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Physico-chemical Characteristics of Pomegranate (*Punica granatum* L.) Selections from Southeastern Turkey

A. KAZANKAYA*, M. GÜNDOGDU, A. DOGAN†, M. FIKRET BALTA and F. ÇELIK†
Department of Horticulture, Faculty of Agriculture
Yuzuncu Yil University, 65080 Van, Turkey
Fax/Tel: (90)(432)2251331; E-mail: akazankaya@hotmail.com

This paper deals with desirable physico-chemical characteristics of pomegranate (*Punica granatum* L.) genetic resources of Siirt province (southeastern Anatolia, Turkey) during 2002 and 2004. Twenty five genotypes were selected as promising in the existing population of pomegranate and they were described with respect to fruit attributes in order to conserve valuable native germplasm of pomegranate and to identify them for future breeding efforts. Genotypes averagely had a range of 234-332 g for fruit weight, 76-83 mm for fruit diameter, 68-81 mm for fruit length, 217-333 cm^3 for fruit volume, 0.86-1.31 fruit density (g/cm^3), 0.87-1.00 for fruit shape index, 19.1-21.9 mm for calyx high, 12.9-16.0 mm for calyx diameter, 86-120 mL for fruit juice volume, 37.4-45.7 g for total seed weight, 52.3-62.5 % for seed percentage, 20-66 % for pink coloured skin percentage, 2.5-3.7 mm for skin thickness, 17-22 % for soluble solids, 3.2-3.8 for pH, 0.7-1.0 % for acidity and 18-76 mg/100 g for vitamin C. Fruits of genotypes contained a range of 168-672 ppm in N, 72-301 ppm in P, 856-4423 ppm in K, 10-93 ppm in Na, 38-74 ppm in Ca, 39-98 ppm in Mg, 1.5-9.2 ppm in Fe, 1.8-9.6 ppm in Zn, 0.1-4.4 ppm in Mn and 0.5-4.2 ppm in Cu. In addition, they had easy separated seeds. Their seed hardness was hard, soft, semi-hard and seed colours were pink, light-pink and red.

Key Words: Pomegranate, *Punica granatum* L., Siirt, Germplasm, Fruit characteristics.

INTRODUCTION

As a fruit species well-adapted to the whole Mediterranean basin, pomegranate (*Punica granatum* L.) is cultivated in arid and semi-arid areas of this basin since ancient times. Turkey considered among its origin centers[1,2] annually produces about 60,000 tons pomegranate[3]. In Turkey, pomegranates are commercially grown in the Aegean, Mediterranean and Southeastern Anatolia region. These three regions are rich in genetic resources of pomegranate. The main varieties such as Hicaznar, Çekirdeksiz-VI, Silifke Asisi, Katirbasi, Mayhos-IV, Lefan and Eksi Göknar are cultivated in the Mediterranean region.

†Professional High School of Ozalp, Yuzuncu Yil University, Van, Turkey.

In Turkey, commercial pomegrane orchards are extended. Particularly 'Hicaznar' that was found by selection studies as a change seedling is one the most common variety. Due to attractive fruit appearance, superior fruit quality, high yield, suitable to transporting and keeping, this variety is highly desired by Turkey and Europe markets[4].

Lately, pomegranate growing expands in southern Anatolia region. Pomegranates are grown in traditional orchards in the region and the cultivation is distributed among various parts of the region including Gaziantep, Kahraman Maras, Urfa, Diyarbakir, Mardin, Siirt, Batman, Sirnak and Adiyaman provinces. In the region, the summers are hot and the winters are cold. Pomegranate fruits are usually presented to sell in the local markets and they are consumed fresh. Siirt province located in the region has genetic resources of pomegranate. So far, pomegranate genetic resources of Siirt have not been studied. The description of local pomegranate germplasm and selection of promising genotypes are of importance for breeding efforts in order to conserve its genetic resources[5].

Large fruit, thin and red coloured skin and soft, abundant juicy, aromatic, large and red coloured seeds and no-fruit cracking are among desirable fruit characteristics for pomegranate breeding objectives[1]. In addition, high and regular bearing; early, medium and late seasonal ripening; sweet, sour and soursweet tasted juice and lower tendency to suckering include the other desired plant characteristics[4]. In Turkey, there exists the limited information on pomegranate genetic resources based on regions and districts. The goal of this study was to select promising genetic resources of pomegranate in Siirt district and to describe them for future breeding efforts.

EXPERIMENTAL

The study was conducted in Siirt province situated on southeastern Anatolia of Turkey during 2002 and 2004. In the first year, a large number of pomegranate bushes were marked based on recommendations of growers prior to harvest season. At the harvest period of the first year, fruit samples were collected from traditional pomegranate orchards in the first week of October in Pervari district of Siirt province. At the harvest season of the the first year, many of genotypes were discarded by taking into consideration the breeding objectives. Twenty five genotypes among them were considered as promising for breeding efforts based on fruit analyses. In the second and third year, fruit samples were collected from the same genotypes. Thirty fruit samples were randomly taken from pomegranate bushes for fruit analyses for three years.

Thirty matured pomegranate fruits were selected for fruit analyses. In the fruits, desirable physico-chemical characteristics such as fruit weight

(g), fruit length (mm), fruit diameter (mm), fruit volume (cm^3), fruit density (g/cm^3), fruit shape index, calyx high (mm), volume of fruit juice (mL), total seed weight (g), seed percentage (%), fruit skin colour as pink (%), fruit skin thickness (mm), seed hardness, seed colour, easiness of seed separation, soluble solids (%), pH, acidity (%), vitamin C content (mg/100 g) and contents of macro-micro nutrients (N, P, K, Na, Ca, Mg, Fe, Zn, Mn and Cu) were spectrophotometrically determined. The content of soluble solids was measured with an automatic compensating hand refractometer[1] and total acidity was determined by titration[5] with 0.1 N NaOH[9]. The content of vitamin C was determined as described earlier[6]. Macro-micro elements were recorded using an atomic absorption spectrometer (JENWAY 6405UV/Vis).

Statistical analysis: The design of a completely randomized was used in the experiment. Statistical package program Minitab release 10.2 for Windows were utilized for the analysis of variance (Anova). The LSD values were computed for multiple comparisons of the means. Significant differences were found at $p < 0.05$.

RESULTS AND DISCUSSION

In the pomegranate selections, values of fruit weight, fruit length, fruit diameter, fruit volume, fruit density, fruit shape index, calyx high, calyx diameter, volume of fruit juice, total seed weight, seed percentage, skin thickness, soluble solids, pH and acidity did not differ statistically ($p < 0.05$).

The mean fruit weight of selections ranged 241 g (SP-13) to 332 g (SP-1), was over 300 g in three genotypes. In some genotypes, fruit weight highly fluctuated from year to year. The majority of genotypes had higher fruit weight in the third year than that of the first and second year. Therefore, values of fruit length, fruit diameter and fruit volume in most selections were higher than those the first and second year. On the basis of fruit weights of the third year, fruit weight was over 300 g in 12 genotypes and over 400 g in two genotypes (SP-1 and SP-15). Although fruit length averagely varied from 68 mm (SP-12) to 81 mm (SP-7), it in the third year reached 99 mm in SP-7 and 91 mm in SP-1. The mean of fruit diameter was between 71 mm (SP-18) and 86 mm (SP-1). But, its value increased in the third year as well and it reached 97 mm in SP-1 and 92 mm in SP-5, SP-15 and SP-22. The mean fruit volume changed between 333 cm^3 (SP-19) and 221 cm^3 (SP-18). In the third year, it was 450 cm^3 in SP-1 and 440 cm^3 in SP-15. The mean fruit density was the lowest in SP-25 with 0.86 cm^3 and the highest in SP-16 with 1.31 cm^3 (Table-1).

The selected genotypes averagely had a range of 0.87 (SP-12 and SP-19) to 1.00 (SP-1 and SP-18) for fruit shape index, 19.1 (SP-1, SP-14 and

SP-25) mm to 21.9 mm (SP-2, SP-3 and SP-9) for calyx high and 12.9 mm (SP-8) to 15.8 mm (SP-22) for calyx diameter. The volume of fruit juice fluctuated by years and it averagely ranged from 83 mL (SP-13) to 120 mL (SP-1). Following SP-1, the genotypes SP-8 (116 mL), SP-14 (110 mL) and SP-8 (110 mL) had averagely the highest volume of fruit juice. The genotypes SP-3 (Fig. 1), SP-10 (Fig. 1), SP-16 and SP-22 in the second and SP-1 (Fig. 1) and SP-15 had the highest volume of fruit juice. In addition, although total seed weight was averagely determined between 37.4 (SP-15) and 46.7 (SP-21), it had higher values in the third (Table-2).

On the other hand, the mean seed percentages of selections changed from 52.2 to 66.9 %. Identified as pink per cent, fruit skin color percentages were averagely recorded between 20 and 66 % (SP-24). The mean skin thickness were between 2.2 mm and 3.8 mm. Selections that averagely contained the highest soluble solids were SP-22 (22 %), SP-7 and SP-10 (21 %), SP-4, SP-6, SP-8, SP-19, SP-20 and SP-24 (20 %).

Seed hardness was soft in two selections (SP-11 and SP-16). In SP-5 (Fig. 1), SP-6 (Fig. 1), SP-7, SP-8 and SP-9 (Fig. 1) had semi-hard seeds and the remaining ones hard seeds. Fruits of most genotypes had red or light-pink colored seeds. The seed separation was easy in all genotypes. The mean pH values were from 3.2 to 3.8. The acidity was determined between 0.7 and 1.0 %. Genotypes contained ascorbic acid between 18 and 78 mg/100 g. With respect to contents of macro-micro nutrients, selections contained a range of 168-672 ppm for N, 72-301 ppm for P, 856-4423 ppm for K, 10-93 ppm for Na, 38-74 ppm for Ca, 39-98 ppm for Mg, 1.5-9.2 ppm for Fe, 1.8-9.6 ppm for Zn, 0.1-4.4 ppm for Mn and 0.5-4.2 ppm for Cu (Table-4).

In Turkey, researches on regional or local pomegranate germplasm are limited. Dokuzoguz and Mendilcioglu[7] defined pomological characteristics of 12 pomegranate genotypes grown in Aegean region. Onur[1] described important fruit attributes of 72 promising pomegranate genotypes selected from the Meditarranean region. He determined that promising genotypes have 192.0-806.6 g fruit weight, 12.1-70.2 mm fruit width, 58.0-105.1 mm fruit length, 1.03-1.37 fruit shape index, 1.27-2.58 cm calyx length, 1.50-4.43 mm skin thickness, 48.4-76.6 % seed percentage, 27-100 % fruit taste score, 11.7-18.9 % soluble solids content and 0.07-4.98 % titratable acidity and fruit juices of genotypes contained 225-542 ppm N, 50-200 ppm P, 22-102 ppm Na, 1004-2116 ppm K, 0.8-26.8 ppm Ca, 80-452 ppm Mg, 0.8-3.8 ppm Fe and 0.3-2.2 ppm Zn. In addition, the same author reported that most genotypes have easy-separated seeds and 10 genotypes have soft seeds. Yilmaz *et al.*[8] reported 411.8-568.3 fruit weight, 13.9-15.8 % soluble

TABLE-1
VALUES OF FRUIT WEIGHT, FRUIT HEIGHT, FRUIT WIDTH, FRUIT VOLUME AND FRUIT DENSITY IN POMEGRANATE GENOTYPES SELECTED FROM OF SIIRT (SOUTHEASTERN ANATOLIA, TURKEY)

Genotype number	Fruit weight (g)				Fruit leghth (mm)				Fruit diameter (mm)				Fruit volume (cm^3)				Fruit density (g/cm^3)			
	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean
SP-1	258	273	464	332	72	73	86	77	80	80	97	86	245	288	450	328	1.05	0.94	0.98	0.99
SP-2	247	237	284	256	69	70	71	70	77	79	79	78	230	252	280	254	1.07	0.93	1.01	1.00
SP-3	252	245	310	269	72	71	72	72	80	78	81	80	300	244	340	295	0.84	1.00	0.91	0.92
SP-4	255	235	333	274	68	67	80	72	74	80	85	80	290	240	220	250	0.85	0.97	0.92	0.91
SP-5	228	235	385	283	67	71	78	72	77	75	92	81	225	236	390	284	1.01	0.99	0.98	0.99
SP-6	198	326	277	267	66	77	79	74	74	84	89	82	200	337	180	239	0.89	0.96	0.99	0.95
SP-7	216	267	362	282	68	75	99	81	74	80	84	79	230	276	330	279	0.94	0.96	0.95	0.95
SP-8	211	258	341	270	68	73	79	74	76	78	85	80	225	264	220	236	0.94	0.97	0.93	0.95
SP-9	221	235	298	251	69	75	74	73	77	77	83	79	230	238	200	223	0.96	0.98	0.97	0.97
SP-10	220	287	287	265	67	74	73	71	77	80	82	80	260	294	280	278	0.84	0.97	0.99	0.93
SP-11	216	239	272	242	65	72	76	71	75	75	78	76	220	246	260	242	0.98	0.97	0.97	0.97
SP-12	219	255	279	251	67	68	69	68	74	77	83	78	240	257	280	259	0.91	0.98	0.94	0.94
SP-13	205	248	271	241	66	71	75	71	75	81	78	78	250	263	274	262	0.82	0.94	0.99	0.92
SP-14	205	280	397	294	67	75	82	75	74	83	90	82	245	306	410	320	0.83	0.91	0.96	0.90
SP-15	209	254	447	303	66	72	91	77	73	79	92	81	210	271	440	307	0.99	0.93	1.01	0.98
SP-16	205	324	285	271	61	76	73	70	72	85	84	80	100	350	200	217	2.05	0.92	0.96	1.31
SP-17	227	251	275	251	71	71	80	74	76	80	81	79	230	257	180	222	0.99	0.97	1.10	1.02
SP-18	213	229	295	246	67	69	75	70	71	61	81	71	235	230	200	221	0.91	0.99	0.95	0.95
SP-19	232	315	336	294	72	78	79	77	75	84	86	82	295	324	380	333	0.78	0.97	0.88	0.88
SP-20	234	275	354	288	70	67	81	73	76	76	86	79	220	262	380	287	1.10	0.85	0.93	0.96
SP-21	310	243	225	259	74	73	70	73	84	80	78	81	290	270	220	260	1.07	0.90	1.02	1.00
SP-22	204	328	390	307	65	77	82	75	72	84	92	83	240	340	380	320	0.85	0.96	1.00	0.94
SP-23	230	296	286	271	69	75	71	72	75	84	84	81	200	308	180	229	1.15	0.96	0.98	1.03
SP-24	197	227	344	256	65	73	79	72	73	77	86	79	200	254	260	238	0.89	0.89	0.98	0.92
SP-25	199	275	229	234	65	72	72	70	72	81	79	77	290	288	200	259	0.68	0.92	0.99	0.86
Significance				NS				NS				NS				NS				NS
LSD (0.05)				–				–				–				–				–

NS: Non-significant

TABLE-2
VALUES OF FRUIT SHAPE INDEX, CALYX HEIGHT, CALYX DIAMETER, VOLUME OF FRUIT JUICE AND TOTAL SEED WEIGHT IN POMEGRANATE GENOTYPES SELECTED FROM OF SIIRT (SOUTHEASTERN ANATOLIA, TURKEY)

Genotype number	Fruit shape index				Calyx high (mm)				Calyx diameter (mm)				Volume of fruit juice (mL)				Total seed weight (g)			
	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean
SP-1	0.89	0.98	0.89	0.92	18.9	23.0	15.5	19.1	13.4	12.2	17.8	14.5	125	76	159	120	36.9	39.7	36.3	37.6
SP-2	0.89	0.87	0.90	0.89	21.6	24.8	19.2	21.9	15.3	11.7	17.9	14.9	90	100	95	95	32.2	39.5	62.0	44.6
SP-3	0.89	0.91	0.88	0.89	22.5	22.7	20.5	21.9	13.6	11.7	19.2	14.8	126	140	64	110	41.0	36.5	58.5	45.3
SP-4	0.91	0.84	0.94	0.90	23.5	24.6	16.7	21.6	12.5	12.8	15.9	13.7	124	90	88	101	31.7	28.6	58.9	39.7
SP-5	0.87	0.95	0.84	0.89	22.1	21.9	19.1	21.0	12.5	12.4	18.5	14.5	105	85	92	94	39.1	33.8	58.4	43.8
SP-6	0.89	0.92	0.88	0.90	22.8	24.0	17.1	21.3	10.4	14.4	16.3	13.7	85	115	53	84	37.7	34.8	62.7	45.1
SP-7	0.91	0.94	1.17	1.00	21.3	24.0	19.4	21.6	12.9	13.7	17.1	14.6	92	135	122	116	41.4	32.9	55.8	43.7
SP-8	0.89	0.93	0.92	0.91	25.0	23.5	15.5	21.3	11.3	13.5	14.1	12.9	100	110	99	103	35.0	33.0	54.6	40.9
SP-9	0.89	0.97	0.88	0.91	21.4	23.5	20.9	21.9	13.6	12.9	20.2	15.6	110	120	81	103	41.6	30.6	53.8	42.0
SP-10	0.87	0.92	0.88	0.89	22.7	23.5	14.7	20.3	13.8	14.8	14.2	14.3	90	170	74	111	34.5	33.2	60.1	42.6
SP-11	0.86	0.96	0.96	0.93	19.4	24.7	19.1	21.1	11.9	13.0	16.9	13.9	82	95	81	86	35.5	32.2	65.0	44.2
SP-12	0.91	0.88	0.83	0.87	19.4	22.7	21.1	21.1	13.4	13.1	18.8	15.1	100	130	52	94	38.4	45.9	49.9	44.7
SP-13	0.87	0.87	0.96	0.90	20.9	22.2	17.2	20.1	13.1	12.5	15.0	13.5	83	90	75	83	29.4	34.5	50.9	38.3
SP-14	0.89	0.89	0.92	0.90	13.3	24.2	19.7	19.1	12.0	12.0	18.2	14.0	105	130	101	112	35.7	28.1	64.8	42.9
SP-15	0.91	0.91	0.98	0.93	23.3	20.1	19.5	21.0	13.0	12.2	18.7	14.6	97	110	130	112	39.6	31.0	41.5	37.4
SP-16	0.85	0.89	0.86	0.87	15.6	23.9	18.2	19.2	12.1	15.3	20.7	16.0	52	145	70	89	33.2	34.9	64.1	44.1
SP-17	0.92	0.88	0.99	0.93	23.6	21.7	15.4	20.2	12.6	12.7	17.6	14.3	81	96	88	88	47.0	26.5	54.8	42.8
SP-18	0.95	1.13	0.92	1.00	21.7	22.6	20.2	21.5	12.0	12.7	18.5	14.4	100	98	96	98	46.3	28.3	62.1	45.6
SP-19	0.95	0.93	0.92	0.93	21.5	23.4	20.0	21.6	11.0	15.1	19.6	15.2	115	120	70	102	38.3	32.0	49.9	40.1
SP-20	0.92	0.88	0.94	0.91	21.0	23.4	17.4	20.6	13.3	12.8	17.5	14.5	105	100	103	103	52.5	30.2	51.4	44.7
SP-21	0.88	0.91	0.89	0.89	20.8	23.7	17.6	20.7	14.3	11.2	13.8	13.1	115	110	67	97	45.1	30.0	65.1	46.7
SP-22	0.90	0.91	0.88	0.90	20.2	21.7	18.9	20.3	13.8	15.1	18.5	15.8	80	151	101	110	52.6	40.1	44.4	45.7
SP-23	0.92	0.89	0.84	0.88	22.2	22.1	20.8	21.7	13.6	13.3	19.2	15.4	64	112	82	86	51.0	34.1	48.6	44.6
SP-24	0.88	0.95	0.91	0.91	22.6	22.4	18.1	20.9	12.9	11.5	17.9	14.1	62	125	82	90	35.0	34.9	50.2	40.0
SP-25	0.90	0.88	0.91	0.90	19.9	21.8	15.7	19.1	11.9	11.9	15.4	13.1	113	124	72	103	39.6	30.9	61.3	43.9
Significance				NS				NS				NS				NS				NS
LSD (0.05)				–				–				–				–				–

NS: Non-significant

TABLE-3
VALUES OF SEED PERCENTAGE, SKIN COLOUR, SKIN THICKNESS AND DRY MATTER IN POMEGRANATE GENOTYPES SELECTED FROM OF SIIRT (SOUTHEASTERN ANATOLIA, TURKEY)

Genotype number	Seed percentage (%)				Skin colour (pink %)				Skin thickness (mm)				Soluble solids (%)			
	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean	2002	2003	2004	Mean
SP-1	51.6	51.2	54.3	52.4	20	20	40	26	2.8	3.1	3.3	3.0	16	20	16	17
SP-2	56.5	46.2	55.2	52.6	20	20	40	26	4.0	3.3	3.8	3.7	19	20	16	18
SP-3	52.4	52.5	51.9	52.3	40	40	20	33	3.0	2.8	2.7	2.8	21	22	15	19
SP-4	52.5	50.8	53.7	52.3	40	40	20	33	2.5	3.0	4.5	3.3	24	20	16	20
SP-5	60.9	60.7	62.6	61.4	20	20	40	26	2.7	3.1	4.4	3.4	20	23	15	19
SP-6	62.9	51.7	59.4	58.0	60	60	20	46	2.3	3.5	3.1	2.9	20	26	16	20
SP-7	59.2	56.9	60.2	58.8	60	60	20	46	2.2	3.5	3.3	3.0	23	23	17	21
SP-8	58.4	50.2	60.1	56.2	20	20	20	20	2.8	3.7	3.5	3.3	22	22	17	20
SP-9	59.2	46.1	62.4	55.9	20	20	20	20	2.5	3.2	4.3	3.3	20	23	15	19
SP-10	64.3	50.8	65.5	60.2	60	60	20	46	3.1	3.4	2.9	3.1	26	22	16	21
SP-11	64.5	47.4	64.7	58.9	20	20	20	20	2.5	3.3	2.9	2.9	22	20	16	19
SP-12	66.4	48.4	58.1	57.6	20	20	40	26	2.6	3.4	3.5	3.1	22	21	16	19
SP-13	54.7	68.7	64.2	62.5	40	40	40	40	2.5	3.2	3.4	3.0	21	19	15	18
SP-14	66.1	45.0	60.4	57.1	20	20	40	26	1.9	4.4	3.5	3.2	19	19	14	17
SP-15	56.1	69.2	58.4	61.2	20	20	40	26	2.5	2.9	3.5	2.9	21	20	15	18
SP-16	65.8	54.1	62.4	60.8	20	20	20	20	1.5	3.8	2.7	2.6	23	14	16	17
SP-17	56.0	51.6	68.6	58.7	20	20	40	26	3.2	3.7	3.6	3.5	20	22	15	19
SP-18	55.3	55.1	59.8	56.7	40	40	20	33	2.2	2.3	3.2	2.5	24	26	15	18
SP-19	62.0	50.2	56.4	56.2	20	20	40	26	3.0	2.5	3.6	3.0	22	25	14	20
SP-20	61.8	67.9	53.2	60.9	20	20	40	26	2.5	2.8	2.7	2.6	23	23	15	20
SP-21	62.7	72.8	65.1	66.9	40	40	20	33	2.5	2.4	3.3	2.7	16	21	15	17
SP-22	56.8	52.8	59.2	56.3	60	60	20	46	4.4	2.3	4.7	3.8	29	21	16	22
SP-23	49.4	51.0	57.6	52.7	40	40	40	40	4.5	2.8	3.6	3.6	20	21	15	18
SP-24	53.7	41.8	61.3	52.3	80	80	40	66	3.5	2.2	3.2	2.9	24	20	16	20
SP-25	50.9	55.9	54.4	53.7	20	20	20	20	2.5	2.6	3.4	2.8	18	20	15	17
Significance				NS				NS				NS				NS
LSD (0.05)				–				–				–				–

NS: Non-significant

TABLE-4
SOME SEED TRAITS, VALUES OF pH, ACIDITY AND VITAMIN C CONTENT AND MINERAL CONTENTS IN FRUIT JUICE OF POMEGRANATE GENOTYPES SELECTED FROM OF SIIRT SIIRT (SOUTHEASTERN ANATOLIA, TURKEY)

Genotype number	Seed hardness	Seed colour	ESS	pH				Acidity (%)				Vitamin C Content (mg/100g)	Macro-micro nutrients (ppm)									
				2002	2003	2004	Mean	2002	2003	2004	Mean		N	P	K	Na	Ca	Mg	Fe	Zn	Mn	Cu
SP-1	H	R	E	3.5	4.0	3.6	3.7	0.7	0.6	0.9	0.7	57	434	246	4355	24	57	79	1.5	3.2	0.9	3.8
SP-2	H	R	E	3.5	4.2	3.5	3.7	0.8	1.1	1.3	1.0	38	294	220	3096	35	43	75	6.5	8.3	2.0	4.2
SP-3	H	R	E	3.6	4.0	3.6	3.7	0.7	1.2	0.9	0.9	57	406	258	2470	93	50	89	3.6	3.5	1.4	1.8
SP-4	H	R	E	3.4	4.0	3.5	3.6	0.8	1.1	1.2	1.0	66	434	165	2906	74	59	71	5.9	4.0	2.3	2.2
SP-5	SH	R	E	3.5	3.8	3.5	3.6	0.6	1.1	0.9	0.8	43	504	169	2547	10	44	73	6.5	7.2	2.9	1.3
SP-6	SH	R	E	3.4	4.0	3.4	3.6	0.7	0.8	1.2	0.9	35	574	148	2207	23	53	65	8.8	3.6	4.4	2.0
SP-7	SH	LP	E	3.4	4.0	3.1	3.5	0.8	0.9	1.1	0.9	78	504	258	2640	22	47	62	6.2	3.7	0.4	1.9
SP-8	SH	P	E	3.4	4.0	3.4	3.6	0.8	0.9	0.8	0.8	59	672	224	1428	44	38	58	4.9	4.1	1.2	1.9
SP-9	SH	P	E	3.5	3.7	2.6	3.2	0.6	1.1	1.1	0.9	57	168	186	2316	14	75	72	6.2	3.3	2.2	1.7
SP-10	H	LP	E	3.4	4.2	3.5	3.7	0.7	0.9	1.3	0.9	62	518	292	2226	18	48	80	6.4	1.8	2.4	2.1
SP-11	S	LP	E	3.3	4.2	3.5	3.6	1.0	1.0	1.2	1.0	54	588	216	2011	21	48	70	9.2	7.2	1.6	0.8
SP-12	H	P	E	3.3	4.2	3.6	3.7	0.7	0.8	1.1	0.8	45	518	241	1876	25	48	71	6.5	9.1	2.0	2.1
SP-13	H	P	E	3.5	3.9	3.6	3.6	0.7	1.1	1.1	0.9	76	476	182	1159	22	45	64	9.2	2.7	1.3	1.8
SP-14	H	R	E	3.4	4.2	3.7	3.7	0.8	1.1	0.9	0.9	51	364	195	856	26	54	56	8.5	3.5	1.9	2.0
SP-15	H	R	E	3.5	3.6	3.2	3.4	0.7	0.9	1.1	0.9	77	378	203	1337	30	49	60	3.9	3.1	0.4	1.7
SP-16	S	LP	E	3.9	4.0	3.5	3.8	0.8	1.1	1.1	1.0	71	350	173	1650	37	36	50	9.0	3.4	2.1	1.9
SP-17	H	LP	E	3.6	4.2	3.4	3.7	0.8	0.9	1.0	0.9	45	462	72	1317	14	66	92	8.0	3.3	0.7	0.9
SP-18	H	LP	E	3.6	4.0	3.4	3.6	0.8	0.8	1.4	1.0	37	476	237	2098	25	67	98	8.4	7.2	2.8	1.8
SP-19	H	LP	E	3.5	4.0	3.5	3.6	0.9	0.6	1.2	0.9	39	560	203	4423	21	64	94	3.9	9.6	1.2	1.9
SP-20	H	LP	E	3.4	3.9	3.7	3.6	1.1	0.7	1.2	1.0	26	406	165	2110	23	68	92	1.2	7.2	2.4	1.9
SP-21	H	LP	E	3.6	4.4	3.4	3.8	0.9	0.8	1.2	0.9	42	462	292	2302	80	56	39	3.4	3.3	0.3	1.8
SP-22	H	LP	E	3.8	3.8	3.2	3.6	0.8	0.7	1.3	0.9	18	420	297	2912	13	74	96	7.9	2.3	0.8	2.1
SP-23	H	P	E	3.9	4.0	3.6	3.8	0.4	0.9	0.8	0.7	68	392	165	1525	22	46	75	7.2	8.0	0.1	0.9
SP-24	H	R	E	3.6	3.9	3.5	3.6	1.0	0.8	1.1	0.9	51	406	140	2391	26	72	97	7.8	2.0	0.9	1.5
SP-25	H	R	E	3.7	3.9	3.7	3.7	0.8	0.8	0.8	0.8	43	421	301	2104	23	66	79	8.8	2.5	0.1	0.5
Significance							NS				NS											
LSD							–				–											

NS: Non-significant, ESS: Easiness of seed separation, H: Hard, SH: Semi-hard, S: Soft, E: Easy, R: Red, P: Pink, LP: Light pink.

TABLE-5
SOME SEED TRAITS, VALUES OF pH, ACIDITY AND VITAMIN C CONTENT AND MINERAL CONTENTS IN FRUIT JUICE OF POMEGRANATE GENOTYPES SELECTED FROM OF SIIRT SIIRT (SOUTHEASTERN ANATOLIA, TURKEY)

Genotype number	Seed hardness	Seed colour	ESS	pH				Acidity (%)				Vitamin C Content (mg/100g)	Macro-micro nutrients (ppm)								
				2002	2003	2004	Mean	2002	2003	2004	Mean		N	P	K	Na	Ca	Mg	Fe	Zn	Mn	Cu
SP-1	H	R	E	3.5	4.0	3.6	3.7	0.7	0.6	0.9	0.7	57	434	246	4355	24	57	79	1.5	3.2	0.9	3.8
SP-2	H	R	E	3.5	4.2	3.5	3.7	0.8	1.1	1.3	1.0	38	294	220	3096	35	43	75	6.5	8.3	2.0	4.2
SP-3	H	R	E	3.6	4.0	3.6	3.7	0.7	1.2	0.9	0.9	57	406	258	2470	93	50	89	3.6	3.5	1.4	1.8
SP-4	H	R	E	3.4	4.0	3.5	3.6	0.8	1.1	1.2	1.0	66	434	165	2906	74	59	71	5.9	4.0	2.3	2.2
SP-5	SH	R	E	3.5	3.8	3.5	3.6	0.6	1.1	0.9	0.8	43	504	169	2547	10	44	73	6.5	7.2	2.9	1.3
SP-6	SH	R	E	3.4	4.0	3.4	3.6	0.7	0.8	1.2	0.9	35	574	148	2207	23	53	65	8.8	3.6	4.4	2.0
SP-7	SH	LP	E	3.4	4.0	3.1	3.5	0.8	0.9	1.1	0.9	78	504	258	2640	22	47	62	6.2	3.7	0.4	1.9
SP-8	SH	P	E	3.4	4.0	3.4	3.6	0.8	0.9	0.8	0.8	59	672	224	1428	44	38	58	4.9	4.1	1.2	1.9
SP-9	SH	P	E	3.5	3.7	2.6	3.2	0.6	1.1	1.1	0.9	57	168	186	2316	14	75	72	6.2	3.3	2.2	1.7
SP-10	H	LP	E	3.4	4.2	3.5	3.7	0.7	0.9	1.3	0.9	62	518	292	2226	18	48	80	6.4	1.8	2.4	2.1
SP-11	S	LP	E	3.3	4.2	3.5	3.6	1.0	1.0	1.2	1.0	54	588	216	2011	21	48	70	9.2	7.2	1.6	0.8
SP-12	H	P	E	3.3	4.2	3.6	3.7	0.7	0.8	1.1	0.8	45	518	241	1876	25	48	71	6.5	9.1	2.0	2.1
SP-13	H	P	E	3.5	3.9	3.6	3.6	0.7	1.1	1.1	0.9	76	476	182	1159	22	45	64	9.2	2.7	1.3	1.8
SP-14	H	R	E	3.4	4.2	3.7	3.7	0.8	1.1	0.9	0.9	51	364	195	856	26	54	56	8.5	3.5	1.9	2.0
SP-15	H	R	E	3.5	3.6	3.2	3.4	0.7	0.9	1.1	0.9	77	378	203	1337	30	49	60	3.9	3.1	0.4	1.7
SP-16	S	LP	E	3.9	4.0	3.5	3.8	0.8	1.1	1.1	1.0	71	350	173	1650	37	36	50	9.0	3.4	2.1	1.9
SP-17	H	LP	E	3.6	4.2	3.4	3.7	0.8	0.9	1.0	0.9	45	462	72	1317	14	66	92	8.0	3.3	0.7	0.9
SP-18	H	LP	E	3.6	4.0	3.4	3.6	0.8	0.8	1.4	1.0	37	476	237	2098	25	67	98	8.4	7.2	2.8	1.8
SP-19	H	LP	E	3.5	4.0	3.5	3.6	0.9	0.6	1.2	0.9	39	560	203	4423	21	64	94	3.9	9.6	1.2	1.9
SP-20	H	LP	E	3.4	3.9	3.7	3.6	1.1	0.7	1.2	1.0	26	406	165	2110	23	68	92	1.2	7.2	2.4	1.9
SP-21	H	LP	E	3.6	4.4	3.4	3.8	0.9	0.8	1.2	0.9	42	462	292	2302	80	56	39	3.4	3.3	0.3	1.8
SP-22	H	LP	E	3.8	3.8	3.2	3.6	0.8	0.7	1.3	0.9	18	420	297	2912	13	74	96	7.9	2.3	0.8	2.1
SP-23	H	P	E	3.9	4.0	3.6	3.8	0.4	0.9	0.8	0.7	68	392	165	1525	22	46	75	7.2	8.0	0.1	0.9
SP-24	H	R	E	3.6	3.9	3.5	3.6	1.0	0.8	1.1	0.9	51	406	140	2391	26	72	97	7.8	2.0	0.9	1.5
SP-25	H	R	E	3.7	3.9	3.7	3.7	0.8	0.8	0.8	0.8	43	421	301	2104	23	66	79	8.8	2.5	0.1	0.5
Significance							NS				NS											
LSD							–				–											

NS: Non-significant, ESS: Easiness of seed separation, H: Hard, SH: Semi-hard, S: Soft, E: Easy, R: Red, P: Pink, LP: Light pink.

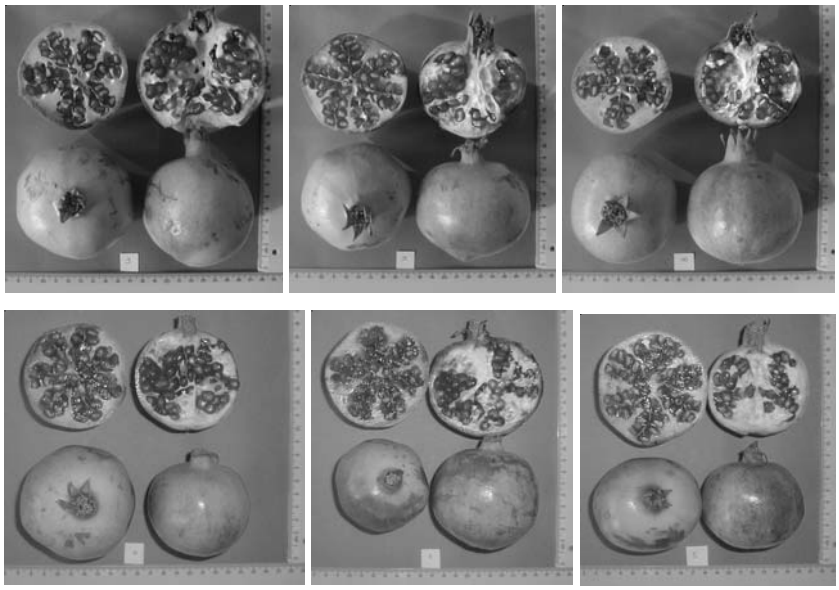

Fig. 1. Fruits of some pomegranate selections (SP-3, 9, 10, 6, 1 and 5) from Siirt (Turkey)

solids content, 0.13-1.51 % acidity, 92.5-104.7 mm fruit width, 79.5-91.0 mm fruit length, 10-100 % fruit taste score over 100, 32.3-57.3 g seed weight in 10 promising pomegranate genotypes selected from Mediterranean region. Ercan *et al.*[9] described fruit traits of 13 pomegrane genotypes from Izmir region and recorded 208-553 g fruit weight, 34.0-63.6 g seed weight and 43.2-62.5 % seed percentage. In addition, they selected very soft or soft seeded genotypes. Tibet and Onur[10] determined 223.0-470.7 g fruit weight, 2.7-5.2 mm skin thickness, 28.3-58.2 g seed weight, 41-64 % seed percentage, 12.8-15.9 % soluble solids content and 0.19-3.67 % acidity in 18 promising pomegranate genotypes from Aegean and Southeastern Anatolia. Yilmaz *et al.*[11] recorded 253.6-308.3 g fruit weight, 4.17-5.43 mm skin thickness, 33.7-52.3 g seed weight, 55.1-60.9 seed percentage and 0.20-0.45 % acidity in 8 promising pomegranate genotypes. Polat *et al.*[12] reported 250.8-461.7 g fruit weight, 2.4-5.0 mm skin thickness, 29.0-50.4 g seed weight, 54.0-73.9 % seed percentage, 14.3-15.8 % soluble solids content and 0.23-4.48 % acidity in pomegranate genotypes from Hatay province and they determined that selected genotypes have semi-hard and hard seeds. Derin and Eti[13] identified fruit traits of Hicaz variety from Antalya and the genotype 33 N 26 from Icel. In Hicaz and 33 N 26 varieties, they determined 280.1-401.9 g fruit weight, 31.9-38.6 % juice percentage, 14.2-16.0 % soluble solids content and 2.5-0.5 % acidity, respectively. Poyrazoglu *et al.*[14] recorded that the thirteen genotypes from Adana, Antalya, Hatay and Içel provinces have a range of 0.56-6.86 % for

acidity (in malic acid), 16-19 % for soluble solids content and 3.29-3.93 for pH values. Yildiz *et al.*[15] reported 263.4 g fruit weight, 69.0 % seed percentage, 31.3 g seed weight, 46.9 % juice percentage, 0.40 % acidity and 12.8 % soluble solids content in 9 sweet pomegranate genotypes selected from Hizan district (Bitlis).

On the other hand, Mars and Marrakchi[5] defined pomegranate germplasm in Tunisia. Reporting of fruit characteristics of 30 genotypes, they determined 196.1-673.6 g fruit weight, 46.5-96.1 mm fruit length, 57.6-111.4 mm fruit diameter, 2.4-6.1 mm skin thickness, 12.4-21.7 mm calyx length, 18.5-33.1 mm calyx diameter, 72.3-100.3 cm^3 juice volume, 2.93-4.6 pH, 13.3-16.9 % soluble solids content, 0.25-3.17 % acidity. Al-Maiman and Ahmad[16] reported 65.5 mm fruit length, 36.7 mm fruit diameter, 156.7 cm^3 fruit volume, 1.38 g/cm^3 fruit density, 216.5 g fruit weight, 129.2 g seed weight, 59.7 % seed percentage and 16.9 % soluble solids content in Taifi variety. In addition, they recorded that fruit juice of this variety contained 333 K, 24.5 Ca, 72.1 Na, 6.25 P, 5.13 Mg, 0.30 Zn, 2.21 Fe and 0.07 Cu as mg/100 g.

Some pomegranate genotypes selected in this study usually had similar fruit characteristics to many promising ones reported by various researches[5,8,10-12,15,16]. But, the majority of genotypes contained higher soluble solids than those reported by the same references. In addition, seed hardiness was soft in only two selections and semi-hard in five selections. Onur[1] (1983) and Yilmaz *et al.*[8] selected 20 pomegranate genotypes with soft seeded fruits from Mediterranean region. The acidity in pomegranates is lower than 1 % in sweet varieties, 1-2 % in sour-sweet varieties and higher than 2 % in sour varieties and consumers usually prefer sweet or sour-sweet varieties[4]. Therefore, all selections from this study were both sweet fruits in acidity and had fruits with lower acidic (0.7-1.0) and higher soluble solids content (17-22 %).

Findings of this study indicated that Siirt district is rich in wild pomegranate genetic resources and has promising genotypes which should be assessed in more details. Physico-chemical characteristics evaluated in this study slightly or highly fluctuated by years in each selection. Fluctuations in fruit attributes might be due to insufficient technical and cultural practices in traditional pomegranate orchards. Fruit weight and other fruit traits might be expected to increase or improve in better cultural practices. Therefore, the replicated trials will reveal the true values of these promising pomegranate selections determined in this study. Some selections with desirable fruit traits, attractive appearances, low acidity contents and high soluble solids might be promising. Particularly, promising genotypes should be assessed with replicated trials in regular bearing and desirable fruit characteristics for breeding efforts.

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