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Impact of Planting Dates and Organic Fertilization on Growth, Productivity and Essential Oil Components of Coriander (*Corianderum sativum* L) Plant.

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THE field experiment was conducted to assess the impact of planting dates, organic fertilization and their combinations during the two successive seasons of 2019/2020 and 2020/2021 at the Experimental Farm of the Faculty of Agriculture, Ain Shams University, Cairo, Egypt on vegetative growth and oil productivity in addition to oil components of (*Corianderum sativum* L.). Four sowing dates were 1st and 15th October, 1st and 15th November. Application of compost was carried out at four levels (0, 10, 20 and 30 m^3 /feddan). Results showed that sowing dates affected on growth of coriander. and the interaction between sowing date at 1th November and 20 m^3/feddan of compost highest meaningful values of vegetative growth, yield metrics, and increased volatile oil percentage in both seasons, whereas unfertilized with sown in 15th November showed the lowest significant values in the both seasons. Coriander oil had 31 different components, according to by GC– MS analysis of essential oil. For plants cultivated under all treatments, linalool was discovered to be the primary ingredient with the highest proportion obtained in oil sample. In addition to the other important components were (Geranyl acetate, γ-Terpinene and α-Pinene).

Keywords: Coriander, Planting dates, Organic fertilization, Compost, Essential oil.

Introduction

Coriander plant (*Coriandrum sativum* L.) is an aromatic annual herbaceous plant belongs to Apiaceae (Umbelliferae) family which originates from Mediterranean area and Middle Eastern (Khater et al., 2021). Frequently referred to as Kazbra in Sudan and Egypt and commonly known as "Dhanya" in India. One of the most important introduced medicinal and aromatic plants in Egypt is coriander. It is one of the important herbs that are used in the manufacture of herbal medicine, spices, cosmetics and perfumes (Saleh and Dina 2021). It is one of a valuable seed species that plays a key role in adding flavour to a variety of foods around the world (Rashed and Darwesh, 2015). The coriander is grown for both the fresh green herb and the spice seed (Shahwar et al., 2012 and Carrubba, 2014) reportedly include coriander fruit essential oil up to 2.6% essential oil. Some vitamins found in coriander leaves include vitamins C, A, and B2 and they also present a high antioxidant activity (Matlok et al., 2021). The essential oil is a blend of different kinds of terpenes that is a yellow or colorless liquid (Kadhim, 2021). Coriander fruits and essential oil have medicinal properties, it has been recommended for stimulate digestion, treatment of rheumatism (Szemplinski et al., 2018), loss of appetite, dyspeptic complaints, convulsion, insomnia and anxiety (Said-Al Ahl and Khalid, 2010).

Coriander is one of these sensitive crops affected by climate change. The planting date is one of the important factors for obtaining

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maximum productivity of plants (Massoud et al., 2016). Climate changes will have far-reaching consequences for agriculture that will disproportionally affect crop productivity**.** There is an urgent need for a long-term strategic plan to reduce the negative effects of climate change. The sowing date is one the most critical factors for obtaining the highest yield of coriander plants. The seeds that were planted late encounters high temperature stress in the stage of seed growth, which causes a great yield reduction. Temperature is a major climatic variable that affects crop growth and production. The timing of planting is significantly influenced by temperature. Between 20 and 25º C is the optimum temperature for germination and the first stages of growth (Ghobadi and Ghobadi, 2012, Lal, 2013 and Moniruzzaman et al., 2015).

Currently, agriculture depends on the use of fertilizers and nutrients. There is a strong trend towards reducing the use of mineral fertilizers and replacing them with less expensive and environmentally safe organic fertilizers in the cultivation of medicinal and aromatic plants. Organic fertilizers were including cattle manure and compost. Moreover, compost is an excellent source of macro and micro-nutrients as well as organic compounds, which make it an excellent organic fertilizer.

Compost improves the physical and chemical characteristics of soil, such as soil structure, soil aggregation, porosity, hydraulic conductivity, air exchange, water holding capacity, and soil pH, in addition to its role in increasing plant output (Khater et al., 2021). Badran et al., (2018) pointed to the role of organic fertilizers in increasing the number of seeds of coriander plants. On another hand, chemical fertilizers are used with the compost because they contain a lot of nutrients and that plants can quickly absorb them (Kadhim, 2021). NPK fertilization should be mixed with compost to enhance soil structure, promote root development, supply nutrients, and allow plants to absorb nutrients (Rashed and Darwesh, 2015)

The objective of this study was the effect of planting dates and organic fertilization on growth, productivity and the essential oil components of (*Corianderum sativum* L) plant under different planting dates and different levels of compost.

Materials and Methods

At the Experimental Farm of the Faculty of Agriculture, Ain Shams University, Cairo, Egypt ; A field experiment was conducted over the period of the two succeeding seasons of 2019/2020 and 2020/2021 to evaluate the effect of sowing dates and organic fertilization on the growth, yield and oil components of *Corianderum sativum* L. plant. Chemical and physical properties of the experimental soil are shown in Table 1.

Chemical fertilizer

Recommended dosages from Agriculture Ministry of N, P and K were used by the rate of 300 kg/feddan of ammonia sulphate (20.5%), mono superphosphate (15.5%) 200 kg /fed. and 50 kg/fed. potassium sulphate (48%). The fertilizers were added at 100% for control, and 50% for all treatments.

Mono superphosphate and agricultural sulphur were added during the soil preparation. Ammonia sulphate was added in two equal doses; the first was after thinning. Which was done after 21 days from planting (2 plants per hill), and the second one was after 45 days of the first addition. Potassium sulphate was added at the beginning of flowering.

Organic fertilizer

The plant compost was added during the soil preparation, with the rates of: 0, 10, 20, and 30 m^3/fed. The compost obtained from El Shafie

TABLE 1. Chemical and physical properties of the experimental soil

Physical analysis				**Chemical analysis**			
Sand (%)	Silt (%)	Clay (%)	Texture	pH	EC_e (dS/m)	$CaCO_3$	Organic matter (%)
22.56	41.21	36.23	Clay loam	7.88	0.84	1.28	-

Soluble Cations meq/l			**Soluble Anions meq/l**			**Available elements ppm**		
Na+	Ca++	Mg++	Cl-	SO_{4-}	HCO_{3-}	N	P	K
3.23	4.83	2.7	3.66	3.28	3.2	0.2	0.31	0.42

Compost Company, Belbies, El Sharqaya, Egypt. Table 2 shows the results of the chemical analysis of the used compost.

Planting dates

Four dates were used (1st and 15th October, 1st and 15th November)

Metrological data

Maximum and Minimum air temperature (˚C) and relative humidity (RH %) records during the two growing seasons were obtained from Central Lab. for Agricultural Climate, Agricultural Research Centre (ARC), are presented in Table 3.

Experimental design

The Experiment was in Shubra-El-Khema, Qalyubiyah, Egypt .located with latitude (30.11) and longitude (31.24). The Experimental design was a split-plot in a randomized complete block design with three replicates.

Each plot (2.5*1.5 m) contains 2 rows. The space between hills was 25 cm and the line was 2.5 m. Main factors were planting dates and the sub- main factors were fertilizer rates.

Recorded data

Data were taken at the beginning of flowering, the plant height (cm), the number of main branches per plant, the fresh and dry weights of each plant (g), and the weight of fruit produced per plant (g), were all recorded. Harvest time was differed for each planting date (Table 4).

Determination of essential oil percentage

The oil percentage was determined according to the method described in the British Pharmacopoeia (1963), by using Clavenger's apparatus for determination of essential oils lighter than water. Fifty g of seeds were put in the distillation flask of the apparatus immediately after being grind (to avoid any loss of the essential oil), then 250 ml of distilled water were added and allowed to boil on a water bath for 3 hours. After finishing the distillation, the essential oil was collected and measured in a graduated tube, and then the percentage of the essential oil was calculated as follows:

$$\text{Essential oil (\%)} = \frac{\text{Essential oil vol. (reading measured pipette)} \times 100}{\text{Weight of sample}}$$

The oil was filtrated on sodium sulphate anhydrous to eliminate any moisture.

The components of essential oils by (GC – MS) analysis

Analysis of the sample was conducted by using a a gas chromatography (Agilent 8890 GC System), coupled to a mass spectrometer (Agilent 5977B GC/MSD) and equipped with a HP-5MS

TABLE 2. Chemical composition Analysis of the used compost

Weight of m3 (kg)	Moisture %	pH	Ec (m.mhos)	Organic matter (%)	N (%)	C (%)	P (%)	K (%)	C/N ratio	Ash %
600	23	8.28	5.01	39.31	1.08	22.8	0.59	0.88	21	60.69

TABLE 3. Maximum and Minimum air temperature (˚C) and relative humidity (RH %) records during the two growing seasons

Months	2019/2020 season			2020/2021season		
	RH	T (˚C)		RH	T (˚C)	
		Max.	Min.		Max.	Min.
October	53.52	32.45	18.7	52.16	33.84	19.48
November	51.79	28.53	14.92	60.35	25.18	14.24
December	63.7	21.05	9.58	58.42	23.11	10.89
January	67.4	18.05	7.31	58.14	21.88	8.74
February	63.82	20.54	8.09	59.37	22.12	8.77
March	56.49	24.73	10	58.58	23.62	9.57
April	53.67	27.2	12.11	44.7	30.06	11.89
May	46.94	32.93	15.77	32.24	37.54	18.01

TABLE 4. Number of days for flowering and harvest

Treatments	Flowering	Harvest
SD1	107	211
SD2	112	215
SD3	142	219
SD4	147	223

SD1= 1st October SD2= 15th October SD3= 1st November SD4 = 15th November

fused silica capillary column (30 m, 0.25 mm i.d., 0.25 mm film thickness). The oven temperature was maintained initially from 50 ˚C/min then the temperature was programmed from 50 ˚ to 200 ˚ C/min at rate 4 ˚ C/min then programmed from 200 to 280 ℃/min at rate 10 ˚ C/min. Helium was used as the carrier gas, at flow rate of 1 mL/ min. The temperature of injection was 230 °C. The injection of sample was a split mode at ratio 1:50. Mass spectra in the electron impact mode (EI) were obtained at 70 eV and scan m/z range from 39 to 500 amu. The isolated peaks were identified by matching them with data from the library of mass spectra (National Institute of Standard and Technology, NIST).

Statistical analysis

The data was submitted for statistical variance analysis. To compare means, the Tukey test was used. To demonstrate the differences between treatments, a one-way ANOVA test was used. SAS's analysis of variance package was used to statistically analysis the data (Snedecor and Cochran, 1972).

Results and Discussion

Influence of planting dates, organic fertilization and their combinations on growth and productivity characters

Data in Table 5 show that the plants sown on 1st November showed the greatest results for plant height and the number of main branches per plant in both seasons, however when addition 20 m^3/ fed. followed by 30 m^3/fed. gave the best value with non-significant differences between them for plant height in both seasons. However adding the same treatment gave the best value with non-significant differences between them in the first season for the number of main branches per plant, but, the best result was adding 0 m^3/fed. in the second season. Concerning of the interaction between sowing dates and organic fertilization, it is clear that the pronounced the best values for plant height and the number of main branches per plant when were plants sown in (SD3 and F3) in the first and second seasons.

Data in Table 6 indicate that the plants sown on 1st November gave the maximum results for weight of each plant's fresh herbs during both seasons .Although, the plants sown on 1st November gave the best results for herb dry weight per plant in the first season. While, when the plants sown on 15th October and 1st November gave the best values with non-significant differences between them in the second season. When addition 20 m^3/fed. of compost produced the best results for weight of fresh herbs per plant in the first and second seasons. While, when addition 20 m^3/fed. gave the best values for herb dry weight per plant in the first season. But, when addition 10 m^3/fed. gave the best values in the second season. As for the interaction between sowing dates and organic fertilization, it is produced that the best result for herb fresh weight per plant in (SD3 and F3) in the first season and (SD2 and F3) in the second season. Regarding to the best results for herb dry weight per plant in (SD2 and F3) in the first season and (SD2 and F2) in the second season.

Data tabulated in Table 7 indicated that the greatest values of fresh and dry weight of the roots per plant (g) from plants sowing in 1st November in the first season without significant differences with 15th October in the second season for root fresh weight and adding 20 m^3/fed. of compost produced the best results for roots fresh and dry weight / plant (g) in the first and the second season without significant differences with 30 m^3/fed. in the second season for root dry weight. Concerning of the interaction between planting dates and organic fertilization, it is clear that the pronounced the best values for roots fresh weight per plant (g) when plants sown in (SD2 and F3)

TABLE 5. Impact of planting dates , organic fertilization and their combinations on plant height and number of main branches per plant of coriander during the 2019/2020 and 2020/2021 seasons

	2019/2020 Season					2020/2021 Season				
	Plant height (cm)									
Treat	**F1**	**F2**	**F3**	**F4**	**Mean**	**F1**	**F2**	**F3**	**F4**	**Mean**
SD1	84.67 d	70.00 h	87.00 gf	89.67 c	80.58 C	70.67 ef	71.33 e	79.00 d	83.66 b	76.17 C
SD2	76.67 g	96.67 b	89.67 c	80.33 ef	85.83 B	84.33 b	78.00 b	76.67 d	82.33 bc	80.33 B
SD3	78.00 gf	96.33 b	101.00 a	81.33 e	89.17 A	82.67 b	79.33 dc	90.33 a	79.00 d	82.83 A
SD4	70.67 h	56.33 j	61.67 i	75.67 g	66.08 D	55.67 h	55.00 h	67.67 gf	65.33 g	60.92 D
Mean	77.50 C	79.83 B	82.58 A	81.75 A		73.33 B	70.92 C	78.42 A	77.58 A	
	Number of main branches/plant									
SD1	11.00 e-f	11.67 e-f	9.67 f	10.33 f	10.67 C	10.00 de	12.00 cd	12.00cd	11.00 de	11.25 B
SD2	13.33 b-c	9.67 f	14.33 b-c	11.33 e-f	12.17 B	15.00 ab	11.33 d	11.00 de	11.00 de	12.08 B
SD3	14.66 b-c	16.33 a	16.33 a	15.33 ab	15.67 A	14.33 bc	14.33 bc	17.33 a	14.33 bc	15.08A
SD4	9.33 f	9.33 f	9.33 f	12.33 c-e	10.08 C	11.67 cd	9.67 de	8.33 e	10.67 de	10.08 C
Mean	12.08 A	11.75 A	12.41 A	12.33 A		12.75 A	11.83 AB	12.17 AB	11.75 B	

Means designed by the same letter at each cell are not significantly different at the 5% level according to Tukey s multiple range tests.
SD1= 1st October SD2= 15th October SD3= 1st November SD4 = 15th November
F1= 0 m^3/fed. F2= 10 m^3/fed. F3= 20 m^3/fed. F4= 30 m^3/fed.

TABLE 6. Impact of planting dates, organic fertilization and their combinations on herb fresh weight (g/plant) and herb dry weight (g/plant) of coriander during the 2019/2020 and 2020/2021 seasons

	2019/2020 Season					2020/2021 Season				
	Herb fresh weight/plant (g)									
Treat	**F1**	**F2**	**F3**	**F4**	**Mean**	**F1**	**F2**	**F3**	**F4**	**Mean**
SD1	101.56 ml	148.20 g	142.26 h	88.34 n	120.09 C	107.45 h	132.44 f	129.36 f	222.08 b	147.83 C
SD2	87.52 n	157.07 f	134.83 i	195.86 d	143.82 B	93.70 j	202.68 c	253.43 a	101.46 i	162.82 B
SD3	203.68 c	190.36 e	285.23 a	208.42 b	221.99 A	156.35 e	201.02 c	170.11 d	154.05 e	170.38 A
SD4	105.86 k	103.80 kl	100.24 m	129.28 j	109.79 D	123.35 g	89.39 k	108.92 h	87.01 k	102.17 D
Mean	124.65 D	149.93 C	165.64 A	155.48 B		120.22 D	156.38 B	165.45 A	141.15 C	
	Herb dry weight/plant (g)									
SD1	25.86 f	19.99 h	25.01 fg	24.28 fg	23.79 C	29.59 c	17.88 fg	27.79 c	19.41 f	23.76 B
SD2	27.89 e	23.25 g	40.00 a	16.71 i	26.96 B	17.78 fg	37.22 a	29.67 c	14.54 h	24.80 A
SD3	31.87 cd	33.07 c	30.62 d	37.20 b	33.19 A	19.89 f	24.39 de	22.48 e	32.47 b	24.81 A
SD4	14.03 j	19.55 h	14.33 j	21.20 h	17.28 D	24.16 de	25.45 d	11.19 i	16.86 g	19.41 C
Mean	24.92 B	23.97 C	27.49 A	24.85 B		22.85 B	26.23 A	22.78 B	20.82 C	

Means designed by the same letter at each cell are not significantly different at the 5% level according to Tukey s multiple range tests.
SD1= 1st October SD2= 15th October SD3= 1st November SD4 = 15th November
F1= 0 m^3/fed. F2= 10 m^3/fed. F3= 20 m^3/fed. F4= 30 m^3/fed.

TABLE 7. Impact of planting dates, organic fertilization and their combinations on roots fresh weight (g/plant) and roots dry weight (g/plant) of coriander during the 2019/2020 and 2020/2021 seasons

	2019/2020 Season					2020/2021 Season				
	Roots fresh weight/plant (g)									
Treat	**F1**	**F2**	**F3**	**F4**	**Mean**	**F1**	**F2**	**F3**	**F4**	**Mean**
SD1	4.27 e	2.69 ih	4.96 d	3.91 e	3.96 C	3.93 ef	4.08 ef	3.38 f	4.92 e	4.08 B
SD2	2.94 gh	5.21 d	10.27 a	6.75 b	6.29 B	3.92 ef	6.79 c	9.87 a	3.37 f	5.99 A
SD3	6.22 c	6.83 b	6.56 bc	6.97 b	6.64 A	6.20 cd	4.93 de	5.01 de	8.43 b	6.14 A
SD4	3.87 ef	4.37 e	2.27 i	3.36 gf	3.46 D	3.99 ef	3.75 ef	4.03 ef	2.90 f	3.67 B
Mean	4.32 D	4.77 C	6.01 A	5.25 B		4.51 B	4.89 B	5.57 A	4.91 B	
	Roots dry weight/plant (g)									
SD1	1.05 e	0.71 h	1.18 d	0.94 f	0.97 C	0.98 de	0.88 f	1.10 b	0.89 f	0.96 C
SD2	1.32 c	1.05 e	1.86 a	1.16 d	1.35 B	0.62 i	0.90 ef	1.00 cd	1.56 a	1.02 B
SD3	1.20 d	1.73 b	1.21 d	1.34 c	1.37 A	0.92 ef	1.54 a	1.59 a	0.80 g	1.21 A
SD4	0.82 g	0.83 g	0.48 j	0.60 i	0.68 D	0.76 gh	0.76 gh	0.71 h	1.10 bc	0.82 D
Mean	1.10 B	1.08 B	1.18 A	1.01 C		0.82 C	1.02 B	1.10 A	1.08 A	

Means designed by the same letter at each cell are not significantly different at the 5% level according to Tukey s multiple range tests.
SD1= 1st October SD2= 15th October SD3= 1st November SD4 = 15th November
F1= 0 m^3/fed. F2= 10 m^3/fed. F3= 20 m^3/fed. F4= 30 m^3/fed.

in 1st and 2nd season and the greatest values of roots dry weight per plant (g) when plants sown in (SD2 and F3) in the first season and (SD3 and F3) in the second season.

The preceding results showed an increase in vegetative growth and coriander crop. This increase may result from an increased uptake of essential nutrients by the plant. Composting enhances the structure of the soil and makes it easier to cultivate when combined with conventional NPK fertilizer, encouraging roots growth and providing them with nutrients and enabling plants to increase their uptake (Rashed and Darwesh, 2015).Moreover, Compost helps absorb water and retain it in the soil (lea Master et al., 1998).And showed that vegetative growth traits, plant height and herb dry weight per plant of coriander plants increase significantly due to fertilizer application and the highest values being obtained due to the higher level of compost (Badran et al., 2018 and Abdallah, 2009)

The maximum values were detected at the middle sowing date on 1th November while the lowest values were detected at the late sowing date on 15th of November. These effects may be due to optimum temperature and a longer photoperiod reaching the crop during its growth period at the early sowing date which can give plants an opportunity to build up more stored foods compared to later sowing dates and this may be reflected in faster growth for plants. Whereas the low yield at the late sowing date was caused by the plant quickly entering the reproductive stage, which left inadequate time for vegetative growth (Sharangi, 2014, Rahnavard et al., 2010) In addition to, early seeding of black cumin plants revealed an increase in plant height and an increase in the number of main and secondary branches each plant (Al-Zubaidy et al., 2020) additionally, the early cultivation of fennel resulted in a considerable increase in plant height, beside an increase in the number of branches and fruits each plant (Al-Dalain et al., 2012).

Fruit yield/ plant and essential oil's components

Data presented in Table 8 indicated that the highest values of Seeds weight/plant (g) and essential oil (%) were recorded from the plants sown on 15th October and 1st November gave the best results for Seeds weight/plant (g)

and essential oil (%) in the first season without significant differences with 1st November in the second season for Seeds weight/plant (g). However, the addition 20 m^3/fed.of compost produced the best results for seeds weight/plant (g) in the first and the second season without significant differences with control and 30 m^3/fed in the first season, while the addition 20 m^3/fed gave the best values for essential oil (%) in the first and the second season without significant differences with 10 m^3/fed in the second season. Regarding to the interaction between sowing dates and organic fertilization, it is produced that the highest values of seeds weight/plant (g) and essential oil (%) when plants sown in (SD3 and F3) in both seasons.

The components of the essential oils

According to Table 9, the GC-MS analysis of coriander essential oil revealed the presence of 31 components in the first season. The main components were (linalool, Geranyl acetate, γ-Terpinene, α-Pinene, Camphor, p-Cymene and Geraniol) respectively. The greatest percentage of Linalool (65.76 %) was gotten from (SD2F3) and the lowest value (53.63%) was obtained from (SD3F2), the highest value of Geranyl acetate content (9.97%) was obtained from (SD3F3) and the lowest value (7.3%) was obtained from (SD3F1), the highest value of γ-Terpinene content (9.27%) was obtained from (SD3F2) and the lowest value (5.63%) was obtained from (SD3F1) , the highest value of α-Pinene content (6.69%) was obtained from (SD3F2) and the lowest value (3.35%) was obtained from (SD2F3), the highest value of Camphor content (5.39%) was obtained from (SD3F1) and the lowest value (2.89%) was obtained from (SD3F4), the highest value of p-Cymene content (4.35%) was obtained from (SD3F2) and the lowest value (2.65%) was obtained from (SD3F1) and the highest value of Geraniol content (3.43%) was obtained from (SD2F4), (SD3F1) and the lowest value (2.36%) was obtained from (SD3F4).The lowest oil components were (Acetone dimethyl acetal, Decanal, cis-Anethole) the value of Acetone dimethyl acetal content (0.15 and 0.14) were obtained from (SD2F3 and SD3F2), the value of Decanal content (0.31) was obtained from (SD2F1) and the value of cis-Anethole content (0.31) was obtained from (SD3F2).

According to the previous results, the early sowing date gave the highest yield because of high temperature during both the vegetative and reproductive phases and the lowest value for yield this may have occurred because temperatures were lower during the early stages of vegetative growth and were higher than ideal during the blooming and fruit forming stages (Msaada et al., 2012). Inan et al., (2014) reported that the essential oil content

TABLE 8. Impact of planting dates, organic fertilization and their combinations on seeds weight (gm/plant) and essential oil (%) of coriander during the 2019/2020 and 2020/2021 seasons

	2019/2020 Season					2020/2021 Season				
	Seeds weight/plant (g)									
Treat	**F1**	**F2**	**F3**	**F4**	**Mean**	**F1**	**F2**	**F3**	**F4**	**Mean**
SD1	15.98 d-f	13.60 fg	13.27 fg	18.30 de	15.29 B	16.35 g-h	13.43 g-h	18.33 ef	17.20 f-g	16.33 C
SD2	19.14 de	20.34 c-d	19.78 cd	24.83 b	21.02 A	22.43 cd	20.03 c-d	23.14 bc	18.77 d-e	21.09 B
SD3	24.40 bc	18.73 de	29.85 a	15.10 ef	22.02 A	24.44 b	21.07 c-d	31.21 a	16.03 g-h	23.19 A
SD4	19.07 de	10.43 g	15.97 d-f	14.81 f-g	15.07 B	17.64 ef	12.93 hi	17.45 f-g	11.13 i	14.79 D
Mean	19.65 A	15.78 B	19.72 A	18.26 A		20.21 B	16.87 C	22.53 A	15.78 C	
	Essential oil (%)									
SD1	0.19 g	0.19 fg	0.26 bc	0.22 ef	0.22 B	0.16 f-h	0.15 gh	0.23 c	0.20 de	0.18 B
SD2	0.23 de	0.27 b	0.25 cd	0.18 g	0.23 A	0.23 bc	0.24 bc	0.25 ab	0.23 c	0.24 A
SD3	0.15 h	0.22 ef	0.35 a	0.23 de	0.24 A	0.23 bc	0.27 a	0.27 a	0.22 cd	0.25 A
SD4	0.25 cd	0.15 h	0.25 cd	0.15 h	0.20 C	0.18 ef	0.22 cd	0.17 fg	0.14 h	0.18 B
Mean	0.20 B	0.21 B	0.28 A	0.19 C		0.20 B	0.22 A	0.23 A	0.20 B	

Means designed by the same letter at each cell are not significantly different at the 5% level according to Tukey s multiple range tests.
SD1= 1st October SD2= 15th October SD3= 1st November SD4 = 15th November
F1= 0 m^3/fed. F2= 10 m^3/fed. F3= 20 m^3/fed. F4= 30 m^3/fed.

TABLE 9. Impact of planting dates, organic fertilization and their combinations on the principal components of coriander essential oil during the 2019/2020 and 2020/2021 seasons

Components	SD2F1	SD2F2	SD2F3	SD2F4	SD3F1	SD3F2	SD3F3	SD3F4
Acetone, dimethyl acetal	-	-	0.15	-	-	0.14	-	-
α-Pinene	3.65	6.79	3.35	5.69	3.88	6.69	4.5	5.83
Camphene	0.34	0.66	-	0.64	0.42	0.71	0.57	0.39
Sabinen	0.31	0.49	0.25	0.5	-	0.55	0.37	0.44
β-Pinene	0.64	1.02	0.55	0.87	0.51	1.12	0.74	0.93
β-Myrcene	0.63	0.9	0.53	0.9	0.64	1.02	0.88	0.78
p-Cymene	3.37	3.97	3.13	4.14	2.65	4.35	3.32	3.81
D-Limonene	1.24	2.03	1.04	2.11	1.76	2.39	2.3	1.42
Eucalyptol	3.07	-	-	-	-	-	0.44	-
β-Ocimene	-	-	-	-	-	-	0.46	-
γ-Terpinene	6.79	9.03	7.57	9.6	5.63	9.27	6.75	8.9
1-Octanol	1.02	-	-	-	-	-	-	-
Octyl formate	-	-	0.46	0.39	0.83	0.84	0.55	0.65
Terpinolene	0.41	0.61	0.39	0.69	0.56	0.74	0.77	0.46
Linalool	56.03	56.41	65.76	55.33	62.5	53.63	56.24	59.01
Camphor	4.4	4.12	3.21	4.3	5.39	3.7	4.61	2.89
(-)-Terpinen-4-ol	0.69	0.57	0.7	0.69	0.49	0.64	0.43	0.67
α-Terpineol	0.67	0.55	0.63	0.65	0.72	0.55	0.66	0.52
Decanal	0.31	-	-	-	-	-	-	-
cis-Anethole	-	-	-	-	-	0.31	-	-
Citronellol	0.65	0.44	0.58	0.61	0.43	0.7	0.55	0.54
Geraniol	3.18	2.5	2.43	3.43	3.43	2.8	3.31	2.36
Myrtenyl acetate	0.39	0.32	0.27	0.34	-	-	-	0.3
Geranyl acetate	7.98	7.43	7.06	8.09	7.3	8.2	9.97	7.7
(E)-2-Dodecenal	-	-	-	-	0.36	-	-	-
α-epi-Cadinol	0.35	-	0.4	-	-	-	-	0.36
Tetradecanoic acid	1.16	-	-	-	0.84	0.53	-	-
Hexahydrofarnesyl acetone	0.56	-	0.49	0.38	-	-	0.44	0.38
n-Hexadecanoic acid	2.18	0.56	1.04	0.64	1.65	0.8	1.23	0.4
α-Bergamotene	-	0.35	-	-	-	0.32	0.48	0.84
13-Docosenamide, (Z)-	-	1.23	-	-	-	-	-	-

SD2F1= 15th October + control (zero) m^3/fed. SD2F2=15th October +10 m^3/fed. SD2F3=15th October +20 m^3/fed.
SD2F4=15thOctober +30m^3/fed. SD3F1= 1st November + control (zero) m^3/fed. SD3F2= 1st November +10 m^3/fed.
SD3F3= 1st November +20 m^3/fed. SD3F4=1st November +30 m^3/fed.

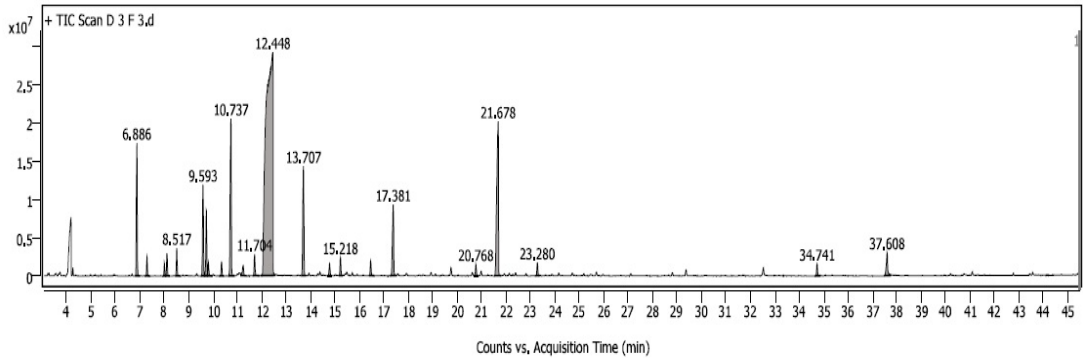

Fig.1. The gas chromatography analysis of essential oil of planting dates, organic fertilization and their combinations on the principal components of coriander essential oil during 2019/2020 (the best treatment for the percentage of oil (SD3F3)).

of coriander fruits ranged from 0.03% to 2.6% according to pharmacopeia. And these differences in essential oils may result from a variety of factors, including climate circumstances, growing conditions and species (Ghobadi and Ghobadi, 2012) reported on coriander essential oil should contain linalool in excess of 50% to 70%.

Badran et al. (2018) showed that increase in compost level was associated by a gradual and consistent increase in each of essential oil percent and yield per plant. Essential oil was increased by (70.4 and 63.5%) in the first and second seasons due to the use of compost at 15 ton/fed in comparison with control plants. (Khater et al., 2021) reported that the application of compost to the coriander plant significantly influenced oil percent. The highest essential oil yield was recorded that received 50m^3/ha an increase of 60% and 46% in oil yield.

Conclusion

This study evaluated different planting dates and various levels of organic fertilization (compost) in coriander (*Corianderum sativum* L.). Results showed that planting dates and organic fertilization had a positive significant effect on coriander growth and productivity.In addition to, components and quantity of the essential oil. The pronounced value in this regard was obtained when the plant was treated with 1st of November and 20m^3/fed. of compost .

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During this study, there were no conflicts of interest.

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تأثير مواعيد الزراعة و التسميد العضوي علي النمو و المحصول و مكونات الزيت الطيار لنبات الكزبرة

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أجريت التجربة الحقلية خلال الموسمين المتتاليين لعام ٢٠١٩/٢٠٢٠ ، ٢٠٢٠/ ٢٠٢١ بالمزرعة التجريبية ، كلية الزراعة ، جامعة عين شمس ، جمهورية مصر العربية. لدراسة تأثير مواعيد الزراعة و التسميد العضوي والتفاعل بينهم على النمو والمحصول ومكونات الزيت الطيار على نبات الكزبرة. كانت مواعيد الزراعة كالتالى : ١ أكتوبر، ١٥ أكتوبر، ١ نوفمبر، ١٥ نوفمبر وتم المعاملة بالسماد العضوي (الكمبوست) على أربعة مستويات وهي : مقارنة ، ١٠، ٢٠، ٣٠ م٣/ الفدان . وأظهرت النتائج أن أفضل القيم لصفات طول النبات، عدد الافرع/ النبات، محصول الثمار/ النبات كانت في موعد الزراعة الأول من نوفمبر والتسميد ٢٠ م٣ كمبوست للفدان في كلا الموسمين. كما أظهرت النتائج أن زيت الكزبرة يحتوي على ٣١ مكونا للزيت. و تم العثور على الليناليول انه من المكونات الرئيسية للزيت و يسجل أعلى نسبة مئوية و التي تم الحصول عليها من العينات النباتية تحت جميع المعاملات بالإضافة إلى المركبات الرئيسية الأخرى كانت (جرانيل اسيتات، جاما تربينين، الفا بنين).