16.17	15.78	12.99	0.75
	Panicles m^{-2}	390.73	419.06	374.74	12.89
	Seeds panicle^{-1}	40.03	31.91	30.76	1.23
	Weight 100 grains g^{-1}	3.61	3.75	3.48	0.22
	Grains yield t ha^{-1}	5.68	5.12	4.11	0.38
	Grain protein (%)	11.78	11.74	12.14	0.23

The period of physiological maturity was similar at both locations for all the genotypes, and it recorded a significant difference ($P\leq 0.05$) among the genotypes. Thus, the lowest period of physiological maturity recorded by the Wallaro genotype (about 111 days) at both locations compared to the highest recorded by Carrolup (114 days) at both locations.

Not only wet forage yield, but also dry forage yield was significantly affected by the genotypes at both locations. Therefore, the highest yield of forage as wet or dry recorded by Carrolup genotypes at both locations. Moreover, the same effect also reported in the yield related measurements for all genotypes at both locations.

Number of panicles m^{-2} significantly differed among the genotypes at both locations, and the highest number of panicles was 419 and 417 for Carrolup genotype at Al-Muthana and Thi-Qar locations respectively.

In addition, number of seeds panicle^{-1} significantly increased for Wallaro genotype at both locations (40 seeds panicle^{-1}) compared to other genotypes.

Table 2. Planting date influence on the related measurements at both locations.

Location	Related measurements	Planting date				L.S.D value
		20-10	1-11	10-11	20-11	
	Plant height cm-1	110.30	106.00	117.50	94.60	8.83
	Flag leaf area cm-2	79.90	91.50	92.61	44.33	10.77
	SPAD	58.14	53.14	56.84	44.80	5.12
Thi-Qar	Physiological mature day^{-1}	101.22	103.1	118.22	128.22	2.27
	Wet forage yield t ha^{-1}	75.72	75.24	49.41	43.37	10.37
	Dry forage yield t ha^{-1}	15.26	15.79	13.61	11.07	1.02
	Panicles m^{-2}	337.80	487.61	400.23	346.42	16.43
	Seeds panicle^{-1}	37.11	33.11	40.12	27.22	1.40
	Weight 100 grains g^{-1}	3.82	3.71	3.62	3.37	0.20
	Grains yield kg ha^{-1}	4.50	5.50 b	6.02 a	3.62 d	0.46
	Grain protein (%)	11.40	11.64	11.82	12.21	0.27
	Plant height cm^{-1}	110.32	108.60	115.52	94.82	7.14
	Flag leaf area cm^{-2}	75.45	84.81	93.04	49.81	8.99
	SPAD	54.65	55.45	52.13	46.70	4.88
Al-Muthana	Physiological mature day^{-1}	102.06	102.62	118.87	126.44	2.01
	Wet forage yield t ha^{-1}	76.42	75.97	50.34	44.78	11.01
	Dry forage yield t ha^{-1}	16.56	16.27	14.81	12.34	1.11
	Panicles m-2	367.67	487.93	390.82	353.96	14.34
	Seeds panicle^{-1}	36.36	34.59	37.53	28.47	1.36
	Weight 100 grains g^{-1}	3.72	3.64	3.63	3.47	0.23
	Grains yield kg ha^{-1}	4.54	5.59	6.04	3.73	0.44
	Grain protein (%)	11.45	11.81	11.98	12.32	0.28

The performance of 100 grains weight g^{-1} was the same as the number of panicle, and the highest weight of 100 grains recorded at both locations for Wallaro and Carrolup genotypes. Grains yield of the genotypes also significantly affected at both locations, therefore; Wallaro genotypes produced the highest productivity of grains (5.76 and 5.68 t ha^{-1}) at Thi-Qar and Al-Muthana respectively, compared to the lowest yield (4 t ha^{-1}) produced by Wild genotype at both locations. On the other hand, the grains protein percentage performance differed among the genotypes at both locations. Wild genotype produced the highest percentage of protein (about 12 %) at both locations compared to other genotypes.

Planting date effectiveness

The significant effect of the planting date on the crop related measurements reported at both locations of crop traits (Table 2). Thus, the planting date (10-11) showed the highest plant height compared to other plating dates at both locations. In contrast, the trend of flag leave area was clear affected by the planting date and increased with delay in planting date, especially with the first three sowing times, but then decreased to the lowest value at the fourth planting date (44.33 and 49.82 cm^2) at Thi-Qar and Al-Muthana fields respectively. The first planting date (20-10) showed the highest significant chlorophyll content (SPAD) 58.14 at Thi-Qar field, but the second planting date (1-11) reported the highest SPAD (55.45) at the second field. The lowest chlorophyll content determined at the last planting date (20-11) at both locations (44.80 and 46.70) respectively. Contrariwise, the period of physiological maturity increased with the planting date delayed and was (128 days at Thi-Qar, and 126 days at Al-Muthana) in the fourth planting date (20-11) comparing with the first planting date (20-10) resulting the lowest period 101 and 102 day at Thi_Qar and Al-Muthana field respectively. A similar significant influence for the planting dates on the wet and dry forage yield was recognized in this study at both locations.

Table 3. Influence of genotype and planting date combination on the related measurements at Thi-Qarlocation.

Related measurements	Genotypes	Planting date				L.S.D value
		20-10	1-11	10-11	20 -11	
Plant height cm-1	Wallaro	115.4	110.11	122.1	94.3	15.3
	Carrolup	116.81	107	112.2	94.7	
	Wild oat	98.7	101	118.1	94.71	
Flag leaf area cm-2	Wallaro	75.41	90.2	96.9	38.61	18.66
	Carrolup	73.5	99.4	97.81	51.89	
	Wild oat	90.9	84.91	83	42.41	
SPAD	Wallaro	62.97	42.97	57.1	40.83	8.87
	Carrolup	58.53	55.17	59.27	41.8	
	Wild oat	52.93	63.73	54.17	51.77	
Physiological mature day-1	Wallaro	102	98	115.67	127.33	3.93
	Carrolup	98.67	103	124.33	130.67	
	Wild oat	103	108.33	114.67	126.67	
Wet forage yield t ha-1	Wallaro	83.62	85.01	49.40	41.01	20.31
	Carrolup	77.20	85.90	65.81	57.01	
	Wild oat	66.35	54.83	33.02	32.10	
Dry forage yield t ha-1	Wallaro	15.66	17.18	14.63	10.94	1.77
	Carrolup	14.96	18.70	15.40	11.49	
	Wild oat	15.16	11.50	10.80	10.78	
Panicles m-2	Wallaro	319.7	483.7	384.7	360.69	28.46
	Carrolup	451.3	507	362.7	349.3	
	Wild oat	242.3	472	453.3	329.31	
Seeds panicle-1	Wallaro	46	42.67	45.33	29	2.43
	Carrolup	34.33	33.67	34.33	26	
	Wild oat	31	23	40.67	26.67	
Weight 100 grains g-1	Wallaro	4.2	3.9	3.27	3.42	0.46
	Carrolup	3.55	3.5	3.78	3.92	
	Wild oat	3.69	3.74	3.8	2.77	
Grains yield kg ha-1	Wallaro	4.82	7.03	6.81	4.38	0.8
	Carrolup	5.85	6.71	4.35	3.24	
	Wild oat	2.85	3.01	6.9	3.24	
Grain protein (%)	Wallaro	11.13	11.62	11.7	12.23	0.35
	Carrolup	11.34	11.56	11.74	11.89	
	Wild oat	11.74	11.76	12.03	12.53	

Thus, the first and second sowing dates recorded the highest wet and dry forage yield at both location, and the yield dropped to the lowest level in the last two planting date especially the wet yield. Grains yield components responded significantly to the planting date; number of panicles m^{-2} increased to the highest level in the second planting date (1-11) at both locations (487 panicles m^{-2}). A significant effect on the number of seeds $panicle^{-1}$ at both locations was recorded, thus the third planting date (10-11) showed the highest number of seeds (40 and 37 seeds $panicle^{-1}$) at Thi-Qar and Al-Muthana respectively. Moreover, 28 and 27seeds $panicle^{-1}$ observed in the fourth planting date (20-11) at Al-Muthana and Thi-Qar respectively. The weight of 100 seeds g^{-1} significantly responded to the planting date. The highest weight of 100 seeds (3.82 and 3.72 g at both locations respectively) recorded in the first planting date (20-10) compared to the lowest weight (3.37 and 3.47 at both fields respectively) at the fourth planting date (20-11). The results showed that the yield of grains increased with delay planting date until the fourth planting date in which the grains yield decreased to the lowest yield at both locations. Therefore, the highest seeds yield was ≈ 6 t/ ha in the third planting date (10-11) compared to lowest yield (≈ 3.5 t/ ha) in the fourth planting date (20-11) at both locations. On the contrary, the percentage of grains protein moved in the back way, which it increased in the fourth planting date (20-11) compared to planting dates at both fields of study.

Genotypes and planting date combination influence

The interaction effect of planting dates and genotypes was significant for crop traits at both locations (Tables 3 and 4). Therefore, the highest plant height and flag leave area were recorded by the third planting date with all genotypes at both locations. The best content of chlorophyll (SPAD) observed from the treatment of the first planting date (20-10) with Wallaro genotype (about 63 and 59), as similar as at the second planting date (1-11) with wild genotype (about 63 and 61) at Thi-Qar and Al-Muthana locations respectively. The results showed due to interaction treatments increasing in period to physiological maturity at the fourth planting date (20-11) with all genotypes for both locations.

Moreover, wet and dry forage yield were significantly increased by the combination treatment of the second planting date with all genotypes at both fields. It is clear to observe the highest yield of wet and dry fodder yield obtained by Carrolup genotype with the second planting date (85 and 18.70 t ha^{-1}) at Thi-Qar field, as well as at Al-Muthana field especially for the dry forage yield (18.96 t ha^{-1}). The highest number of panicles m^{-2} recorded at the interaction of the second planting date (1-11) with all the genotypes at both locations. It cleared to see that from the results that the interaction of planting dates with genotypes was unstable at both locations for the number of seeds per panicle and the weight of 100 seeds. Although, the highest number of seeds was 46 seeds at the interaction of the first planting date with Wallaro genotype at Thi-Qar location and 44 seeds of the interaction of the second planting date with Wallaro genotype at Al-Muthana location. Likewise, the 100 seeds weight was (4.2 and 4.01 g) for the interactions of the first planting date with Wallaro at Thi-Qar field and Al-Muthana respectively. Moreover, increasing of grains yield for the interaction between planting dates and genotypes associated with delay of planting date for all genotypes until the fourth planting date (20-11). The highest grains yield was 7.03 and 6.88 t ha^{-1} for the interaction of the second planting date with Wallaro genotype at Thi-Qar and Al-Muthana locations respectively. The interaction of planting dates with Wild genotypes produced the highest percentage of grains protein, especially at the fourth planting date, and it was 12.53 and 12.66 % at Thi-Qar and Al-Muthana locations respectively.

Discussion

The genotypes and planting dates effect, and their combinations significantly observed on the plant height, flag leave area, and chlorophyll content especially Wallaro genotype compared to Wild genotype. Thus, plant height was significant at Thi-Qar location but not significant at Al-Muthana location, but the flag leave area was not significant at both locations. The reasons might be due to the influence of genetic structure of the genotypes. On the other hand, the effect of planting date on those two traits was significant as well as the combination of planting dates with genotypes at both fields.

However, the climate affects such as temperature and may show in this effectiveness, thus; Fowler (1982) reported that the high temperature led to decrease the oat crop height because of reduction in elongation stage of crop.

Early planting dates led to produce the highest height of oat genotypes (Lodhi *et al.*, 2009; Ayub *et al.*, 2011). Flag leave area was not significant among genotypes but significant among planting dates at both locations. Likewise; delay in planting dates led to reduce the leave area and depending upon genotypes (Benaragama, 2011).

Table 4. Influence of genotype and planting date combination on the related measurements at Al-Muthana location.

Related measurements	Genotypes	Planting date				L.S.D value
		20-10	1-11	10-11	20 -11	
	Wallaro	116.56	112.11	116.1	93.98	
Plant height cm^{-1}	Carrolup	113.48	110.45	114.24	96.85	12.11
	Wild oat	100.92	103.24	116.22	93.62	
	Wallaro	69.56	89.88	98.59	42.55	
Flag leaf area cm^{-2}	Carrolup	70.23	83.28	94.43	59.78	16.34
	Wild oat	86.56	81.27	86.11	47.09	
	Wallaro	59.23	45.55	53.12	42.27	
SPAD	Carrolup	54.48	59.47	52.32	45.56	7.65
	Wild oat	50.23	61.34	50.94	52.27	
	Wallaro	104.22	95.37	117.45	125.44	
Physiological mature day^{-1}	Carrolup	100.56	105	122.39	129.29	3.88
	Wild oat	101.39	107.48	116.78	124.6	
	Wallaro	85.12	86.56	51.04	43.34	
Wet forage yield t ha^{-1}	Carrolup	76.78	84.46	66.33	59.13	22.89
	Wild oat	67.75	56.34	36.89	34.65	
	Wallaro	17.34	18.68	16.34	12.34	
Dry forage yield t ha^{-1}	Carrolup	15.66	18.96	15.94	12.56	1.82
	Wild oat	16.19	12.78	11.56	11.45	
	Wallaro	332.67	483.45	373.24	373.56	
Panicles m^{-2}	Carrolup	467.45	499.23	355.16	354.42	32.6
	Wild oat	302.89	481.12	444.07	333.89	
	Wallaro	43.24	44.19	42.59	30.11	
Seeds panicle^{-1}	Carrolup	33.45	34.29	31.7	28.22	2.12
	Wild oat	32.39	25.29	38.3	27.08	
	Wallaro	4.01	3.17	3.89	3.39	
Weight 100 grains g^{-1}	Carrolup	3.62	3.99	3.4	4	0.48
	Wild oat	3.54	3.77	3.59	3.02	
	Wallaro	4.66	6.88	6.77	4.44	
Grains yield kg ha^{-1}	Carrolup	5.92	6.69	4.52	3.37	0.78
	Wild oat	3.04	3.21	6.83	3.38	
	Wallaro	11.23	11.74	11.83	12.34	
Grain protein (%)	Carrolup	11.44	11.67	11.89	11.97	0.32
	Wild oat	11.69	12.01	12.21	12.66	

The importance of chlorophyll content to the plant in the photosynthesis system; therefore, the current study focused to observe the oat chlorophyll content. Wild genotype produced the highest chlorophyll content, and the genetic impact might be affected. However, chlorophyll content differed among the genotypes, and this results agreed with other previous observations. Hisir *et al.* (2012) found a different content of chlorophyll among the oat genotypes in their studies. The period of physiological maturity is one of the indicators to understand the performance of the genotypes that grow under different climate conditions. In this scenario, the oat genotypes and planting dates recorded a different period in physiological maturity so that it increased with the delay in sowing times and significantly differed among the genotypes. Accordingly, Nawaz *et al.* (2004) and Ziya *et al.* (2012) mentioned that the presence of differences in period of physiological maturity among oat genotypes and planting date was due to the changing in temperature among the planting dates. Moreover, the treatments and their combinations showed the performance and impact of treatments individually and their interaction on growth and productivity of oat genotypes because of the influence of genetic structure, temperature and moisture. Thus, Forage yield whether a wet or dry is the main product that was significantly responded to the planting date and genotype and decreased with delay in planting dates for all genotypes at both fields. These results agreed with (Hussain *et al.*, 2002; and Aydin *et al.*, 2010). Number of panicles m^{-2}, number of seeds $panicle^{-1}$, weight of 100 seeds g^{-1}, and grains yield t ha^{-1} showed response to the genotypes depending upon the planting dates. All these traits were affected by planting dates manipulating because of the temperature and moisture changing. Thus, in very early (20-10) and very late (20-11) planting dates, these traits decreased for all genotypes at both locations in current study as well as in the combinations among the genotypes with planting dates. The anthesis of oat genotypes more sensitive to temperature than other stage and might be affected on the seeds weight (Taylor, 1967).

These results coincided with previous studies (Nawaz *et al.*, 2004; Zute *et al.*, 2010; Malik *et al.*, 2011; Ziya *et al.*, 2011; Atefah and Bahraminejad, 2012; Hisir *et al.*, 2012). They observed that oat genotypes were differed in these traits depending upon planting date because of the temperature and moisture. Protein content in oat seeds was also measured because it is one of the importance quantity affected by the genotypes and climate conditions (Wroble and Kijora, 2004). Thus, this trait in the current study increased when planting date delayed, and increased at wild oat genotype. These results agreed with previous studies, Hussain *et al.* (1993) when they found the genotype PD2-LV65 produced the highest forage yield (58.90 t ha^{-1}) compared to other genotypes in their study. In the same time, comparing to forage yield of wheat and barley crops, oat yield of fodder was significantly high (64.60, 56.39, and 30.66 t ha^{-1}) of oat, barley, and wheat respectively (Hussain *et al.*, 1998). The genotype Laima produced the highest cereal yield (5830 kg ha^{-1}) compared to other genotypes (Zute *et al.*, 2010). Malik *et al.* (2011) found in Australia significant differences of oat genotypes and sowing date in cereal yield. Thus, the genotype Calingiri grew in planting date at 1 May produced the highest yield of cereal (3500 kg ha^{-1}) compared to planting date at 1 June (2500 kg ha^{-1}). Furthermore, the genotype Bozkir 1-5 produced the highest biological yield (17200 kg ha^{-1}), but the lowest biological yield (13040 kg ha^{-1}) produced by the genotype Ankara- 76 (Hisir *et al.*, 2012).

Conclusion

In this scenario, oat genotypes were highly responsive to different planting date at both locations. Crop height, flag leave area, chlorophyll content, number of panicles m^{-2}, number of seeds $panicle^{-1}$, weight of 100 seeds g^{-1}, and grains yield t ha^{-1}, wet and dry forage yield and seeds protein percentage were significantly affected by planting dates and differed among oat genotypes. Wallaro and Carrolup genotypes were suitable for the growth and production at both locations compared to wild oat genotype. Furthermore, all genotypes of oat can grow well with high forage and seeds production if it plants during November in this area of southern Iraq.

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