Evaluation the Impact of Mulch Technique and Irrigation Intervals on Coriander Plant Growth, Productivity and Volatile Oil Active Components Under Southern Valley (Toshka) Conditions

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ABSTRACT

Two field experiments were performed during two consecutive seasons of 2018/2019 and 2019/2020 at Toshka Station (Southern Valley), Desert Research Center, to evaluate the using of mulch technique, irrigation intervals and their interaction treatments on growth, productivity and volatile oil active components of coriander plants under the southern valley (Toshka) conditions. Obtained results indicate the superiority of the interaction between mulch technique and irrigating plants every day or two days compared with other tested treatments. These treatments gave the highest values of growth (plant height, fresh and dry weights/plant) and productivity (number of umbels/plant, seed index, fruit yield/plant and fruit yield/feddan, volatile oil percentage, oil yield and oil yield /fed.) parameters of coriander plant during both seasons. Moreover, Active ingredients of the essential oil reached their maximum values when mulch technique was applied with irrigating plants every two days. Our recommendation is to use mulch technique and irrigating coriander plants every two days to obtain the maximum yield from this plant under Southern Valley (Toshka) conditions.

Keywords: Coriander- Essential oil- Mulch technique.

INTRODUCTION

The agricultural sector consumes about 70% of Egypt's share of water. Water scarcity during the planting season leads to a significant decrease in crop production per plant and feddan. Places suffering from a significant water shortage or where it does not rain are at risk of desertification, poverty and famine due to food shortages linked to water scarcity, which directly affects the agricultural sector FAO (2023).

There is no doubt that good planning for irrigation periods contributes significantly to improving agricultural production by increasing the efficiency of natural resources, as it improves the absorption of nutrients, which helps in the transfer of nutrients from the soil to plant roots, which is reflected in improving the quality of fruits and seeds and increasing their quantity and size. Regular irrigation helps increase flowering and thus increase pollination and production. It also reduces the fall of fruits and seeds during the growth period. Regulating irrigation periods also helps avoid exposing plants to drought or over-irrigation, which is known as water stress, as lack of water may lead to drying out of plants, and its increase may destroy the roots or increase the rate of diseases. It also contributes to increasing water use efficiency in reducing water waste, especially in areas that suffer from water scarcity, which enhances the sustainability of resources Hellegers and Van Halsema (2021).

Agricultural mulch is a cover that covers the surface of the soil and does not allow any growth to appear except for the plants that are desired to be planted only. It is usually used as a plastic cover or any other material that warms the plants and improves the quality of the crop. Many studies have been conducted on in this respect such as Diaz-Perez (2009) on broccoli, and Chakraborty et al. (1994), Hooda et al. (1999), Agrawal et al. (2010), Baye (2011), Gudugi et al. (2012) and Tipu et al. (2014) on tomato (*Lycopersicon esculentum* Miller).

Coriander (*Coriandrum sativum* L.) is an herbaceous plant that reaches a height

of 100 cm. Coriander belongs to *Apiaceae* family and is native to the Mediterranean basin. It is the most popular and widely used spice in the world. It is a plant grown for its seeds, which are the economic part that is exported and used for many purposes, such as the food and medicine industries, etc. (Abdo et al., 2015). Its leaves are lobed and contain some components useful for human nutrition such as carbohydrates, proteins, fibers, vitamins, Ca, Fe and P, (Khater and Salama, 2021 and Khater et al., 2022). The fruits contain aromatic oil (ranging from 0.03-2.6%), of which linalool represents 50% of the components of the volatile oil. The oil also contains monoterpenes, limonene, α-pinene, g-terpinene, para-cymene, citronellol, borneol, camphor, coriandrin, geraniol, etc. (Lopez et al., 2008). The aromatic smell of coriander oil is characterized by the availability of aldehydic compounds in the essential oil (Al-Sanafi, 2016).

This study aimed to evaluate the use of mulching technique, irrigation interval and their interaction treatments on productivity of coriander plants and volatile oil active components under South Valley (Toshka) conditions.

MATERIALS AND METHODS

Two field experiments were performed during two successful growing seasons at Toshka Station (Southern Valley), Desert Research Center, to evaluate the effect of using mulch technique, irrigation intervals and their interaction treatments on productivity and volatile oil active components of coriander plants under southern valley (Toshka) conditions.

Table (1). Chemical analysis of irrigation water using in the experimental

pH	EC	TDS (mg/l)	Element mg/l							
			CO_3^{--}	HCO_3^-	SO_4^-	Cl^-	Na^+	K^+	Mg^{++}	Ca^{++}
7.5	750 µS/cm	480	0	140	134.6	95.4	75.8	3.76	11.24	66.14

Table (2): Physical and chemical properties of experimental farm soil (0–30 cm)

Physical and Chemical Properties				pH	Electrical conductivity (dSm^{-1})	Organic matter (%)
Sand (%)	Silt (%)	Clay (%)	Texture			
92.52	2.22	5.26	Sandy	7.53	16.59	0.24

Soluble ions (meq/l)								
Cations					Anions			
$CaCO_3$ (%)	Ca^{++}	Mg^{++}	K^+	Na^+	Cl^-	CO_3^{--}	HCO_3^-	SO_4^{--}
4.51	42	24	0.17	207	67.5	0	11.2	144.3

Coriander (*Coriandrum sativum* L.) seeds were obtained from the Research Center for Medicinal and Aromatic Plants, Dokki, Giza. Coriander seeds were planted directly in the soil during the period from 10th to 15th of October in the first and second seasons, respectively. After 45 days from sowing, the plants were thinned to one plant per hill. Seeds were sown on rows 70 cm apart and in hills 30 cm apart, (20000 plant/feddan).

The design of the experiment was a split plot including 6 treatments with 3 replicates. The main plot included 2 treatments of mulch technique viz; black polyethylene mulch (50 µ thick), and un-mulch. While the three irrigation intervals treatments were arranged in the Sub-plot included irrigation for two hours daily using drip irrigation system at a rate of 4 liters/hour at the intervals of 1, 2, or 3 days during the growing season. Organic and chemical fertilization was carried out in the quantities and dates recommended in previous studies, as well as replanting of absent plants after planting, removing weeds, and plant protection when necessary. Plants were harvested on the

20th and 25th of May in both seasons, respectively.

The following data were recorded which included; plant height (cm), fresh and dry weights per plant (g), number of umbels/plant, fruit yield per plant (g) and feddan (kg), seed index (weight of 1000 seeds, g), oil percentage (%), oil yield per plant (ml) and feddan (L) and essential oil main components percentage. Main essential oil components percentage was detected by G.L.C apparatus. Extraction of coriander essential oil was conducted according to Guenther (1972).

Data were recorded and statistically analysed according to Snedecor and Cochran (1980) by using the computer program Statistic Version 9 (Analytical software, 2008). Differences between means were compared by using Duncan multiple range test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

1- Plant height:-

Effect of mulch technique:

Data in **Table (1)** demonstrate that mulch technique treatment led to a significant increase in plant height. The maximum plant height recorded with this treatment was 108.44 cm in the first season and 111.61 cm in the second season. On the other hand, in the minimum plant height was observed with un-mulch plants which recorded 73.27 cm in the first season and 73.12 cm in the second season.

Effect of irrigation intervals:

There was a significant increase in plant height (103.47 cm) in the first season and second season (106.34 cm) when plants were irrigated every day. Also, the treatment of irrigation every three days recorded the lowest values of plant height (72.13 cm and 75.62 cm) during both seasons, respectively.

Effect of the interaction between mulch technique and irrigation intervals:

All interaction treatments between mulch technique and different irrigation intervals led to a significant increase compared with the interaction treatments between un-mulch and different irrigation intervals. The best treatment was the interaction between mulch and irrigation every day, which recorded the best values of plant height (121.28 cm and 126.22 cm) during both seasons, respectively. Meanwhile, the treatment of un-mulch with irrigation every three days recorded the lowest values of plant height (56.14 cm and 58.36 cm) during both seasons, respectively.

2- Fresh weight/plant (g):-

Effect of mulch technique:

Data in **Table (1)** explore a significant increase in fresh weight/plant (g) when mulching technique was used since plant height reached its maximum values (392 g and 383.10 g) during both seasons, respectively. Also data show a decrease in fresh weight/plant (g) when plants did not treat with mulch technique.

Effect of irrigation intervals:

As shown in **Table (1)** irrigation intervals had a significant effect on fresh weight/plant (g) specially when plants were irrigated every day since this treatment gained the heaviest fresh weight of plant (383.9 g and 378.5 g) during both seasons, respectively. On the other hand, irrigating plants every 3 days led to a significant decrease in fresh weight/plant (g) as it recorded 271.7 g and 262.4 g during the first and second seasons, respectively.

Effect of the interaction between mulch technique and irrigation intervals:

Data exhibit that the best interaction treatment for enhancing fresh weight/plant was the treatment of mulch technique + irrigating plants every day as it gave the highest values (446.3 g and 424.6 g) during both seasons, respectively. While the treatment of un-mulch technique + irrigating plants every 3 days led to a significant decrease in fresh weight/plant (189.30 g and 179.60 g) during both seasons, respectively

3- Dry weight/plant (g):

Effect of mulch technique:

Data in **Table (1)** illustrate a significant increase in dry weight/plant (g) when using the mulching technique. This increase reached its maximum values (114.83 g and 110.97g) during both seasons, respectively. Data also show a decrease in dry weight/plant (g) when plants did not treat with mulch technique.

Effect of irrigation intervals:

Data in **Table (1)** show the effect of irrigation intervals on dry weight/plant (g) where the significant increase was detected when plants were irrigated every day. This treatment recorded the maximum values (104.57 g and 102.35 g) during both seasons, respectively. On the other hand, irrigating plants every 3 days led to a significant decrease in dry weight/ plant (g) as it recorded 80.97 g and 79.18 g during both seasons, respectively.

Effect of the interaction between mulch technique and irrigation intervals:

Data in **Table (1)** demonstrate that the best interaction treatment was using mulch technique + irrigating plants every two days, as it gave the highest values (128.56 g and 125.14 g) during both seasons, respectively. While the treatment of un-mulch technique + irrigating plants every 3 days led to a significant decrease in dry weight/plant (68.78 g and 65.75 g) during both seasons, respectively.

Table (1). Effect of mulch technique, irrigation intervals and their interactions on plant height (cm), fresh and dry weights/plant (g) of coriander plant during both seasons

Characters	Plant height (cm)			Fresh weight/plant (g)			Dry weight/plant (g)		
Irrigation interval (days)	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean
				First season					
1	85.25 d	121.68 a	103.47 A	321.5 d	446.3 a	383.9 A	86.36 d	122.78 b	104.57 A
2	78.42 e	115.54 b	96.98 B	280.8 e	375.5 b	328.1 B	77.75 e	128.56 a	103.16 A
3	56.14 f	88.11 c	72.13 C	189.3 f	354.1 c	271.7 C	68.78 f	93.15 c	80.97 B
Mean	73.27 B	108.44 A		263.8 B	392.0 A		77.63 B	114.83 A	
				Second season					
1	86.45 d	126.22 a	106.34 A	332.5 d	424.6 a	378.5 A	89.54 d	115.15 b	102.35 A
2	74.55 e	115.74 b	95.15 B	298.3 e	379.6 b	338.9 B	76.45 e	125.14 a	100.80 B
3	58.36 f	92.87 c	75.62 C	179.6 f	345.2 c	262.4 C	65.75 f	92.61 c	79.18 C
Mean	73.12 B	111.61 A		270.1 B	383.1 A		77.25 B	110.97 A	

Means within a column or row having the same letters are not significantly different according to Duncan`s new Multiple Range t-Test at 5 % level

4- Number of umbels/plant:

Analysis of variance show that number of umbels/plant of coriander was significantly affected by using of mulch technique as well as by irrigation intervals and the interaction between them, as the results show significant differences among different tested treatments during both seasons.

Effect of mulch technique:

The effect of the mulch technique on number of umbels/plant is shown in **Table (2)**. It is evident that mulch technique gave a considerable increase compared to un-mulch treatment since it gave the highest values (69.48 and 70.52) during both seasons, respectively.

Effect of irrigation intervals:

Data in **Table (2)** proved that there were significant differences among different irrigation intervals. The best values of No. of umbels/plant were detected during both seasons when plants have been irrigated every day or every two days without significant difference between both treatments. On the other side, irrigating plants every 3 days recorded the lowest value of No. of umbels/ plant (56.16 and 55.30) during both seasons, respectively

Effect of the interaction between mulch technique and irrigation intervals:

Data tabulated in **Table (2)** indicate that the interaction between mulch technique and irrigation intervals had a significant effect on number of umbels/plant. The best treatments were using the mulching technique and irrigating plants every day or every two days during both seasons. While the lowest values of number of umbels/plant (45.86 and 44.85) were recorded when mulch technique did not use and plants were irrigated every three days during both seasons, respectively.

5- Seed index (weight of 1000 seeds) (g):

Effect of mulch technique:

Mulch technique led to a significant increase in the weight of 1000 seeds (g) as it gave the highest values (15.72 g and 16.91 g) during both seasons, respectively. On the other hand, the lowest values of the weight of 1000 seeds (12.45 g and 12.80 g) during both seasons, respectively, were observed in the case of using un-mulch technique **(Table 2).**

Effect of irrigation intervals:

Data in Table 2 illustrate that the best treatment during first season was irrigating plants every two days as it recorded the highest value (14.78 g) while irrigating plants every day or every two days were the best treatments in the second season without insignificant difference between both treatments.

Effect of the interaction between mulch technique and irrigation intervals:

The statistical analysis shows that the interaction between mulch technique and irrigation intervals led to a significant increase in weight of 1000 seeds (g). The highest values (16.77 g and 17.99 g) were obtained when mulch technique was used combined with irrigating plants every two days during both seasons, respectively. On the other side, the lowest values (11.00 g and 10.10 g) of the weight of 1000 seeds (g) were recorded during both seasons, respectively, as un-mulch technique was used with irrigating plants every three days **(Table 2).**

6- Fruit yield/plant (g):

Effect of mulch technique:

As seen in **Table (2)** using mulch technique increased fruit yield/plant which reached its maximum values (93.70 g and 95.74 g) during both seasons, respectively. The data also show a decrease in fruit yield /plant (g) in plants did not treat with mulch technique.

Effect of irrigation intervals:

Data presented in **Table (2)** show the effect of irrigation intervals on fruit yield /plant (g). There was a significant increase when plants were irrigated every two days, as the maximum values (85.76 g and 87.40 g) were recorded with this treatment during both seasons, respectively.

On the other hand, irrigating plants every 3 days led to a significant decrease in this parameter as it recorded 80.54 g and 71.36 g during both seasons, respectively

Effect of the interaction between mulch technique and irrigation intervals:

Analysis of variance illustrate that the best interaction treatment was the using mulch technique + irrigating plants every two days as it gave the highest values (99.30 g and 102.13 g) during both seasons, respectively. on the other side, the treatment of un-mulch technique + irrigating plants every 3 days gained the lowest fruit yield /plant (65.75 g and 46.36 g) during both seasons, respectively

7- Fruit yield/fed (kg):

Effect of mulch technique:

Data in **Table (2)** illustrate using mulch technique significantly increased fruit yield/fed which reached its maximum values (1835.40 kg and 1916.00 kg) during both seasons, respectively. Data also shows a decrease in fruit yield/fed (kg) when plants did not treat with mulch technique.

Effect of irrigation intervals:

There was a significant increase when plants were irrigated every two days, as the maximum values (1648.00 kg and 1734.30 kg) were gained during both seasons, respectively. On the other hand, irrigating plants every 3 days led to a significant decrease in fruit yield/fed (kg) as it recorded 1511.40 kg and 1418.80 kg during both seasons, respectively **(Table 2).**

Effect of the interaction between mulch technique and irrigation intervals:

As seen in **Table (2)** the best interaction treatment was the mulch technique + irrigating plants every two days, as it gave the highest values (1986.0 kg and 2042.6 kg) during both seasons, respectively. On contrary, the treatment of un-mulch technique + irrigating plants every 3 days led to a significant decrease in fruit yield/fed (1315.0 kg and 927.20 kg) during both seasons, respectively.

The above mentioned results are in agreement with those obtained by Diaz-Perez (2009) on broccoli and Chakraborty et al. (1994), Hooda et al. (1999), Agrawal et al. (2010), Baye (2011), Gudugi *et al*. (2012) and Tipu et al. (2014) on tomato (*Lycopersicon esculentum* Miller).

Table (2). Effect of mulch technique, irrigation intervals and their interactions on number of umbels/plant, seed index (g), fruit yield/plant (g) and fruit yield/feddan (kg) of coriander plant during both seasons

Characters	No. of umbels/plant			Seed index (g)		
Irrigation interval (days)	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean
			First season			
1	64.54 c	70.48 a	**67.51 A**	13.58 d	14.96 c	**14.27 B**
2	60.96 d	71.52 a	**66.24 A**	12.78 e	16.77 a	**14.78 A**
3	45.86 e	66.45 b	**56.16 B**	11.00 f	15.44 b	**13.22 C**
Mean	**57.12 B**	**69.48 A**		**12.45 B**	**15.72 A**	
			Second season			
1	66.45 c	71.85 b	**69.15 A**	14.85 d	16.74 b	**15.80 A**
2	62.77 d	73.96 a	**68.37 A**	13.45 e	17.99 a	**15.72 A**
3	44.85 e	65.75 c	**55.30 B**	10.10 f	16.00 c	**13.05 B**
Mean	**58.02 B**	**70.52 A**		**12.80 B**	**16.91 A**	
	Fruit yield/plant (g)			**Fruit yield/fed (kg)**		
			First season			
1	79.56 d	86.46 c	**83.01 B**	1591.2d	1729.2c	1660.2B
2	72.22 e	99.30 a	**85.76 A**	1444.4e	1986.0a	1715.2A
3	65.75 f	95.33 b	**80.54 C**	1315.0f	1906.6b	1610.8C
Mean	**72.51 B**	**93.70 A**		**1450.2B**	**1874.0A**	
			Second season			
1	78.12 d	88.78 c	**83.44 B**	1562.4d	1775.6c	166.8B
2	72.68 e	102.13 a	**87.40 A**	1453.6e	2042.6a	1748.0A
3	46.36 f	96.36 b	**71.36 C**	927.2f	1927.2b	1427.2C
Mean	**65.72 B**	**95.74 A**		1314.4B	1914.8A	

Means within a column or row having the same letters are not significantly different according to Duncan`s new Multiple Range t-Test at 5 % level

Moreover, mulch technique preserves the soil from drought, and adjusts the basic and important factor in the transfer of water and nutrients from the soil to the plant. It is important in the stages of the initial growth of the plant, which affects the production, development, and creation of suitable conditions for obtaining a strong vegetative and root system, and thus an increase in the efficiency of photosynthesis and an increase in the efficiency of absorption of nutrients from the soil solution, especially in the early stages of growth. Studies also indicate the role of cover in improving the physical and chemical properties of the soil and the provision of nutrients necessary for plant growth and meeting the plant's needs during the various growth stages, which positively

affects the productivity and characteristics of the final crop.

8- Volatile oil (%):

Effect of mulch technique:

Data in **Table (3)** show that oil percentage in *Coriandrum sativum*, L. was significantly affected by mulch technique in both seasons. Also, mulch technique was the better than um-mulch treatment, as it recorded the highest oil percentages (2.64% and 2.73%) during both seasons, respectively.

Effect of irrigation intervals:

Using different irrigation intervals in both seasons significantly affected volatile oil (%) in *Coriandrum sativum*, L. Data show a significant increase in volatile oil (%) when plants were irrigated every day or every two days compared with plants irrigated every three days during first season while irrigation every two days proved to be the best treatment during second season **(Table 3).**

Effect of the interaction between mulch technique and irrigation intervals:

The interaction between mulch technique and different irrigation intervals had a significant effect on volatile oil percentage during both seasons. Mulch technique treatment with irrigation every two days gave the highest values of oil percentage (2.95% and 3.00%) compared to other interaction treatments during both seasons, respectively **(Table 3).**

9- Oil yield (ml/plant):

Effect of mulch technique:

Data in **Table (3)** show that oil yield (mL/plant) of the coriander plant was significantly affected by mulch technique in both seasons. Mulch technique outperformed un-mulch technique which gave 0.81 ml to 0.79 ml/plant during both seasons, respectively.

Effect of irrigation intervals:

Data in **Table (3)** reveal that the highest values of oil yield (ml/plant) were observed when plants were irrigated every day or every two days without significant difference between both treatments.

Effect of the interaction between mulch technique and irrigation intervals:

In most cases the maximum oil yield (ml/plant) values were observed when plants were treated with mulch technique regardless irrigation intervals **(Table 3).**

10- Oil yield (l/fed.):

Effect of mulch technique:

Data in **Table (3)** show that oil yield (l/fed.) of coriander plant was significantly affected by mulch technique in both seasons where mulch technique outperformed un-mulch technique which ranged from 16.20 L to 15.73 L in both seasons, respectively.

Effect of irrigation intervals:

In most cases irrigation intervals had no significant effect on volatile oil yield (l/fed.), especially during second season **(Table 3).**

Effect of the interaction between mulch technique and irrigation intervals:

The maximum oil yield (l/fed.) values were observed when mulch technique was used in addition to irrigating plants every three days since this treatment gave 17.40 and 16.20 l/fed during both seasons, respectively **(Table 3).**

Table (3). Effect of mulch technique, irrigation intervals and their interactions on volatile oil (%), oil yield/plant (ml) and oil yield/fed. (L) of coriander plant during both seasons

Characters	Volatile oil (%)			Oil yield/plant (ml)			Oil yield /fed. (L)		
Irrigation interval (days)	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean
First season									
1	1.94 c	2.75 a	**2.35 A**	0.74 ab	0.77 ab	**0.76 A**	14.80d	15.40c	**15.10A**
2	1.88 c	2.95 a	**2.42 A**	0.65 b	0.79 ab	**0.72 A**	13.00e	15.80b	**14.40B**
3	1.55 d	2.22 b	**1.89 B**	0.35 c	0.87 a	**0.61 B**	7.00f	17.40a	**12.20C**
Mean	**1.79 B**	**2.64 A**		**0.58 B**	**0.81 A**		**11.60B**	**16.20A**	
Second season									
1	1.75 d	2.45 c	**2.10 B**	0.71 ab	0.75 ab	**0.73 A**	14.20d	15.00c	**14.60A**
2	1.53 e	3.00 a	**2.27 A**	0.62 b	0.81 a	**0.72 A**	12.40e	16.20a	**14.30B**
3	1.28 f	2.75 b	**2.02 B**	0.38 c	0.80 a	**0.59 B**	7.60f	16.00ab	**11.80C**
Mean	**1.52 B**	**2.73 A**		**0.57 B**	**0.79 A**		**11.40B**	**15.73A**	

Means within a column or row having the same letters are not significantly different according to Duncan`s new Multiple Range t-Test at 5 % level

11- Oil chemical constituents:

Fruits obtained from the second season were analyzed by using chromatographic spectroscopy (G.L.C) to explore the chemical components of volatile oil. Data in **Table (4)** show the presence of six compounds, namely Limonene, p-Cymene, Linalool, Nerol, Borneol, and Geraniol, in the volatile oil of coriander. It was also clear that Linalool, the main component of coriander oil, reached to 38.42% when mulch technique was applied with irrigating plants every two days. The second main component was p-Cymene, which reached 26.85%, followed by Limonene, which reached 19.82% when the plants were treated with above mentioned treatment.

Effect of mulch technique:

The enhancing effect of mulch technique on coriander plants was observed since the maximum values of main volatile oil components (Linalool 38.51%, p-Cymene 26.75%, Limonene 19.70%, Nerol 7.93%, Borneol 2.81% and Geraniol 2.51%) were gained with mulch technique **(Table 4).**

Effect of irrigation intervals:

Most of main essential oil active compounds were reached their maximum percentages when plants were irrigated every day or two days, while the lowest percentages of these compounds were detected as plants were irrigated every three days.

Effect of the interaction between mulch technique and irrigation intervals:

All the coriander essential oil components were increased when mulch technique was applied with irrigating plants every two days. The highest percentages (19.82, 26.85, 38.77, 7.99, and 2.88) of Limonene, p-Cymene, Linalool, Nerol, and Borneol, respectively, were recorded as the above mentioned interaction treatment was applied. While, Geraniol compound recorded its maximum percentage (2.86) when mulch technique was applied with irrigating plants every three days.

These results are in line with those obtained by Al-Azzony and Khater (2021) on fennel, Gewefile et al. (2009 a) on *Nicotiana glauca*, Khater (2019) on *Origanum majorana*, Khater (2020) on marjoram plant, Gewefile et al. (2009 b) on Nicotiana glauca and Khater and Al-Azzony (2020) on sweet basil.

The use of mulch technique may have contributed to the increase in vegetative growth and productivity parameters (plant height, fresh and dry weights/plant), a number of umbels/plant, seed index, fruit yield/plant, and fruit yield/feddan of coriander plants during both seasons. This could be because mulch improves the environmental conditions surrounding the plant, particularly in the early stages of cultivation and growth, which led to plants flowering at the right time, as evidenced by the increase in nodes prior to the rise in summer temperatures, which may have an impact on the formation of flowers and nodes.

The above mentioned results clearly demonstrated that all recorded vegetative growth and productivity parameters were affected by irrigation intervals. This may be because irrigation is an important factor in achieving optimal crop productivity. The availability of continuous moisture in the soil is one of the most important factors in producing a strong plant as it affects the strength and growth of the roots, which makes the plant more resistant. It also facilitates the absorption of elements and nutrients from the soil to the plant, thus the growth is regular, especially in the early stages of plant growth from germination to flowering and fruiting.

Moreover, regular irrigation during the flowering period leads to stimulate the process of photosynthesis and the transfer of carbohydrates and sugars, which is reflected in the increase in productivity of fruits and seeds, and thus an increase in the production of seeds per acre, the economic part of the coriander plant, as well as the amount of volatile oil per acre (Moniruzzaman et al., 2013).

Table (4). Effect of mulch technique, irrigation intervals and their interactions on coriander plant main essential oil components percentage of during second season

Irrigation interval (days)	Main components (%)								
	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean	Un–mulch	Mulch	Mean
	Limonene			**p-Cymene**			**Linalool**		
1	19.55	19.76	**19.66**	26.26	26.85	**26.56**	37.54	38.42	**37.98**
2	19.64	19.82	**19.73**	26.46	26.85	**26.66**	36.23	38.77	**37.50**
3	19.11	19.51	**19.31**	26.22	26.56	**26.39**	35.66	38.35	**37.01**
Mean	**19.43**	**19.70**		**26.31**	**26.75**		**36.48**	**38.51**	
	Nerol			**Borneol**			**Geraniol**		
1	7.74	7.94	**7.84**	2.65	2.78	**2.72**	2.02	2.45	**2.24**
2	7.54	7.99	**7.77**	2.55	2.88	**2.72**	1.97	2.21	**2.09**
3	7.41	7.85	**7.63**	1.89	2.77	**2.33**	1.84	2.86	**2.35**
Mean	**7.56**	**7.93**		**2.36**	**2.81**		**1.94**	**2.51**	

Means within a column or row having the same letters are not significantly different according to Duncan`s new Multiple Range t-Test at 5 % level

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الملخص العربي

تقييم استخدام تقنية التغطية وفترات الري على إنتاجية نباتات الكزبرة والمكونات الفعالة للزيت الطيار تحت ظروف وادي الجنوب (توشكى)

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تم إجراء تجربتين ميدانيتين خلال موسمين زراعيين متتاليين أعوام 2019/2018 و2020/2019 في محطة توشكى (الوادي الجنوبي)، مركز بحوث الصحراء، لتقييم استخدام تقنية التغطية وفترات الري وتداخلاتهما على نمو وإنتاجية والمكونات الفعالة للزيت الطيار لنبات الكزبرة تحت ظروف الوادي الجنوبي (توشكى).

تشير النتائج المتحصل عليها إلى تفوق التفاعل بين تقنية التغطية و الري كل يوم او يومين مقارنة بقية المعاملات المختبرة. هاتان المعاملتان سجلتا أعلى القيم لخصائص النمو الخضري (ارتفاع النبات ، الوزن الطازج والجاف/نبات) و المحصول (عدد النورات الخيمية/نبات، دليل البذور ، محصول الثمار/نبات ومحصول الثمار/فدان ، النسبة المئوية للزيت الطيار ، محصول الزيت /نبات، ومحصول الزيت /فدان) لنبات الكزبرة خلال كلا الموسمين.

علاوة على ذلك فإن المكونات الفعالة بالزيت العطري بلغت قيمتها القصوى عندما استخدمت تقنة التغطية مع ري النباتات كل يومين و تلك المعاملة هي التي نوصي بها للحصول على أقصى محصول من هذا النبات تحت ظروف الوادي الجنوبي (توشكى).