Mesopotamia J. of Agric. ISSN: 2224 - 9796 (Online) مـجلــة زراعــة الـرافديـن
Vol. (45) No. (2) 2017 ISSN: 1815 - 316 X (Print) المجلد (45) العدد (2) 2017

DETERMINATION OF OPTIMUM SOWING DATE AND PLANT POPULATION OF SOME SAFFLOWER CULTIVARS (*Carthamus tinctorius* L.) UNDER MOSUL CITY CONDITIONS

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ABSTRACT

To determine the optimum sowing date and plant population for safflower crop (*Carthamus tinctorius* L.), a factorial experiment was conducted by using randomized completed block design with three replications in AL-Rashidia location about (20 km) west north Nineveh province, Iraq, during the 2008-2009 and 2009-2010 winter growing seasons. Three sowing dates (1st, 3rd October, 4th, 5th November and 2nd,1st December for two seasons 2008-2009 and 2009-2010 respectively) and two plant populations (50000 and 100000 plants.ha^{-1}) were selected. Hartinan, Syrian and Gila cultivars were used. The results showed that the different sowing dates had significant effect on growth characters, yield, yield components and quality, except linoleic acid in 2009-2010 season, the highest mean values were obtained at second sowing date in the two seasons 2008-2009 and 2009-2010. Safflower cultivars significantly differed for all the studied yield, its component and seed quality traits in both seasons, the highest mean values were obtained from Syrian cultivar in both seasons. Seed yield and oil yield influenced by different plant population significantly. Plant population of 50000 plants.ha^{-1} gave the highest mean for seed oil content and oil yield, while increasing the plant population to 100000 plants.ha^{-1} caused a significant increase of plant height and palmitic acid percentage in both growing seasons. The result of interaction among sowing dates, cultivars and plant population showed that the highest seed yield was obtained in Syrian cultivar sown in November using plant population of 50000 plants.ha^{-1}. Therefore, Syrian cultivar sown in November with plant population of 50000 plants.ha^{-1} is recommended for this region.

Keywords: Safflower cultivars, sowing dates, plant populations.

Received: 1/7/2012, Accepted: 6/5/2013.

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an important annual industrial crop. The stem, leaves, seeds and flowers are used for different purposes. The orange-red dye (carthamin) extracted from it's brilliant colored flowers. Moreover, it's flowers are known to have many medicinal properties for curing several chronic diseases, and they are widely used in herbal preparations (Li and Mundel, 1996). The leaves and shoots of safflower are used in salad. They are rich in vitamin A, iron, phosphorus, and calcium. Bundles of young plants are commonly sold as a green vegetable in markets (Nimbkar, 2002). Safflower can be grazed or stored as hay or silage. It's forage is palatable, and it's feed value and yields are similar to or better than those for oats or alfalfa. Thus, each part of safflower has a value attached to it. Safflower is an oil crop

that can be grown in arid agricultural areas due to its high tolerance to heat and cold (Kaya *et al*., 2003; Zel *et al*., 2004; Dordas and Sioulas, 2008 and Moghanlou *et al*., 2011). Its seeds contain 13 to 46% oil, and approximately 90% of this oil is composed of unsaturated fatty acids, namely oleic and linoleic acids (Johnson *et al*., 1999). Safflower oil, contains approximately 75% linoleic acid, also contains tocopherol, which is have antioxidant effect and high vitamin E content. The yield and quality properties of safflower are largely determined by ecological factors and cultivation techniques. It was reported that the sowing date and plant population of safflower depend on ecological conditions (Alessi *et al*., 1981; Gencer *et al*., 1987; Rao *et al*., 1990; Pujari *et al*., 1993; Tomar, 1995; Patel *et al*., 1997; Samarthia and Muldoon, 1997). Gur and Ozel (1997) reported that the highest yield for safflower was obtained from November sowing of the cultivar Diner. Therefore, in order to obtain safflower with high yield and quality, it is essential to determine the suitable growth conditions and cultivation techniques. The aim of this study was to determine the optimum sowing date and plant population for safflower cultivars under semiarid conditions (193 mm rainfall) of Mosul City.

MATERIALS AND METHODS

Field trials were conducted in 2008-2009 and 2009-2010 winter growing seasons at AL-Rashidia location about (20 km) west north Nineveh province. Some climate data concerning the research area are given in table 1 (Anonymous, 2010). In 2008-2009 growing season, the total rainfall was much lower than the pattern of rainfall in 2009-2010 (see Table 1). According to soil analysis, the soil of the research area had an average levels of organic matter, $Caco_3$ and pH of 0.905 $mg.kg^{-1}$, 2.03 $mg.kg^{-1}$ and 7.81, respectively in both seasons (Table 2), and had a sandy loom texture using the methods described by Black, (1965); Jackson, (1973) and Page *et al.*, (1982). Three sowing dates (October, November and December) and two plant population (50000 and 100000 $plants.ha^{-1}$) were applied. Hartinan, Syrian and Gila (with red flowers and unspiny) were used as the safflower cultivars and were supplied by the crops industrial company, Baghdad. Sowings were performed on 1^{st}, 3^{rd} October, 4^{th}, 5^{th} November and 2^{nd} ,1^{st} December for two seasons 2008-2009 and 2009-2010 respectively. Each plot 18 m^2 (6*3), included six rows 50 cm apart and six meters long and the intra-row spacing was 40 and 20 cm to attain a plant population of 50000 and 100000 $plant.ha^{-1}$, respectively.

The sowings were performed under rainfed only without supplemental irrigation. Plants were thinned after 20 days from sowing in both years. Nitrogen fertilizer was applied in the form of Urea 100 $kg.ha^{-1}$ (46%N) in two equal doses, after thinning immediately and 10 days later and super phosphate 60 $kg.ha^{-1}$ ($45\%P_2O_5$) and 40 $kg.ha^{-1}$ potassium ($48\%K_2O$) were applied to the soil during the sowing period. Plant protection practices were carried out when needed. Observations were carried out on 4 central rows, and 1m from both ends of the rows was left as it represented the border effect, and the following data were recorded: Plant height (cm), number of primary branches, number of $head.plant^{-1}$ and head diameter.

Table (1): The temperature, month precipitation and relative humidity in AL-Rashidia location at 2008-2009 and 2009-2010 seasons.

Month	Temperature (C°)			Month Precipitation (mm)	relative humidity (%)
	Max	Min	Mean		
2008-2009 season					
September	38.6	22.9	30.75	0.50	35
October	30.4	15.6	23.00	34.20	48
November	22.3	8.6	15.45	72.60	62
December	15.0	3.2	9.10	18.60	71
January	14.3	-0.1	14.30	0.001	68
February	17.5	5.6	11.55	24.90	63
March	19.7	8.5	14.10	28.10	60
April	25.8	11.7	18.75	35.70	52
May	34.2	18.2	26.20	0.001	37
Total				214.60	
2009-2010 season					
September	34.4	21.6	28	1.50	34
October	32.3	15.0	23.65	24.00	43
November	20.4	9.3	14.85	35.00	73
December	16.0	7.0	11.5	75.00	81
January	10.0	6.2	8.1	32.50	60.6
February	15.8	8.8	12.3	61.50	58.2
March	16.6	10.2	13.4	62.00	62.2
April	24.6	22.8	23.7	14.50	58.0
May	36.2	24.0	30.1	17.50	32.8
Total				323.50	

Funding seismographic and meteorological commission, Mosul, Iraq.

Table (2): The physical and chemical characters of soil field experiments in both seasons at 0 to 30 depth.

Seasons		2008-2009	2009-2010
physical characters			
Sand	(%)	59.00	55.00
Silt		21.00	32.00
Clay		20.00	13.00
Texture		Sandy loom	Sandy loom
chemical characters			
O.M.	($mg.kg^{-1}$)	0.824	0.986
Total $CaCo_3$		1.64	2.42
Available N	(ppm)	26.60	28.44
Available P		12.20	13.68
Available K		154.00	162.00
E.C.	($ds.cm^{-1}$)	0.84	0.66
pH		7.20	8.42

Harvesting was performed manually in 137, 132, 145 and 142, 141, 142 days after sowing for each cultivar Hartinan, Syrian and Gila to both seasons 2008-2009, 2009-2010, respectively. The two inner rows were taken to determine the following characters (No. of seeds.head^{-1} and 1000 seed weight). The final seed yield (ton per ha^{-1}) was determined from the whole harvested plot area (m^2). Oil content was determined in 5 g by Soxhlet apparatus. Gas liquid chromatography was done for determining relative composition of different fatty acids in oil (Stoffel *et al*., 1995). Oil yield was calculated by multiplying oil content and the seed yield (Anonymous, 1980). The experimental design was factorial experiment in a Randomized Completely Block Design (RCBD) with three replications according to Snedecor and Cochran, (1982). Then Duncan's multiple range test (Duncan, 1955) was used to compare among means (Anonymous, 2001).

RESULTS AND DISCUSSION

Sowing dates effect: Temperature, rainfall and relative humidity for the experiment site during the study years are presented in table (1). The average rainfall for 2009-2010 (323.50 mm) was higher than that observed (214.60 mm) in 2008-2009. Based on variance analysis table, all the investigated characteristics were affected by planting dates significantly at 0.05 and 0.01 probability level, except linoleic acid in 2009-2010 season (Table 5). Delaying in sowing date from October to November resulted in significant increase of plant height (62.96, 56.50 cm), number of primary branches (6.03, 7.79), number of head.plant^{-1} (10.59, 11.09), head diameter (1.96, 2.45 cm), number of seed.head^{-1} (11.41, 11.73), weight of 1000 seed (29.29, 27.73), seed yield (1.62, 1.64 ton.ha^{-1}), oleic acid (8.41, 8.23%), palmitic acid (6.87, 9.73%) in the two seasons 2008-2009 and 2009-2010, respectively (Tables 3 and 4). Seed yield significantly decreased in October sowing date, as a result of the decrease in mean temperature during the period of vegetative growth of crop (Table 1). Growth conditions at October sowing date in comparison with December sowing date were not favorable because of very low temperature during seed filling stage and shrinkage of photoperiod. Seed yield obtained from the first and third planting dates decreased at the rate of 3.08, 5.55% and 7.92, 12.19% as compared with the second sowing date in the two seasons 2008-2009 and 2009-2010 respectively, mainly due to the optimum temperature during growth and seed formation stage in the second sowing date (Table 1). Safflower is a long day plant (Zimmerman, 1972) and it's flowering time is postponed in short day conditions. The physiological maturity of plant was delayed with declining mean temperature (Table 3). Similar results were reported by Cholaki *et al*., (1993); Tomar, (1995); Cazzato *et al.*, (1997); Dadashi and Khajehpour, (2004) and Heydarizadeh *et al*., (2008).

Cultivars effect: Data pertaining to cultivars are presented in tables 3 and 4. All investigated characteristics were significantly affected by cultivars (Table 5). The data revealed that Syrian cultivar surpassed over Hartinan and Gila cultivars in the growth characters (plant height, number of primary branches, number of head.plant^{-1}, head diameter). High number of heads per plant in Syrian cultivar indicated that this cultivar had the most adaptability to the climatic conditions of the region. On the other hand, the high number of seeds per head in Syrian cultivar may be attributed to large head formation in this cultivar (Table 3). Moreover producing the heaviest seeds by Syrian

was probably as the result of desirable transportation of photosynthesis products to seeds of this cultivar. Superiority of Syrian cultivar over Hartinan and Gila with respect to seed yield, oil yield, oleic and palmitic acid percentage in this study suggested that Syrian was the most compatible cultivar for cultivation in the region. Variations among different cultivars regarding productivity and yield have been shown by other authors (Gonzalez *et al.*, 1994; Camas *et al.*, 2007; Koutroubas *et al.*, 2009 and Beyyavas *et al.*, 2011). These results about yield components responses to cultivar factor are very similar to the findings of Gonzalez *et al.*, (1994); Arslan *et al.*, (1997) and Dadashi and Khajehpour, (2004).

Plant populations effect: Increasing the plant population from 50000 to 100000 plants.ha^{-1} resulted in decreasing the all investigated characteristics except plant height and palmitic acid percentage (Tables 3 and 4). Although the high population (100000 plants.ha^{-1}) produced the highest plant height (63.00, 55.73 cm) and palmitic acid (6.84, 9.37 %), the low population (50000 plant.ha.$^{-1}$) gave the highest number of primary branches (5.46, 7.08), seed oil percentage (29.13, 29.16%), oil yield (0.46, 0.46 ton.ha^{-1}) in the two growing seasons, respectively. The consequent increase in seed yield per ha^{-1} by decreasing the plant population from 100000 to 50000 plants.ha^{-1} may be attributed to increases in head diameter and number of head per plant^{-1} as a result of decreased plant competition. This is in agreement with those reported by Alessi *et al.*, (1981) and Fazeli Kakhaki *et al.*, (2007).

Oil yield also, was lower in the plant population of 100000 plants per ha^{-1} than the population of 50000 plants perha^{-1}. It seems that the ratio of growth enhancement in vegetative parts of plant (height) was more evident than reproductive organs, due to increasing of plant population. This increase may be due to the decreased plant competition for resources in low plant population. These results were in agreement with the findings of Mundel *et al.*, (1994). On the other hand, the reduction of heads number per plant, decreased branching in the plants, and the acceleration of plant height in higher plant population can be ascribed to inter and intra plant competition for resources. These results were in agreement with the findings of Azari and Khajehpour, (2005).

Interactions effect: Tables (3 and 4) showed that the interaction between sowing dates and cultivars had a significant effect on plant height and no. of seed.head^{-1} in 2009-2010 season, head diameter, 1000 seed weight, seed yield, seed oil percentage, oil yield, oleic, linoleic and palmitic acid percentage for both seasons. It seems that the late planting date at November produce more vegetative branches due to longer vegetative period. Similar conclusions were obtained by Jose *et al.*, (2004). The interaction between sowing dates × plant population showed significant effects on plant height and linoleic acid percentage in 2008-2009 season, as well as number of seed per head^{-1},oil yield and oleic acid percentage in 2009-2010 season, while number of head.plant^{-1}, weight of 1000 seed, seed yield, seed oil content significantly increased in both seasons as illustrated in tables 3 and 4. The increase in number of heads per plant and weight of 1000 seed in November planting date and 50000 plants per ha^{-1} may be due to the favorable climate conditions and low plant competition that lead to enough plant nourishment, so the yield component increased and total seed yield. These results are in agreement with those obtained by Ozel *et al.*, (2004).

Table (3): Mean values of plant height, no. of primary branches. plant^{-1}, no. of head. plant^{-1}, head diameter (cm), no. of seed.head^{-1} and 1000 seed weight as affected by sowing dates and plant population for the safflower cultivars in 2008-2009 and 2009-2010 seasons.

Main effect and interaction	plant height (cm)		no. of primary branches. plant^{-1}		no. of head.plant^{-1}		head diameter (cm)		no. of seed.head^{-1}		weight of 1000 seed (g)	
	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010
Sowing dates												
October	59.25b	51.76b	4.56b	5.98b	10.48a	10.79a	1.74b	1.99b	11.12a	11.00b	26.90b	24.78b
November	62.96a	56.50a	6.03a	7.79a	10.59a	11.09a	1.96a	2.45a	11.41a	11.73a	29.29a	27.73a
December	55.58c	48.42b	4.84b	6.28b	9.31b	9.52b	1.50c	1.78b	10.01b	9.88c	25.83c	23.71c
cultivars												
Hartinan	54.41c	47.25c	4.61b	6.02b	8.59c	8.79c	1.45b	1.70b	10.37b	10.25b	26.56b	24.44b
Syrian	63.85a	57.06a	5.83a	7.60a	11.66a	12.27a	1.89a	2.38a	11.29a	11.61a	28.17a	26.61a
Gila	59.53b	52.37b	4.99b	6.43b	10.13b	10.34b	1.86a	2.14a	10.87ab	10.75b	27.29b	25.17b
Plant population (plants.ha^{-1})												
50000	55.53b	48.73b	5.46a	7.08a	10.37	10.83	1.77	2.18	10.93	11.07	27.54	25.74
100000	63.00a	55.73a	4.82b	6.29b	9.88	10.11	1.69	1.97	10.76	10.68	27.14	25.08
Interactions												
S × C	N.S.	**	N.S.	N.S.	N.S.	N.S.	**	**	N.S.	**	**	**
S × P	**	N.S.	N.S.	N.S.	*	**	N.S.	N.S.	N.S.	*	**	**
C × P	**	**	N.S.	**	N.S.	N.S.	**	**	N.S.	**	N.S.	*
S × C × P	**	**	*	**	N.S.	*	*	*	N.S.	*	**	**

The mean values with in column followed by different letters are significantly at 0.05 and 0.01 level.
*, ** significant at the 0.05 and 0.01 probability level, respectively.
N.S. not significant.

Table (4): Mean values of seed yield, seed oil percentage, oil yield, oleic, linoleic and palmitic acid percentage as affected by sowing dates and plant population for the safflower cultivars in 2008-2009 and 2009-2010 seasons.

Main effect and interaction	seed yield (ton.ha^{-1})		seed oil (%)		oil yield (ton.ha^{-1})		oleic acid (%)		linoleic acid (%)		palmitic acid (%)	
	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010	2008-2009	2009-2010
Sowing dates												
October	1.57b	1.51b	27.56b	27.34b	0.43b	0.41b	8.12a	7.44b	70.21b	66.51	6.53a	8.84b
November	1.62a	1.64a	29.09a	29.32a	0.47a	0.48a	8.41a	8.23a	72.55a	65.80	6.87a	9.73a
December	1.53c	1.44b	27.93b	27.66b	0.42b	0.40b	7.01b	6.41c	70.88b	66.80	5.64b	8.20b
cultivars												
Hartinan	1.45c	1.39b	26.15c	25.93c	0.37b	0.36c	7.37b	6.70c	69.68c	65.99b	5.75b	8.06b
Syrian	1.74a	1.76a	27.64b	27.87b	0.48a	0.49a	8.29a	8.12a	71.30b	64.55c	6.78a	9.65a
Gila	1.53b	1.44b	30.80a	30.53a	0.47a	0.44b	7.87ab	7.28b	72.66a	68.58a	6.50ab	9.06a
Plant population (plants.ha^{-1})												
50000	1.58	1.58a	29.13a	29.16a	0.46a	0.46a	7.93	7.55	72.87a	67.19a	5.85b	8.48b
100000	1.57	1.49b	27.26b	27.06b	0.42b	0.40b	7.76	7.17	69.56b	65.55b	6.84a	9.37a
Interactions												
S × C	**	**	**	**	**	**	*	**	**	**	*	**
S × P	**	**	*	*	N.S.	**	N.S.	**	**	N.S.	N.S.	N.S.
C × P	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	N.S.	**	N.S.	N.S.
S × C × P	**	**	N.S.	N.S.	N.S.	**	N.S.	**	N.S.	**	**	**

The mean values with in column followed by different letters are significantly at 0.05 and 0.01 level.
*, ** significant at the 0.05 and 0.01 probability level, respectively.
N.S. not significant.

Table (5): Analysis of variance F values for some growth characters, yield and yield components and quality in 2008-2009 and 2009-2010 seasons.

S.O.V	D.f	M.S. for 2008-2009 season											
		plant height (cm)	no. of primary branches. plant^{-1}	no. of head.plant^{-1}	head diameter (cm)	no. of seed.head^{-1}	weight of 1000 seed (g)	seed yield (ton.ha^{-1})	seed oil (%)	oil yield (ton.ha^{-1})	oleic acid (%)	linoleic acid (%)	palmitic acid (%)
Replications	2	126.157	3.3523	2.56193	0.0113	4.1905	1.0007	0.0065	0.7318	0.0002	4.3438	4.3634	1.4074
A	2	244.943**	10.8666**	9.04007*	0.9296**	9.8900**	56.655**	0.0351**	11.494*	0.0101**	9.8900**	26.217**	7.2130**
B	2	402.348**	7.0327**	42.3667**	1.0931**	3.8150*	11.763**	0.4020**	101.447**	0.0580**	3.8150*	40.018**	5.1347*
C	1	754.13**	5.4403**	3.2462$^{N.S.}$	0.0816$^{N.S.}$	0.3833$^{N.S.}$	2.1600$^{N.S.}$	0.0024$^{N.S.}$	47.601**	0.0148**	0.3833**	147.47**	13.093*
A × B	4	130.39$^{N.S.}$	0.411$^{N.S.}$	4.7083$^{N.S.}$	0.4784**	1.8632$^{N.S.}$	19.760**	0.0251**	20.944**	0.0088*	1.8632**	68.449**	3.9149**
A × C	2	4.9312**	0.502$^{N.S.}$	7.93127*	0.1784$^{N.S.}$	1.1849$^{N.S.}$	18.346**	0.0432**	11.473**	0.0009$^{N.S.}$	1.1849$^{N.S.}$	17.141**	2.7299$^{N.S.}$
B × C	2	344.509**	1.640$^{N.S.}$	2.0022$^{N.S.}$	0.6776**	1.5038$^{N.S.}$	3.5332$^{N.S.}$	0.0037$^{N.S.}$	4.2355$^{N.S.}$	0.0001$^{N.S.}$	1.5038$^{N.S.}$	4.4565$^{N.S.}$	0.7136$^{N.S.}$
A B×C	4	245.032**	2.1768*	3.1238$^{N.S.}$	0.2313*	0.7202$^{N.S.}$	38.740**	0.0265**	1.0104$^{N.S.}$	0.0014$^{N.S.}$	0.7202$^{N.S.}$	4.4706$^{N.S.}$	6.2114**
Error	34	26.29447	0.572135	2.046903	0.09047	0.743332	1.526230	0.003310	2.691459	0.000753	0.734312	2.072011	1.289760
Total	53												
S.O.V	D.f	M.S. for 2009-2010 season											
Replications	2	15.05722	1.337362	155.38040	3.597016	120.6307	167.4401	1.306903	68.19334	0.192789	71.96072	27.35778	16.70456
A	2	296.567**	16.9587**	12.5315**	2.11802**	15.5907**	78.0422**	0.18450**	20.2835**	0.03630**	15.0977**	4.7232$^{N.S.}$	10.7092**
B	2	433.442**	11.9681**	54.5140**	2.13060**	8.56466**	21.9391**	0.73782**	95.7507**	0.08409**	9.16766**	74.9364**	11.6032**
C	1	662.900**	8.51247**	6.9265$^{N.S.}$	0.5601$^{N.S.}$	2.0611$^{N.S.}$	5.8674$^{N.S.}$	0.1084$^{N.S.}$	59.5350**	0.04764**	1.9078$^{N.S.}$	36.2440**	10.6577**
A × B	4	164.720**	1.0947$^{N.S.}$	4.5305$^{N.S.}$	1.17944**	4.44230**	26.6476**	0.12996**	25.0921**	0.02083**	5.08269**	105.286**	7.96376**
A × C	2	17.019$^{N.S.}$	1.1698$^{N.S.}$	13.6891**	0.5836$^{N.S.}$	3.03162*	20.6536**	0.13114**	16.0542*	0.01108**	3.95217**	11.675$^{N.S.}$	2.8652$^{N.S.}$
B × C	2	350.987**	4.11419**	4.8069$^{N.S.}$	1.78746**	4.58159**	9.30397*	0.0320$^{N.S.}$	1.5444$^{N.S.}$	0.0040$^{N.S.}$	5.36259**	72.0870**	0.7687$^{N.S.}$
A B×C	4	216.788**	4.11911**	6.303279*	0.87151*	2.84862*	49.8158**	0.15849**	0.5990$^{N.S.}$	0.01561**	2.90201**	55.6259**	6.52740**
Error	34	30.50055	0.684664	2.165739	0.27136	0.810608	2.015555	0.011556	3.162701	0.001950	0.678308	3.926979	1.424531
Total	53												

*,** Significant at the 0.05 and 0.01 probability level, respectively. and n.s. not significant.

According to the results of mean comparisons (Tables 3 and 4) interaction of safflower cultivars × plant population showed significant effects on number of primary branches, number of seed.head^{-1}, weight of 1000 seed, oleic and linoleic acid percentage in 2009-2010 season, while plant height, head diameter significantly increased in both seasons as illustrated in tables 3 and 4. Similar results were found by Cazzato *et al.*, (1997). As it is shown in variance analysis table, plant height, number of primary branches, head diameter, weight of 1000 seed, seed yield and palmitic acid percentage influenced by interaction among sowing dates × cultivars × plant population significantly at 0.05 and 0.01 probability level (Table 5) at two seasons. Syrian cultivar in November planting date and low plant density surpassed over Hartinan and Gila cultivars in total seed yield and oil yield. November planting date is suitable for vegetative growth and organ reproductive, the environmental temperature is consistent with optimal condition for biological performance and dry matter accumulation improvement. The insignificant effect among the three studying factors on other characteristic showed that each of these three factors acted independently on these traits.

According to the results of present study, and in order to cultivate safflower in conditions similar to the region of this experiment, it recommended that safflower should be sown at November. Delaying of safflower planting to December will cause a decrease in yield and oil yield due to day length shortage consequently the reproductive phase of crop development and seed filling stage may coincide with low temperatures leading to expressing drop in crop yield and productivity. The relatively high yielding of Syrian cultivar with more compatibility than other two cultivars is suggested for cultivation at November in the region with a plant population of about 50000 plants.ha^{-1}.

تحديد أمثل موعد زراعة وكثافة نباتية لبعض أصناف العصفر (*Carthamus tinctorius* L.) تحت ظروف مدينة الموصل

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الخلاصة

لتحديد أمثل موعد زراعة وكثافة نباتية لمحصول العصفر(*Carthamus tinctorius* L.)، أجريت تجربة عاملية بتصميم القطاعات العشوائية الكاملة بثلاثة مكررات في موقع الرشيدية الذي يبعد (20 كم) شمال غرب مدينة الموصل أثناء موسم النمو الشتوي للعامين 2008-2009 و2009-2010. اختيرت ثلاثة مواعيد زراعية (الأول والثالث من تشرين الأول، الرابع والخامس من تشرين الثاني والثاني والأول من كانون الأول للموسمين 2008-2009 و2009-2010 على التوالي) وكثافتين نباتيتين (50000 و100000 ألف نبات. هكتار$^{-1}$) واستخدمت الأصناف هرتنان، سوري وجيلا. أشارت النتائج بان مواعيد الزراعة المختلفة قد أثرت معنوياً في صفات النمو والحاصل ومكوناته والنوعية، عدا نسبة حامض اللينوليك في الموسم 2009-2010، تم الحصول على أعلى متوسط لتلك الصفات في موعد الزراعة الثاني في كلا الموسمين 2008-2009 و2009-2010. اختلفت أصناف العصفر معنوياً في جميع صفات الحاصل المدروسة ومكوناته ونوعية البذور في كلا الموسمين، فقد أعطى الصنف السوري أعلى متوسط لجميع صفات النمو والحاصل وحاصل الزيت في

كـلا الموسـمين 2008-2009 و2009-2010. تـأثر حاصـلي البـذور والزيـت معنويـاً بـاختلاف الكثافـة النباتيـة. أعطـت الكثافـة النباتيـة 50000 نبـات.هكتـار$^{-1}$ أعلـى متوسـط لمحتـوى البـذور مـن الزيـت وحاصـل الزيـت، بينمـا سببت زيادة الكثافة النباتية إلى 100000 نبات.هكتار$^{-1}$ زيادة معنوية في ارتفاع النبات ونسبة حامض البالمتيك في كلا موسمي النمو. بينت نتائج التداخل بين مواعيد الزراعة والأصناف والكثافة النباتية بان أعلى حاصل من البذور تم الحصول عليه بزراعة الصنف السوري في تشرين الثاني بكثافة نباتية 50000 نبات.هكتار$^{-1}$، لذا يوصى بزراعة الصنف السوري في تشرين الثاني بكثافة نباتية 50000 نبات.هكتار$^{-1}$ في تلك المنطقة.

الكلمات الدالة: أصناف لمحصول العصفر، مواعيد زراعة وكثافات نباتية.

تاريخ تسلم البحث: 2012/7/1 ، وقبوله: 2013/5/6.

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