Turkish Journal of Field Crops, 2012, 17(2): 105-110

GENOTYPIC VARIATIONS ON YIELD, YIELD COMPONENTS AND OIL QUALITY IN SOME CAMELINA (*Camelina sativa* (L.) Crantz) GENOTYPES

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Received: 19.03.2012

ABSTRACT

This research was conducted to determine performance of different false flax (*Camelina sativa* (L.) Crantz) genotypes (Vinimik 17, PI304269, CR 476/65, CR 1674/90, Ames 26665, Ames 26667, Ames 26673, Ames 26676, Ames 26680, Ames 26686 and Ames 28372) in terms of the plant height, the branch number, 1000 seed weight, the seed yield, oil content, oil yield and fatty acid components. Results showed that having highest seed yield, and oil yield, Vinimik 17, Ames 26665, Ames 26667 and Ames 26673 could be suggested to be used as oil crops for oil industry or as medicine plant. Having low saturated fat content this crop seems quality edible oil. Though genotypes are higher in erucic acid than 2% (maximum limit for canola quality edible oil), Genotypes having less erucic acid content should be developed by breeding programs/biotechnology.

Key words: False flax, seed yield, yield components, oil content, oil acids, genotypes

INTRODUCTION

False flax (*Camelina sativa* (L.) Crantz) is a member of the Cruciferae family, named as false flax or gold of pleasure (Abramovic et. al., 2007; Karaman et al., 2011). False flax (*Camelina sativa* (L.) Crantz), known as an oilseed crop, has been cultivated and used for human consumption for 3000 years (Zubr, 1997; Crowley and Fröhlich, 1998). Among six species of false flax (*C. sativa, C. laxa, C. rumelica, C. microcarpa, C. hispida, C. anomala*) *C. sativa* has solely economic importance (Kurt and Seyis, 2008). Studies revealed that linolenic acid in false flax is about 2-4 times higher than canola, soybean and olive oil (Korsrud et al., 1978; Crowley and Fröhlich, 1998; Karvonen et al., 2002; Kurt and Seyis, 2008). Containing high proportion of oil content and some important amino acids, false flax (*Camelina sativa* (L.) Crantz) could be taken into account as substantial input for food and industrial purposes (Karvonen et al., 2002; Eeva-Liisa et al., 2007). False flax could cause tremendous increase in omega-3 fatty acid that is important for human health when is used for poultry sector (Rokka et al. 2001; Eeva-Liisa et al., 2007). Moreover, false flax seems as essential source not only for biodiesel production and but industrial machinery. High level iodine in methyl ester keeps this oil undeteriorated and this phenomenon in this oil creates opportunity to be used in industrial use (Frohlic and Rice, 2005). So, high level adaptability, lower nutrient requirement, higher competition ability to other oil crops, higher oil quality for human health/consumption make false flax promising crop in the world (Korsrud et al., 1978; Crowley and Fröhlich, 1998; Kurt and Seyis, 2008). Though, false flax (*Camelina sativa* (L.) Crantz) is summer-habit plant, winter resistant types of false flax exist (Crowley and Fröhlich, 1998). Once, oil content is about 42 % in summer-habit types, 45 % in winter-habit types in false flax (*Camelina sativa* (L.) Crantz), This study was carried out to determine the performance of eleven false flax genotypes for yield, yield components and quality of oil acid components.

MATERIALS AND METHODS

This study was carried out in research area of Central Research Institute for Field Crops in Turkey in 2010 and 2011 years. Genotypes, Vinimik 17 (1), PI 304269 (2), CR 476/65 (3), CR 1674/90 (4), Ames 26665 (5), Ames 26667 (6), Ames 26673 (7), Ames 26676 (8), Ames 26680 (9), Ames 26686 (10) and Ames 28372 (11) were used in the study. All genotypes are alternative habit genotypes but were sown in fall as a winter-habit genotype. Soil characteristics were given in Table 1. Soils in the research area had lime-loamy structure with 8.06 in pH, 0,041 % in salt, 1.57 % in organic matter and 2.65 % in lime. Besides, climatic conditions consisting of 2010-2011 years and long term (1975-2010) were given Table 2. Total rainfall in 2010 was 379.9 mm so do 401.8 mm in 2011, it was also 402.1 mm in long term (1975-2010) years. Temperature in 2010, 2011 and long term years were 11.8°C, 10.5°C and 12.0°C, respectively, so did 60.5%, 60.0% and 60.1%, respectively in humidity.

Table 1. Physical and Chemical Characteristics of Soil in Research Area

Structure	Lime (%)	Total Salt (%)	Plant-Available Phosphorus (P_2O_5) (kg/da)	Plant-Available Potassium (K_2O) (kg/da)	pH	Organic Matter (%)
Clay-Loam	2.65	0.041	11.41	215.233	8.06	1.57

Source: Soil Fertilizer and Water Resources Research Institute.

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

Years	January	February	March	April	May	June	July
				Total Rainfall (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)			
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
				Mean Humidity (%)			
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	August	September	October	November	December	Tot/Mean
			Yearly Total Rainfall (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
			Yearly Mean Temperature (°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
			Yearly Mean Humidity (%)			
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.

This study was conducted in Randomized Complete Block Design with three replications. Plot size was 1.2 m x 5.0 m = 6.0 m^2 and distance between plants was also 30 cm (Kara, 1994). Genotypes were sown in 12-15 of March (Koncıus and Karcauskıene, 2010). No fertilizer was applied and genotypes were harvested in 15-20 of June (Vollman et al., 2007). One row at both sides and 0.5 m in both edges were discarded and harvest area was 5 m^2 (Vollman et al., 2007; Gugel and Falk, 2006). In the study, plant height, branch number per plant, 1000 seed weight, yield, oil content and oil yield were measured and analysed (Kara, 1994; Rokka et al. 2001; Gugel and Falk, 2006; Vollman et al., 2007; Eeva-Liisa et al., 2007;). For oil measurements, the seeds were properly grounded and the oil was extracted with n-hexane in a Soxhlet extractor for 4 h. Recovered crude oils were taken to dry out on a rotator at 35 ^{0}C. The oil content was calculated on dry mass basis. Fatty acids were etherified as methyl esters and analysed by Agilent 6890N Network with equipment with DB-23 capillary column (JW Scientific 122-2362 DB-23 ; 60.0 m x 250 µm x 0.25 µm) GC and FID detector. Helium was used as carrier gas at a flow rate of 1 mL/min. Injector and detector temperature were 260 ^{0}C and 240 ^{0}C, respectively. Column temperature was kept at 220 ^{0}C for 69 min. Samples of 0.5 uL was injected by hand and in the split mode (20:1). FAMEs were identified by comparison of their retention times with those of reference standards. The content of fatty acids was calculated from corresponding integration data (Rahamatalla, et al., 2001). Statistical analyses were made in TARİST, Minitab 15 pocked statistical programs (Düzgünes et al., 1987).

RESULTS AND DISCUSSION

Having rich oil content, false flax is getting an important crop for oil industry and high yielding genotypes having high quality fatty acids could help to meet deficit in oil industry (Budin et al., 1995). In our study, some plant characteristics, plant height (cm), the branch number per plant, 1000 seed weight (g), the seed yield (kg/da), oil content (%), oil yield (kg/da) were analyzed. False flax genotypes, Vinimik 17 (1), PI 304269 (2), CR 476/65 (3), CR 1674/90 (4), Ames 26665 (5), Ames 26667 (6), Ames 26673 (7), Ames 26676 (8), Ames 26680 (9), Ames 26686 (10) and Ames 28372 (11) were used and their variance analysis tables and means of characters were given in Table 3 and 4.

Table 3. Variance Analyses Table of Characters in False Flax (*Camelina sativa* (L.) Crantz) Genotypes

Source of Variation	D.F.	Plant Height (cm)		Branch Number per Plant		1000 Seed Weight (g)	
		Sum of Means	F Value	Sum of Means	F Value	Sum of Means	F Value
Replication	2	17.32	1.17ns	0.43	0.27ns	0.04	1.81ns
Years	1	3053.20	412.53**	493.64	314.21**	0.38	18.56*
Error$_1$	2	7.40		1.57		0.02	
Genotypes	10	49.51	6.97**	1.41	1.04ns	0.52	26.71*
Year x Gen.	10	13.85	1.95ns	2.18	1.61ns	0.01	0.73ns
Error$_2$	40	7.11		1.35		0.02	
Mean	65	61.59		9.0		0.10	
C.V.(%)		13.48		31.88		27.63	

Source of Variation	D.F.	Yield (kg/da)		Oil Content (%)		Oil Yield (kg/da)	
		Sum of Means	F Value	Sum of Means	F Value	Sum of Means	F Value
Replication	2	2.94	0.05ns	1.53	2.53ns	4.36	2.42ns
Years	1	23743.99	420.22**	788.33	1304.65**	4099.02	2273.61**
Error$_1$	2	56.50		0.60		1.80	
Genotypes	10	1461.44	12.87**	51.16	41.48**	179.73	13.53**
Year x Gen.	10	496.50	4.37**	41.72	33.83**	119.88	9.02**
Error$_2$	40	113.57		1.23		13.28	
Mean	65	738.24		27.24		117.52	
C.V.(%)		36.29		18.36		18.68	

ns: not significant, *: significant at 5%, **: significant at 1%.

Table 4. Means of Evaluated Characters in False Flax (*Camelina sativa* L. Crantz) Genotypes

	Plant Height (cm)			Branch Number per Plant			1000 Seed Weight (g)			
	1st Year	2nd Year	Mean	1st Year	2nd Year	Mean	1st Year	2nd Year	Mean	
Vinimik 17	59.17	73.43	66.30**A**	7.57	12.87	10.22	0.777	0.860	0.82**de**	1
PI 304269	53.43	63.36	58.40**B**	7.30	12.60	9.95	0.787	0.843	0.82**de**	2
CR 476/65	49.93	65.84	57.88**B**	6.27	11.97	9.12	0.770	0.827	0.70**e**	3
CR 1674/90	53.93	63.20	58.57**B**	6.77	12.10	9.43	1.263	1.480	1.37**ab**	4
Ames26665	50.53	64.57	57.55**B**	6.63	11.87	9.25	0.727	0.967	1.24**de**	5
Ames26667	52.23	63.20	57.72**B**	6.30	12.23	9.27	1.183	1.293	1.24**bc**	6
Ames 26673	51.70	63.67	57.68**B**	7.27	10.73	9.00	1.353	1.580	1.47a	7
Ames26676	49.87	65.27	57.57**B**	6.90	11.13	9.02	1.467	1.490	1.48a	8
Ames26680	45.73	63.97	54.85**B**	4.80	12.77	8.78	1.317	1.473	1.39**ab**	9
Ames26686	50.27	62.20	56.23**B**	6.13	13.00	9.57	1.377	1.530	1.45**ab**	10
Ames28372	48.86	66.60	57.73**B**	7.73	12.57	10.15	0.860	1.203	1.03**cd**	11
Mean	51.42**B**	65.02**A**	58.23	6.69**B**	12.17**A**	9.43	1.08**B**	1.23**A**	1.16	
L.S.D.(%)	Year: 6.647,Gen: 4.16			Year: 3.06			Year: 0.15,Gen: 0.22			

	Seed Yield (kg/da)			Oil Content (%)			Oil Yield (kg/da)			
	1st Year	2nd Year	Mean	1st Year	2nd Year	Mean	1st Year	2nd Year	Mean	
Vinimik 17	62.46	126.63	94.57**A**	28.13	37.30	32.72**A**	17.57	47.24	32.45**A**	1
PI 304269	47.50	75.50	61.50**CD**	25.63	35.53	30.58**BC**	12.13	26.81	19.44**D**	2
CR 476/65	46.82	78.50	62.66**CD**	22.17	37.07	29.62**CD**	10.39	29.15	19.71**D**	3
CR 1674/90	48.26	77.76	63.01**CD**	24.50	39.77	32.13**AB**	11.88	30.97	21.45**CD**	4
Ames26665	63.27	120.37	91.87**AB**	23.50	33.77	28.63**DE**	14.89	40.66	27.78**AB**	5
Ames26667	61.10	112.63	86.87**AB**	28.60	30.70	29.65**CD**	17.47	34.87	26.17**BC**	6
Ames 26673	68.81	130.67	99.74**A**	24.43	30.67	27.55**EF**	16.72	40.08	28.41**AB**	7
Ames26676	63.15	71.43	67.29**CD**	26.40	28.43	27.42**EF**	16.63	20.23	18.43**D**	8
Ames26680	44.07	80.40	62.23**CD**	25.07	27.90	26.48**F**	11.10	22.45	16.77**D**	9
Ames26686	47.31	67.20	57.25**D**	23.63	25.60	24.62**G**	15.35	17.22	16.28**D**	10
Ames28372	62.16	91.10	76.63**BC**	22.70	24.07	23.38**G**	14.12	21.92	18.02**D**	11
Mean	55.90**B**	93.84**A**	74.87	24.98**B**	31.89**A**	28.43	14.39**B**	30.1**A**	22.27	
L.S.D.(%)	Year: 18.37,Gen: 16.64			Year: 1.90,Gen: 1.74 Ye.x Gen:2.45			Year: 3.28,Gen: 5.69 Ye.x Gen:8.05			

A: denotes significant at 1%, a: denotes significant at 5%

In all parameters, differences between years were found as significant at 1% (only significant at 5% in 1000 seed weight). Besides, differences among genotypes and year x genotype interactions were also significant at 1 % in plant height, seed yield, oil content and oil yield. Differences among genotypes in branch number per plant and 1000 seed weight were insignificant and significant at 5%, respectively. Though year x genotype interactions in plant height, branch number per plant, 1000 seed weight were determined as insignificant, interaction between genotype and year were found as significant at 1% (Table 3).,

Means of plant height (cm), the branch number, 1000 seed weight (gr), the seed yield (kg/da), oil content (%), oil yield (kg/da) in False Flax (*Camelina sativa* L. Crantz) genotypes were shown in Table 4. Plant height is considered as one of the important plant characteristics (Vollman et al. 1996) and is highly relevant to yield and some yield components (Vollman and Rajcan, 2009). The highest plant height was taken from Vinimik 17 (66,30 cm) and with 54,85 cm lowest one belonged to Ames 26680 (Table 4). Plant height in false flax is accepted as stable for each genotype but it could be influenced by yearly climatic variations (Vollman et al. 1996; Urbaniak et al., 2008, Kaleem et al., 2010). This means that homogenous influence in genotypes occurred versus environmental and yearly differences. Similar to this, studies accepted that plant height is a genotypic stable character and changes with changes in environmental climatic conditions differences (El-Moueı et al., 2011, Kaleem et al., 2010) but mostly homogenous changes occur among genotypes versus ambient conditions (Vollman and Rajcan, 2009; El-Moueı et al., 2011). These results could explain why significantly differences among genotypes and insignificant genotypes x year interactions. Correlations between branch number, seed yield, oil content and oil yield were determined as significant at 1% (Table 5).

Table 5. Correlation Matrix of Characters in False Flax (*Camelina sativa* (L.) Crantz) Genotypes.

	Plant Height	Br. Nu.per PL	1000 Seed We.	Yield	Oil Content
Br.Nu.per Pl.	0.878**				
1000 Seed We.	0.032ns	0.145ns			
Yield	0.703**	0.645**	0.088ns		
Oil Content	0.667**	0.611**	-0.028ns	0.552**	
Oil Yield	0.752**	0.668**	0.035ns	0.942**	0.761**

**: significant at 0,01 level

Branch number per plant in most oil crops is major character refers valuable characteristic for oil content and yield (Agegnehu and Honermerier, 1997; Vollman and Rajcan, 2009). First year had (6,69) lower branches number per plant than second year (12,17, Table IV). This difference shows that yearly variations had significant effect on branch number per plant. Studies revealed that branch number per plant shows little differences in most plants and these differences among genotypes are more or less insignificant. More effect on branch number per plant could belong to environmental variations, having more effect than genotypic character (Koncıus and Karcauskıene, 2010; Wysocki and Sirovatka, 2007; Agegnehu and Honermerier, 1997; Akk and Ilumae, 2005). Similar to this, insignificant differences occurred among genotypes in the study. On the other hand, correlations between seed yield, oil content, and oil yield and plant height with branch number per plant were positive and significant at 1 % (Table 5).

Another major yield component in false flax is known as 1000 seed weight (Vollman and Rajcan, 2009, Vollman et al. 1996, Koncıus and Karcauskıene, 2010) and variations and fluctuations in 1000 seed weight commonly occur and these changes could be originated from environmental conditions and/or genotypic characters (Vollman and Rajcan, 2009; Vollman et al. 1996; Akk and Ilumae, 2005). Similar effects were recorded in this study and obviously differences between years and genotypes were determined as significant ($p<0.05$). 1000 seed weight in the second year (1.23 g) was significantly higher than the first year (1.08 g). The highest 1000 seed weights were taken from Ames 26673 (1,479 g) and Ames 26676 (1,489 g). The CR 476/65 (0,70 g) had the lowest value (Table 4).

As in every plant cultivated, yield is expressed as amount and quality (Vollman and Rajcan, 2009). Yearly fluctuations in rainfall and temperature must have differently affected genotypes and this reason could make interaction important. A number of studies pointed out that the seed yield in dry conditions mostly depends upon rainfall in most plants and yearly fluctuations rainfall and temperature more often affect seed yield and relatively oil content and oil yield (Seehuber, 1984; Seehuber et al., 1987; Putnam et al. 1993; Diepenbrock et al., 1995; Vollman et al. 1996; Akk and Ilumae, 2005; Vollman and Rajcan, 2009). Yield in the second year (93,84 kg da^{-1}) was so higher than previous year (55.90 kg da^{-1}). Since, rainfall in 2010- 2011 and long term (1975-2010) were 379.9 mm, 401.8 mm and 402.1 mm, respectively. More rainfall in 2011 seems reliable more seed and oil yield. In the same way, total rainfall in year including tillering stage (in May) plays vital role for yield and false flax needs exorbitant water in this stage. Rainfalls during March-June (crop growing period) in the second year were 213 mm and 172 mm in the previous year. Rainfalls in May were only 22 mm in 2010 and 86 mm in 2011. Vinimik 17 had the highest seed yield (94.57 kg/da), whereas Ames 266686 genotype (57.25 kg/da) was the lowest one (Table 4). In dry conditions seed yield performance in genotypes are naturally be different (Vollman and Rajcan, 2009, Vollman et al. 1996, Budin et al, 1995). Correlations between plant height, branch number per plant, oil content and oil yield with seed yield were significant at 1% (Table 5).

With about 40-45% oil content and high level of some oil acids such as linolenic, linoleic and oleic acids, false flax (*Camelina sativa* (L.) Crantz) seems promising crop for industrial and edible oil (Korsrud et al., 1978; Crowley and Fröhlich, 1998; Koncıus and Karcauskıene, 2010). Studies reported that oil yield changes with changing seed yield and oil content (Alessi et al., 1981; Putnam et al., 1993; Kara, 1994; Budin et al., 1995; Crowley and Frohlick, 1998; Karahoca, 2002; Vollman and Rajcan, 2009; Tomas et al., 2011; Berti et al., 2011, Gugel and Falk, 2006). Oil content and oil yield draw similar trend like seed yield. The effect of years, differences among genotypes and year x genotype interaction were found as significant at 1% (Table 3). The second year had higher oil content (31.89 %) and oil yield (30.15 kg/da) than the first year (24.98 % in oil content and 14.39 kg/da in oil yield, respectively). Vinimik 17 was found as the highest yielding genotype in oil content (32.72 %) and in oil yield (32.45 kg/da). Moreover, Ames 28372 gave the lowest oil content (23.38 %) and oil yield (18.02 kg/da). Year x genotype interactions were significant at 1% in both oil content and oil yield. Genotypes were significantly affected by changes in rainfall and temperature. Basically, climatic changes, especially changes in rainfall and temperature that have tremendous potential on seed yield and oil content could greatly affect oil yield (Zubr, 2003; Vollman et al., 1996; Koncıus and Karcauskıene, 2010; Kara, 1994; Gugel and Falk, 2006). Correlations between plant height, branch number per plant, seed yield and oil yield with oil content; correlations between plant height, branch number per plant, yield and oil content with oil yield were determined at 1% (Table 5).

In view of results, cluster analysis including similarities/dissimilarities, were given in Figure 1. Vinimik 17 (1, Group 1) and Ames 28372 (11, Group 5) created their own groups alone. Moreover, the other genotypes formed three groups; namely, PI304269 (2,), CR 476/65 (3,) and CR 1674/90 (4) one group (Group 3); Ames 26665 (5), Ames 26667 (6) and Ames 26673 (7) one group (Group 2); Ames 26676 (8), Ames 26680 (9), Ames 26686 (10) one group (Group 4).

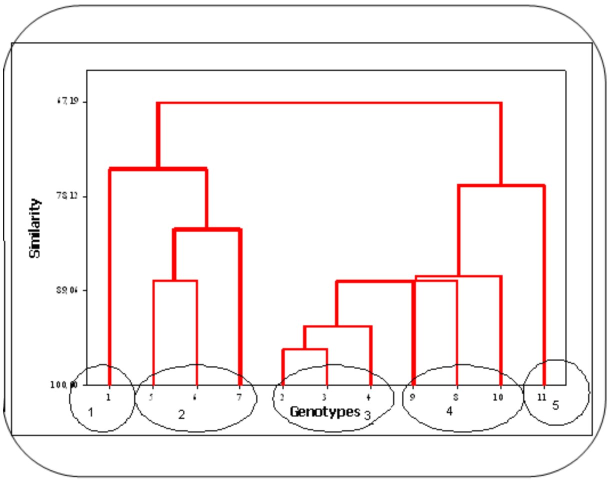

Figure 1. Cluster analysis of false flax (*Camelina sativa* (L.) Crantz) genotypes.

Oil content and its composition in oil crops is important feature (Abromovic et al., 2007; Urbaniak et al., 2008; Koncıus and Karcauskıene, 2010; Budin et al., 1995; Vollman and Rajcan, 2009; Velasco and Fernandez-Martinez, 2002,) and determine values of crops to be used in oil industry/medicine (Budin et al., 1995; Sabzalian et al. 2008; Vollman and Rajcan, 2009), False flax carries great potential for this. Compositions of oil fatty acids of genotypes in false flax were given Table 4. High contents of linolenic, linoleic and oleic acids, total saturated acid and polyunsaturated acid were determined in all genotypes. Similar to our findings, Budin et al., (1995) stated that false flax genotypes are higher in linolenic, linoleic and oleic acids, total saturated acid and polyunsaturated acid, lower in monounsaturated acid than that of canola and olive oils.

CONCLUSION

Results in Table 4, and 6, and Figure 1 showed that having highest seed yield, and oil yield, Vinimik 17, Ames 26665, Ames 26667 and Ames 26673 could be considered as an oil crops for oil industry or as medicine plant. Besides, false flax could be source of essential fatty acids, lowering cholesterol level in human diet. Having low saturated fat content this crop seems quality edible oil. Though genotypes are higher in erusic acid than 2% (maximum limit for canola quality edible oil), Genotypes having less erucic acid content should be developed by breeding programs/biotechnology. More studies to reveal characteristics and efficacy of oil acids in false flax genotypes and to develop genotypes having less erusic acid level under food codex level and rich in linolenic, linoleic and oleic acids, total saturated acid and polyunsaturated acid are hastily needed.

Table 6. Compositions of Oil Acids in False Flax (*Camelina sativa*) Genotypes.

Compositions	Genotypes													
	Vniimk17	**PI 304269**	**CR 476/65**	**CR 1674/90**	**Ames 26665**	**Ames 26667**	**Ames 26673**	**Ames 26676**	**Ames 26680**	**Ames 26686**	**Ames 28372**	**Mean**	**Canola Oil***	**Olive Oil****
Erusic Acid	3.20	2.85	2.95	3.26	3.19	3.16	3.57	3.44	3.39	3.35	3.13	3.23	0.21	0.00
Metil-cis 11.14.17 ech.	1.04	1.03	1.00	1.11	1.10	1.08	0.87	0.86	1.05	1.05	1.09	1.03	0.00	0.00
Echosadienoic Acid	1.78	1.78	1.77	1.69	1.77	1.74	1.58	1.76	1.88	1.78	1.75	1.75	0.00	0.00
Echosenoic Acid	13.80	13.80	14.11	14.40	13.96	14.00	14.17	13.99	14.18	14.45	13.93	14.07	0.22	0.00
Arachydic Acid	1.99	1.89	1.76	1.75	1.80	1.78	1.97	1.89	1.64	2.01	1.92	1.85	0.00	0.00
Linolenic Acid	**31.23**	**30.88**	**30.46**	**31.97**	**31.75**	**31.65**	**29.11**	**28.05**	**30.61**	**31.73**	**33.36**	**30.98**	**6.14**	**8.31**
Linoleic Acid	**20.16**	**20.73**	**20.34**	**18.46**	**19.96**	**19.95**	**20.99**	**22.39**	**21.33**	**18.59**	**18.87**	**20.16**	**20.25**	**10.01**
Oleic Acid	**15.79**	**16.15**	**16.67**	**17.05**	**15.53**	**15.92**	**16.72**	**15.77**	**15.07**	**16.06**	**15.55**	**16.03**	**55.65**	**29.05**
Stearic Acid	2.90	2.81	2.81	2.61	2.66	2.62	2.51	2.43	2.50	2.52	2.61	2.63	1.62	17.94
Palmitic Acid	6.21	6.06	6.35	5.92	6.47	6.29	6.25	6.82	6.77	6.50	6.34	6.36	3.64	25.38
Total Saturated Acid	**12.07**	**11.49**	**11.47**	**11.16**	**11.78**	**11.55**	**12.00**	**12.63**	**11.72**	**11.93**	**11.84**	**11.79**	**10.30**	**43.32**
Monounsaturated Acid	**33.55**	**33.56**	**34.51**	**35.46**	**33.45**	**33.86**	**35.28**	**34.14**	**33.52**	**34.76**	**33.48**	**34.14**	**62.64**	**33.37**
Polyunsaturated Acid	**51.39**	**51.61**	**50.80**	**50.43**	**51.71**	**51.60**	**50.10**	**50.44**	**51.94**	**50.32**	**52.23**	**51.14**	**28.02**	**23.20**

*(Akk and Ilumae,2005), **(Sirtori et al.,1992)

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