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Determination of Effect of Plant Density on Oil content and Composition for Milk Thistle (*Silybum marianum* L. Gaertn.)

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Abstract: The study has been carried out in Field Crops Central Research Institute, Ankara in 2010 and 2011 years for the purpose of determining the impact of different plant densities on the oil content and oil composition of the milk thistle (*Silybum marianum* L. Gaertn.) plant. In the experiment,a randomized complete block design with three replications were used. The seeds of milk thistle were obtained from Department of Field Crops, Faculty of Agriculture, University of Ankara. The results showed that the densities of plant and growing years didn't have a significant effect on the oil contents. On the other hand; the years had a significant effect on the fatty acids profile, except for palmitic acid, but it showed that the densities of plant had no effect on the profile of the fatty acids.

Key words: *Silybum marianum* L. Gaertn., Plant density, Oil content and Oil acid composition

Farklı Bitki Sıklıklarının Meryemana Dikeni (*Silybum marianum* L. Gaertn.) Bitkisinin Yağ Oranı ve Yağ Asitleri Kompozisyonu Üzerine Olan Etkisinin Belirlenmesi

Özet: Bu çalışma 2010-2011 yıllarında Ankara Merkez Tarla Bitkileri Araştırma Enstitüsü'nde meryemana dikeni bitkisinin yağ oranı ve yağ asitleri kompozisyonu üzerine farklı bitki sıklığının etkisini belirlemek amacıyla yürütülmüştür. Deneme Tesadüf Blokları Deneme Desenine göre 3 tekerrürlü olarak kurulmuştur. Çalışmada kullanılan meryemana dikeni bitkisini tohumları Ankara Üniversitesi Ziraat Fakültesi Tarla Bitkileri Bölümü'nden temin edilmiştir. Çalışmadan elde edilen sonuçlar bitki sıklıkları ve yılların yağ oranı üzerinde önemli düzeyde etkili olmadığını göstermiştir. Diğer taraftan, palmitik asit hariç yıllar istatistiksel olarak önemli düzeyde yağ asitleri üzerinde etkiliyken, bitki sıklığı yağ asitleri kompozisyonu üzerinde önemli düzeyde etkili olmadığı görülmüştür.

Anahtar kelimeler: *Silybum marianum* L. Gaertn., bitki sıklığı, yağ oranı ve yağ asitleri kompozisyonu

Introduction

Milk thistle *(Silybum marianum* L. Gaertn.) is a member of the family Asteraceae of the species of *Silybum* has two different types. These are *S. marianum* and *S. eburneum*. The species of *Silybum marianum* L. has two sub-types in our country and these are *Silybum marianum ssp. marianum* and *Silybum marianum* ssp. *anatolicum.* The wild species of milk thistle are biennial, the cultured *Silybum marianum* is an annual plant. Both sub-species of *Silybum marianum* L. contain the same bioactive substance and their content of silimarin are above 1%. Moreover; this content exceeds 2% in the plant materials collected in Denizli Pamukkale territory (Tanker and Tanker, 2003 ve Karkanis et al., 2011).

The origin of the plant is the steps of Africa, South Europe and Asia Minor (Tanker and Tanker, 2003) and the plant shows natural deployment in many regions such as mainly North and South America,

Africa, Australia, Middle East, Europe and Mediterranean Region countries (Martin et al., 2006, Andrzejewska et al., 2011 and Tahernia et al., 2014). The cultivation of the plant is made in many regions of South Europe, Africa, China, Australia, South America and North America and the hot and arid regions of Western Asia (Andrzejewska et al., 2011 and Tahernia et al., 2014).

The plant of milk thistle is used in the treatment of liver and kidney illnesses in different places of the world for at least 2000 years (Geneva et al., 2008; Shamsi, 2009 and Askari et al., 2014). The plant is widely used today in the treatment of various liver illnesses (cirrhosis stemming from alcohol, hepatitis, necrosis etc.) in different countries being mainly Germany and the USA for medical purposes (Martin et al., 2006 and Arouiee et al., 2011). In addition; silimarin being the bioactive substance of the plant and that is obtained from its fruits is densely used against the skin and prostate cancer (Martin et al., 2006 and Shaker et al., 2010). As well as being used in the treatment of the liver illnesses, silimarin is also used in the treatment of the poisoning of *Amanita phalloides* mushroom and used as antioxidant (Tahernia et al., 2014 and Anonymous, 2015). The plant has drugs sold in the pharmacies with various trade names in Europe (Demirezer et al. 2007).

The parts of the milk thistle plant that are used as drug are fruits (*Fructus silybi mariani*) (Tanker and Tanker, 2003 and Andrzejewska et al., 2011). The bioactive substance of the fruits used as drug is silimarin being a mixture of flavolignan (silibin A, silibin B, isosilibin A, isosilibin B, silidianin and siliktristin) (Geneva et al., 2008; Andrzejewska et al., 2011; Arouiee et al., 2011 and Tahernia et al., 2014). Together with the fruits of the plant, all parts above ground are used for medical purposes (Karkanis et al., 2011). The seeds of the plant contain silimarin by the content of 1.0-4.0% (Martin et al., 2006 and Tahernia et al., 2014). Furthermore; the fruits of the plant contain fatty oil (25-30%), starch and tannin as well as silimarin (Baytop, T. 1999; Özer et al., 2002 and El-Mallah et al., 2003).

The purpose of this study is to determine the effect of different plant densities on the composition of fatty oil content and fatty acid composition in the fruits of the milk thistle plant.

Materials and Methods

This study was carried out in research area of Field Crops Central Research Institute in Turkey during 2010 and 2011 vegetation periods. The seeds of milk thistle [*Silybum marianum* (L.) Gaertn.] were obtained from Department of Field Crops, Faculty of Agriculture, University of Ankara. Soil characteristics are given in Table 1.

Table 1. Physical and Chemical Characteristics of Soil in Research Area.
Çizelge 1. Araştırma alanı toprağının fiziksel ve kimyasal özellikleri

Structure ***Tekstür***	**Lime** ***Kireç*** **(%)**	**Salt** ***Tuz*** **(%)**	**Plant-Available Phosphorus** ***Yarayışlı Fosfor*** **(P_2O_5) (kg/da)**	**Plant-Available Potassium** ***Yarayışlı Potasyum*** **(K_2O) (kg/da)**	**pH**	**Organic Matter** ***Organik Madde*** **(%)**
Clay-loam (*Killi-tınlı*) (2010)	2,35	0,046	13,48	185,45	7,52	1,77
Clay-loam (*Killi-tınlı*) (2011)	2.81	0,048	10,32	205,36	7,62	1,78

Source: Soil Fertilizer and Water Resources Research Institute.
Kaynak: Toprak Gübre ve Su Kaynakları Araştırma Enstitüsü

Research area had lime-loamy soil structure having 7.52 pH, 0.046% salt, 1.77% organic matter and 2.35% lime. Besides, climatic conditions during the two years (2010 and 2011) are given Table 2. Total rainfalls in 2010 and 2011 (379.9 and 401.5 mm, respectively) were lower than long term year rainfall (402.1mm). In 2010 period, total

rainfall (March-June) was 172 mm so was 213 mm in 2011period. Rainfall in tillering stage (in May), important for yield, was 22 mm in 2010 and 86 mm in 2011 period. Mean temperatures in 2010 and 2011 (11.8ºC and 10.5ºC, respectively) were lower than long term mean temperature values (12.0ºC).

Table 2. Rainfall, Temperature and Humidity values for 2010, 2011 and Long Term Average Years (1975-2010) in Ankara Climatic Conditions

Çizelge 2. Ankara iklim koşullarının 2010 ile 2011 yılları ve uzun yıllar (1975-2010) için yağış, sıcaklık ve nem değerleri

Years *Yıllar*	**January** *Ocak*	**February** *Şubat*	**March** *Mart*	**April** *Nisan*	**May** *Mayıs*	**June** *Haziran*	**July** *Temmuz*
			Total Rainfall (mm) *Toplam Yağış (mm)*				
2010	56,2	39,4	41,0	13,8	22,0	76,0	20.2
2011	28,0	5,0	42,0	35,0	86,0	37,0	13.0
1975-2010	39,2	33,6	36,1	50,0	49,7	35,1	16.0
			Mean Temperature (°C) *Ortalama Sıcaklık (°C)*				
2010	1,2	4,0	7,0	9,4	15,0	19,0	21.0
2011	0,2	-0,6	3,0	8,0	12,0	17,0	23.0
1975-2010	0,3	2,1	6,2	11,3	16,0	20,2	23.5
			Relative Humidity (%) *Nispi Nem (%)*				
2010	58,8	59,5	60,1	61,2	60,5	58,6	57.4
2011	59,7	62,1	62,4	60,8	60,7	58,9	58.4
1975-2010	58,2	59,4	61,2	60,8	60,3	59,1	60.0
Years *Yıllar*	**August** *Ağustos*	**September** *Eylül*	**October** *Ekim*	**November** *Kasım*	**December** *Aralık*	**Tot/Mean** *Toplam/Ort*	
			Total Rainfall (mm) *Toplam Yağış (mm)*				
2010	0,0	3,0	16,5	26,4	65,6	379,9	
2011	0,2	0,0	81,6	24,0	50,0	401,8	
1975-2010	12,4	18,9	32,5	36,0	42,6	402,1	
			Mean Temperature (°C) *Ortalama Sıcaklık (°C)*				
2010	25,5	16,7	14,5	5,2	3,4	11,8	
2011	21,0	17,0	12,3	8,7	4,6	10,5	
1975-2010	23,2	18,7	13,0	6,8	2,2	12,0	
			Mean Humidity (%) *Nispi Nem (%)*				
2010	62,5	61,7	65,2	59,4	61,4	60,5	
2011	60,4	61,2	57,8	57,3	60,8	60,0	
1975-2010	61,3	63,1	60,7	57,9	59,2	60,1	

[1/]Data were taken from Ankara Regional Meteorological Service.

[1/]*Veriler Ankara Bölge Meteoroloji Servisi'nden alınmıştır.*

The research was conducted to determine the effect of different plant densities on oil content and fatty acid composition. Different plant densities 25 x 10 cm (400 000 plants/ha), 25 x 20 cm (200 000 plants/ha), 25 x 30 cm (133 330 plants/ha), 25 x 40 cm (100 000 plants/ha), 50 x 10 cm (200 000 plants/ha), 50 x 20 cm (100 000 plants/ha), 50 x 30 cm (66 660 plants/ha) and 50 x 40 cm (50 000 plants/ha) were used. Study was carried out in a randomized complete block design with three replications. Plants were sown on 16 March 2010 and 25 March 2011 and harvested at the middle of July in both 2010 and 2011. Weeding was done by hand 30 days later from plantation. No fertilizer and irrigation were applied. One row at both the sides and 0.5 m in both the edges were

discarded and rest area was harvested on 15-20 July, when 50% of the achene heads matured (Karkanis *et al.,* 2011).

Oil Content and Composition

The oil content and composition were determined in the Unit of Oily Seeded Plants quality laboratories of the Central Research Institute for Field Crops in Ankara University. For oil measurements, the seeds were properly grounded and the oil was extracted with petroleum ether in a Soxhlet extractor for 4 h. Recovered crude oils were taken drying oven to petroleum ether evaporation at 35 °C for 3h. After the cooling in desiccator, was weighed by precision scales. The oil content was calculated on mass basis.

For determination of fatty acid compositions; 0.1 g oil was shaked with n-hekzan 10 ml, added 0,5 ml 2N KOH (dissolved in methanol), incubated 30 minute thus fatty acids were esterified as methyl esters and placed to Shimadzu AOC-20i automatic injector (split ratio 1:100), than analysed by Shimadzu GC-2010 (Japan) with equipment with Teknokroma capillary column (100 m x 0.25 mm ve 0.2 µm) and FID detector. Helium was used as carrier gas at a flow rate of 0.94 ml/min. Injector and detector temperature were 250 °C. Column temperature programed to waiting 140 °C for 5 min., increase 4 °C /min and was kept at 240 °C for 20 min. FAMEs were identified by comparison of their retention times with those of reference standards.

Statistical Analysis

In randomized complete block design, analytical data collected with three replications of each treatment were subjected to analysis of variants using MSTAT-C statistical program, and difference between means were compared via the LSD (Least Significant Difference) test using the same program (Düzgüneş et al., 1987).

Result and Discussion

Milk thistle is a plant that is candidate for being a significant source of fatty oil due to the high fatty oil content and the fatty oil composition owned by its seeds (Baytop, T. 1999; Özer et al. 2002; El-Mallah et al., 2003). It is also known that milk thistle is used in the treatment of different diseases due to the presence of secondary metabolites besides fatty oil (Martin et al., 2006, Karkanis et al., 2011, Tahernia et al., 2014 and Anonymous, 2015).

Oil content (%)

When the values of the oil contents attained from the study have been examined, it was observed that the densities of plant and the impact of the years were not statistically significant (Table 3). In 2010; while the oil content as the average of the plant densities has been determined as 18.22%, it has been detected that this rate has become 17,86% in 2011. As the average of the years, the oil content was observed as 18,04 %.

In the study; while the highest oil content was taken from the plant density of 25 x 20 cm as 21,62 %, the lowest oil content was taken from the plant density of 50 x 40 cm as 15,55 % in 2010. In 2011; while the highest oil content was taken from the plant density of 25 x 20 cm as 19,21 %, the lowest oil content was taken from the plant density of 25 x 10 cm as 16,01 %. As the averages of the years; when the plant densities are examined; while the highest oil content was taken from the plant density of 25 x 20 cm as 20,41 %, the lowest oil content was taken from the plant density of 50 x 40 cm as 16,49 %. These results have shown that the density of plant did not have a statistically significant effect on the oil content and the plant density of 25 x 20 cm increases the oil content for a small amount. Many studies conducted for the purpose of determining the oil contents of the plants with oily seed have shown that changes occur in the oil contents depending on the genotype of the plant material used in the production, environmental conditions in which production has been made and the cultivation applications (Flagella et al., 2002; Ali and Ullah, 2012; Turhan et al., 2011; Yeilaghi et al., 2012). The fact that the different plant densities used in our study and the years were not statistically effective in a significant level on the oil yield could be explained by the fact that the densities of plant and the years did not become different in a way to form a difference in the oil.

Table 3. Means of effect of different plant density on oil content and composition of Milk thistle

Çizelge 3.Farklı bitki sıklıklarının meryemana dikeninin yağ oranı ve kompozisyonu üzerine etkisine ait ortalamalar

OIL CONTENT (%) /*YAĞ ORANI (%)*

Plant densities / *Bitki Sıklığı*									
Years ***Yıllar***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	20,76	21,62	18,01	17,79	17,91	16,96	17,18	15,55	**18,22**
2011	16,01	19,21	18,76	17,02	18,55	17,22	18,7	17,44	**17,86**
Mean ***Ort***	**18,39**	**20,41**	**18,38**	**17,41**	**18,23**	**17,09**	**17,94**	**16,49**	**18,04**

C.V.(%): 12,38 **L.S.D.(%): -**

F_{values}: Year: 0,14ns; Plant density: 2,33ns; Year × Plant density: 2,11ns.

$F_{değerleri}$: *Yıl: 0,14öd; Bitki Sıklığı: 2,33öd; Yıl × Bitki Sıklığı: 2,11öd.*

LINOLEIC ACID CONTENT (%) / *LİNOLENİK ASİT ORANI (%)*

Plant densities / *Bitki Sıklığı*									
Years ***Yıl***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	38,41	38,48	37,59	37,7	38,16	37,8	37,72	38,84	**38,09[a]**
2011	35,86	36,07	36,56	34,93	36,55	35,41	36,32	35,45	**35,89[b]**
Mean ***Ort***	**37,14**	**37,28**	**37,08**	**36,32**	**37,36**	**36,61**	**37,02**	**37,15**	**36,99**

C.V.(%): 4,34 **L.S.D.(%): Year (*Yıl*): 1,375**

F_{values}: Year: 47,19*; Plant density: 0,59ns; Year × Plant density: 0,72ns.

$F_{değerleri}$: *Yıl: 47,19*; Bitki Sıklığı: 0,59öd; Yıl × Bitki Sıklığı: 0,72öd.*

OLEIC ACID CONTENT (%) / *OLEİK ASİT ORANI (%)*

Plant densities / *Bitki Sıklığı*									
Years ***Yıllar***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	31,7	32,11	32,05	32,86	31,75	32,62	31,97	32,56	**32,20[b]**
2011	32,94	33	33,36	33,38	33,27	33,26	33,47	33,27	**33,24[a]**
Mean ***Ort***	**32,32**	**32,55**	**32,71**	**33,12**	**32,51**	**32,94**	**32,72**	**32,92**	**32,72**

C.V.(%): 2,66 **L.S.D.(%): Year (Yıl): 0,781**

F_{values}: Year: 32,77*; Plant density: 0,79ns; Year × Plant density: 0,47ns.

$F_{değerleri}$: *Yıl: 32,77*; Bitki Sıklığı: 0,79öd; Yıl × Bitki Sıklığı: 0,47öd.*

PALMITIC ACID CONTENT (%) / *PALMİTİK ASİT ORANI (%)*

Plant densities / *Bitki Sıklığı*									
Years ***Yıllar***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	10,76	10,57	10,57	10,92	11,14	10,84	10,78	10,81	**10,8**
2011	10,05	10,18	10,31	10,17	10,06	10,17	10,09	9,86	**10,11**
Mean ***Ort***	**10,4**	**10,38**	**10,44**	**10,55**	**10,6**	**10,51**	**10,44**	**10,33**	**10,45**

C.V.(%): 5,12 **L.S.D.(%): -**

F_{values}: Year: 3,90ns; Plant density: 0,37ns; Year × Plant density: 0,84ns.

$F_{değerleri}$: *Yıllar: 3,90öd; Bitki Sıklığı: 0,37öd; Yıl × Bitki Sıklığı: 0,84öd.*

Continuation of Table 3 / *Çizelge 3'ün Devamı*

STEARIC ACID CONTENT (%) / *STEARİK ASİT ORANI (%)*

Plant densities / *Bitki Sıklığı*									
Years ***Yıl***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	9,2	8,96	8,7	8,77	8,58	8,63	8,33	8,8	**8,75[a]**
2011	8,36	8,2	8,39	8,39	8,24	8,37	8,35	8,04	**8,29[b]**
Mean Ort	**8,78**	**8,58**	**8,55**	**8,58**	**8,41**	**8,5**	**8,34**	**8,42**	**8,52**

C.V.(%): 4,51 **L.S.D.(%): Year (Yıl): 0,367**

F_{values}: Year: 28,37*; Plant density: 1,59ns; Year × Plant density: 1,94ns.
$F_{değerleri}$: *Yıl: 28,37*; Bitki Sıklığı: 1,59öd; Yıl × Bitki Sıklığı: 1,94öd.*

ARACHIDIC ACID CONTENT (%) / *ARAŞİDİK ASİT ORANI (%)*

Plant densities / *Bitki Sıklığı*									
Years ***Yıl***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	5,78	5,72	5,58	5,44	5,46	6,01	5,41	5,63	**5,63[a]**
2011	5,17	5,09	5,22	5,24	5,16	5,22	5,18	4,97	**5,16[b]**
Mean ***Ort***	**5,48**	**5,41**	**5,4**	**5,34**	**5,31**	**5,62**	**5,3**	**5,3**	**5,39**

C.V.(%): 6,42 **L.S.D.(%):** Year (Yıl): 0,324

F_{values}: Year: 39,80*; Plant density: 1,51ns; Year × Plant density: 1,60ns.
$F_{değerleri}$: *Yıl: 39,80*; Bitki sıklığı: 1,51öd; Yıl × Bitki Sıklığı: 1,60öd.*

BEHENIC ACID CONTENT (%) / *BEHENİK ASİT ORANI (%)*

Plant densities / *Bitki sıklığı*									
Years ***Yıllar***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	3,94	3,95	3,91	3,6	3,8	3,82	3,81	3,87	**3,84[a]**
2011	3,41	3,38	3,47	3,45	3,46	3,48	3,46	3,33	**3,43[b]**
Mean ***Ort***	**3,68**	**3,67**	**3,69**	**3,53**	**3,63**	**3,65**	**3,63**	**3,6**	**3,63**

C.V.(%): 7,09 **L.S.D.(%): Year (Yıl):** 0,305

F_{values}: Year: 33,36*; Plant density: 0,70ns; Year × Plant density: 1,30ns.
$F_{değerleri}$: *Yıl: 33,36*; Bitki Sıklığı: 0,70öd; Yıl × Bitki Sıklığı: 1,30öd.*

GADOLEIC ACID CONTENT (%) /*GADOLEİK ASİT ORANI (%)*

Years ***Yıl***	**25×10**	**25×20**	**25×30**	**25×40**	**50×10**	**50×20**	**50×30**	**50×40**	**Mean** ***Ort***
2010	3,94	3,95	3,91	3,6	3,8	3,82	3,81	3,87	**3,84[a]**
2011	3,41	3,38	3,47	3,45	3,46	3,48	3,46	3,33	**3,43[b]**
Mean ***Ort***	**3,68**	**3,67**	**3,69**	**3,53**	**3,63**	**3,65**	**3,63**	**3,6**	**3,63**

C.V.(%): 6,86 **L.S.D.(%): Year (*Yıl*):** 0,050

Fvalues: Year: 23,35*; Plant density: 0,50ns; Year × Plant density: 0,80ns.
Fdeğerleri: Yıl: 23,35; Bitki Sıklığı: 0,50öd; Yıl × Bitki Sıklığı: 0,80öd*.

*: significant at P<0.05, ns: non significant.
**: %5'te önemli (P<0.05), öd: önemli değil*

contents. In addition; the fixed oil content by the ratio of 18,04 % attained from our study was lower than the oil contents observed in some other studies as 25-30 % (Baytop, 1999; Özer et al. 2002 and El-Mallah et al., 2003). This situation could be explained with the

genotype of the plant materials used in the conducted studies, the ecological factors and the differences in the cultivation applications

Oil composition (%)

The oil composition in the fatty oils obtained from the oily seeds is the most significant factor that determines the quality of the fat and for which purposes these fats shall be benefited (Yeilaghi et al., 2012, Flagella et al., 2002 and Schulte et al., 2013). The oil composition owned by the fatty oils occurs under the impact of various factors. These factors are the type and variety of the plant used in the production, the climate and soil conditions of the region in which the production has been carried out and the cultivation applications (Sipalova et al., 2011, Schulte et al., 2013 and Ardali, 2014). The fat to be produced in the production of the vegetable oils having the fatty acids profile that is the most convenient with their usage purpose is determined as the main target. Firstly, the selection of the convenient types and varieties of the plants is necessary. In addition; the determination of the production techniques with the climate and soil conditions that shall produce the most convenient oil composition is needed. For this reason; studies are sustained to be conducted by using different genotypes in many places of the world.

It has been determined in this study that the oil composition of the oil attained from the seed of the milk thistle plant contains %36,99 linoleic, %32,72 oleic, %10,45 palmitic, %8,52 stearic, %5,39 arachidic, %3,63 behenic ve %1,27 gadoleic acid (Table 3). Out of these fatty acids; while linoleic acid is known as polyunsaturated fatty acid, oleic and gadoleic acid is known as monounsaturated fatty acid. On the other hand; palmitic, stearic, arachidic and behenic acids are known as saturated fatty acids (Ardali, 2014).

The results obtained from the studies have shown that 70,98% of the fatty acids consists of unsaturated fatty acids and 36,99 % of them consists of polyunsaturated fatty acids and 33,99 % of them consists of monounsaturated fatty acids. On the other hand; it has been determined that the rate of saturated fatty acids is 27,99 % (Table 3). When the situation of all these fatty acids compositions is taken into consideration; oil of the milk thistle plant is a good source of nutrition for human (Kayahan, 2000).

The results of the conducted study have revealed that the density of plant does not have a significant difference statistically on the oil compositions (Table 3). However; it was observed that the years were effective in significant level on the composition of the fatty acids in all other fatty acids except for palmitic acid (Table 3). The linoleic acid content (38,09%) in 2010 has been found as higher than the content (35,89%) belonging to 2011 growing year. On the contrary; the content of 2011 (33,24%) has been found as higher than the value of 2010 (32,20%) in oleic acid content. In the formation of this situation; it could be accepted that the average temperatures and the amount of precipitation changing depending on the years have become effective. Especially the average temperature differences belonging to July being the maturation period of the seed have become effective in the occurrence of this situation. While the average temperature belonging to the July of 2011 in which the content of oleic acid was higher at 23,0 ^{o}C, the average temperature belonging to the same year of 2010 has been measured as 21,0 ^{o}C (Table 2). It is known that the content of oleic acid contained in the oily seeds increases together with the increase in the temperature in the maturation period of the seed. On the contrary, the content of linoleic acid decreases. The most important reason for this stuation is the high temperature in the maturation period of the seed which decreases the synthesis and activity of the oleate desaturase enzyme (Flagella et al., 2002; Baux et al., 2008; Turhan et al., 2011; Yeilaghi et al., 2012; Schulte et al., 2013). Our findings of the oleic and linoleic acid values confirm this situation.

The palmitic, stearic, arachidic and behenic acid content being the saturated fatty acids have been found as higher in 2010 when compared to the values of 2011 (Table 3). These findings could be explained with the temperature and precipitation differences changing depending on the years.

The gadoleic acid (C20:1) value attained from the study has been found as higher in 2010 in which the temperature in the maturation period of seed was higher when compared to 2011 (Table 2 and Table 3). This results were in accordance with the change depending on temperature notified by Turhan et al. (2011) for the plant of colza (*Brassica napus* spp. *olerifera*).

On the other hand; the small changes occurring in the composition of the fatty acids in relation to the density of plant could be explained with the change of temperature in the plant microclimates occurring depending on the difference in the plant densities **(**Flagella et al., 2002**).**

Conclusion

When the results observed from the study conducted for 2 years (2010 and 2011) under the ecological conditions of Ankara were assessed, it was determined that the densities of plant and the years did not have a significant impact on the oil content. The oil content of the plant was detected as 18,04% in this study. When the impact of the plant densities and years on the oil composition was examined, it was determined that the plant densities were not effective on the oil composition, but the years had a significant effect on other fatty acids profiles except for palmitic acid. It was observed that the fatty acid composition of milk thistle plant had been detected to consist of 36,99% linoleic acid, 32,72% oleic acid, 10,45% palmitic acid, 8,52% stearic acid, 5,39% arachidic acid, 3,63% bahanic acid and 1,27% gadoleic acid. Although the density of plant was not effective in a significant level on the oil content and fatty acid composition, the density of 25 x 20 cm had the highest oil productivity rate which seems to be advisable to the manufacturers.

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