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Evaluation of Yield and Quality Performance of Groundnut Varieties under the Eastern Mediterranean Condition

Ahmet Yenikalayci[1,*]

[1]Mus Alparslan University, Faculty of Applied Sciences, Plant Production and Technologies Department, Mus, Turkey

[*]Corresponding Author: a.yenikalayci@alparslan.edu.tr

Abstract

High yielding superior groundnut cultivar development is the main objective of groundnut breeding programs. A four-year study was conducted in the Eastern Mediterranean Agricultural Research Institute in 2001, 2002, 2003 and 2004 growing seasons to evaluate for yield and quality characteristics of 80 groundnut varieties. The field experiments were laid out in a 3 replicated randomized complete block design. In the research, row spacing was 70 x 25 cm and 80 kg/ha nitrogen and phosphorus fertilizers were applied. The investigated plant parameters were plant growth form, seed husk color, flower color, number of seeds in capsule, shelling percentage, 100 seed weight, number of pod per plant, pod weight per plant, pod yield and seed oil content. The groundnut varieties GK-3 and VAC-92R could be cultivated as main crop in the Eastern Mediterranean Region due to their higher yield performance then the standard varieties Com and NC-7. The groundnut genotypes PI 361753, PI 288153, AT-108, AT120 and March 1 could be used to develop large seeded confectionery type groundnut varieties in the breeding programs.

Keywords: Groundnut, adaptation, cultivar, line, pod yield.

Introduction

Groundnut is an important nutritional source for human being and animals due to its high oil, protein, carbohydrate, vitamins and mineral contents (Arioglu, 2018). Most of the produced groundnuts are domestically consumed as roasted-in-shell nuts, raw nuts, salted nuts, and confectionaries. Peanut seeds contain up to 56% oil, 30% protein, 19.0% carbohydrates. Also, it has a good source of minerals, antioxidants, essential fatty acids (linoleic) and vitamin E, K, and B (Andrea and Palafoxdela, 1986; Eskalen and Yılmaz, 1993; Jagannathan et al., 1974; Sebei et al., 2013). Groundnut oil is much more superior then many other vegetable oils in terms of taste and shelf life (Arioglu, 2014). After extraction of the oil, the remaining pulp has approximately 45% crude protein, 24% nitrogen-free essence substances and 5.5% minerals. Therefore, groundnut pulp is added into animal feed in most of the developed countries.

The world shelled groundnut production was around 47 million tons in 27.8 million ha with an average yield of 1.78 t/ha (Anonymous, 2019a). The groundnut cultivation area in Turkey was 41.950 ha and the production was 165.330 tones (Anonymous, 2019b). The production of oilseed crops is not enough in Turkey, therefore, a certain amounts of oil seeds are imported. Every year, Turkey imports vast amount of oilseeds and raw oils and pays millions of foreign currency. According to data in 2016, five million tons of oilseeds were produced in the world and 43.9 million tons of them were obtained from groundnuts. On the other hand, 2.6 million tons of oilseeds and 780 thousand tons of vegetable raw oil were produced in Turkey. The production of vegetable raw oil in the world was 187 million tones (Anonymous, 2016). Chine, USA, Nigeria and Indonesia are the leading countries in world groundnut production.

The groundnut variety performance results in the Mediterranean Region showed that groundnut yield varied between 2340 and 8796 kg/ha (Gulluoglu et al., 2017a; Asik et al., 2018; Arioglu et al., 2016; Kurt et al., 2009; Onat et al., 2017; Arioglu et al., 2018; Gulluoglu et al., 2018; Onceler, 2005; Kadiroglu, 2012; Yılmaz, 1999). Variety NC-7 is widely cultivated in the groundnut cultivated areas of Turkey due to its high yield. Canavar, (2011) obtained up to 5210 kg/ha yield from NC-7 type groundnut varieties in Aydın province. Similarly Aytekin and Calıskan,

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(2016) obtained up to 5022 kg/ha seed yield in Nigde province. Shelling rates of groundnuts were reported as 62-76% in Turkey (Asik et al.,, 2018; Onceler, 2005). 100 seeds weight values for different varieties were reported between 53 and 137 grams (Asik et al., 2018; Arioglu et al., 2016; Gulluoglu et al., 2018; Canavar, 2011). Pod number per plant varied between 10 and 96 (Kurt et al., 2008; Kurt et al., 2009; Asik et al., 2018; Onat et al., 2017; Gulluoglu et al., 2017b; Onceler, 2005; Canavar, 2011) and the pod weight per plant varied between 35-120 g (Kurt et al., 2008; Onat et al., 2017; Gulluoglu et al., 2017b; Gulluoglu et al., 2018; Canavar, 2011). Oil content of groundnut varieties grown in Turkey varied between 29.43 and 55.60% Kurt et al.,, 2008; Kurt et al.,, 2009; Arioglu et al.,, 2016; Campos-Mondragon et al., 2009; Onceler, 2005; Aytekin and Calıskan, 2016; Gulluoglu et al., 2017b; Canavar, 2011; Yol et al., 2017).

About 95% of the groundnut is produced in the Mediterranean region of Turkey. Therefore, it is quite important to determine groundnut varieties with superior yield and quality features for the Mediterranean region.

This study was carried out to determine the performance of some selected groundnut cultivars and lines and determine their potential as breeding materials in the breeding programs.

Materials and Methods

In this study, 80 large seeded Virginia type groundnut varieties and lines were used as plant materials (Table 1). Two experimental plots in the Mediterranean Agricultural Research Institute and one in Osmaniye province, were selected for test locations. The field trials were conducted in two locations (Tasci in 2001 and 2002 and Dogankent 2001, 2002, 2003 and 2004) in the Mediterranean Agricultural Research Institute research fields. The groundnut varieties and lines were also tested in a farmer field in Osmaniye province in 2004. The selected varieties and genotypes (superior than the standard varieties in terms of yield or shelling percentage) of 2001 growing season were planted in the yield trials in 2002, 2003 and 2004.

In all locations, the seeds were sown by hand in the first half of April. The seeds were sown by hand in 4-row plots, 5 m long with the spacing of 70 cm between rows, and at a rate of 4 seeds per meter of row. Before sowing, 45 kg/ha N and 35 kg/ha P_2O_5 was applied. At flowering and pod formation (before first and third irrigation) 400 kg/ha Ammonium nitrate was applied. Standard cultural practices for groundnut (hoeing, irrigation, pest and disease control) were applied for all locations. Pod yields were determined by harvesting the middle two rows of each plot at all locations. The measured plant parameters were plant growth form, seed husk color, flower color, seed number per pod, shelling percentage (%), 100 seed weight (g), pod number per plant, pod weight per plant (g), pod yield (kg/ha) and oil content (%).

Data for investigated plant parameters were statistically analyzed using a standard analysis of variance in randomized blocks experimental design using the general linear model (SAS Institute, 1996). Means were separated using by Duncan.

Results and Discussion

In 2001, field variety performance trials were conducted in Dogankent and Tasci locations in the Eastern Mediterranean Agricultural Research Station. Compared to Dogankent, Tasci location, had fine textured soil such as clay, clay loam and silt loam.

During the growing seasons, some phenological observations like plant growth habit and flower color were recorded. The phenological observations showed that, 11 genotypes had prostrate (flat) growth habit, 43 genotypes had semi prostrate growth habit and 26 had runner growth habit. The seed husk color varied greatly among groundnut genotypes, particularly in red, shaded-red, dark red, bright dark red, pink, shaded pink, claret red, dark claret red, shaded claret red, tawny-brown, light red, bright orange. The flower colors varied from yellow, light yellow, dark yellow, bright dark yellow, dark matt yellow, orange, the mix of orange and yellow, the mix of yellow and bright orange, to matt orange yellow. The number of seed in the pod was two in general for all tested groundnut genotypes.

Shelling percentage, 100 seeds weight, the number of pods per plant, the pod weight per plant and pod yield per hectare in Dogankent and Tasci locations in 2001 growing season were given in Table1.

Table 1. Shelling percentage, 100 Seed weight, Pod number/plant, Pod weight/plant and pod yield of tested groundnut genotypes in Dogankent and Tasci in 2001.

Genotypes	Pod Number /Plant)		Pod Weight (g/plant)		100 Seed Weight (g)		Pod Yield (kg/ha)		Shelling Percentage (%)	
	DK	TS	DK	TS	DK	TS	DK	TS	DK	TS
1- PI 121071	125	44	115	45	85	81	5730	4090	57	64
2- PI 313361	78	71	88	64	83	76	4990	4340	58	66
3- PI 378013	146	50	124	30	92	93	4870	1690	54	64
4- PI 269704	112	70	107	60	83	73	5470	4300	57	65
5- PI 393525	125	33	139	39	68	63	1990	2200	54	56
6- PI 343361	98	55	83	63	78	89	4550	4160	57	66
7- PI 370326	61	58	61	57	78	73	4870	3790	53	63

8- PI 315624	98	59	97	59	85	79	5070	3400	56	63
9- PI 269699	72	36	71	44	85	83	2520	2370	60	67
10-PI 196732	46	39	46	41	71	85	4620	3250	55	67
11-NC-lOC	285	45	54	50	74	85	4280	2730	59	67
12-PI 221067	76	30	72	33	92	85	4250	3500	55	68
13-PI 361753	95	27	90	66	82	74	5760	5440	53	64
14-PI 295208	84	36	87	33	79	73	5120	2380	55	64
15-PI 259802	98	61	93	61	109	78	5770	3580	69	64
16-PI 319177	81	58	55	67	94	82	5800	4070	63	69
17-PI 269068	57	29	55	32	77	81	4140	2260	61	68
18-GK-3	130	113	112	86	76	77	5890	4350	56	64
19-PI 259861	94	63	74	58	70	67	4850	3690	63	70
20-PI 337455	58	55	58	50	84	77	5890	2340	65	66
21-PI 268882	97	51	89	42	98	70	6330	2750	67	63
22-H-3	96	38	94	47	94	84	5980	3510	55	60
23-PI 313197	57	42	55	31	112	72	4610	2860	74	62
24-PI 269082	65	65	53	72	98	78	4620	2180	63	64
25-PI 268885	48	22	45	20	92	68	2570	2480	70	61
26-PI 315609	82	45	88	55	85	88	4930	4700	60	70
27-PI 269722	48	47	47	70	80	88	4260	3590	63	65
28-PI 288153	119	54	116	59	89	79	6120	4410	60	67
29-PI 259649	140	72	142	71	89	71	5430	3180	58	64
30-PI 269723	30	37	29	39	111	91	3310	2510	65	65
31-PI 259815	156	88	141	79	75	78	5190	3500	63	67
32-PI 315616	103	51	109	44	93	72	5940	3520	57	62
33-PI 268883	160	68	159	56	76	61	5180	3620	59	58
34-PI 215628	212	71	119	49	61	60	3730	3840	62	74
35-NY-7	58	89	51	59	65	62	2860	3350	60	68
36-PI 124681	59	53	52	42	69	74	5040	3290	55	71
37-Shulamit	86	56	74	67	83	89	6140	4090	61	69
38-PI 291985	85	58	74	56	86	84	3950	3410	60	68
39-H-5	93	75	90	79	77	86	6090	4490	59	65
40-PI 378012	74	67	69	66	88	88	6080	3520	58	63
41-PI 343400	69	36	85	39	91	95	4630	3570	57	63
42-7 Selection H-1	106	47	88	48	71	82	5550	3530	60	70
43-Homobay	52	48	44	45	74	83	5490	3130	61	71
44-PI 378017	88	71	65	58	79	81	4950	3920	59	64
45-PI 259510	87	60	85	54	85	76	5680	3450	59	65
46-PI 315621	96	38	90	44	85	93	5540	3490	58	65
47-PI 378015	48	36	44	38	92	85	5110	3760	61	62
48-Turkmenistan	84	28	54	17	42	44	3280	1880	63	65
49- Edirne Tag 24	136	73	78	47	52	50	4310	4390	70	64
50- E VA 910212	63	89	58	87	84	82	4770	4160	65	67
51- Edirne TG-17	127	98	67	63	63	76	4120	5410	60	68
52-PI 346385	77	93	61	90	83	81	3670	3890	60	66
53-PI 315633	58	74	50	77	88	78	3520	4200	56	67
54-Edirne 138	60	67	68	45	49	51	5180	4750	63	70
55-Edirne 80	47	64	20	39	40	41	2150	2780	60	62
56- Edirne (CTGS)	55	56	37	34	46	46	3560	2590	63	62
57-Edirne 53	135	129	60	77	42	62	4150	5040	65	71
58-GA Runner	220	36	71	25	44	71	4750	3990	66	69

59-Florunner	83	16	91	17	83	92	5240	3680	64	71
60-GA Browne	72	78	34	27	65	41	3940	3250	72	70
61- 108ADV7	68	51	45	49	86	60	6210	4990	71	73
62-GA Green	55	88	28	54	54	60	5540	4780	68	68
63- AT120	87	29	73	23	97	69	5640	4450	75	75
64-GA Brown	95	60	69	46	61	73	4890	3900	71	71
65-Florunner	128	120	59	66	57	53	5940	3550	65	75
66- Sunoleic 95R	39	51	18	30	44	49	4140	2830	64	70
67-Andru 93	55	12	40	10	66	75	2950	1490	58	60
68-GA Runner	53	26	30	14	53	51	4140	2410	63	65
69-Southern Runner	93	66	45	33	44	48	4610	2460	68	69
70-March 1	82	131	54	86	59	63	7014	5080	66	75
71- VAC 92 R	47	58	44	57	93	89	3440	3400	63	68
72-269084	105	59	88	70	87	89	6000	3580	62	63
73-Adana	58	86	53	82	89	77	3600	3110	60	65
74-Çom	53	75	52	69	77	79	3840	4020	60	65
75-7511073	144	49	135	52	81	77	5740	3340	58	63
76-NC-7	52	78	63	81	94	91	5520	4320	68	70
77-7X	104	48	85	55	62	96	5230	3770	62	69
78-ATVCI	49	73	46	63	78	77	3190	3380	63	68
79-PI 346385	35	48	34	45	74	80	5440	3450	56	65
80-PI 372317	34	64	38	68	81	80	3100	2630	48	59

DK: Dogankent, TS: Tasci

As can be seen in Table 1, the highest pod number per plant was obtained from NC-lOC with 285 number/plant, and the lowest pod number per plant was obtained from Andru 93 with 12 number/plant in Dogankent and Tasci, respectively. The pod weight values of the tested groundnut genotypes were between 10 and 159 g and the highest and lowest pod weights were obtained from PI 268883 and Andru 93, respectively. The highest 100 seed weight was observed from PI 313197 with 112 g, and the lowest was obtained from Edirne 80 with 40 g. The highest pod yield was obtained from March 1 with 7014 kg ha^{-1}, and the lowest was obtained from Andru 93 wşth 1490 kg ha^{-1} in Dogankent and Tasci, respectively. Shelling percentage values in Dogankent and Tasci locations varied between 48% and 75%, the highest values were obtained from AT120, Florunner and 7511073 and the lowest value was obtained from PI 372317.

Groundnut variety Çom which is one of the standard varieties had pod yields with 3840 and 4020 kg/ha in Dogankent and Tasci locations, respectively. Additionally, 5520 and 4320 kg/ha pod yields were obtained from NC-7 v in Dogankent and Tasci locations, respectively. In Dogankent and Tasci, PI 361753, GK-3, PI 288153, 108ADV7, GA Brown, AT120, and March 1 had higher yielding groundnut genotypes than the standard varieties.

In 2002, 8 groundnut genotypes were chosen for further yield evaluations in two locations, since they were superior to the control genotypes. When Dogankent and Tasci locations was compared, pod yield of groundnut genotypes were higher than Tasci. The yield differences between two locations could be attributed the soil structure. Since Dogankent has heavier textured soil structure than Tasci location. Yield is higher in heavy textured soils; however, harvest is more difficult and harvest losses are high in heavy textured soils. Out of 8 genotypes, 4 genotypes were in the semi prostrate, 3 in runner and 1 in prostrate growth habit. The seed husk color of those genotypes PI 361753, GK-3, PI 288153 and GA Green were pink; genotypes in H-5 and 108 ADV7 were shaded pink, genotype AT120 was bright orange, genotype March 1 was shaded brown. The shaded seed husk color is not preferred by Turkish groundnut consumers. Based on evaluated yield and quality parameters, the groundnut variety March 1 had great performance in both locations.

Pod number per plant, pod weight per plant,100 seeds weight, pod yield and shelling percentages of genotypes in Dogankent and Tasci in 2002 were given in Table 2. The yield trials were conducted with 10 genotypes including standard ones in 2002. Groundnut genotypes PI 361753, GK-3, PI 288153, H-5, At-108ADV7, GA Green, AT120 and March 1ADV had higher pod yields than the standard varieties (Çom and NC-7) in Dogankent and Tasci locations in 2002.

Table 2. Shelling Percentage, 100 Seed weight, Pods Number, Pod Weight and Pod Yield of Groundnut Genotypes in Dogankent and Tasci in 2002

Genotypes	Pods Number /Plant		Pod Weight (g/plant)		100 Seed weight (g)		Shelling Percentage (%)		Pod Yield (kg ha^{-1})	
	DK	TS	DK	TS	DK	TS	DK	TS	DK	TS
1- PI 361753	54.9 c	87.3 a	55.3 cde	60.1 bc	74 c	73.3 cd	61.5 e	61.3 c	3230 bc	3650 bcd
2- GK-3	80.4 bc	54.3 b	66.3 abc	78.3 b	82.0 b	88.0 b	64.9 cde	66.0 b	4510 a	4600 a
3- PI 288153	50.1 c	85.4 a	74.8 ab	64.1 bc	74.7 c	68.7 d	62.9 de	60.9 c	3940 abc	3910 b
4- H-5	70.3 bc	88.9 a	78.4 a	99.9 a	86.0 ab	74.0 cd	66.2 bcd	62.0 c	4240 ab	4160 ab
5- AT-108	100.1 ab	85.7 a	44.9 de	61.0 bc	53.3 e	48.7 f	70.4 a	73.5 a	3140 bc	3260 cd
6- GA Green	119.3 a	106.4 a	54.7 cde	58.3 bc	53.3 e	50.0 f	69.5 ab	69.3 b	3010 c	3520 bcd
7- AT 120	76.8 bc	94.0 a	63.3 abc	57.2 bc	64.0 d	62.0 e	69.1 ab	69.1 b	3200 bc	3050 d
8- March1	51.3 c	57.3 b	40.1 e	45.7c	58.0 e	60.0 e	70.0 a	73.7 a	2940 c	3230 cd
9- ÇOM	84.1 bc	85.5 a	68.0 abc	73.7 b	75.3 c	75.3 c	62.9 de	66.0 b	3590 abc	3800 bc
10- NC-7	55.9 c	51.9 b	59.3 bcd	60.7 bc	89.3 a	98.0 a	67.6 abc	68.4 b	3790 abc	3910 b
CV (*:%5, **:%1)	14.25**	16.81**	25.31**	18.35**	4.60**	5.05**	2.84**	2.78**	17.0*	9.09**

DK: Dogankent, TS: Tasci

As can be seen in the Table 2, according to analyzed characters in 2002, in both locations the highest shelling percentage was obtained in AT-108ADV-7with the rate of 70.4% and then in March 1 ADV-6 with the rate of 73.7%; additionally, the lowest shelling percentages were observed from PI 288153 (% 60.9) and PI 361753 (% 61.5), respectively. Furthermore, the highest 100 seed weight was found in standard variety NC-7 and then GK-3 with 82-88 g. The lowest 100 seed weights were obtained from AT-108ADV-7 and GA Green with 48-53 g. The shelling percentages are similar with the other studies (Asik et al., 2018; Onceler, (2005). Whereas 100 seed weight was between 53.3-89.3 g in Dogankent and it was between 48.7 and 98 g in Tasci location. In both locations, the lowest was obtained from AT-108ADV-7 and GA Green. The highest value was obtained from standard variety NC-7. When 100 seed weight was in consideration, results were consistent with the findings of other studies (Asik et al., 2018; Arioglu et al., 2016; Gulluoglu et al., 2018; Canavar, 2011). The number of pod results was close to the finding of other researches (Kurt et al., 2008; Kurt et al., 2009; Asik et al., 2018; Onat et al., 2017; Gulluoglu et al., 2017b; Onceler, 2005; Canavar, 2011). Groundnut genotype H-5 had highest pod weight per plant with 78.4-99.9 g in both locations March 1 had the lowest value with 40.1-45.7 g. The pod weight per plant was compatible with other researchers' findings (Kurt et al., 2008; Onat et al., 2017; Gulluoglu et al., 2017b; Gulluoglu et al., 2018).

Whereas GK-3 had the highest pod yield in both locations (4510 and 4600 kg/ha), March 1 (2940 kg/ha) had the lowest in Dogankent and AT120 (3050 kg /ha) in Tasci. Pod yield obtained from the yield test conducted in Turkey had similar results (Gulluoglu et al., 2017a; Asik et al., 2018; Arioglu et al., 2016; Kurt et al., 2009; Onat et al., 2017; Arioglu et al., 2018; Gulluoglu et al., 2018; Onceler, 2005; Kadiroglu, 2012; Yılmaz 1999).

Variety yield test in 2003 were conducted with 13 genotypes including standard varieties in Dogankent location. PI 378017, VAC-92R and 7X had lower pod yield values lower than the standard varieties, but which have promising results in the yield experiments conducted by Çukurova University and which are also proper for appetizer consumption, were included in our studies on the recommendation of advisor.

Pod number per plant, pod weight per plant, 100 seed weight, pod yield, the shelling percentage and oil content of genotypes sowing in Dogankent were given in Table 3.

Table 3. Pods Number, Pod Weight, Pod Yield, 100 Seed weight, Shelling Percentage, and Oil Content of Groundnut Genotypes in Dogankent in 2003

Genotypes	Pods Number /Plant	Pod Weight (g/plant)	Pod Yield (kg/ha)	100 Seed weight (g)	Shelling Percentage (%)	Oil Content (%)
1- PI 361753	30.6 d	41.3 c	4100 d	90.0 b	61.0 c	50.17
2- GK-3	54.0 abc	69.3 a	5110 ab	100. ab	62.2 c	-
3- PI 288153	42.6 abcd	46.6 c	4970 abc	96.6 ab	61.0 c	50.68
4- H-5	38.0 cd	54.0 bc	4550 bcd	96.6 ab	63.3 bc	-
5- AT-108	66.6 a	52.0 bc	4260 cd	60.0 c	72.2 a	51.58
6- GA Green	62.3 ab	49.3 bc	4650 bcd	63.3 c	73.3 a	-
7- AT 120	57.3 abc	63.3 ab	4150 d	70.0 c	68.8 ab	50.65
8- March 1	45.6 abcd	50.6 bc	4550 bcd	70.0 c	68.8 ab	51.53
9- PI 378017	50.6 abcd	52.0 bc	4690 abcd	100.0 ab	65.50 bc	49.14
10- VAC-92R	62.0 ab	63.3 ab	5460 a	100.0 ab	63.30 bc	
11- 7X	51.6 abcd	63.3 ab	4640 bcd	100.0 ab	63.30 bc	49.27
12- ÇOM	41.0 bcd	53.3 bc	4790 abcd	90.0 b	61.07 c	-
13- NC-7	45.3 abcd	46.4 c	5150 ab	110.0 a	65.50 bc	-
CV (*:%5, **:%1)	19.31**	16.3*	9.99*	8.6**	4.00**	-

Pod number per plant varied between 30 and 66 number/plant. The lowest pod number was obtained from PI 361753, and the highest was obtained from AT-108ADV-7. Our findings for pod number was similar to the findings of the others (Kurt et al., 2008; Kurt et al., 2009; Asik et al, 2018; Onat et al., 2017; Gulluoglu et al., 2017b; Onceler, 2005; Canavar, 2011). The values of pod weight varied between 41.3 and 69.3 g, and also the lowest value was obtained from PI 361753 while the highest one was obtained from GK-3. Those values were compatible with the values reported by Kurt et al. (2008), Onat et al. (2017), Gulluoglu et al. (2017b) Gulluoglu et al. (2018).

Shelling percentage varied between 61 and 73.3% in the experiment carried out in Dogankent in 2003 and PI 361753 had the lowest and GA Green had the highest shelling percentage (Table 3). Our findings were compatible with the findings of Asik et al. (2018), Onceler (2005). While 100 seed weight was varied between 60 and 110 g, the lowest was obtained from AT-108 and the highest was obtained from NC-7. Seed weight values correspond to the values reported by Asik et al. (2018), Arioglu et al. (2016), Gulluoglu et al. (2018), Canavar (2011).

Pod yield of groundnut genotypes varied between 4100 and 5460 kg/ha, the lowest pod yield was obtained from PI 361753 and the highest was obtained from VAC-92R. Pod yields were similar with the findings of Gulluoglu et al. (2017b), Asik et al. (2018), Arioglu et al. (2016), Kurt et al. (2009), Onat et al. (2017), Arioglu et al. (2018), Gulluoglu et al. (2018), Onceler (2005), Kadiroglu (2012) and Yılmaz (1999). The seed oil contents were not analyzed for all genotypes. The highest oil ratio was obtained from AT-108ADV with 51.58% and the lowest was obtained from PI 378017 with 49.14%. The seed oil content results were close to finding of other researchers (Kurt et al., 2008; Kurt et al., 2009; Arioglu et al., 2016; Campos-Mondragon et al., 2009; Onceler, 2005).

In the 2003 yield test, some of the high yielding genotypes were eliminated due to their lower quality characteristics. Since they could not be preferred by groundnut farmers. GK-3, H-5 and VAC-92R were further tested one more year in Osmaniye and the the Eastern Mediterranean Agricultural Research Institute with standard varieties by paying attention to seed rate and 100 seed weight and yield in 2004.

In the yield tests carried out in 2004, variety yield experiments was established in Dogankent field of institute and the village of Çona in Osmaniye by using 5 varieties and lines together with standard varieties in field of farmers. The yield experiments were conducted in Osmaniye for a year in order to see the performance of lines in the province of Osmaniye wich has the largest groundnut cultivation areas.

Pod number per plant, 100 seed weight, shelling percentage of genotypes tested in Dogankent and in farmer's field in Osmaniye were given Table 4.

Table 4. Shelling Percentage, 100 Seed Weight and Pod Number in Groundnut Genotypes in Dogankent and Osmaniye in 2004

Genotypes	Pods Number/Plant		100 Seed Weight (g)		Shelling Percentage (%)	
	DK	OMY	DK	OMY	DK	OMY
1- GK-3	190.7 a	217.3 a	78.6 c	74.6 c	66.0 bc	54.6a
2- H-5	147.7 b	145.3 b	74.6 c	80.0 bc	58.0 d	52.6 a
3- VAC-92R	125.7 b	144.3 b	104.0 a	88.0 ab	68.67 a	55.3 a
4- ÇOM	213.3 a	189.7 ab	77.3 c	73.3 c	64.0 c	48.6 b
5- NC-7	135.0 b	160.7 b	85.3 b	93.3 a	68.0 ab	54.6 a
CV (*:%5, **:%1)	12.56**	14.26*	3.40**	5.43**	1.87*	3.70*

DK: Dogankent, OMY: Osmaniye

The shelling percentage values significantly varied in both Dogankent and Osmaniye locations (Table 4). In Dogankent, the highest shelling percentage was obtained from VAC-92R with 68.67% , and the lowest was obtained from H-5 with 58.0%. In osmaniye location, shelling percentage varied between 48.6 and 55.3%, and the lowest and the highest values were obtained from Çom and VAC-92R, respectively. The shelling percentages in Dogankent location are close to findings obtained by Aşık et al., (2018) and Onceler, (2005); however, lower shelling percentage was obtained in Osmaniye location. When 100 seed weight was in consideration, there were significant 100 seed weight differences among groundnut genotypes in both locations. In Dogankent location the highest 100 seed weight was obtained from VAC_92R with 104.0 g and the lowest was obtained from H-5 with 74.6 g. Similarly, 100 seed weight significantly varied among groundnut genotypes. In Osmaniye location the highest 100 seed weight was obtained from NC-7 with 93.3 g and the lowest was obtained from Com with 73.3 g. The 100 seed weight values are similar to the finding of Asik et al.,(2018); Arioglu et al., (2016); Gulluoglu et al., (2018); Canavar, (2011). Pod number per plant significantly varied among groundnut genotypes in both locations. In Dogankent, Çom had the highest pod number with 213.3 and VAC-92R had the lowest pod number per plant with 125.7. In Osmaniye location pod number per plant varied between 217.3 and 144.3 among groundnut genotypes. The highest and the lowest pod number plant was obtained from GK-3 and VAC-92R, respectively. Our finding for pod number per plant were higher than the finding of Kurt et al., (2008); Kurt et al., (2009); Asik et al.,

(2018); Onat et al., (2017); Gulluoglu et al., (2017b); Onceler, (2005); Canavar, (2011).

Pod weight per plant, pod yield and seed oil content of the selected groundnut genotypes were given n Table 5.

Table 5. Pod Weight, Pod Yield and Oil Content of Selected Groundnut Genotypes in Dogankent and Osmaniye in 2004.

Genotypes	Pod Weight Per Plant (g/plant)		Pod Yield (kg ha^{-1})		Oil Content (%) (Dogankent)
	DK	OMY	DK	OMY	DK
1- GK-3	152.3 ab	160.3	5815 ab	3435 ab	48.4
2- H-5	124.7 bc	123.3	4826 c	3175 b	52.0
3- VAC-92R	130.3 bc	126.7	6343 a	3332 ab	48.2
4- ÇOM	180.7 a	140.0	5252 bc	3530 a	48.8
5- NC-7	114.0 c	144.0	5085 bc	3760 a	49.0
CV (*:%5, **:%1)	12.55**	11.68	9.49**	8.50**	

DK: Dogankent, OMY: Osmaniye

In Dogankent locations, pod weight per plant varied significantly among the tested groundnut genotypes. The highest and the lowest pod weight obtained from Çom and NC-7 with 114.0 and 180.7 g, respectively (Table 5). Osmaniye location, pod weight per plant varied between 123.3 and 160.3 g, however, pod weight per plant did not significantly vary among the groundnut genotypes. The reason for the high pod weight per plant is attributed to pod size in each genotype. Our results for pod weight were higher than the values reported by Kurt et al. (2008); Onat et al. (2017), Gulluoglu et al. (2017b), Gulluoglu et al. (2018). When pod yield was in consideration, the lowest was obtained from H-5 in both Dogankent and Osmaniye locations. The pod content was obtained from H-5 and the lowest was obtained from VAC-92R. Our results for oil content are similar to the findings obtained by (Kurt et al., 2008; Kurt et al., 2009; Arioglu et al., 2016; Campos-Mondragon et al., 2009; Onceler, 2005).

Conclusion

In this experiment, 80 groundnut varieties and lines were tested for yield and yield characteristics at three locations (Dogankent, Tasci and Osmaniye) under the Eastern Mediterranean condition. In the first year, high yielding groundnut genotypes were chosen to further evaluation for their yield and quality performance. The result showed that pod yield varied between 2940 and 6340 kg ha^{-1}, shelling percentage varied between 48% and 73.7%; 100 seed weight varied between 48 and 110 g, pod number varied between 30 and 217 number/plant, pod weight varied between 40 and 180 g/plant and finally the seed oil content varied 48.2% and 52.0%. (Table 2. 3, 4, 5). The groundnut varieties GK-3 and VAC-92R had higher pod yield and larger seed size, therefore, these two varieties cold be cultivated in the Mediterranean region for confectionery purposes. The groundnut genotypes PI 361753, PI 288153, AT-108, AT 120 and March could be used in the groundnut breeding programs to develop new superior varieties for confectionery purposes. Groundnut genotypes over 4000 kg ha^{-1} pod yield and over 50% oil content could be used to develop new groundnut varieties for oil industry.

yields varied between 6343 and 4826 kg/ha, and the lowest and the highest pod yields were obtained from VAC-92R and H-5, respectively in Dogankent. Compared with Dogankent, pod yields were lover in Osmaniye. The highest pod yield was obtained from NC-7 with 3760 kg ha^{-1}, and the lowest was ontained from H-5 with 3175 kg ha^{-1}. The pod yield results of the current study are similar to the results obtained by different researchers in the same region (Gulluoglu et al., 2017; Asik et al., 2018; Arioglu et al., 2016; Kurt et al., 2009; Onat et al., 2017; Arioglu et al., 2018; Gulluoglu et al., 2018; Onceler, 2005; Kadiroglu, 2012; Yılmaz, 1999). Seed oil content of groundnut genotypes varied between 48.2 and 52.0%, and the highest oil

Compliance with Ethical Standards

Author contribution

Author read and approved the final manuscript. Author verify that the Text, Figures, and Tables are original and that they have not been published before.

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Data availability

Not applicable.

Consent for publication

Not applicable

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