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Yield, yield components and fatty acid composition of *Artemisia dracunculus* L. local breeds under organic cultivation conditions

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The importance of medicinal and aromatic plants in people's lives is growing due to their various uses and diverse cultivation conditions. This study aimed to determine the yield and yield components and quality features (oil ratio and fatty acid composition according to GC-MS) of six different tarragon (*Artemisia dracunculus* L.) local breeds grown organically in Bayburt province, Turkey. For this purpose, the data obtained by growing the plants in the experimental area during the two crop years, 2018 and 2019, were evaluated. As for the yield values, the highest values for green herb yield (275.41 kg ha^{-1}), drug herb yield (99.89 kg ha-1), drug-herb percentage (44.00%), green leaf yield (208.97 kg ha^{-1}), green leaf percentage (75.09%) and drog leaf yield (72.48 kg ha^{-1}) were found in the local breed from Bayburt Central location. It was found that the oil percentages, evaluated to determine the quality traits, ranged from 5.39% to 7.02%. The most important fatty acid was α-linolenic acid (9.49%-23.1%), followed by linoleic acid (4.18%-13.89%) and palmitic acid (4.05-13.89%). As far as we know, this is the first study investigating tarragon's total oil content and fatty acid composition. The results show that the total oil content of this plant, which has remarkable pharmacological effects, is present in useful quantities compared to the leafy green and does not contain fatty acids that prevent its consumption as food. Therefore, this plant is expected to be used directly in various food products.
Keywords: Medicinal and aromatic plants, oil ratio, linoleic acid, oleic acid, *Artemisia,* industrial plants.

INTRODUCTION

It is well known that medicinal and aromatic plants have played an important role in human life from the past to the present. Aromatic medicinal herbs are utilized in various fields, including health protection, disease prevention and treatment, and the production of nutritional supplements (Faydaoglu and Driveroglu, 2011; Anonymous, 2012; Maver *et al.,* 2015; Gul and Celik, 2016; Temel *et al.,* 2018). *Artemisia* spp. contains important medicinal aromatic plants in terms of antimicrobial, antioxidant and enzyme inhibitory properties (Trifan *et. al.,* 2022). *Artemisia dracunculus* L. (*Tarragon)*, which belongs to medicinal and aromatic plants, is mainly cultivated in Turkey in the regions of eastern Black Sea (Bayburt), Eastern Anatolia (Erzurum), Central Anatolia (Ankara), and Southeastern Anatolia (Gaziantep, Şanlıurfa). *Tarragon* is a perennial shrub that can reach heights between 60 and 120 cm. It has a round body with branches that are light green. The aroma is dispersed through the oil glands on the underside of the leaves. Its leaves are an excellent source of iodine, mineral salt, and vitamins A and C (Turkozu, 2010). The tarragon plant is used widely in French cuisine and is also gaining popularity in Turkish cuisine. It contains diuretic, carminative, digestive, and antispasmodic properties and is effective against periodontal disease and toothache. In addition to its medicinal properties, it is also used to make toothpaste, perfume, and alcoholic beverages and to extend the shelf life of food. This plant, which is also used as a seasoning, is typically consumed with soup, salad, meat, chicken, and fish (Hassanzadeh *et al.,* 2016). However, aromatic medicinal plants are not yet grown in sufficient quantities to meet demand. Therefore, increasing the amount of medicinal aromatic plants in the existing cultivated areas should become a priority issue (Sonmez *et al.,* 2019). Kordali *et al.,* (2005) identified the components of the essential oil of the tarragon plant and found thirty components that account for 99.5% of the essential oil content. Moreover, they found that the essential oil of the tarragon plant showed antimicrobial activity against some fungi and bacteria and that this oil showed cytotoxic activity, which is important for human lymphocytes (Tuylu *et al.,* 2009). Zawiślak and Dzida, (2012), analyzed tarragon-grown plants' minerals and

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essential oils and found that total nitrogen and potassium were the dominant elements; they found 35 compounds in its essential oil. In addition, 48 components have been identified in studies of tarragon essential oil (Yilmaz *et al.*, 2019). Cil (2013), identified 32 components of tarragon in Erzurum and Bayburt ecotypes and found that methyl chavicol, methyl eugenol, germacrene, α-zingiberene, spathulenol, β-cubebene, trans-β-ionene, and ocimene components were the most abundant. In addition, it has been reported that the most suitable planting densities is 40×40 cm. It was discovered that the antibacterial properties of the tarragon plant reduced food poisoning caused by eating hamburger patties (Ceran, 2018). The results revealed that the plant *A. dracunculus* L. can be useful for cosmetics, medicine, and food as a natural antimicrobial agent. Fildan *et al.*, (2019) found that the essential oil isolated from the leaves of *A. dracunculus* L. by steam distillation was rich in sabinene (42.38%), isoemicin (12.91%), methyl eugenol (9.09%), elemicin (7.95%), and beta ocimene (6.46%). The research on *Artemisia dracunculus* L. mainly relates to the essential oil. Since there is a lack of a study on the ratio of the oil content, and fatty acid composition, this study is thought to address the literature gap. The present study was conducted to determine the yield and yield-related aspects and quality features of tarragon (*A. dracunculus* L.) local breeds produced from various locations in Bayburt province under organic and ecological production conditions.

MATERIALS AND METHODS

In this study, tarragon local breeds from six different locations, A1 (Bayburt Merkez), A2 (Bayburt Yedigozeler village1), A3 (Bayburt Yedigozeler village 2), A4 (Bayburt Ugurgeldi village), A5 (Mersin) and A6 (İzmir), were vegetatively propagated and used as plant material. An example of tarragon obtained from A1 location and used for vegetative propagation is presented in Fig. 1.

***Experimental Site*:** The experimental applications of the study were carried out in 2018 and 2019 in the experimental field of organic land management at the Faculty of Applied Sciences of Bayburt University, located in the central district of Bayburt. The soil cultivation and preparation of the experimental site were carried out according to the ecological conditions. Tarragon plants of local breeds were planted at a planting density of 40×40 cm in the field trial plot, which was prepared in three replicates according to the randomized block trial design based on previous studies (Cil, 2013). The soil properties of the experimental plot were analyzed, and the pH was 7.75, organic matter content was 0.99%, lime content was 9.30%, phosphorus amount was 11.44 kg ha^{-1}, potassium amount was 80.30 kg ha^{-1}, and total salt content was 0.47%. Comparing the results to the soil criteria analyzed by Gedikoglu, (1990), Ulgen and Yurtsever, (1995), the soil is slightly alkaline, highly poor in organic matter, very rich in phosphorus, moderately calcareous, and rich in potassium. The data on temperature, humidity, and precipitation, the factors affecting the growth and development of the plants in the experimental area, are presented in Figure 2.

Figure 1. The tarragon plant, which was obtained from Bayburt Merkez locality and used in vegetative propagation, was transformed into a seedling and planted in the trial area

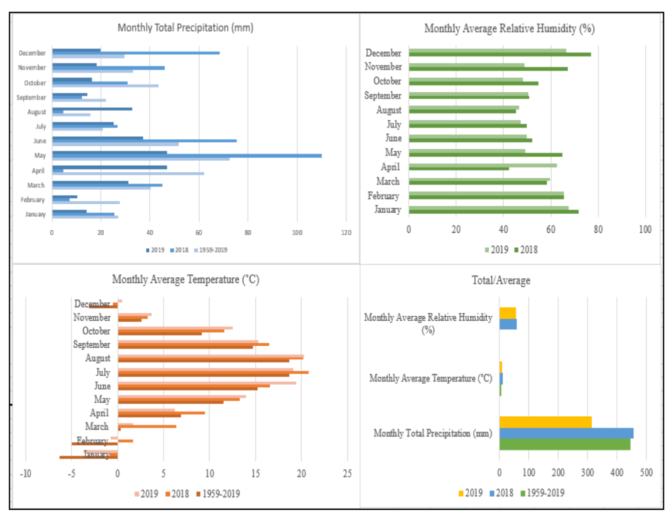

Figure 2. The averages of 1959-2019, which are stated as long years of the experimental area, and the monthly average precipitation, monthly average relative humidity, monthly average temperature and total average values for the years 2018 and 2019 are shown

***Cultivation of Plants: Cultivation of Plants*:** Tarragon plants were regularly irrigated by drip irrigation, and no artificial fertilization was applied. Plants reaching harvest maturity were harvested and morphologically measured to determine yield, yield-related aspects, and quality characteristics. The plants were harvested at the height of 3 to 4 centimeters above the soil surface and dried for analysis at room temperature in a dry and shaded environment for an average of 10 to 12 days. Tarragon plants were regularly irrigated by drip irrigation, and no artificial fertilization was applied. Plants reaching harvest maturity were harvested and morphologically measured to determine yield, yield-related aspects, and quality characteristics. The plants were harvested at the height of 3 to 4 centimeters above the soil surface and dried for analysis at room temperature in a dry and shaded environment for an average of 10 to 12 days.

***Extraction of oil from leaves and preparation of fatty acid methyl esters*:** Dried tarragon leaves were ground, weighed 2 g, and added to the cartridge in the extraction section of the Soxhlet apparatus (Buchi B-811). It was extracted with hexane for 4 hours, and the oil fractions were determined by removing the hexane with an evaporator. The fatty acid composition was determined using GC-MS (gas chromatography-mass spectrometry) by preparing methyl esters of the extracted oils (Regulation, 1991). DBA column of 23 60 m × 0.25 mm ID, 0.15 µm (J&W 122-2361), and helium as carrier gas was used for the analysis. Oven temperature is set as 50°C for 1 minute, 25°C steps to 175°C, 4 °C steps to 230°C for 5 minutes, injection temperature to 230°C, 1 µL injection, and split ratio to 1/50 (IUPAC Standard Methods, 1992).

***Statistical Analysis*:** The data obtained in this study were statistically evaluated using SPSS version 25.0 using analysis of variance, significance/T test, Pearson Correlation analysis and principal component analysis (PCA).

RESULTS

The fatty acid composition of plants consumed as food is important. Therefore, in this study, tarragon local breeds obtained from different locations in the ecological conditions of Bayburt province under organic production conditions in 2018 and 2019 were grown, and the oil content ratio and fatty acid composition of these plants were determined. The obtained results are presented in Table 1 and Table 2.

Table 1. Oil content ratios of tarragon local breeds.

Locations where tarragon local breeds are procured	Oil content (%)
A1	5.39±0.85bc
A2	6.65±0.41a
A3	6.52±0.28a
A4	7.02±0.78a
A5	6.18±0.06ab
A6	5.68±0.56bc

As a result of the evaluations, it was found that the most oil content was found in local breed A4 with 7.02±0.78%, while the lowest oil content was found in local breed A1 with 5.39±0.85%. Analysis of fatty acid composition revealed that the most important fatty acid was α-linolenic acid (9.49-23.10%). In A4 and A1, erucic acid values ranged from 0.06%

Table 2. Fatty acid composition (%) of tarragon local breeds.

Fatty acids	Common name	A1(%)	A2 (%)	A3 (%)	A4 (%)	A5(%)	A6 (%)
C10:0	Capric acid	0.67	0.62	0.64	0.50	0.34	0.81
C12:0	Lauric acid	0.41	0.25	0.25	0.25	0.25	0.59
C14:0	Myristic acid	2.08	1.36	1.23	1.28	1.88	3.26
C14:1	Myristoleic acid	0.60	n.d	n.d	n.d	n.d	0.52
C16:0	Palmitic acid	8.61	4.87	4.05	4.67	8.02	11.53
C16:1	Palmitoleic acid	0.33	0.75	n.d	n.d	0.33	0.40
C18:0	Stearic acid	1.28	0.86	0.79	0.77	1.49	1.95
C18:1 cis (n9)	Oleic acid	0.48	1.11	0.24	0.29	n.d	0.62
C18:2 cis (n6)	Linoleic acid	10.34	4.68	4.18	5.25	6.49	13.89
C18:3n3	α-Linolenic acid	19.54	9.49	9.50	9.91	15.24	23.10
C20:0	Arachidic acid	4.06	1.72	1.76	1.90	1.65	3.61
C22:0	Behenic acid	1.93	0.77	0.80	0.79	1.36	n.d
C22:1n9	Erucic acid	1.83	1.28	1.46	0.06		n.d
C24:0	Lignoceric acid	0.33	1.80	0.49	0.37	0.46	0.56
C24:1	Nervonic acid	0.03	n.d	0.14	1.21		n.d
C22:6 (n3)	cis-4,7,10,13,16,19-Docosahexaenoic acid (DHA)	n.d	1.32	n.d	n.d	n.d	n.d

n.d: Not detected

to 1.83%. The low erucic acid value supports the consumption of tarragon as a food. For behenic acid, values between 0.77% and 1.93% were determined.

Average Values of Yield and Yield Components Aspects of Tarragon Local Breeds:

Plant height (cm): Since the green leaves of the tarragon plant are used commercially, plant height is an important yield parameter to obtain more product per unit area. The average plant height values of tarragon local breeds were measured between 14.52-41.90 cm in the 2018 and 2019 cropping years, and the longest average plant height (41.90 cm) was determined in local breeds A5 (Table 3). According to the results of the analysis of variance, it was found that there were no significant differences between the average plant height of local breeds ($p>0.05$) (Table 4).

***Green herb yield (kg ha^{-1})*:** Tarragon is a plant that belongs to green leafy plants, and its green parts are directly used in foods such as salads from time to time. For this reason, the green herb yield of per unit area is important for the plant's economic value. According to the results, the annual average values of green herb yield ranged from 60.16 kg ha^{-1}-275.41 kg ha^{-1}, and the maximum green herb yield (275.41 kg ha^{-1}) was recorded in local breeds A1 (Table 3). In the analysis of the variance of green herb yield of the local breeds in the experimental years, it was found that there was a significant difference between the local breeds in terms of green herb yield ($p<0.05$) (Table 4).

***Green leaf yield (kg ha^{-1})*:** The green leaves of the tarragon plant are used in the food industry. Green leaf yield is an important parameter for selecting tarragon varieties and the determine the location where a higher yield can be obtained. The highest annual average value of green leaf yield (208.97 kg ha^{-1}) was obtained in local breed A1 (Table 3). As a result of the analysis of the variance of green leaf yield between local breed, it was found that there was a significant difference in the interaction of local breed x year ($p<0.01$) (Table 4).

***Green leaf rate (%)*:** Although tarragon is a plant with green parts, the green leaf parts are generally more preferred than the stems, so the proportion of green leaves in the whole plant is important for yield evaluation. The maximum value (75.09%) of the proportion of green leaves was obtained in A1 local breed in the experimental years (Table 3). Since tarragon is a plant whose leaves are used, a high rate of green leaves is one of the important traits desired for yield. The analysis of the variance of the green leaves ratio was performed, and no significant difference was found ($p>0.05$) (Table 4).

Table 3. Yield and yield components of tarragon local breeds grown in 2018 and 2019.

	Plant height (cm)	Green herb yield (kg ha^{-1})	Green leaf yield (kg ha^{-1})	Green leaf rate (%)	Green stem yield (kg ha^{-1})	Green stem rate (%)	Drog herb yield (kg ha^{-1})	Drog herb rate (%)	Drog leaf yield (kg ha^{-1})	Drog leaf rate (%)	Drog stem yield (kg ha^{-1})	Drog stem rate (%)
A1	17.50cd	275.41a	208.97a	75.09a	26.66bc	8.21def	99.89a	44.00a	72.48a	69.15a	10.71cd	9.37cde
A2	15.12de	71.36def	50.42de	69.54ab	14.43def	19.73cd	24.46def	36.96bc	16.53e	65.40ab	5.95def	21.84ab
A3	17.85cd	179.43cd	130.55bc	70.12ab	45.62a	22.68bc	68.49bc	34.47cd	41.68bc	66.94ab	22.63a	29.39a
A4	14.52de	95.59de	67.66cd	70.20ab	17.23cd	18.15cd	35.59cd	37.81bc	24.93cd	70.39a	6.98de	19.65bc
A5	41.90a	193.68bc	12.67g	66.29bc	42.28ab	22.04bc	84.01ab	43.90a	53.66ab	63.40bc	18.66bc	22.23ab
A6	18.30bc	60.16ef	36.48def	60.41cd	16.90cd	30.76a	23.46def	41.96ab	13.76ef	59.32cd	6.71de	30.78a
LSD 0.05	6.04	24.12	5.31	27.06	6.13	3.01	9.15	15.60	5.12	28.34	1.92	3.43

Table 4. Analysis of variance (Univariate) of the average green yield components such as plant height, green grass yield, green leaf yield, green leaf rate, green stem yield, green stem rate of local tarragon breeds grown in the experimental area.

F Values	Variation Sources	SD	Plant height (cm)		Green herb yield (kg ha^{-1})		Green leaf yield (kg ha^{-1})		Green leaf rate (%)		Green stem yield (kg ha^{-1})		Green stem rate (%)	
			2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Years	Bloc	2	0.07	0.79	0.29	0.54	0.36	0.81	1.15	0.31	0.59	0.87	1.28	0.22
	Local breed	5	**72.48**	1.336	**14.30**	**23.25**	**15.18**	1.38	3.14	1.76	3.01	1.50	3.06	**4.12**
	Eror	10												
Years Average	Bloc	2	1.01		0.85		0.77		0.37		1.23		0.52	
	Local breed(LB)	5	**74.65**		**4.10**		**4.69**		1.24		2.22		3.40	
	Year (Y)	1	**19.27**		2.70		3.57		1.56		0.04		0.07	
	LB*Y	5	2.40		**3.69**		**4.20**		2.36		1.44		0.63	
	Eror	22												
	Total	35												

***Green Stem Yield (kg ha^{-1})*:** The highest average annual green stem yield (45.62 kg ha^{-1}) was obtained in A3 local breed (Table 3). Since tarragon is a plant whose leaves are used, the high yield in the stem parts is not considered a positive characteristic. No significant difference was found in the analysis of the variance of green stem yield (*p>0.05*) (Table 4).

***Green Stem Rate (%)*:** Since the tarragon plant is a plant that uses mostly leaves, it is advantageous to have a low green stem rate. Considering the values obtained from the green stem ratio, the average of 2019 was found to be higher than 2018. The top value was observed in the A6 local breed with 30.76% in the average of years. There is no significant difference between the local breeds in terms of green stem ratio during the trial years (Table 4). The absence of this difference is seen in the local breed x year interaction (*p>0.05*).

***Drug Herb Yield (kg ha^{-1})*:** Tarragon is mostly consumed as a drug because it cannot maintain its green state for a long time after harvest. The highest value (99.89 kg ha^{-1}) of drug herb yield in the experimental years was observed in A1 local breed (Table 3). Analysis of the variance of drug herb yield was performed, and it was found that there was no significant difference among local breeds in drug herb yield during the experimental years (*p>0.05*) (Table 5).

***Drug Herb Rate (%)*:** The maximum value (44%) of drug herb rate averaged over the experimental years was obtained in A1 local breed (Table 3). The drug herb rate shows important values for the drug plant obtained from the green plant after harvesting the tarragon. Analysis of the variance of drug herb rate was performed, and it was found that there was a significant difference between local breeds in terms of drug herb rate in the experimental years (*p>0.05*) (Table 5).

Table 5. Analysis of variance (Univariate) of the average drug yield components such as drug herb yield, drug herb rate, drug leaf yield, drug leaf rate, drug stem yield, drug stem rate, of local tarragon breeds grown in the experimental area.

F Values	Variation Sources	SD	Drug herb yield (kg ha^{-1})		Drug herb rate (%)		Drug leaf yield (kg ha^{-1})		Drug leaf rate (%)		Drug stem yield (kg ha^{-1})		Drug stem rate (%)	
			2018	2019	2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
Years	Bloc	2	0.32	0.75	0.18	1.33	0.23	0.727	0.91	0.74	0.28	0.99	0.43	1.01
	Local breed	5	**15.20**	1.50	2.41	**15.43**	**18.13**	1.717	**11.40**	0.92	**3.65**	1.40	**18.58**	3.06
	Eror	10												
Years Average	Bloc	2	0.82		1.154		0.750		1.516		1.134		1.278	
	Local breed (LB)	5	**4.73**		**12.366**		**6.346**		**3.624**		1.530		**7.446**	
	Year (Y)	1	0.11		**227.28**		0.93		**19.86**		0.09		0.01	
	LB*Y	5	2.39		**10.05**		**3.80**		**8.05**		1.57		1.88	
	Eror	22												
	Total	35												

Table 6. Correlation between the monthly average temperature, monthly total precipitation, monthly average relative humidity of years average and yield components.

		Plant height (cm)	Green herb yield (kg ha^{-1})	Green leaf yield (kg ha^{-1})	Green leaf rate (%)	Green stem yield (kg ha^{-1})	Green stem rate (%)	Drog herb yield (kg ha^{-1})	Drog herb rate (%)	Drog leaf yield (kg ha^{-1})	Drog leaf rate (%)	Drug stem yield (kg ha^{-1})	Drug stem rate (%)
Monthly average temperature	r_p	**-0.49**	0.20	0.13	**-0.36**	0.19	0.19	-0.22	-0.09	**-0.40**	-0.03	**-0.41**	**-0.43**
Monthly total precipitation	r_p	**0.61**	-0.27	-0.25	**-0.56**	0.07	**0.45**	0.02	-0.04	0.10	**0.40**	-0.04	-0.27
Monthly average relative humidity	r_p	0.16	**-0.46**	**-0.47**	**-0.37**	**-0.50**	**0.66**	0.28	0.03	**0.41**	0.27	0.28	0.04

***Drug Leaf Yield (kg ha^{-1})*:** Tarragon is a rich and preferred plant in terms of essential oil and aroma. Especially the leaf parts of the drug are the most used. The drug leaves are used directly as a spice, and processed products are considered the most important yield parameter for tarragon. While in the average of experimental years (Table 3), the maximum value in drug leaf yield was found in A1 local breed with 72.48 kg/ha. Analysis of the variance of drug leaf yield was performed, and there was a significant difference between local breeds in terms of drug leaf yield in the experimental years ($p<0.05$) (Table 5).

***Drug Leaf Rate (%)*:** The highest value averaged over the years of the experiment was found at 70.39% of the A4 local breed for drug leaf rate (Table 3). Analysis of the variance of drug leaf rate was performed, and it was found that there was a significant difference between local breeds in terms of drug leaf rate in the experimental years ($p<0.01$) (Table 5).

***Drug Stem Yield (kg ha^{-1})*:** The maximum value (22.63 kg ha^{-1}) in drug stem yield averaged over the experimental years was obtained in A3 local breed (Table 3). Analysis of variance of drug stem yield was performed, and no significant difference was found between the local breeds in terms of drug stem yield in the experimental years. The absence of such a difference is also evident in the interaction between local breed and year ($p>0.05$) (Table 5).

***Drug Stem Rate (%)*:** The highest value in drug stem rate averaged over the experimental years was 30.78% in A6 local breed (Table 3). Analysis of the variance of the drug stem rate was performed, and it was found that there was no significant difference between local breeds in the drug stem rate in experimental years ($p>0.05$) (Table 5).

Pearson correlation analysis was performed to determine the correlation between climatic factors (temperature, precipitation, and humidity) and morphological characteristics of the average experimental years 2018 and 2019. The result of the correlation analysis reveals that there is a negative correlation between temperature and all variables. In contrast, the correlation coefficients (r-value) and probability value (p-value) between plant height, green leaf rate, drug leaf yield, drug stem yield, and drug stem rate are significant. In all these models, the severity of the correlation value is moderate. Table 6. shows the results of the correlation analysis. There is a positive linear and moderately strong correlation between the monthly total precipitation variable of the annual average and the variables of plant height, green stem yield, and drug leaf value. A negative correlation is observed with the green leaf value. There is a negative correlation between the monthly average relative humidity of the years and the variables green stem yield, green leaf yield, green leaf rate, and green stem yield. There is a positive correlation between green stem rate variables and drug leaf yield.

PCA is a method for revealing the variance structure of the original p variable using a smaller number of new variables that are the linear components of the variables. The fatty acid composition of tarragon was broken down into four components using PCA1. Table 7 contains the eigenvalues and variance percentages of the PCA1 and PCA2 analyses, as well as graphs in Figure 3. In the PCA analysis, variance explanation ratios of over 70% were found to be sufficient (Larrigaudiere, 2004). For PCA1, PC1 and PC2 explained 72.57% of the total variation, while PC1 explained 53.00% and PC2 explained 19.57% of the total variation. In PCA2, PC1 explained 40.99%, PC2 explained 21.93%, and PC3 explained 20.04% and the total variation explained 82.96%. According to Kaiser rules, eigenvalues of greater than 1.0 are accepted as the principal component and descriptor of the variance (Kaiser, 1960). In PCA1, eigenvalues of PC1 (8.78), PC2 (4.32), PC3 (1.89) and PC4 (1.00) were greater than 1.0. In PCA2, eigenvalues of PC1 (10.38), PC2 (6.38), PC3 (5.12) and PC4 (3.12) were greater than 1.0.

Table 7. Principal Component Analysis of fatty acid composition and soil and climate data of local tarragon strains grown in the experimental area.

		PC1	PC2	PC3	PC4
PCA-1	Eigenvalue	8,78	4,32	1,89	1,00
	Variability (%)	53,00	19,57	16,18	11,25
	Cumulative (%)	53,00	72,57	88,75	100,00
		PC1	**PC2**	**PC3**	**PC4**
PCA-2	Eigenvalue	10,38	6,38	5,12	3,12
	Variability (%)	40,99	21,93	20,04	17,04
	Cumulative (%)	40,99	62,91	82,96	100,00

The Kaiser–Meyer–Olkin (KMO) test was used to measure sampling adequacy in principal component analysis. According to Kaiser, (1960), the KMO coefficient is unacceptable between 0–0.5, 0.5 is the minimum, between 0.5–0.7 is the medium, between 0.7–0.8 is good, 0.8–0.9 is considered very good, and 0.9 and above is considered perfect. According to this evaluation, the graphical distributions of the main components were obtained.

The results of Pearson correlation analysis were analyzed to determine the correlation between climate (monthly average temperature, monthly total precipitation, monthly average relative humidity, variables of 2018 and 2019) and soil (variables pH, lime rate, organic matter rate, potassium rate, phosphorus rate, and total salt rate) and oil rate. The results of the analysis are shown in Table 8. A negative linear and moderate correlation exists between the variable oil rate, monthly total precipitation, and monthly average relative humidity. On the other hand, there is no correlation between the monthly average annual temperature data variable and the soil size variables, indicating that increasing precipitation levels negatively affect oil rates. Similarly, it was reported by Gıdık, (2021) that there is a negative correlation between the amount of precipitation and humidity and the oil rate of the plant.

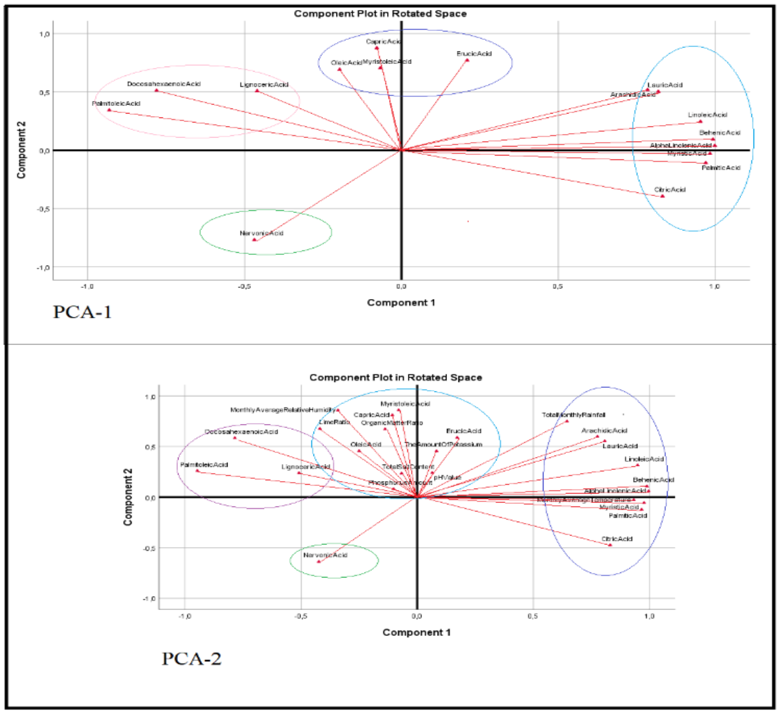

Figure 3. Principal component analysis using the main components that make up the fatty acid composition of the local breeds grown in the experimental area with PCA-1, the fatty acid composition of the local breeds grown in the experimental area with PCA-2 and the main components that make up the soil of the trial area, and the principal component analysis using the climate data are shown.

Table 8. Pearson Correlation analysis between monthly average temperature, monthly total precipitation, monthly average relative humidity, Ph value, lime ratio, organic matter ratio, potassium amount, phosphorus amount, total salt ratio and oil content.

Variables		**Oil Content**
Monthly Average Temperature	r_P	0.154
	p	0.634
Monthly Total Precipitation	r_P	**-0.691**
	p	0.013
Monthly Average Relative Humidit	r_P	**-0.452**
	p	0.040
PH value	r_P	0.262
	p	0.410
Lime Ratio	r_P	-0.029
	p	0.928
Organic Matter Ratio	r_P	-0.079
	p	0.806
Potassium Amount	r_P	0.000
	p	1.000
Phosphorus Amount	r_P	-0.148
	p	0.645
Total Salt Ratio	r_P	0.105
	p	0.745

DISCUSSION

In this study, oil content and fatty acid composition of six different *Artemisia dracunculus* L. local breeds were determined. It is important to determine the fatty acid composition of plant products consumed as food. The fatty acid content of vegetable oils, particularly the proportions of oleic and linoleic acids and saturated fatty acids, affects the oil quality (Onemli, 2012). Results of fatty acid composition in this study, revealed that the most important fatty acids were α-linolenic acid and linoleic acid. Similarly, Kursat *et al.* (2015) determined the oil content value between 11.32±0.41% and 22.21±0.43% in different species of *Artemisia* genus and presented similar results to this study. Different results for palmitoleic acid (0.33-0.75%) were previously reported for *Artemisia* spp. (0.23%-3.08%) (Carvalho *et al.*, 2010; Kursat et al. 2015; Payamalle *et al.*, 2019). It is suggested that the resulting differences are due to the fact that the species of plants employed in the two studies are different. Some studies have reported different results for stearic acid (0.77-1.95%), although similar to this study (0.47-3.04%) (Carvalho *et al.*, 2010; Kursat *et al.*, 2015; Payamalle *et al.*, 2019). The percentage of oleic acid (0.24-1.11%) was determined by Kursat *et al.*, (2015) (2.59%), Carvalho *et al.*, (2010) (0.26%-1.00%), and Payamalle *et al.*, (2019) (9.404%), which was quite low. There are both similarities and differences compared with previous studies. In similar studies, erucic acid value was reported as 0.56% to 1.04%, and although it is close to this study, other values were also obtained (Carvalho *et al.,* 2010; Kursat *et al.,* 2015). These differences are believed to be due to the climatic characteristics of the plant species employed in the studies and the regions where cultivation occurs, as well as the different extraction techniques used in the fatty acid analysis. Cil (2013) determined the longest average plant height of 49.31 cm in the plants the obtained from Erzurum Dadaşköy. Basiri and Nadjafi (2019), in their study, found that the plant height for tarragon varied between 38.29-74.45 cm and showed similar results to this study. The obtained results are lower than the 60-120 cm value mentioned by Turkozu (2010), probably due to soil properties, climate, and irrigation differences.

NurzyĚska-Wierdak and Zawiślak (2014), reported results supporting this study for tarragon green herb yield. In contrast, there are studies in which green herb yield was lower for *Artemisia* spp. (Ozguven *et al.,* 2008) and studies in which the average green herb yield was higher (Cil and Kara, 2014). This situation is influenced by temperature, humidity, spring precipitation, and the seedling age difference. This difference can also be explained by the genetic difference of the plants (Telci, 2001).

There are also studies reporting lower green leaf yield and green leaves rate for tarragon (NurzyĚska-Wierdak and Zawiślak 2014), Cil (2013) found that Erzurum Dadaskoy local breed gives higher green leaf yield and green stem yield but, the green leaves rate was 57.57% in the local breed Bayburt, which supports this study.It is suggested that the main reason for the high proportion of green leaves compared to previous studies may be due to differences such as mechanical applications and irrigation amounts during cultivation.

Drug herb yield is known as an important yield value for tarragon. In recent years, research has been conducted to increase the yield of the drug herb for tarragon, which is commonly used as a drug (Mumivand *et al.,* 2021). In a study using closely related *Artemisia* spp., lower values were reported for the drug herb (Ozguven *et al.,* 2008). In a similar study, the average drug herb yield was 1323.58 kg ha^{-1} (Cil, 2013). It is thought that these differences result from the plants' genetic structures, the growing areas' ecological-geographical characteristics, and the seedlings' age.

When the correlation data were examined, it was seen that there was generally a positive correlation between the monthly average precipitation and the yield elements. These obtained data are also supported by the study conducted by Irdem (2022). This situation suggests that precipitation is generally related to yield and the climate data of the location where the plants are grown have an effect on yield and yield components.

***Conclusions*:** Tarragon belongs to medicinal and aromatic plants. It is a plant cultivated in certain regions of Turkey, but its value is increasing daily due to its important bioactive properties recently discovered. This is the first study in which the rate of total oils and fatty acid composition was determined, which was also conducted to determine the yield and yield-related aspects and quality features of tarragon plants grown under organic conditions in Bayburt province. According to the results, the highest values for important parameters such as drug and green herb yield were found in the A1 local breed. The plant's maximum values for stem yield were found in the A6 local breed, which is undesirable because the green leaves are used as drugs. It was found that the ecological conditions of the central district of Bayburt province are quite suitable for organic tarragon cultivation. In this study, it was found that under the ecological conditions of Bayburt province, local breeds of tarragon grown under organic conditions gave high yields and quality products without synthetics applications and contained valuable fatty acids and total oils suitable for industrial use. The yield and quality characteristics of study suggest that Bayburt province has suitable ecological conditions for organic tarragon cultivation and that cultivation of this plant can be expanded in the region.

Authors' contribution statements: ÖG and BG executed the field research and, laboratory analyses, conceived the idea and supervised the work, together. BG analized the statistical data and wrote the article.

***Conflict of interest*:** Özlem GÖKTAŞ and Betül GIDIK declare that they have no competing interests.

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