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EFFECT OF ROW SPACING ON GROWTH AND YIELD OF THREE SAFFLOWER VARIETIES (*CARTHAMUS TINCTORIUS* L.)

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Abstract

A field experiment was conducted during the winter season for the year 2021-2022 in two locations: the first in the fields of the College of Agriculture and Forestry / University of Mosul and the second in the Badoush Dam location with the aim of studying the effect of three row spacing between lines (30, 45, 60 cm) and three safflower varieties (Gila, Almis, Jordanian) on growth and yield traits. The experiment was applied as a factorial experiment with a randomized complete block design (RCBD) with three replicates. The results showed that there were significant differences between the row spacing in most of the studied traits for both experimental location .The row spacing of 30 cm gave the highest value for plant height in the Badush Dam location, and the distance of 45 cm gave the highest value for the number of seeds/head in both locations .While the row spacing of 60 cm gave the highest value for the number of branches/plant, leaf area, weight of 1000 seeds, seed yield, oil percentage, and oil yield in both experimental location, and the number of heads/plant in college location. The varieties had a significant effect on all studied traits and for both location of the experiment, where Gila cultivar recorded the highest value of 1000 seed weight in both location,While Almis cultivar recorded the highest value for plant height, number of branches/plant, leaf area, number of heads/plant, number of seeds/head, seed yield, and oil percentage and yield.The interaction between cultivation distances and varieties was significant in most of the studied traits.The row spacing was 60 cm, and the Almis cultivar was higher as a result of the number of branches/plant in college location, leaf area in Badush Dam location, and seed yield in both locations.

Keywords: safflower, row spacing, varieties.

Introduction

The safflower crop is one of the most important oil crops that plays a major role in the global production of vegetable oils. It is grown for the purpose of extracting oil from its seeds, which is characterized by a high percentage of essential fatty acids and a low percentage of non-essential fatty acids. It has many health benefits, including lowering cholesterol and treating blood diseases as well as Other industrial, oil and fodder uses of this crop (Munoz-valenzuela et al., 2007).The International Food and Agriculture Organization shows that the safflower crop is still cultivated in relatively small areas compared to the rest of the other oil crops.The cultivated area reached 850 thousand hectares, and the most important countries that grow safflower are India, the United States of America, Ethiopia and Mexico (Faostat, 2004).Appropriate agricultural practices improve safflower production, as well as its tolerance to drought and harsh environmental conditions, making it a good competitor for winter grain crops (Blackshaw, 1993).Crop service operations and genetic factors play an important role in the growth and productivity of the

safflower crop, and the most important of these factors are the row spacing and the variation between varieties.Safflower varieties vary in the extent of success of their cultivation and production in different environments, depending on their differences in growth characteristics and other productive characteristics (Nikabadi et al., 2008.(Eryiğit et al. (2015) found in their study of three row spacing between lines (20, 30, 40 cm) that there were significant differences between the row spacing in the traits of plant height, number of branches/plant, number of inflorescences/plant, seed yield, and oil percentage. Kőse and Bilir (2017) indicated, during their study of three row spacing (15, 30, and 45 cm), that there were significant differences between the row spacing in the number of branches/plant, number of seeds/inflorescence, weight of 1000 seeds, seed yield, and oil yield.The results obtained by Mirza et al. (2018) in their experiment in which they used several row spacing (30, 45, 60, 75, and 90 cm) showed that there were significant differences between the row spacing in plant height, number of branches/plant, leaf area, and seed yield. The results reached by Caliskan and Caliskan (2018) during their study of four row spacing (15, 30, 45, and 60 cm) showed that the distance was significantly higher than 60 cm in the number of branches/plant, the number of inflorescences/plant, and the number of seeds/inflorescence, while the distance was significantly excelled to 45 cm. In weight of 1000 seeds, seed yield and oil percentage.when studying five safflower varieties (Al-Mays Wardani, 400-s, 540, and 2081), there were significant differences between varieties in plant height, number of inflorescences/plant, number of seeds/inflorescence, weight of 1000 seeds, and seed yield.Omidi et al. (2012) found in their experiment in which they used three safflower varieties (Goldasht, Padideh, and K.w.2) that there were significant differences between the varieties in plant height, number of inflorescences/plant, number of seeds/inflorescence, weight of 1000, seed yield, oil percentage, and oil yield.Killi et al. (2016) during their study of several safflower varieties (Dincer, Balc1, Remzibey, Rio, Nebraska, Oleicleef, Qairieq088, San Jose, Sina, and Gila) indicated that there were significant differences between varieties in plant height, number of branches/plant, number of inflorescences/plant, weight of 1000 seeds, seed yield, and oil percentage and yield.Al-Doori (2017) showed during his study of three safflower varieties (Hartinan, Syrian and Gila) that the Syrian cultivar was significantly excelled in plant height, number of branches/plant, number of inflorescences/plant, number of seeds/inflorescence, weight of 1000 seeds, seed yield and oil yield, and Gila was excelled in percentage the oil.

The research aims to study the effect of row spacing between lines on the growth and yield traitsof three safflower varieties .

Materials and methods

A field experiment was conducted during the winter season for the year 2021-2022 in two locations: the first in the fields of the College of Agriculture and Forestry / University of Mosul, and the second in the Badoush Dam area, in clay and sandy loam soils, respectively. In order to study the effect of three row spacing between lines (30, 45, 60 cm) and three safflower varieties (Gila, Almays, Jordanian) on growth and yield traits .The experiment was designed according to the randomized complete block design (RCBD) with two factors: the first is three row spacing and the second is three varieties of safflower with three replicates. As the number of experimental

units will be 3 x 3 x 3 = 27 experimental units, and the experimental unit consists of four lines with a length of 2.5 m and the distance between one plant and another is 20 cm. The two extreme lines were left as guard lines, and the readings were taken from the plants of the two middle lines. The treatments were randomly distributed among the experimental units within each replicate, and the experimental units were separated from each other by a distance of 1m. The ground of the field was plowed with the perpendicularly Moldboard plows ,Then smoothing, leveling and division operations were performed. Sowing took place on 11/15/2021, and after the completion of the emergence of the seedlings, the plants were thinned 14 days after planting by leaving one plant in the pit, and crop servicing operations were conducted, including hoeing and weeding, all that was required for that.

Studied traits:

1. Plant height (cm): measured from the area where the stem contacts the soil to the top of the plant.
2. Number of branches / plant.
3. Leaf area (cm2): The leaf area was calculated based on the method reported by Jordan and others (1993) by adopting the tableting method, where 50 tablets of a known diameter were taken from 50 leaves of the five plants, then the leaves and tablets were dried and weighed, then the total leaf area was estimated to a plant using proportion and proportion.
4. Number of heads/plant: Estimated on the basis of the average number of heads of the ten plants taken at random.
5. Number of seeds/head: It was calculated by dividing the average number of seeds by the average number of heads per plant.
6. Weight of 1000 seeds (g): After mixing the seeds of the harvested plants, 1000 seeds were randomly taken from each experimental unit and then weighed.
7. Seed yield (kg/ha): This was done by harvesting the two middle lines for each experimental unit and then estimated according to the area.
8. Oil Percentage (%): Determined using the Soxhlet device and according to the A.O.A.C method. Anonymous (2000).
9. Oil yield (kg/e) = oil percentage (%) x seed yield (kg/e).

statistical analysis

The data were analyzed statistically according to the analysis of variance method using the ready-made statistical program SAS, and the arithmetic means were compared using Duncan's multiple range test at the probability level of 1 and 5% (Al-Rawi and Khalaf-Allah, 2000).

Results and discussion

plant height (cm)

The results shown in Table (2) showed that there were no significant differences between the row spacing in plant height at the collage location.As for the Badush Dam location, it is noted that there are significant differences, as the row spacing of 30 cm recorded the highest mean for the trait, which amounted to (81.20 cm), and it did not differ significantly from the row spacing of 45 cm, which recorded an average of (79.83 cm .(While the row spacing of 60 cm was the lowest

mean for the trait, which was (78.13 cm). The reason for this may be due to the fact that the lack of row spacing (increased plant density) leads to an increase in the elongation of stem cells to obtain the largest amount of light, which leads to an increase in plant height.This result is consistent with the findings of Eryiğit et al. (2015) and Mirza et al. (2018.(The varieties had a significant effect on plant height for both experimental location, as shown in Table (3.(The plants of the Almis cultivar gave the highest mean of the trait (80.46 and 82.71 cm), which did not differ significantly from the Gila cultivar, which gave an average of (78.64 cm.(While the Jordanian cultivar plants gave the lowest mean of the trait (75.60 and 76.11 cm) for both location, respectively. The reason may be due to the genetic variation between the varieties used in the experiment. This result is consistent with what was indicated by Meddeb et al. (2012) and Killi et al. (2016.(It appears from Table (4) that there are no significant differences between the row spacing and varieties in plant height in both the college and Badoush dam location.

Number of branches/plant

Table (2) indicates that there are significant differences between the row spacing in the number of branches per plant in both experimental location, as the row spacing of 60 cm gave the highest average for this trait (6.24 and 6.23 branches/plant), while the row spacing of 30 cm gave the lowest average For this trait, it reached (5.55 and 5.48 branches/plants) for both location, respectively. The reason may be due to the lack of competition for growth factors (water, light, nutrients), which led to an increase in the number of branches of the plant.This finding is consistent with what was found by Eryiğit et al. (2015), Kőse and Bilir (2017), and Mirza et al. (2018.(It is clear from Table (3) that there are significant differences between the varieties in the number of branches of the plant in both locations .The plants of the Almis cultivar gave the highest average for this trait (6.72 and 6.65 branches/plant), while the Jordanian cultivar plants gave the lowest average for this trait (4.96 and 5.12 branches/plant) for both locations, respectively. The reason for this may be due to the nature of the genetic varieties and their interaction with the environmental conditions of the region (Nasrallah et al., 2012). This result is consistent with what was reported by Killi et al. (2016) and Al-Doori (2017(The results of table (4) show that there are significant differences between the row spacing and varieties in the number of plant branches in the college location, where the row spacing was 60 cm, and the affected cultivar had the highest mean for this trait, which reached (7.36 branches/plant ,(While the row spacing was 30 cm, and the Jordanian cultivar had the lowest mean for this trait (4.66 branches/plant). As for the Badush Dam location, the interaction did not reach the level of statistical significance.

Leaf area (cm^2)

The results show in Table (2) that there are significant differences between the row spacing in the leaf area for both location, where the row spacing of 60 cm gave the highest amount for this trait amounted to (1910.11 and 1971.00 cm^2), while the row spacing of 30 cm gave the lowest amount for this traits amounted to (1719.56 and 1775.33 cm2) for both location, respectively. The reason may be due to the increase in the number of branches at the same row spacing (60 cm) (Table 2), which led to an increase in the leafy area. This result is consistent with what was reported by Mirza et al. (2018.(The results shown in Table (3) show that there are significant differences between the

varieties in the leaf area in both location of the experiment, where the plants of the hit cultivar gave the highest mean for this trait, which reached (1975.33 and 2060.67 cm^2,(While the Jordanian cultivar plants gave the lowest mean for this trait (1688.67 and 1731.22 cm^2) for both location, respectively. The reason for this may be due to the excelled of the infected cultivar in the number of branches in the plant, which was reflected positively in increasing the leafy area of the plant.It is clear from the results in Table (4) that there are no significant differences between the row spacing and varieties in the leaf area at the college location.As for the Badoush Dam location, it is noted that there are significant differences, where the row spacing was 60 cm, and the affected cultivar had the highest average for this trait, which reached (2145.33 cm^2), while the row spacing was 30 cm, and the Jordanian cultivar had the lowest average for this trait, which amounted to (1665.67 cm^2.(

Number of heads/plant

The results of the statistical analysis in Table (2) indicated that there were no significant differences between the row spacing in the number of heads per plant at the location of the college, but in the Badoush Dam location, the row spacing of 60 cm gave the highest value for the number of inflorescences (30.96 head/plant,(While the row spacing of 30 cm gave the lowest value for the number of inflorescences (28.20 heads/plant.(The reason for this may be due to the lack of competition between plants at wide distances, which increases their access to a greater amount of nutrients and light, which lead to improving plant growth and increasing the efficiency of the photosynthesis process, which is reflected positively in increasing the number of inflorescences/plant.This result is consistent with the findings of Eryiğit et al. (2015) and Caliskan and Caliskan (2018.(It is evident from Table (3) that there are significant differences between the varieties in the number of heads per plant for both location of the experiment, as the infected cultivar plants recorded the highest value for the trait amounted to (30.44 and 32.01 head/plant,(While the Jordanian plants recorded the lowest value for the trait (25.06 and 26.50 heads/plant) for both locations, respectively.The reason may be due to the difference in genotype between the varieties used in the study. This result is consistent with what was indicated by Meddeb et al. (2012), Killi et al. (2016) and Al-Doori (2017.(The results in Table (4) indicate that there are no significant differences between row spacing and varieties in the number of heads per plant for both experimental location.

number of seeds/head

The results referred to in Table (2) showed that there were significant differences between the row spacing in the number of seeds per inflorescence for both experimental location, as the row spacing of 45 cm recorded the highest amount for this trait (29.48 and 30.27 seeds/head) and did not differ significantly from the row spacing 45 cm, which recorded an amount of (7.18) on the college location, While the row spacing of 30 cm recorded the lowest amount for this trait (25.75 and 26.67 seeds/head) for both location, respectively. The reason may be attributed to the low number of heads/plant at the row spacing of 45 cm.Which led to a lack of competition between them in obtaining the products of the photosynthesis process, which was positively reflected in the number of seeds / head. This finding is consistent with the findings of Caliskan and Caliskan

(2018).The varieties had a significant effect on the number of seeds per head for both experimental location, as shown in Table (3).While the Jordanian cultivar plants gave the lowest amount of this trait (24.84 and 25.34 seeds/head) for both location, respectively.The reason may be attributed to the difference in the genetic makeup of the varieties . This result is consistent with what was indicated by Omidi et al. (2012) and Al-Doori (2017).It is clear from Table (4) that there are no significant differences between the sowing distances and varieties in the number of seeds per head in both the location of the college and Badush dam.

Weight of 1000 seeds (gm)

The results shown in Table (2) show that there are significant differences between the row spacing in the weight of 1000 seeds in both experimental location. The row spacing of 60 cm gave the highest mean for this trait (43.07 and 43.74 g), which did not differ significantly from the distance of 45 cm, which gave an average of (42.01 and 42.32 g). While the row spacing of 30 cm gave the lowest mean for this trait, which was (41.23 and 41.61 g) for both location, respectively. The reason may be due to the lack of competition for growth factors (water, light, nutrients) in the wide distances, which led to an increase in the weight of 1000 seeds. This result is consistent with what was found by Kőse and Bilir (2017) and Caliskan and Caliskan (2018).It is noted from Table (3) that there are significant differences between the varieties in the weight of 1000 seeds in both locations, as the plants of the cultivar recorded the highest average generation for this trait amounted to (43.42 and 43.95 g),While the Jordanian cultivar plants gave the lowest mean for this trait (40.88 and 41.21 g) for both location, respectively. The reason may be due to the nature of genetic varieties and their interaction with the conditions of the region (Nasrallah et al., 2012). This result is consistent with what was reported by Meddeb et al. (2012), Killi et al. (2016) and Al-Doori (2017).The data of Table (4) show that there are no significant differences between the row spacing and varieties in the weight of 1000 seeds in both experimental location.

Seed yield (kg/ha)

The results referred to in Table (2) show that there are significant differences between the row spacing in the seed yield in both the college and Badoush dam location, where the row spacing of 60 cm gave the highest seed yield amounting to (1088.28 and 1093.73 kg / h), While the row spacing of 30 cm gave the least amount of seed yield (1041.41 and 1049.40 kg/ha) for both location, respectively.The reason may be due to the increase in the number of branches per plant, the number of heads per plant, and the weight of 1000 seeds at the same row spacing (60 cm) (Table 2), which led to an increase in seed yield. This result is consistent with what was reported by Eryiğit et al. (2015) and Mirza et al. (2018).The data of Table (3) indicate that there are significant differences between varieties in seed yield in both experimental location.Where the plants of the Almis cultivar gave the highest amount of seed yield (1115.55 and 1122.00 kg/ha), while the plants of the Jordanian cultivar gave the lowest amount of seed yield (1024.30 and 1031.94 kg/ha) for both location, respectively.The reason for this may be due to the excelled of the infected cultivar in the number of branches per plant, the number of heads per plant, and the number of seeds/head (Table 2), which was positively reflected in the increase in seed yield. This finding is consistent with what was found by Omidi et al. (2012) and Al-Doori (2017).It is noted

from the results of Table (4) that there are significant differences between row spacing and varieties in seed yield in both experimental location.The row spacing was 60 cm, and the infected cultivar recorded the highest average seed yield (1140.70 and 1145.60 kg/ha).While the row spacing was 30 cm, and the Jordanian cultivar had the lowest average seed yield (1001.30 and 1015.10 kg/ha) for both location, respectively.

Oil content (%)

The results of the statistical analysis in Table (2) indicated that there were significant differences between the row spacing in the percentage of oil in both experimental location. The row spacing of 60 cm gave the highest value for the trait amounted to (31.61 and 31.72%).While the row spacing of 30 cm gave the lowest value for the trait (28.27 and 28.71%) for both location, respectively. The reason for this may be due to the lack of competition between plants at wide distances, which increases their access to a greater amount of nutrients and light.This result is consistent with the findings of Eryiğit et al. (2015) and Caliskan and Caliskan (2018).Table (3) shows that there are significant differences between varieties in the percentage of oil in both experimental location, as the plants of the infected cultivar recorded the highest value for the trait amounted to (32.08 and 32.28%).While the Jordanian variety plants recorded the lowest value for the trait amounted to (28.50 and 28.84%) for both location, respectively.This may be due to the difference in genetic structure between varieties . This result is consistent with what was indicated by Killi et al. (2016) and Al-Doori (2017).It is noted from the results, Table (4), that there were no significant differences between the row spacing and varieties in the percentage of oil for both experimental location.

Seed yield (kg/ha)

The results referred to in Table (2) show that there are significant differences between the row spacing in the seed yield in both the college and Badoush dam location, where the row spacing of 60 cm gave the highest seed yield amounting to (1088.28 and 1093.73 kg / h), While the row spacing of 30 cm gave the least amount of seed yield (1041.41 and 1049.40 kg/ha) for both location, respectively.The reason may be due to the increase in the number of branches per plant, the number of heads per plant, and the weight of 1000 seeds at the same row spacing (60 cm) (Table 2), which led to an increase in seed yield. This result is consistent with what was reported by Eryiğit et al. (2015) and Mirza et al. (2018).The data of Table (3) indicate that there are significant differences between varieties in seed yield in both experimental location.Where the plants of the Almis cultivar gave the highest amount of seed yield (1115.55 and 1122.00 kg/ha), while the plants of the Jordanian cultivar gave the lowest amount of seed yield (1024.30 and 1031.94 kg/ha) for both location, respectively.The reason for this may be due to the excelled of the infected cultivar in the number of branches per plant, the number of heads per plant, and the number of seeds/head (Table 2), which was positively reflected in the increase in seed yield. This finding is consistent with what was found by Omidi et al. (2012) and Al-Doori (2017).It is noted from the results of Table (4) that there are significant differences between row spacing and varieties in seed yield in both experimental location. The row spacing was 60 cm, and the infected cultivar recorded the highest average seed yield (1140.70 and 1145.60 kg/ha).While the row

spacing was 30 cm, and the Jordanian cultivar had the lowest average seed yield (1001.30 and 1015.10 kg/ha) for both location, respectively.

Oil content (%)

The results of the statistical analysis in Table (2) indicated that there were significant differences between the row spacing in the percentage of oil in both experimental location. The row spacing of 60 cm gave the highest value for the trait amounted to (31.61 and 31.72%).While the row spacing of 30 cm gave the lowest value for the trait (28.27 and 28.71%) for both location, respectively. The reason for this may be due to the lack of competition between plants at wide distances, which increases their access to a greater amount of nutrients and light. This result is consistent with the findings of Eryiğit et al. (2015) and Caliskan and Caliskan (2018).Table (3) shows that there are significant differences between varieties in the percentage of oil in both experimental location, where the plants of the infected cultivar recorded the highest value for the trait amounted to (32.08 and 32.28%).While the Jordanian cultivar plants recorded the lowest value for the trait amounted to (28.50 and 28.84%) for both location, respectively.

This may be due to the difference in genotype between varieties . This result is consistent with what was indicated by Killi et al. (2016) and Al-Doori (2017).

It is noted from the results, Table (4), that there were no significant differences between the row spacing and varieties in the percentage of oil for both experimental location.

Oil yield (kg/ha)

The results of the statistical analysis in Table (2) indicated that there were significant differences between the row spacing in the oil yield in both experimental location.The row spacing of 60 cm gave the highest value for this trait (344.58 and 347.56 kg/ha), while the row spacing of 30 cm gave the lowest value for this trait (295.01 and 101.73 kg/ha) for both location, respectively. The reason may be due to its superiority in seed yield and oil percentage (Table 2). This finding is consistent with the findings of Caliskan and Caliskan (2018).Table (3) shows that there are significant differences between varieties in oil yield for both experimental location.The plants of the infected cultivar recorded the highest value for the trait (358.16 and 362.50 kg/ha).While the Jordanian cultivar plants recorded the lowest value for the trait amounted to (292.08 and 297.74 kg / h) for both location, respectively.The reason may be attributed to the excelled of the infected cultivar in seed yield and oil percentage (Table 2). This result is consistent with what was indicated by Killi et al. (2016) and Al-Doori (2017).The results in Table (4) show that there are no significant differences between row spacing and varieties in oil yield for both experiment location.

Table 2: Effect of row spacing on some safflower traits.

Oil yield (kg/ha)	Oil content (%)	Seed yield (kg/ha)	100-seed weight	No. of seeds/ head	No. of heads / plant	Leaf area (cm^2)	No. of branches/plant	Plant height (cm)	traits / Row spacing (cm(
college location									

295.01c	28.27c	1041.41c	41.23b	25.75b	26.52	1719.56c	5.55b	80.44	**30**
316.41b	29.74b	1061.93b	42.01ab	29.48a	27.48	1851.11b	5.26b	78.01	**45**
344.58a	31.61a	1088.28a	43.07a	27.18ab	28.53	1910.11a	6.24a	76.25	**60**
Badush Dam location									
101.73c	28.71b	1049.40c	41.61b	26.67b	28.20b	1775.33c	5.48c	81.20a	**30**
320.70b	29.93b	1069.66b	42.32b	30.27a	29.15ab	1898.67b	5.84b	79.83ab	**45**
347.56a	31.72a	1093.73a	43.74a	27.61b	30.96a	1971.00a	6.23a	78.31b	**60**

Values followed by different letters within the same column are significantly different according to Duncan's multiple range test.

Table 3: Effect of varieties on some growth traits and safflower yield.

Oil yield (kg/ha)	**Oil content (%)**	**Seed yield (kg/ha)**	**100-seed weight**	**No. of seeds / head**	**No. of heads/ plant**	**Leaf area (cm^2)**	**No. of branches/plant**	**Plant height (cm)**	**traits / varieties**
college location									
305.75b	29.04b	1051.77a	43.42a	27.68a	27.03b	1816.78b	5.63b	78.64ab	**Gila**
358.16a	32.08a	1115.55a	42.01b	29.90a	30.44a	1975.33a	6.82a	80.46a	**Almis**
292.08c	28.50b	1024.30c	40.88b	24.84b	25.06c	1688.67c	4.96c	75.60b	**Jordanian**
Badush Dam location									
309.75b	29.23b	1058.85b	43.95a	27.72b	29.81b	1853.11b	5.78b	80.34b	**Gila**
362.50a	32.28a	1122.00a	42.24b	31.50a	32.01a	2060.67a	6.65a	82.71a	**Almis**
297.74b	28.84b	1031.94c	41.21b	25.34b	26.50c	1731.22c	5.12c	76.11c	**Jordanian**

Values followed by different letters within the same column are significantly different according to Duncan's multiple range test.

Table 4: The effect of the interaction between row spacing and varieties on some growth and yield traits of safflower.

Oil yield (kg/ha)	Oil content (%)	Seed yield (kg/ha)	100-seed weight	No. of seeds/ head	No. of heads/ plant	Leaf area (cm^2)	No. of branches/plant	Plant height (cm)	varieties	Row spacing (cm(
college location										
277.33	27.00	1027.53f	42.30	25.93	26.33	1709.00	50.10de	80.16	**Gila**	**30**
334.40	30.53	1095.40c	41.33	28.60	29.53	1820.67	6.90b	84.50	**Almis**	
273.30	27.30	1001.30g	40.06	22.73	23.70	1629.00	4.66e	78.66	**Jordanian**	
305.73	29.13	1049.63e	43.13	29.56	27.83	1837.00	5.50d	79.40	**Gila**	**45**
355.00	31.90	1110.56b	41.80	31.40	30.03	2035.33	6.20c	80.40	**Almis**	
288.50	28.13	1025.60f	41.10	27.50	24.06	1681.00	5.16d	74.03	**Jordanian**	
334.20	31.00	1078.16d	44.83	27.56	26.93	1904.33	6.30c	76.36	**Gila**	**60**
385.10	33.76	1140.70a	42.90	29.70	31.76	2070.00	7.36a	78.50	**Almis**	
314.46	30.06	1046.00e	41.50	24.30	26.60	1756.00	5.06de	73.90	**Jordanian**	
Badush Dam location										
284.27	27.43	1032.73g	42.80	26.30	28.50	1743.00f	5.40	81.96	**Gila**	**30**
337.27	30.70	1136.00c	41.30	30.70	30.93	1917.33c	6.31	84.46	**Almis**	
283.17	27.90	1015.10h	40.73	40.03	25.16	1665.67g	4.93	77.16	**Jordanian**	
311.80	29.46	1058.36e	43.53	29.80	29.76	1863.00d	5.76	80.66	**Gila**	**45**
358.73	32.03	1120.03b	42.30	32.73	31.40	2110.33b	6.60	82.76	**Almis**	
291.57	28.30	1030.60g	41.13	28.30	26.30	1722.67f	5.16	76.06	**Jordanian**	

333.20	30.70	1085.46d	45.53	27.06	31.26	1953.33c	6.20	78.40	**Gila**	**60**
391.00	34.13	1145.60a	43.13	31.06	33.70	2145.33a	7.23	80.90	**Almis**	
318.50	30.33	1050.31f	41.76	24.70	28.03	1805.33e	5.26	75.10	**Jordanian**	

Values followed by different letters within the same column are significantly different according to Duncan's multiple range test.

conclusion:

We conclude from this experiment that the row spacing is 60 cm, and the plants of the hit variety were the best to give the highest productivity of safflower within the conditions of the experimental area.

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