Effect of Sowing Date and Varieties on Essential Oil Ratio and Essential Oil Components of Coriander (*Coriandrum sativum* L.) in Van Ecological Condition

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Abstract: This study was carried out as random blocks experiment design that three recurrent in Van ecological condition in 2009 infour sowing time (April 5 and 20, May 5 and 20) which to determine essential oil ratio and components of one local coriander population and two coriander varieties. The highest essential oil ratio was obtained as 0.45% from Gurbuz variety. The highest essential oil ratio was obtained as 0.5% from May 20 sowing time. In terms of essential oil it was no different in varieties and in sowing times. The essential oil yield average yields changed from 0.09-0.116 L ha⁻¹. Linalool which essential oil component ratio was changed from 68.3-74.8%. Gamma terpinen ratio was changed from 7-8%. The highest gamma terpinen ratio was obtained as 8.8% from April 20 sowing time.

Key words: Coriander, sowing time, essential oil ratio, essential oil component, population, Turkey

INTRODUCTION

Coriander is based on very old dates. According to the Egyptian papyrus writings cific BC medicinal plants has been reported that between the years 2500-1500 (Harten, 1974). Coriander is a plant of annual herbaceous (Baytop, 1994). Coriander is represented by 2 species (Davis, 1984) and the two varieties (Zeybek and Zeybek, 1994) of flora of Turkey. Mainly due to the therapeutic properties of coriander aromatizan or food, pharmaceutical, perfumery and cosmetics have been widely used in many fields including. Fresh coriander leaves and young plants as well as Asian, Middle Eastern, Central and South America is consumed in extraordinary quantities. In some countries, the pungent green leaves of the coriander plant, Chinese parsley is used with the name. Green coriander leaves to soups, sauces, salads and vegetables used in cooking. Such as kitchens, parsley is used in different regions of Turkey. Coriander plant, cultivated for fruits and essential oil (Dogan and Akgun, 1987). Coriander fruits contains, essential oil, fixed oil, tannin, mucilage, carbohydrate, proteins, minerals, flavonoids, glucolipids, coumarins, sterols and extracts Arslan and Gurbuz (1994) and Dogan and Akgun (1987).

World essential oil production is around 45,000 tons, corresponds to approximately 700 million dollars.

Coriander is one of the world's most essential oil produced from 15 plants. Coriander essential oil production of 750 tons of volatile oil is located within 15 plant (Baser, 1998). Coriander is a product of Turkey's exports in 2003 up to 68 tonns were exported (Uzun *et al.*, 2010). Coriander seed yield as 500-2000 kg ha⁻¹ range.

MATERIALS AND METHODS

The study was carried out in Van ecological condition and aqueous conditions. One local coriander population and two different registered varieties are used in the study. This varieties Arslan and Gurbuz varieties.

Climatic characteristics of the place of research: There is continental climate in Van and rather than the temperature difference between day and night. Winters are quite harsh and passes under a blanket of snow. The summer is very arid.

Soil characteristics: Soil samples were taken from trial area and physical and chemical properties were analyzed. According to analyses results, trial area soils are semi alcalin and poor as organic substance, on the contrary, rich as receivable phosphorus. It is determinent that salt content as 0.43% and lime content as 9%.

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Factors for the trial and the trial plan: Trial randomized block design with factorial experiment was conducted with three replications. Each plots are 1×4 m $= 4$ m^2 and consisted of five ordinary. Row distance is 20 cm. The edges of the parcel and 0.5 m of end of the parcel were eliminated as a side effect. The variety and sowing time combinations of factors were distributed by chance into blocks. Total number of parcels are $3 \times 4 \times 3 = 36$.

Data collection
Obtaining the essential oil: About 100 g dry sample portion of the plant herb in 1 L of water and boiled in Clevenger apparatus enclosed within the balloon kept in 3 h and then lowering the temperature of volatile oil was obtained.

Gas Chromatography-Mass Spectrometry (GC/MS) analysis: Shimadzu model QP2010 Plus GC/MS instrument using the essential oil components in the extract (%) were identified in the Laboratory of Erciþ Vocational High School.

GC parameters: TRB-WAX column was used and the temperature program is applied to the device. The temperature program was implemented. The column oven temperature held for 2 min at 60°C then raised up to 240°C min^{-1} in increments of 10°C. The temperature program is 25 min. While the injection port at 240°C injection is made. Interface temperatures were 240°C. Helium gas was used as carrier gas. Column pressure: 57.4 kPa, total flow: 9 mL min^{-1}, column flow rate: 1 mL min^{-1}, linear velocity: 36.5 cm sec^{-1} and split ratio: 1/10 as implemented.

MS parameters: Applied 3 min solvent cut time, so the MS detector worked between 3-25 min. MS detector scanned between 40-350 m z^{-1} mass size. The components of essential oil were determined by scanning Valley 7, Nist 27 and Nist 147 libraries.

Analysis of data: The data were analyzed statistically Costat package program according to the randomized block factorial experiment design and averages were compared according to Duncan's Multiple Comparison Method (Yildiz, 1986).

RESULTS AND DISCUSSION

Essential oil ratio: The results of analysis of variance ratio essential oil shown in Table 1. As shown in the analysis of variance in terms of applications of different variety sowing time and rate of essential oil has shown a significant impact at the level of 5%. Essential oil ratio, averages and Duncan grouping are shown in Table 2.

As shown in Table 2 the average rate of essential oil ranged from 0.45-0.32%. The difference between the average values are statistically significant, the highest value obtained with the Arslan variety as 0.45%. Arslan variety was followed the local population as 0.44%, the lowest value obtained with variety of Gurbuz as 0.32%. Arslan variety and local population took part in the same group according to Duncan.

Difference between sowing dates is significant as statistically. The highest value was obtained from May 20 with 0.5%. May 5 took second place with 0.44%, April 20 followed with 0.34%. The lowest value was obtained from April 5 with 0.33%. About 5 April and 20 April to was in the same group.

Ozel *et al.* (2009) reported that temperature and the exposure to light increased the rate of essential oil. These findings are supported with the opinions of the

Table 1: Variance analysis results of the essential oil ratio and essential oil yield and essential oil components

Sources of variation	SD	EOR	EOR	Linalool	Gamma terpinen	Geranyl asetat	Geraniol	Alfa pinen	P-cymen
Block	2	1.16	0.06	0.15	0.11	0.01	0.58	0.17	0.26
Sowing date	3	4.45*	2.41	2.47	3.81*	1.00	1.49	1.09	1.41
Variety	2	4.27*	0.76	2.06	1.04	0.16	4.60*	0.03	0.41
Sowing date, X variety	6	1.51	0.93	0.46	0.80	0.79	1.40	0.34	0.64
Error	22	-	-	-	-	-	-	-	-
General	35	-	-	-	-	-	-	-	-

*Statistically important at the level of probability 0.05; **Statistically important at the level of probability 0.01

Table 2: Essential oil ratio (%) and essential oil yield averages (L ha^{-1}) and Duncan grouping

| | Sowing dates | | | | | | | | | |
| | April 5 | | April 20 | | May 5 | | May 20 | | Average* | |
Varieties	EOR	EOY	EOR	EOY	EOR	EOY	EOR	EOY	EOR	EOY
Local	0.39	0.116	0.39	0.098	0.45	0.067	0.53	0.099	0.44[a]	0.095
Gurbuz	0.33	0.182	0.28	0.135	0.27	0.074	0.40	0.072	0.32[b]	0.116
Arslan	0.27	0.075	0.36[b]	0.138	0.60	0.061	0.57	0.084	0.45[a]	0.090
Average*	0.33[b]	0.124	0.34[b]	0.123	0.44[ab]	0.067	0.50[a]	0.085	-	-

*No difference was observed at possibility level 0.05 between the averages represented with the same letter. EOR = Essential Oil Ratio, EOY = Essential Oil Yield

researchers. Different researchers have found rates of different essential oils. Kan and Ipek 0.22-0.34%, Kizil and Ipek (2004) 0.29-0.32%, Arabaci and Bayram (2005) 0.30-0.47%, Gumuscu et al. (2006) 0.2-0.4%, Ozel et al. (2009) 0.28-0.42%, Uzun et al. (2010) 43-54%. Reason for such different results, due to different ecological conditions.

Essential oil yield: The results of variance analysis of essential oil yield shown in Table 1. The F-values were not significant for sources of variation. Table 2 shows the average essential oil yield between varieties such as 0.90-1.16 L ha^{-1} ranged. The difference between means is statistically insignificant between varieties. Local population, Gurbuz and Arslan varieties have been involved in the same group.

The difference between sowing dates were not significant. Sowing dates were in the same group. Different researchers have obtained different yields of essential oil. Kirici et al. (1997) 6.5-8.5 L ha^{-1}, Kizil and Ipek (2004) 3.11-5.39 L ha^{-1}, Arabaci and Bayram (2005) 1.70-7.29 L ha^{-1}, Gumuscu et al. (2006) 2.96-6.70 L ha^{-1}, Ozel et al. (2009) 0.1.5-11.3 L ha^{-1}.

Essential oil yield values obtained from this trial, remained quite low from the other researchers. In this study, yield has remained low due to low temperatures. The average temperature value is low of the Province of Van.

Essential oil components
Linalool: The variance analysis results of Linalool are shown in Table 1. The F-values were not significant for sources of variation. Linalool ratios (%) and Duncan grouping are shown in Table 3.

The difference between varieties are statistically insignificant, averages between 74.8 and 68.3% have changed (Table 3). Local population, Gurbuz and Arslan coriander Duncan grouping varieties have been involved in the same group.

Effect of sowing dates is insignificant on linalool. Linalool values ranged from 68.4-76.8%. Sowing dates were in the same group (Table 3). Other researchers have

found different values. Some of these values are similar to values in this study. Diederichsen (1996) 19.8-83.0%, Kaya et al. (2000) 50.52-92.52%, Iscan et al. (2004) 67.1%, Unlike, Akgul (1993) 82.67% Dogan et al. (1984) 78.40-84.67% is different from the values in this study.

Gamma-terpinene: The variance analysis results of Gamma-terpinene are shown in Table 1. The F-values were significant for sowing dates (Table 1). Gamma-terpinene ratios (%) and Duncan grouping are shown in Table 3. The difference between varieties are statistically insignificant, the means have changed between 7 and 8%.

Local population, Gurbuz and Arslan coriander varieties have been involved in the same group. The average difference between sowing dates was statistically significant. The highest value of 8.8% was obtained with the 20 April sowing date. It was followed by 8.5% with April 5, 6.7% with May 20, 6.5% with May 5.

The findings of gamma-terpinene ratios higher than of Iscan et al. (2004) 2.2% similar to Ozel et al. (2010) 7.55 and 3.07%.

Geranyl asetat: The variance analysis results of geranyl asetat are shown in Table 1. The F-values were insignificant for sowing dates (Table 1).

Geranyl asetat ratios (%) and Duncan grouping are shown in Table 3. The difference between varieties are statistically insignificant, the means have changed between 2.7-2.9%. Indigenous, Gurbuz and Arslan coriander varieties have been involved in the same group. The difference between sowing date is insignificant, the means have changed between 2.5-3.2%.

The sowing times have been involved in same group. Geranyl acetate was found that by Akgul (1993) 2.77%, Iscan et al. (2004) 5.9%, Ozel et al. (2010) 1.06 and 2-2.8%. Geranyl acetate ratios are similar to Akgul (1993) and Ozel et al. (2010) and lower from Iscan et al. (2004) 5.9%. Because of these differences may be different ecologies.

Geraniol: The variance analysis results of geraniol are shown in Table 1. The F-values of varieties are important 0.05 in probability level.

Table 3: Linalool, gamma terpinene and geraniol acetate essential components ratios (%) and Duncan grouping

Varieties	Sowing dates												Average*		
	April 5			April 20			May 5			May 20					
	L	GT	GA	L	GT	GA	L	GT	GA	L	GT	GA	L	GT	GA
Local	74.0	7.5	3.6	72.4	10.1	2.3	74.3	6.8	2.6	78.4	6.7	2.8	74.8	7.7	2.8
Gurbuz	65.1	9.0	3.4	70.1	7.7	3.1	78.8	5.3	2.5	77.9	6.0	2.6	73.0	7.0	2.9
Arslan	66.8	9.0	2.6	62.5	8.5	3.2	70.0	7.3	3.0	74.0	7.4	2.1	68.3	8.0	2.7
Average*	68.6	8.5^{ab}	3.2	68.4	8.8^a	2.9	74.4	6.5^c	2.7	76.8	6.7^{bc}	2.5	-	-	-

*No difference was observed at possibility level 0.05 between the averages represented with the same letter; L = Linalool, GT = Gamma Terpinen, GA = Geranyl Asetat

Table 4: Geraniol, Alpha pinene and Para-Cymen Essential components ratios (%) and Duncan grouping

	Sowing dates														
	April 5			April 20			May 5			May 20			Average*		
Varieties	G	AP	PC	G	AP	PC	G	AP	PC	G	AP	PC	G	AP	PC
Local	2.2	4.1	3.4	1.5	4.5	3.9	3.3	3.4	1.9	1.9	2.9	2.5	2.2[b]	3.7	2.9
Gurbuz	3.5	5.3	2.4	4.2	4.3	2.5	2.8	2.6	2.1	2.2	2.9	2.9	3.2[a]	3.8	2.5
Arslan	2.9	3.5	3.4	4.4	4.0	2.9	3.8	4.2	2.4	3.1	2.5	1.8	3.5[a]	3.5	2.6
Average*	2.8	4.3	3.1	3.3	4.3	3.1	3.3	3.4	2.1	2.4	2.8	2.4	-	-	-

*No difference was observed at possibility level 0.05 between the averages represented with the same letter. G = Geraniol, AP = Alfa Pinen, PC = Para-Cymen

Geraniol ratios (%) and Duncan grouping are shown in Table 4. The difference between varieties are significant as statistically. The highest value was obtained from Arslan variety with of 3.5%. It was followed by Gurbuz variety with 3.2%, local population with 2.2%. Gurbuz and Arslan varieties took place in the same group.

Effect of sowing date on geraniol essential oil component is insignificant, averages have changed between 2.4-3.3%. The sowing dates have been involved in the same group. This values similar to Akgul (1993) 3.66% and Iscan *et al.* (2004) 3.7%, higher from Ozel *et al.* (2010) 0.15-0.46%.

Alfa pinen: The variance analysis results of Alfa pinen are shown in Table 1. As shown in the analysis of variance, F-values were not significant. Alpha-pinene essential oil component averages and Duncan grouping are shown in Table 4. The difference between varieties are insignificant, averages have changed 3.5-3.8%. Local, Gurbuz and Arslan coriander varieties have been involved in the same group.

The difference between of sowing time averages are insignificant, averages have changed 2.8-4.3%. Sowing times have been involved in the same group. The findings are similar to Iscan *et al.* (2004) 3.1% and higher than Akgul (1993) 1.28% and Ozel *et al.* (2010) 0.20-0.87%. The reasons of the difference may be different soil and ecological conditions.

P-cymen: The results of analysis of variance for the P-cymen essential oil component in are shown in Table 1. As shown in the analysis of variance, F-values were not significant. Alpha-pinene essential oil component averages and Duncan grouping are shown in Table 4. The difference between varieties are insignificant, averages have changed 2.5-2.9%. Local, Gurbuz and Arslan coriander varieties have been involved in the same group.

The difference between of sowing time averages are insignificant, averages have changed 2.1-3.1%. Sowing times have been involved in the same group. The findings are similar in partial to Iscan *et al.* (2004) 3.3% and Ozel *et al.* (2010) 2.33-7.42%.

CONCLUSION

Coriander is grown as vegetable in the region of Van. That is not very common to use as seed. This study focused on the determination of coriander essential oil and its components. The higest essential oil yield and geranyl acetate, alpha-pinene and P-cymen essential oil components were obtained from April 5 sowing time, gamma-terpinene, geraniol from April 20, linalool from May 20 sowing time.

Become more prevalent the use of the coriander's as medicinal and aromatic plant determination of constituents of essential oil will become more important.

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