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Variation of Certain Characters and Line Selection for Yield, Oil, Oleic and Linoleic Acids in the Turkish Sesame (Sesamum indicum L.) Populations*

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Abstract: The goal of this study was to determine the variation of certain characters in the 72 local sesame populations, which were collected from different sites of Turkey, and develope superior lines with high seed yield, high oil, high oleic and high linoleic acid content via pure line selection.

A great deal of variation for the characters examined was found among the populations. 8 out of 72 sesame populations were determined as superior for the characters of seed yield, oil, oleic acid and linoleic acid contents in 1993. 800 single plants for the characters mentioned above were sampled within the superior populations in 1994. 160 lines selected from the 800 single plants were grown in 1995. Total of 16 superior lines selected from the 160 lines were planted along with the control variety `Muganly-57' in randomized complate block design with 4 replication in 1996.

`TR 3821560' and `TR 3821593' lines which had 16.9% and 15.9% higher seed yield than the control variety were developed as superior for high yield and `TSP 933749' line with 63.25% oil content was developed as superior for high oil content. `TSP 933229' and `TR 3821512' lines which had oleic acid over 45% and `TSP 932410' and `TSP 932403' lines which had linoleic acid over 45% were determined as high oleic and linoleic acid type lines, respectively.

Türkiye Susam (*Sesamum indicum* L.) Populasyonlarında Bazı Özelliklerin Varyasyonu ile Verim, Yağ, Oleik ve Linoleik Tipi Hat Seleksiyonu

Özet: Bu çalışmada Türkiye'de kültürü yapılan yerel susam populasyonlarında bazı özelliklerin varyasyonunu saptamak, bu varyasyondan saf hat seleksiyonu ile yüksek verim tipi, yüksek yağ tipi, yüksek oleik asit tipi ve yüksek linoleik asit tipi hat geliştirme olanaklarını araştırmak amaçlanmıştır.

Türkiye susam populasyonları arasında incelenen özellikler bakımından geniş bir varyasyon olduğu saptanmıştır. 1993 yılında 72 susam populasyonu arasından, tohum verimi, yağ, oleik asit ve linoleik asit içerikleri bakımından 8 üstün populasyon belirlenmiştir. 1994 yılında bu üstün populasyonlar arasından, bahsedilen özellikler ile ilgili toplam 800 adet tek bitki örneklenmiştir. Bu teksel örnekler arasından seçilen 160 adet hat 1995 yılında yetiştirilmiştir. Bu hatlar arasından seçilen 16 üstün hat, kontrol çeşit 'Munganlı-57' ile birlikte, 1996 yılında tesadüf blokları deneme deseninde 4 tekerrürlü olarak ekilmiştir.

Kontrol çeşide göre sırasıyla %16.9 ve %15.9 daha yüksek verimli bulunan 'TR 382160' ve 'TR 3821593' hatları yüksek verim tipleri olarak ve %63.25 yağ içeren 'TSP 933749' hattı yüksek yağ tipi hat olarak geliştirilmiştir. %45'in üzerinde oleik asit içeren 'TSP 933229' ve 'TR 3821512' hatları yüksek oleik tipi ve %45'in üzerinde linoleik asit içeren 'TSP 932410' ve 'TSP 932403' hatları ise yüksek linoleik tipi hatlar olarak belirlenmiştir.

Introduction

A lot of sesame varieties and ecotypes which have been grown for hundreds of years are distributed in various ecological regions of Turkey. Sesame cultivation in Turkey are mostly widespread in the places influenced by Mediterranean climate with approximately 80 000 ha (1). Use of improved breeding varieties in production is very limited because of hundreds of local varieties and

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ecotypes adapted well to their own specific conditions. Maintenance of local varieties until today is played a large part in preventing the loss of genetic variability in Turkish sesame populations. However, new commercial varieties may be replaced the local varieties in the near future. For this reason, these important genetic materials must be classified and preserved for the future sesame breeding programmes. Although Turkish sesames had a very great range of variation in genetic, morphological and quality characters (2,3,4), very little information has been given.

The objective of this research was to describe the results of the distribution of frequencies for certain morphological and quality characters of Turkish sesame populations and also to develope superior lines with high yield, high oil, high oleic acid and high linoleic acid type via pure line selection from the variation existed in the populations.

Materials and Methods

Field experiments were counducted at the Mediterranean Agricultural Research Institute in Antalya province (cost of Southern Turkey) in 1993-1996. Structure of the experiment field was silted containing high percent of clay, alkalic with pH 7.8 and medium amount of organic matter. 72 Turkish sesame populations used as material in this study that have been still grown by local farmers are presented in Table 1. The first 60 populations (TSP series) were collected from the culture areas of 4 regions and the last 12 populations (TR series) were obtained from Germplasm Bank in the Aegean Agricultural Research Institute, İzmir.

All sesame populations were sown in the modified augmented design along with control varieties `Muganlı-57', `Gölmarmara' and `Özberk-82'in plots consisted of rows 10 m long with 70 cm apart on 25th June 1993. Control varieties were sown with 7 replication. All plants of the populations were analysed based on phenotypic frequencies for certain characters: carpel number per capsule (bicarpellata or quadricarpellata), capsule number per leaf axil (monocapsulle or tricapsulle), branching habit (branching or nonbranching), seed coat colour (black, darkbrown, brown, yellow or white), density of capsule and stem hair (naked, sparse or dense), leaf shape (tri-lobed or ovate), seed yield (g/plant), oil and fatty acids content (%). These characters were detailed in the sesame descripter list published by the IBPGR (5).

8 populations determined as superior for the characters of seed yield, oil, oleic acid and linoleic acid contents were sown on 14th June 1994 and each one was represented with 1000 plants. From each superior populations 100 plants (total 8x100=800 plants) were randomly simpled and they were accepted as base populations. Selecting 20% upper part of each base population, 20 lines (total 8x20=160 lines) were determined and they were grown on 20th June 1995. Total of 16 superior lines (8x2) choosen among the 160 lines were sown along with the best control variety `Muganlı-57' in randomized complete block design with four replication on 17th June 1996. The traits measured in the experiment were seed yield (kg/ha), oil content (%), oil yield (kg/ha), oleic and linoleic acid contents (%).

Oil contents and fatty acids were analysed in Justus-Liebig University (Giessen-Germany) in 1993, and Aegeaen University and Akdeniz University in Turkey in 1994, 1995 and 1996. Oil contents of the dried seed samples were determined by using NMR (New Port Analyser Magnet Type 10). Fatty acids were analysed by using gas chromatography (Fisions Series HRGC Mega 2 Type, with FID detoctor). Esterification of fatty acids was made using a method given by Marquard (6). Fatty acid methylesters were separated on 250 cm x 0.25 mm Permabond FFAP-DF-ID type stainless steel column. Palmitic (C16:0), stearic (C18:0), oleic (C18:1), linoleic (C18:2) and other fatty acids (miristic C14:0, palmitoleic C16:1 and arachidic C22:0) were determined by computing integrator.

LSD test was performed using a metod given by Petersen (7) in comparison with populations and control varieties for seed yield obtained in 1993. The plant seed yields were adjusted to prevent the differences arise from field variation (7). Analyses of variance and Duncan's multiple range test were done using the MSTATC package for personal computers (8).

Results

The distribution of mean frequencies for the morphological and quality characters in the local sesame populations was presented in Table 1 and 2. It was found that the means of the population sampled were 99.6% of bicarpellata with quadriloculi and 0.4% of quadricarpellata with octoloculi types; 94.8% of monocapsulle and 5.2% of tricapsulles types. Their leaf shapes were 48.4% of tri-lobed and 51.7% of ovate on the average. 80.2% of the plants had naked or short hairy stem, 19.1% had sparse hairy stem and 1.3% had dense hairy stem, while 42.6% of the capsules was naked (or smooth), 47.2% was sparse and 11.2% was dense hairy on the average (Table 1).

Table 1. Distrubitions based on frequencies of certain characers in the Turkish sesame populations (%)

Origin of the population	Population	Carpel		Capsule		Capsule			Stem			Leaf	
	Number	number		number		hairiness			hairiness			shape	
		B	Q	M	T	N	S	D	N	S	D	L	O
Thrace-Marmara region													
Edirne (Uzunköprü,Maksutlu)	TSP 9301	100.0	0.0	100.0	0.0	89.2	10.8	0.0	96.0	4.0	0.0	0.0	100.0
Edirne (Uzunköprü,Türkobası)	TSP 9302	100.0	0.0	100.0	0.0	59.0	30.5	10.5	98.0	2.0	0.0	0.0	100.0
Edirne (Uzunköprü,Altınyazı)	TSP 9303	100.0	0.0	100.0	0.0	34.5	54.5	10.9	91.1	5.9	3.0	0.0	100.0
Edirne (Uzunköprü, Balaban)	TSP 9304	100.0	0.0	100.0	0.0	41.3	53.3	5.4	97.0	3.0	0.0	0.0	100.0
Edirne (Uzunköprü, Gönekını)	TSP 9305	100.0	0.0	100.0	0.0	34.0	60.0	6.0	92.0	3.0	5.0	0.0	100.0
Edirne (Uzunköprü, Balıklı)	TSP 9306	100.0	0.0	100.0	0.0	23.0	70.0	7.0	90.5	7.6	1.9	0.0	100.0
Edirne (Meriç, Kavaklı)	TSP 9307	100.0	0.0	100.0	0.0	33.5	64.7	1.8	91.9	7.0	1.1	0.0	100.0
Çanakkale (Ecebat, Anafarta)	TSP 9308	100.0	0.0	100.0	0.0	70.0	30.0	0.0	74.4	22.4	3.2	0.0	100.0
Çanakkale (Lapseki, Çavuşköy)	TSP 9309	100.0	0.0	100.0	0.0	33.3	57.7	8.9	86.1	13.9	0.0	0.0	100.0
Çanakkale (Lapseki, Alpagat)	TSP 9310	100.0	0.0	100.0	0.0	38.7	53.3	8.0	76.2	17.5	6.3	0.0	100.0
Çanakkale (Lapseki, Taştepe)	TSP 9311	100.0	0.0	100.0	0.0	50.0	45.7	4.3	89.0	10.0	1.0	0.0	100.0
Çanakkale (Lapseki, Dişbudak)	TSP 9312	100.0	0.0	100.0	0.0	62.0	35.0	3.0	88.2	11.8	0.0	0.0	100.0
Bursa (Orhangazi, Çeltikçi)	TSP 9313	100.0	0.0	100.0	0.0	63.4	33.3	3.3	90.0	9.1	0.9	0.0	100.0
Region		100.0	0.0	100.0	0.0	48.7	46.0	5.3	89.3	9.0	1.7	0.0	100.0
Aegean region													
Manisa (Turgutlu, Merkez1)	TSP 9314	100.0	0.0	100.0	0.0	4.7	60.0	35.3	94.5	5.5	0.0	6.7	93.3
Manisa (Turgutlu, Merkez2)	TSP 9315	100.0	0.0	97.6	2.3	58.2	18.2	22.7	98.5	1.5	0.0	10.0	90.0
Manisa (Turgutlu, Merkez3)	TSP 9316	100.0	0.0	90.0	10.0	38.9	51.1	11.0	99.0	1.0	0.0	11.0	89.0
Manisa (Alaşehir, Killik)	TSP 9317	100.0	0.0	100.0	0.0	42.8	42.8	14.4	86.7	13.3	0.0	15.5	84.5
Manisa (Alaşehir, Hacıaliler)	TSP 9318	100.0	0.0	100.0	0.0	31.8	62.7	5.4	93.4	4.6	1.5	6.2	93.8
Manisa (Alaşehir, Tepeköy)	TSP 9319	100.0	0.0	100.0	0.0	58.3	35.8	5.9	96.5	2.0	1.5	7.7	92.3
Balıkesir (Merkez, Çamdibi)	TSP 9320	100.0	0.0	1.0	99.0	0.0	100.0	0.0	45.5	54.5	0.0	18.2	81.8
İzmir (Menemen, Türkeli)	TSP 9321	100.0	0.0	100.0	0.0	13.0	75.0	12.0	0.0	95.7	4.3	13.0	87.0
İzmir (Menemen, Çavuş)	TSP 9322	100.0	0.0	90.0	10.0	20.0	70.4	9.6	0.0	96.7	3.3	21.7	75.0
İzmir (Menemen, Kesik)	TSP 9323	100.0	0.0	100.0	0.0	37.5	47.5	15.0	0.0	100.0	0.0	23.5	76.5
Aydın (İncirliova, Merkez)	TSP 9324	100.0	0.0	42.9	57.1	18.0	74.0	8.0	95.2	4.8	0.0	15.2	84.8
Aydın (Bozdoğan, Kazandere)	TSP 9325	100.0	0.0	80.0	20.0	24.3	70.1	5.6	88.9	11.1	0.0	55.5	44.5
Aydın (Bozdoğan, Haydere)	TSP 9326	100.0	0.0	100.0	0.0	19.0	75.0	6.0	88.7	11.3	0.0	34.7	65.3
Denizli (Güney, Çorbacılar)	TSP 9327	100.0	0.0	98.0	2.0	27.7	52.2	20.1	93.0	7.0	0.0	0.0	100.0
Denizli (Acıpayam, Kumavşarı)	TSP 9328	100.0	0.0	100.0	0.0	76.5	21.2	2.3	20.0	69.3	10.7	15.0	85.0
Denizli (Acıpayam, Gümüş1)	TSP 9329	90.1	9.9	66.7	33.3	13.6	71.8	14.6	90.0	8.3	1.7	4.0	96.0
Denizli (Acıpayam, Gümüş2)	TSP 9330	96.0	4.0	93.6	6.4	18.0	64.0	18.0	94.0	5.1	0.9	4.8	95.2
Denizli (Acıpayam, Gümüş3)	TSP 9331	94.9	5.1	94.1	5.9	14.0	59.0	27.0	72.9	21.2	5.9	4.2	95.8

Table 1. Continued

Origin of the population	Population Number	Carpel number		Capsule number		Capsule hairiness			Stem hairiness			Leaf shape	
		B	Q	M	T	N	S	D	N	S	D	L	O
Muğla (Dalaman, Akçataş)	TSP 9332	100.0	0.0	100.0	0.0	17.0	78.0	5.0	41.7	58.3	0.0	100.0	0.0
Muğla (Ortaca, Ekşiliyurt)	TSP 9333	100.0	0.0	100.0	0.0	57.1	42.9	0.0	96.2	3.8	0.0	97.6	2.4
Muğla (Köyceğiz, Kavakarası)	TSP 9334	100.0	0.0	100.0	0.0	14.0	76.0	10.0	66.0	33.3	0.7	100.0	0.0
Muğla (Fethiye, Seydiler)	TSP 9335	100.0	0.0	100.0	0.0	81.0	16.8	2.2	100.0	0.0	0.0	5.5	94.5
Region		99.1	0.9	88.8	11.2	31.5	58.3	9.7	72.6	26.2	1.4	25.9	74.1
Mediterrenean region													
Burdur (Keçiborlu, İlyas)	TSP 9336	100.0	0.0	92.2	7.8	13.3	58.1	28.6	87.0	7.8	5.2	6.1	93.9
Burdur (Bucak, Ürkütlü)	TSP 9337	100.0	0.0	96.8	3.2	83.7	16.3	0.0	100.0	0.0	0.0	9.5	90.5
İçel (Mut, Kadıköy)	TSP 9338	100.0	0.0	100.0	0.0	2.2	25.6	73.2	90.0	10.0	0.0	25.4	74.6
Adana (Ceyhan, Yeşildam)	TSP 9339	100.0	0.0	89.5	10.5	33.3	38.1	28.6	94.9	4.3	0.8	99.0	1.0
Adana (Ceyhan, Gündoğan)	TSP 9340	100.0	0.0	82.6	17.4	28.6	46.7	24.7	87.0	13.0	0.0	82.6	17.4
Adana (Ceyhan, Dokuztekne)	TSP 9341	100.0	0.0	95.0	5.0	73.3	20.5	6.2	96.0	3.0	1.0	80.0	20.0
Adana (Ceyhan, Kızıldere)	TSP 9342	100.0	0.0	100.0	0.0	64.7	31.7	3.6	95.0	4.7	0.3	92.4	7.6
Adana (Kadirli, Y.Bozkuyu)	TSP 9343	100.0	0.0	94.8	5.2	72.0	25.0	3.0	95.7	2.6	1.7	91.4	8.6
Adana (Kadirli, Topraktepe)	TSP 9344	100.0	0.0	100.0	0.0	62.3	28.2	9.4	93.0	7.0	0.0	97.0	3.0
Adana (Kadirli, Çığlık)	TSP 9345	100.0	0.0	95.2	4.8	62.5	30.0	7.5	96.2	3.8	0.0	98.0	2.0
Adana (Kozan, Zerdali)	TSP 9346	100.0	0.0	100.0	0.0	68.4	29.5	2.1	100.0	0.0	0.0	85.0	15.0
Adana (Kozan, Poskabasakal)	TSP 9347	100.0	0.0	100.0	0.0	64.0	25.8	7.2	98.0	2.0	0.0	100.0	0.0
Adana (Kozan, Akdam)	TSP 9348	100.0	0.0	96.9	3.1	66.6	28.4	5.0	100.0	0.0	0.0	100.0	0.0
Adana (Kozan, Gazi)	TSP 9349	100.0	0.0	100.0	0.0	80.0	15.6	4.4	100.0	0.0	0.0	100.0	0.0
Adana (Osmaniye, Selimiye)	TSP 9350	100.0	0.0	83.4	16.6	72.7	21.8	5.5	96.7	3.3	0.0	100.0	0.0
Hatay (Dörtyol, Yeniyurt)	TSP 9351	100.0	0.0	93.7	6.3	50.0	42.8	7.2	85.0	15.0	0.0	87.5	12.5
Region		100.0	0.0	95.0	5.0	56.1	30.3	14.1	94.6	4.8	0.6	77.4	22.6
South East Anatolia region													
Şanlıurfa (Hilvan, Üçüzlen)	TSP 9352	96.1	3.9	96.1	3.9	21.4	74.2	4.4	92.0	8.0	0.0	86.6	13.4
Şanlıurfa (Hilvan, Faik)	TSP 9353	100.0	0.0	96.7	3.3	62.5	35.0	2.5	94.5	5.5	0.0	100.0	0.0
Şanlıurfa (Hilvan, Özbaş)	TSP 9354	96.2	3.8	92.2	7.8	32.8	64.2	3.0	93.6	6.4	0.0	93.5	6.5
Şanlıurfa (Hilvan, Konçik)	TSP 9355	100.0	0.0	96.0	4.0	43.5	56.5	0.0	95.0	5.0	0.0	90.0	10.0
Şanlıurfa (Hilvan, Merkez)	TSP 9356	97.5	2.5	97.5	2.5	46.1	44.6	9.3	2.5	97.5	0.0	100.0	0.0
Diyarbakır (Dicle, Merkez1)	TSP 9357	100.0	0.0	100.0	0.0	9.2	60.0	30.8	0.0	96.2	3.8	100.0	0.0
Diyarbakır (Dicle, Merkez2)	TSP 9358	100.0	0.0	100.0	0.0	11.1	44.4	44.5	9.3	72.7	18.0	100.0	0.0
Şırnak (Cizre, Dirsekli)	TSP 9359	100.0	0.0	100.0	0.0	51.5	48.5	0.0	75.5	22.2	2.3	100.0	0.0
Şırnak (Cizre, Dirsekli)	TSP 9360	100.0	0.0	100.0	0.0	52.7	42.7	5.6	70.9	27.5	1.6	100.0	0.0

Table 1. Continued

Origin of the population	Population Number	Carpel number		Capsule number		Capsule hairiness			Stem hairiness			Leaf shape	
		B	Q	M	T	N	S	D	N	S	D	L	O
Region		98.9	1.1	97.6	2.4	36.7	52.2	10.6	60.0	37.9	2.9	96.7	3.3
From Turkish Sesame Collection													
Gene Center (İzmir)	TR 37549	100.0	0.0	100.0	0.0	-	-	-	75.0	25.0	0.0	96.0	4.0
Gene Center (İzmir)	TR 38215	100.0	0.0	97.4	2.6	-	-	-	89.6	7.8	2.6	74.0	26.0
Gene Center (İzmir)	TR 38253	100.0	0.0	100.0	0.0	-	-	-	87.0	13.0	0.0	30.0	70.0
Gene Center (İzmir)	TR 39702	100.0	0.0	84.6	15.3	-	-	-	64.7	35.3	0.0	35.3	64.7
Gene Center (İzmir)	TR 39712	100.0	0.0	100.0	0.0	-	-	-	92.0	8.0	0.0	27.8	72.2
Gene Center (İzmir)	TR 39716	100.0	0.0	100.0	0.0	-	-	-	94.0	6.0	0.0	40.0	60.0
Gene Center (İzmir)	TR 45506	100.0	0.0	98.0	2.0	-	-	-	57.0	43.0	0.0	42.0	58.0
Gene Center (İzmir)	TR 45515	100.0	0.0	96.5	3.5	-	-	-	63.6	36.4	0.0	75.0	25.0
Gene Center (İzmir)	TR 45524	100.0	0.0	100.0	0.0	-	-	-	74.0	26.0	0.0	100.0	0.0
Gene Center (İzmir)	TR 45532	100.0	0.0	97.6	2.4	-	-	-	76.0	24.0	0.0	88.0	12.0
Gene Center (İzmir)	TR 48929	100.0	0.0	100.0	0.0	-	-	-	94.0	6.0	0.0	100.0	0.0
Gene Center (İzmir)	TR 48930	100.0	0.0	100.0	0.0	-	-	-	95.2	4.8	0.0	100.0	0.0
Collection means		100.0	0.0	97.8	2.2	-	-	-	80.2	19.6	0.4	67.3	34.9
Overall mean		99.6	0.4	94.8	5.2	42.6	47.2	11.2	80.2	19.1	1.3	48.4	51.7

M: Monocapsulle, T: Tricapsulle, B: Bicarpellata, Q: Quadricarpellata, N: Naked, S: Sparse, D: Dense, L: Lobed, O: Ovate

Table 2. Seed coat colour, adjusted seed yield per plant, oil content and fatty acid composition of Turkish sesame populations

	Seed Coat Colours (%)					Seed yield	Oil	Fatty Acid Composition (%)				
	White	Yellow	Brown	D.brown	Black	g/plant	%	Palmitic	Stearic	Oleic	Linoleic	Others
Thrace-Marmara												
TSP 9301	0	86	14	0	0	7.0	39.5	10.0	4.4	44.5	40.1	1.0
TSP 9302	0	11	89	0	0	5.0	43.1	9.6	4.2	44.2	40.8	1.2
TSP 9303	0	70	30	0	0	5.5	44.5	9.9	4.2	43.5	41.6	0.8
TSP 9304	0	84	16	0	0	5.2	43.5	9.7	4.0	44.3	40.9	1.1
TSP 9305	0	71	29	0	0	5.8	39.3	9.8	4.0	45.3	39.9	1.0
TSP 9306	0	100	0	0	0	6.0	40.7	9.8	4.0	44.1	40.9	1.2
TSP 9307	0	90	10	0	0	6.8	41.8	9.6	4.0	44.5	40.7	1.2
TSP 9308	0	99	1	0	0	11.6	42.7	9.3	4.0	43.2	42.6	0.9
TSP 9309	0	78	22	0	0	6.1	43.6	9.8	4.0	43.7	41.5	1.0
TSP 9310	0	82	18	0	0	9.0	42.8	9.5	4.3	42.8	43.2	0.2
TSP 9311	0	65	35	0	0	8.2	35.1	9.8	4.5	43.3	41.6	0.8

Table 2. Continued

	Seed Coat Colours (%)					Seed yield	Oil	Fatty Acid Composition (%)				
	White	Yellow	Brown	D.brown	Black	g/plant	%	Palmitic	Stearic	Oleic	Linoleic	Others
TSP 9312	0	51	49	0	0	6.6	42.4	9.6	4.5	42.4	41.8	1.7
TSP 9313	0	65	35	0	0	6.0	39.8	9.7	4.4	42.0	42.9	1.0
Region	0	73	27	0	0	6.8	41.4	9.7	4.2	43.7	41.4	1.0
Aegean												
TSP 9314	100	0	0	0	0	7.4	43.7	9.8	4.3	41.7	43.4	0.8
TSP 9315	54	35	11	0	0	9.1	44.8	9.6	4.3	42.0	42.8	1.3
TSP 9316	0	0	100	0	0	8.2	42.8	9.6	4.3	42.5	42.9	0.7
TSP 9317	1	10	89	0	0	9.3	47.3	9.7	4.5	42.5	41.8	1.5
TSP 9318	0	17	83	0	0	7.2	47.1	9.6	4.4	43.3	42.0	0.7
TSP 9319	1	0	99	0	0	5.6	45.2	9.6	4.4	43.4	41.8	0.7
TSP 9320	0	0	100	0	0	9.4	44.6	9.6	4.4	41.1	43.2	1.7
TSP 9321	95	5	0	0	0	8.5	43.9	10.2	4.6	42.6	41.9	0.7
TSP 9322	90	10	0	0	0	8.1	45.9	9.8	4.4	42.0	42.8	1.0
TSP 9323	85	10	5	0	0	9.9	44.5	10.0	4.6	41.9	42.7	0.8
TSP 9324	99	1	0	0	0	9.5	46.2	9.8	4.4	41.4	43.2	1.2
TSP 9325	55	0	0	0	45	4.5	45.0	9.4	4.5	42.9	42.4	0.8
TSP 9326	100	0	0	0	0	5.1	43.1	9.7	4.9	42.5	42.2	0.7
TSP 9327	0	24	76	0	0	6.1	45.5	9.8	4.5	42.9	42.1	0.7
TSP 9328	0	2	98	0	0	6.3	44.1	9.7	4.4	44.0	40.5	1.4
TSP 9329	100	0	0	0	0	7.6	46.3	9.8	4.3	42.7	42.4	0.8
TSP 9330	0	0	100	0	0	5.0	44.0	9.7	4.2	42.9	42.0	1.2
TSP 9331	0	100	0	0	0	5.5	47.3	9.6	4.2	44.4	40.4	1.4
TSP 9332	0	95	5	0	0	4.2	38.6	9.1	4.8	47.2	38.2	0.7
TSP 9333	0	86	14	0	0	6.6	45.2	9.1	4.5	45.5	40.2	0.7
TSP 9334	0	95	5	0	0	4.3	44.0	8.7	4.8	46.7	38.5	1.3
TSP 9335	0	52	48	0	0	8.7	50.1	9.3	4.3	44.9	40.5	1.0
Region	35	25	38	0	2	7.1	45.0	9.6	4.4	43.2	41.7	1.0
Mediterranean												
TSP 9336	3	59	38	0	0	3.2	47.9	9.6	4.2	44.3	40.5	1.4
TSP 9337	0	9	91	0	0	5.3	51.9	9.5	4.6	44.6	40.5	0.8
TSP 9338	0	38	62	0	0	3.5	46.5	9.3	4.7	46.5	38.5	1.0
TSP 9339	0	43	57	0	0	5.6	42.2	9.2	4.3	44.2	41.6	0.7
TSP 9340	0	20	80	0	0	3.5	46.5	9.3	4.8	43.8	41.5	0.6
TSP 9341	0	8	92	0	0	4.4	50.0	9.3	4.8	42.6	42.7	0.6
TSP 9342	0	1	99	0	0	2.8	46.9	9.4	4.8	42.6	41.9	1.3

Table 2. Continued

	Seed Coat Colours (%)					Seed yield	Oil	Fatty Acid Composition (%)				
	White	Yellow	Brown	D.brown	Black	g/plant	%	Palmitic	Stearic	Oleic	Linoleic	Others
TSP 9343	0	0	100	0	0	2.1	46.9	9.2	4.8	42.8	42.1	1.1
TSP 9344	0	0	100	0	0	1.7	46.1	8.9	4.6	43.4	42.1	1.0
TSP 9345	0	0	100	0	0	3.4	47.8	9.3	4.9	42.1	42.9	0.8
TSP 9346	0	0	100	0	0	4.7	41.6	9.3	4.9	42.7	42.5	0.6
TSP 9347	0	1	99	0	0	2.9	44.1	9.4	4.7	42.4	42.9	0.6
TSP 9348	0	0	100	0	0	4.5	45.7	9.2	4.8	43.5	42.0	0.5
TSP 9349	0	0	100	0	0	6.6	46.6	9.3	5.0	42.5	42.2	1.0
TSP 9350	0	2	98	0	0	2.7	43.1	9.1	5.0	43.1	41.7	1.1
TSP 9351	0	7	93	0	0	7.5	46.4	9.3	4.8	43.5	41.3	1.1
Region	0	12	88	0	0	4.0	46.3	9.3	4.7	43.4	41.7	0.9
South East Anatolia												
TSP 9352	0	13	85	0	2	3.9	42.9	9.6	4.4	43.5	41.1	1.4
TSP 9353	0	10	0	90	0	5.5	45.6	9.3	4.9	46.2	39.0	0.6
TSP 9354	0	0	0	99	1	3.6	48.2	9.3	4.7	46.0	39.0	1.0
TSP 9355	0	0	0	99	1	3.6	43.3	9.2	4.8	45.1	40.4	0.5
TSP 9356	0	10	0	90	0	7.2	44.0	9.3	5.0	45.1	39.6	1.0
TSP 9357	0	0	45	53	2	4.6	39.0	9.4	5.0	45.5	38.8	1.3
TSP 9358	0	35	65	0	0	5.0	39.1	9.4	5.0	45.7	39.2	0.7
TSP 9359	0	25	70	0	5	5.7	42.2	9.4	4.9	45.0	39.3	1.4
TSP 9360	0	30	70	0	0	5.2	44.6	9.6	4.9	45.2	39.5	0.8
Region	0	13	37	48	2	4.9	43.2	9.4	4.8	45.3	39.5	0.9
From Turkish Sesame Collection												
TR 37549						9.1	44.3	9.5	4.5	45.8	38.8	1.4
TR 38215						11.6	43.5	9.3	4.9	46.6	38.9	0.3
TR 38253						12.3	39.8	9.3	4.6	45.0	39.5	1.6
TR 39702						6.7	42.4	9.5	4.8	44.3	40.7	0.7
TR 39712						8.1	37.8	9.6	4.7	45.6	39.5	0.6
TR 39716						8.0	43.7	9.5	4.7	44.6	39.9	1.3
TR 45506						5.7	45.8	9.5	4.7	44.3	40.2	1.3
TR 45515						7.8	46.6	9.5	4.6	43.0	42.0	0.9
TR 45524						6.6	44.3	9.4	4.3	43.6	41.9	0.8
TR 45532						5.3	44.4	9.8	4.4	42.6	39.7	3.5
TR 48929						6.8	44.6	9.5	4.3	45.3	40.1	0.8
TR 48930						8.0	50.1	9.9	4.4	42.9	41.3	1.5
Collection means						8.0	43.9	9.5	4.6	44.4	40.2	1.2
Overall mean	12.8	30.1	48.9	7.2	1.0	6.1	44.1	9.5	4.5	43.8	41.1	1.1
Muganlı-57						9.4 a						
Özberk-82						7.3 b						
Gölmarmara						7.3 b						
LSD (%5) (based on controls)						0.9						
LSD (%5) (based on populations)						3.2						

The frequency of the seed coat colours in the sesame populations was 58.9% of brown, 30.1% of yellow, 12.8% of white, 7.2% of darkbrown and 1.0% of black. The frequency of seed colours among the region was

Table 3. Variation of seed yield, oil, oleic and linoleic acid contents in the individual plants (1994) and lines (1995) derived from different superior population types.

	1994				1995			
	n	Mean ± S.D.	min-max	C.V.(%)	n	Mean ± S.D.	min-max	C.V.(%)
Yield types				seed yield, g/plant				
TSP 9324	100	10.1 ± 3.7	4.0-25.1	36.6	20	8.59 ± 1.72	4.92-11.96	20.0
TR 38215	100	13.8 ± 4.8	5.8-27.9	34.8	20	9.21 ± 1.85	5.42-12.40	20.1
Oil types				oil content %				
TSP 9337	100	58.3 ± 2.3	50.6-62.6	3.7	20	62.2 ± 0.8	60.7-63.9	1.3
TR 48930	100	59.0 ± 2.0	52.5-63.8	3.4	20	61.4 ± 1.0	59.9-63.4	1.6
Oleic types				oleic acid %				
TSP 9332	100	44.2 ± 1.6	40.6-48.9	3.6	20	44.4 ± 1.3	41.2-46.3	2.9
TR 38215	100	44.0 ± 1.7	40.4-48.6	3.9	20	43.1 ± 1.3	41.0-45.4	3.0
Linoleic types				linoleic acid %				
TSP 9314	100	45.5 ± 2.0	41.7-54.3	4.4	20	44.8 ± 1.5	42.7-48.0	3.3
TSP 9324	100	42.6 ± 1.6	39.7-48.9	3.8	20	44.1 ± 0.9	42.5-45.8	2.0

*) S.D. = Standard Deviation, C.V. = Coefficient of Variation

different: brown was most frequent in Mediterranean (88%) and Aegean (38%), yellow was in Thrache-Marmara (73%) and darkbrown was in South East Anatolia (48%) regions (Table 2).

All Turkish sesame populations consisted of the plants with dehiscent (shattering), branching and indeterminant types. The varieties that constitute their branches and first capsules on the upper part of the main stem were in the late maturity group, while varieties constitute their branches and first capsules on the bottom part of the main stem were in the early maturity group.

Adjusted seed yield per plant showed a range between 1.7 g (TSP 9344) and 12.3 g (TR 38253). The average oil content was 44.1% with a range of 35.1 %(TSP 9311) and 51.9% (TSP 9337). Fatty acid compositions had the following range; palmitic acid 8.7-10.2%; stearic acid 4.0-5.0%; oleic acid 41.1-47.2% and linoleic acid 38.2-43.4%. Other fatty acid present in small quantities were myristic, palmitoleic and arachidic acid (Table 2).

Oil and fatty acid contents varied dramatically according to the growing regions. The varieties introduced from northern altitudes contained more palmitic and linoleic acid, but less oil, stearic and oleic acid contents than the varieties from southern altitudes.

Superior populations were determined for high seed yield (TSP 9324 and TR 38215), high oil content (TSP 9337 and TR 48930), high oleic acid (TSP 9332 and TR 38215) and high linoleic acid (TSP 9314 and TSP 9324) according to results of the analysis in 1993. Also, `Muganlı-57' was found the best among the control varieties for seed yield (Table 2).

A large variation was found within the plants sampled from the superior populations and within the lines selected by 20% upper part of the plants (Table 3).

Although oil type lines had significantly more oil content than their base populations, yield type lines had less seed yield than their base populations due to mainly year differences. 16 superior lines selected among the 160 lines were compared for seed yield, oil content, oleic acid and linoleic acid contents (Table 4). All characters were found significant at the level of 1 % based on F-values.

`TR 3821560' and `TR 3821593' lines which had

Table 4. Seed yield, oil yield, oil, oleic and linoleic acid contents of the superior lines in 1996.

Lines	Seed yield kg/ha	Oil content %	Oil yield kg/ha	Oleic acid content %	Linoleic acid content %
Yield types					
TSP 932454	914.7 bcd*	60.80 bc	556.0 bcd	40.51 bcd	42.68 cd
TSP 932440	863.2 bcd	60.05 cde	518.4 cd	40.57 bcd	41.76 de
TR 3821560	1074.1 a	59.77 c-f	642.5 a	41.62 b	40.78 efg
TR 3821593	1061.6 a	59.10 efg	627.7 ab	41.87 b	39.69 fgh
Oil types					
TSP 933749	982.4 ab	63.25 a	620.9 ab	41.29 bc	40.85 efg
TSP 933752	938.6 bc	60.80 bc	571.1 abc	41.76 b	42.02 de
TR 4893091	819.2 cde	61.56 b	504.7 cde	40.40 bcd	41.16 def
TR 4893057	863.4 bcd	61.75 b	533.5 cd	41.43 bc	41.68 de
Oleic types					
TSP 933235	715.6 ef	58.52 gh	419.0 fg	44.73 a	39.47 gh
TSP 933229	667.4 f	57.52 h	384.2 g	45.69 a	38.36 hy
TR 3821553	909.1 bcd	58.85 efg	535.2 cd	44.15 a	39.69 fgh
TR 3821512	925.6 bcd	60.17 cde	557.0 bcd	45.45 a	37.70 y
Linoleic types					
TSP 931432	814.7 cde	60.47 bcd	492.9 c-f	40.11 bcd	44.21 bc
TSP 931414	847.9 cd	59.35 cde	503.6 cde	40.09 bcd	43.84 bc
TSP 932410	711.8 ef	60.12 cde	428.1 efg	39.78 cd	45.96 a
TSP 932403	795.2 de	59.80 cde	475.6 def	38.98 d	45.02 ab
Control (Muganlı-57)	891.9 bcd	59.47 c-f	530.7 cd	41.51 bc	41.19 def
F values	7.99**	14.38**	7.99**	14.20**	19.71**

*) Values within a group followed by the same letter or letters are not significantly different at the 5 % level (Duncan's Multiple Range Test)

**) Significant at P = 0.01 based on F-value determined by analysis of variance technique

16.9% and 15.9 % higher seed yield than the control, respectively were determined as superior for high yield types. `TSP 933749' line with 63.25 % oil content was determined as superior for high oil content type. It gave 5.98% more oil content and 14.52% more oil yield when compared to the control variety.

The highest oleic acid and linoleic acid contents were found in `TSP 933229' (45.69%) and `TSP 932410'(45.96%), respectively. `TSP 933229' and `TR 3821512' lines which had oleic acid over 45% were determined as high oleic acid type lines and `TSP 932410' and `TSP 932403' lines which contain linoleic acid content over 45% were determined as high linoleic acid type lines. Thus, superior lines with high yield, high oil, high oleic and high linoleic types were evaluated via pure line selection from variability existed in the sesame

populations.

Discussion

There were no quadricarpellata type plants in the Turkish sesames according to Hildebrandt (1932). However, this study showed that this type plants were also present as well as low frequences (0.4%). It was found interesting that similar results in the distribution of mean frequencies of morphological characters in the Turkish sesames were observed by Demir in 1962. So, it could be said that the variability of the Turkish sesames concerning these morphogenetic characters has not changed importantly so far. It seems that the local varieties were spontenously preserved by farmers due to the lack of the adequate breeding varieties. Although three varieties namely `Muganlı-57', `Gölmarmara' and `Özberk-82' were released, they were grown in a limited areas due to their low yield capacity and susceptibilty to some diseases such as Fusarium sp., Rhizoctonia sp., Alternaria sesemicola and Phylloidy. Today in Turkey, the local varieties are grown in almost all of the national sesame production areas (9). It is neccassary to alter this state in order to improve the sesame cultivation in Turkey without loss of the local varieties which are very valuable genetic materials for the plant breeders.

High yield lines developed by using selection breeding from the Turkish sesame populations may be a great opportunity to reach to this goal. The lines `TR 3821560' and `TR 3821593' showed high yield capacity (over 1000 kg/ha) and tolerant or resistant to the diseases mentioned above in comparison with the control variety. They both are BMB (Branching, Monocapsulle, Bicarpellata) plant types, have brown seeds and 59.77% and 59.10% average oil contents, respectively.

Turkish sesames were observed with high oil contents by Arzumanova (10). Also, Lee and Choi (11) and Yermanos et al (12) reported that oil contents in the sesame collections and introductions inculding Turkish sesames were 45.0-55.5% and 40.4-59.2%, respectively. In the present study, oil content varied between 35.1-51.9% in the 72 sesame populations, 50.6-63.8% in the 200 individual plants and 59.9-63.9% in the 40 oil type lines (Table 2,3). The oil content of `TSP 933749' line selected from Burdur population was found as high as 63.25% which was appeared to be statistically significant at the level of 1% when compared to other types (Table 4). This superior high oil type line could be used as a parent for any sesame breeding with the object of obtaining varieties with high oil yield.

Since in many parts of the world, sesame is a major source of high quality edible oil, the improvement of oil content and modification of its fatty acid's composition are of primary importance (13). It was indicated that average percentages of oleic and linoleic acid contents in the 420 sesame germplasms were 41.3% and 43.7%, respectively (14). So, the percentages of oleic and linoleic acids in sesame oil were very close to each other, and with this characteristic sesame oil was appeared to be different from other seed oils. For this reason, it is important to obtain high oleic/low linoleic and high linoleic/low oleic acid genotypes for producing new types of sesame oil accomplishing different demands for nutritional or industrial consumptions. Strong negative correlations between C18 fatty acids may be helpful in evolving the varieties rich in either oleic acid or linoleic acid (15,16). There was a great variability for the fatty acids composition among and within the Turkish sesame populations. In particular, `TSP 933229' and `TR 3821512' lines for high oleic/low linoleic acid, and `TSP 932410' and `TSP 932403' for high linoleic/low oleic acid

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