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Research Article

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Investigation of Quality Traits of Some Chickpea (*Cicer arietinum* L.) Varieties Winter Grown in Different Locations

Abstract
This research was carried out in the experimental fields of the Regional Agricultural Research Institutes in the ecological conditions of the Eastern Mediterranean Region (Adana province) and Southeastern Anatolia Region (Şanlıurfa province). The research was executed according to the randomized blocks experimental design in the growing seasons of 2014 and 2015. The aim of the study is to determine the quality characteristics of 23 chickpea genotypes (20 genotypes and 3 control varieties (Hasanbey, Seckin, Inci)) grown in different locations. As a result of the research, in Adana location, it was determined that dry weight 53.74-33.21 g, wet weight 112.27-64.20 g, water intake capacity 0.59-0.24 g/seed, water intake index 1.12-0.91%, dry volume 91-75 ml, wet volume 200.00-154.50 ml, swelling capacity 0.51-0.02 ml/seed, swelling index values 2.45-2.19% varied between. However, in Sanlıurfa location, it was detected that dry weight 51.01-29.70 g, wet weight 110.10-59.08 g, water absorption capacity 0.60-0.24 g/seed, water absorption index 1.44-0.97%, dry volume 90.00-71.50 ml, wet volume 199.00-150.50 ml, swelling capacity 0.59-0.29 ml/seed and swelling index 2.97-2.11% varied between.

INTRODUCTION

Chickpea (*Cicer arietinum* L) is a plant that can be grown in poor soils as it is highly tolerant in terms of temperature and drought resistance among legume crops (Mart, 2000). Chickpea plays a big role in increasing the yield obtained from the unit area and reducing our fallow areas by entering crop rotation practices in our arid regions. Additionally, In addition, as chickpea is a legume plant, it naturally fixes nitrogen in the air to the soil, thanks to its capacity to form nodosite (Gan et al., 2005). As our country is one of the homelands of leguminous plants such as chickpeas and lentils (Eylem, 2017), it can generally be grown without need to bacteria inoculation. As a matter of fact, legume nodosites are extremely important for plant nutrition and maintaining soil fertility. This is also very significant in terms of contributing to the reduction of nitrogen fertilizer use. However, it is reported that organic fertilizers provide significant increases in nodulation, plant growth and development and yield by helping to regulate metabolic and enzymatic processes such as photosynthesis and respiration (Ipekesen and Bicer, 2021). However, it has been reported by other researchers that the treatments of nitrogen fertilizers as a starter dose will contribute positively to seed quality besides bacterial treatments in soils that are poor in organic matter (Soysal and Erman, 2020). Legumes have an important place in the nutrition of people in the world and in our country. Plant-based protein and carbohydrates in chickpea plant have a very important place for public health in closing the nutritional deficit (Ulukan, 2012) and and its richness in terms of vitamins and minerals have made it an important nutritional food in people's diet (Kaur et al., 2005; Ipekesen et al., 2022). The digestibility of protein (89%) and its high availability (92-97%) make it attractive for people to consume. Thus, it can complement the vitamin requirement of an individual when consumed with other food (Ipekesen et al., 2022). Chickpea, which is the most cultivated edible legume plant, has wide cultivation areas in the Mediterranean Region and Southeastern Anatolia Region and is home to the majority of production in our country. With this study, it was aimed to investigate the quality values of chickpea grains grown in different locations.

MATERIAL and METHODS

In this research, it was carried out as field experiment in the research experiment fields in the Eastern Mediterranean Agricultural Research Institute (Adana location) and GAP Agricultural Research Institute (Şanlıurfa location) during the 2014 and 2015 growing seasons. This study, formed of 20 genotypes and 3 control varieties (Hasanbey, Seçkin, İnci) developed by the GAP Agricultural Research Institute and prominent in chickpea breeding studies, was conducted in two different locations (Adana and Sanlıurfa). The experiments were carried out in a randomized block design with 23 chickpea genotypes. In this study, sowing was performed as 4 rows of 5 m in length and 9 m^2 plots with 45 cm row spacing and 8 cm spacing between rows. Before sowing, the fertilization treatment was applied with 20-30 kg of N and 50-60 kg of P_2O_5 ha^{-1}. While the sowing of the experiments were occured in both locations and in both years in winter, the harvests in July. After harvesting, quality evaluations were made from the seeds obtained. The climate characteristics and meteorological values of the research area are given for Adana an Sanlıurfa locations in Table 1 and Table 2, respectively. It was determined that the uneven distribution of precipitation for the November-July period in the first year for Adana region. As this case make stressed the plants, parcel losses were experienced in sensitive varieties (Table 1). Additionally, the drought stress was experienced in the experiments especially after sowing. In the second year, it was observed that both the intensity of *Ascochyta blight* disease and the precipitation (115.81 mm) increased.

Table 1. Climate values at 2013-2014, 2014-2015 and long years grown season for Adana province.

	Mean Temp (C^0)			Precipitation (mm)			Relative Humidity (%)		
Months	**Long Years Av.**	**2013-2014**	**2014-2015**	**Long Years Av.**	**2013-2014**	**2014-2015**	**Long Years Av.**	**2013-2014**	**2014-2015**
November	15.3	17.7	14.76	67.2	1.0	36.06	63	57.5	54.8
December	11.1	10.4	13.0	118.1	12.2	50.05	66	42.7	71.6
January	9.7	11.48	8.9	111.7	28.19	56.39	66	69.58	66.3
February	10.4	10.84	10.9	92.8	18.54	90.68	66	56.90	70.1
March	13.3	15.06	13.9	67.9	56.09	115.81	66	65.55	64.6
April	17.5	17.68	15.8	51.4	18.56	7.88	69	66.94	62.5
May	21.7	21.26	21.7	46.7	22.36	81.02	67	70.39	64.3
June	25.6	24.03	24.2	22.4	50.04	0	66	68.19	69.1
July.	27.7	28.23	28.0	5.4	0.25	0	68	72.58	69.3

Source: Turkish State Meteorological Service

In Sanlıurfa region in the first year, the total rainfall remained below the long-term average. On the other hand, temperature data remained close to the average for long years. Although the precipitation was higher than the average for long years, it was below the long-term average in April and May of the second year (Table 2).

Table 2. Climate values at 2013-2014, 2014-2015 and long years grown season for Sanlıurfa province.

	Mean Temp (C^0)				Precipitation (mm)				Relative Humidity (%)		
Months	**Long Year. Av.**	**2013-2014 min temp.**	**2014-2015 max temp.**	**2014-2015 min temp.**	**Long Year. Av.**	**2013-2014**	**2014-2015**	**2014-2015**	**Long Year. Av.**	**2013-2014**	**2014-2015**
November	13.1	-	-	-3.1	17.2	24.4	-	-	60.8	-	-
December	7.8	2.5	9.5	-0.6	18.2	49.9	55.4	-	68.3	-	-
January	6.3	2.4	18.0	2.5	24.8	83.9	44.3	82.5	70.6	65.6	68.8
February	7.5	-1.1	22.1	4.7	29.9	68.4	20.8	100.8	67.0	44.0	74.3
March	11.6	2.2	24.7	11.8	36.9	52.5	91.6	79.0	60.8		58.9
April	16.4	3.6	30.8	16.7	38.4	45.5	33.3	24.3	57.2	47.5	49.7
May	23.1	12.4	38.7	42.8	21.4	21.6	6.0	10.3	45.4	-	38.0
June	29.0	15.3	40.1	-	-	4.0	20.6	0.7	34.8	-	35.3

Source: Turkish State Meteorological Service

RESULTS and DISCUSSION

The main location yield experiment quality results and sieve values

The average values of the quality results of the yield experiment carried out with 23 chickpea genotypes in Adana location are given in Table 3, Table 4, Table 5 and Table 6, respectively. It can be seen Table 1 and Table 2, in Adana location, it was determined that the highest and lowest dry weight values 58.93-36.23 g, wet weight 119.80-69.63 g, water intake capacity 0.61-0.33 g $seed^{-1}$, water absorption index 1.15-0.88%, dry volume 95-78 ml, wet volume 205-66 ml, swelling capacity 0.60-0.32 ml $seed^{-1}$ and the swelling index 2.47-2.14% varied between. As can be seen in Table 3 and Table 4, among the genotypes included in the yield test in Adana location, in the second year, Sanlıurfa-Ç-18 came to the forefront by giving the highest values in terms of the dry weight, wet weight, water intake capacity, wet volume, swelling capacity and sieve analysis in 9 mm the sieve. In Adana location, it was reported that quality results such as the highest and lowest dry weight were 47.57-30.18 g, wet weight 104.73-66.77 g, water intake capacity 0.56-0.33 g $seed^{-1}$, water absorption index 1.16-0.89%, dry volume 87-72 ml, wet volume 195-149 ml, swelling capacity 0.58-0.30 ml/seed, swelling index values 2.57-2.00% varied between. Among the genotypes included in the yield test in Adana location, compared to other genotypes, Sanlıurfa-Ç-18 came to the forefront by giving the highest values in terms of wet weight, water intake capacity, water intake index, dry volume, wet volume, swelling capacity, swelling index.

The two-year averages, the highest and lowest dry weight values in terms of quality values Adana locations were 53.74-33.21 g, wet weight values were 112.27-64.20 g, water intake capacity were 0, 59-0.24 g grain^{-1}, water absorption index were 1.12-0.91%, dry volume values were 91-75 ml, wet volume values were 200.00-154.50 ml, swelling capacity were 0.51-0.02 ml seed^{-1}, swelling index were found to varied between 2.45-2.19%. Ozcan and Yücel (2022) reported that the hundred-seed weight values of chickpea genotypes varied between 27.7 g and 42.3 g in the experiment they conducted under Sirnak ecological conditions. The findings we obtained about 100 seed weight are higher than the findings of the researchers. The reason for this is thought to be due to the genotype difference used. It was determined that the sieve analysis values varied between 1.26-72.00 in the 9 mm sieve, 26.81-75.43 in the 8 mm sieve, 0.42-55.51in the 7 mm sieve. The highest and lowest sieve analysis values varied between 0.47-0.17, 18.92-0.55, 76.00-9.40 and 91.41-5.08, and in the 6, 7, 8 and 9 mm sieves, respectively. It was the highest and lowest sieve values 70.11-3.17 in the 9 mm sieve, 70.42-29.33 in the 8 mm sieve and 15.31-0.93 in 7 mm sieve for both growing seasons in the yield experiment in Adana location (Table 5). The rotein analysis values were the highest with 20.63% from the Sanlıurfa- Ç-5 genotype, and the lowest with 16.86% from the Sanlıurfa Ç-17 genotype. The highest protein value was obtained from the Sanlıurfa-Ç-1 genotype with 24,7425%, and the lowest value from the Sanlıurfa-Ç-17 genotype with 19,5875% , and protein values varied between them in other genotypes. For the both growing seasons, the highest protein value was obtained from Sanlıurfa-10 genotype with 22.99% and the lowest value from Sanlıurfa-17 genotype with 18.22%. Among the genotypes in Adana Location, Sanlıurfa-18 genotype came to the forefront by giving the highest values for wet weight, water intake capacity, dry volume, wet volume, swelling index compared to other genotypes and control varieties (Table 6). The other researchers, such as Amir et al. (2006) and Poniedziaek et al. (2006), reported that chickpeas grown in Algerian conditions showed higher protein content and total sugar content in years when precipitation was high. Additionally, they found that other parameters were higher in years with less precipitation. It was reported by the another researchers, the protein content of chickpea genotypes ranged from 18.71%-23.4% (Gaur et al., 2016; Wang et al., 2017; Ipekesen et al., 2022). The findings we obtained regarding the protein ratio in our study differ from the findings of the researchers. This difference is thought to be due to the difference in the genotype used and the effect of environmental factors. Togay et al. (2001), found that the water intake capacity of chickpea cultivars ranged from 0.979-1.223 g/seed and the difference between varieties was significant (Togay et al. 2001).

The yield experiment quality results and sieve values of şanlıurfa location

The average values related to the quality results of the yield experiment conducted with 23 chickpea genotypes in Sanlıurfa location are given in Table 7, Table 8, Table 9 and Table 10, respectively. As can be seen from Table 7 and Table 8 in the first year, genotypes in Şanlıurfa location exhibited the highest and lowest dry weight values ranged from 52.26-30.31 g, wet weight values 113.84-60.82 g, water intake capacity 0,73-0.00 g/seed, water absorption index 1.81-0.86%, dry volume values 90-73 ml, wet volume values 202-154 ml, swelling capacity 0.62 /-0.5 ml/seed, swelling index values 3.50-2.00%.

Table 3. Yield experiment quality results in Adana location (2014-2015)

	Dry Weight (100 seed) (g)			Wet Weight (g)			Water intake (g/seed)			Water Intake Index (%)		
Genotypes	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**
Sanlıurfa-Ç-1	52.62	47.49	50.06	104.84	93.54	99.19	0.52	0.46	0.49	0.99	0.97	0.98
Sanlıurfa- Ç-2	42.79	41.57	42.18	85.78	83.1	84.44	0.43	0.42	0.43	1.00	1.00	1.00
Sanlıurfa-Ç-3	50.99	41.21	46.10	101.77	85.94	93.86	0.51	0.45	0.48	1.00	1.09	1.05
Sanlıurfa-Ç-4	48.28	-	-	100.69	-	-	0.52	-	-	1.09	-	-
Sanlıurfa-Ç-5	56.28	41.17	48.73	109.94	86.79	98.37	0.54	0.46	0.50	0.95	1.11	1.03
Sanlıurfa-Ç-6	47.73	42.32	45.03	97.65	86.61	92.13	0.50	0.44	0.47	1.05	1.05	1.05
Sanlıurfa-Ç-7	36.23	30.18	33.21	69.63	58.76	64.20	0.33	0.29	0.31	0.92	0.95	0.94
Sanlıurfa-Ç-8	44.03	41.19	42.61	91.17	86.8	88.99	0.47	0.46	0.47	1.07	1.11	1.09
Sanlıurfa-Ç-9	45.76	40.41	43.09	91.37	83.85	87.61	0.46	0.43	0.45	1.00	1.07	1.04
Sanlıurfa-Ç-10	43.96	-	-	90.89	-	-	0.47	-	-	1.07	-	-
Sanlıurfa-Ç-11	47.35	46.26	46.81	91.25	89.8	90.53	0.44	0.44	0.44	0.93	0.94	0.94
Sanlıurfa-Ç-12	47.64	47.57	47.61	97.93	99.15	98.54	0.50	0.52	0.51	1.06	1.08	1.07
Sanlıurfa-Ç-13	47.62	46.67	47.15	92.07	88.2	90.14	0.44	0.42	0.43	0.93	0.89	0.91
Sanlıurfa-Ç-14	46.62	39.2	42.91	91.28	78.38	84.83	0.45	0.39	0.42	0.96	1.00	0.98
Sanlıurfa-Ç-15	47.67	46.70	47.19	92.40	90.22	91.31	0.45	0.44	0.45	0.94	0.93	0.94
Sanlıurfa-Ç-16	42.98	39.17	41.08	83.29	77.87	80.58	0.40	0.39	0.40	0.94	0.99	0.97
Sanlıurfa-Ç-17	48.31	41.02	44.67	90.85	80.85	85.85	0.43	0.40	0.42	0.88	0.97	0.93
Sanlıurfa-Ç-18	58.93	48.55	53.74	119.80	104.73	112.27	0.61	0.56	0.59	1.03	1.16	1.10
Sanlıurfa-Ç-19	53.49	47.74	50.62	107.89	98.88	103.39	0.54	0.51	0.53	1.02	1.07	1.05
Sanlıurfa-Ç-20	38.81	37.86	38.34	83.57	79.26	81.42	0.45	0.41	0.43	1.15	1.09	1.12
İnci	48.81	33.75	41.28	96.18	66.77	81.48	0.47	0.33	0.40	0.97	0.98	0.98
Hasan Bey	44.62	43.73	44.18	91.53	88.68	90.11	0.47	0.45	0.46	1.05	1.03	1.04
Seçkin	39.29	45.1	42.20	75.18	88.96	82.07	0.36	0.44	0.40	0.91	0.97	0.94

Table 4. Yield experiment quality results in Adana location (2014-2015)

	Dry Volume (ml)			Wet Volume (ml)			Swelling Capacity (ml/seed)			Swelling Index (%)		
Genotypes	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**
Sanlıurfa-Ç-1	90	87	88.50	194	183	188.50	0.54	0.46	0.50	2.35	2.24	2.30
Sanlıurfa- Ç-2	83	81	82.00	176	173	174.50	0.43	0.42	0.43	2.30	2.35	2.33
Sanlıurfa-Ç-3	89	81	85.00	190	176	183.00	0.51	0.45	0.48	2.31	2.45	2.38
Sanlıurfa-Ç-4	87	-	-	190	-	-	0.53	0.50	0.02	2.43	2.00	2.22
Sanlıurfa-Ç-5	95	81	88.00	200	177	188.50	0.55	0.46	0.51	2.22	2.48	2.35
Sanlıurfa-Ç-6	86	82	84.00	188	176	182.00	0.52	0.44	0.48	2.44	2.38	2.41
Sanlıurfa-Ç-7	78	72	75.00	160	149	154.50	0.32	0.27	0.30	2.14	2.23	2.19
Sanlıurfa-Ç-8	84	82	83.00	180	177	178.50	0.46	0.45	0.46	2.35	2.41	2.38
Sanlıurfa-Ç-9	84	80	82.00	180	174	177.00	0.46	0.44	0.45	2.35	2.47	2.41
Sanlıurfa-Ç-10	83	-	-	180	-	-	0.47	-0.50	-0.02	2.42	2.00	2.21
Sanlıurfa-Ç-11	85	84	84.50	180	180	180.00	0.45	0.46	0.46	2.29	2.35	2.32
Sanlıurfa-Ç-12	86	86	86.00	186	188	187.00	0.5	0.52	0.51	2.39	2.44	2.42
Sanlıurfa-Ç-13	86	86	86.00	180	178	179.00	0.44	0.42	0.43	2.22	2.17	2.20
Sanlıurfa-Ç-14	85	80	82.50	180	168	174.00	0.45	0.38	0.42	2.29	2.27	2.28
Sanlıurfa-Ç-15	86	86	86.00	182	180	181.00	0.46	0.44	0.45	2.28	2.22	2.25
Sanlıurfa-Ç-16	82	80	81.00	174	168	171.00	0.42	0.38	0.40	2.31	2.27	2.29
Sanlıurfa-Ç-17	86	81	83.50	180	171	175.50	0.44	0.40	0.42	2.22	2.29	2.26
Sanlıurfa-Ç-18	95	87	91.00	205	195	200.00	0.6	0.58	0.59	2.33	2.57	2.45
Sanlıurfa-Ç-19	90	87	88.50	195	189	192.00	0.55	0.52	0.54	2.38	2.41	2.40
Sanlıurfa-Ç-20	80	79	79.50	174	169	171.50	0.44	0.40	0.42	2.47	2.38	2.43
İnci	87	76	81.50	184	156	170.00	0.47	0.30	0.39	2.27	2.15	2.21
Hasan Bey	84	84	84.00	182	178	180.00	0.48	0.44	0.46	2.41	2.29	2.35
Seçkin	80	84	82.00	166	178	172.00	0.36	0.44	0.40	2.20	2.29	2.25

The highest and lowest sieve values varied between 76.94-1.36 in the 9 sieve, 80.95-22.14 in the 8 sieve, 33.51-2.43 in the 7 sieve, and 3.78-0.17 in the 6 sieve. Among the genotypes included in the Şanlıurfa location yield test, the Sanlıurfa-Ç-18 genotype came to the forefront by giving the highest values compared to other genotypes and control varieties for the dry weight, wet weight, dry volume, wet volume and swelling capacity.

Table 5. Adana location yield experiment sieve values (2014-2015)

Genotypes	2014 Sieve Values (%)				2015 Sieve Values (%)			
	9 mm	8 mm	7 mm	6 mm	9 mm	8 mm	7 mm	6 mm
Sanlıurfa-Ç-1	63.08	35.09	2.02	-	51.18	40.99	7.53	0.38
Sanlıurfa- Ç-2	32.22	62.44	5.45	-	21.98	66.81	11.25	-
Sanlıurfa-Ç-3	50.35	48.05	1.68	-	4.98	72.83	22.27	-
Sanlıurfa-Ç-4	34.49	56.29	9.27	-	-	-	-	-
Sanlıurfa-Ç-5	79.98	17.33	2.33	0.47	34.51	59.35	6.52	-
Sanlıurfa-Ç-6	44.96	51.61	3.61	-	29.28	64.99	5.76	-
Sanlıurfa-Ç-7	5.08	76.00	18.92	-	1.26	42.47	55.51	1.35
Sanlıurfa-Ç-8	34.78	59.71	5.63	-	22.13	69.99	7.81	0.2
Sanlıurfa-Ç-9	40.66	53.06	6.50	-	30.82	61.5	7.81	-
Sanlıurfa-Ç-10	24.17	68.54	7.36	-	-	-	-	-
Sanlıurfa-Ç-11	60.10	39.6	1.04	-	72.46	26.81	0.81	-
Sanlıurfa-Ç-12	59.63	40.57	0.61	-	53.99	43.92	2.11	-
Sanlıurfa-Ç-13	55.06	43.75	1.69	-	63.85	35.81	0.42	-
Sanlıurfa-Ç-14	43.79	52.14	4.24	-	24.75	70.21	5.1	-
Sanlıurfa-Ç-15	50.96	48.84	0.62	-	41.39	56.4	2.24	-
Sanlıurfa-Ç-16	26.48	68.15	5.41	-	14.20	72.69	13.11	-
Sanlıurfa-Ç-17	59.5	39.93	0.59	-	19.23	75.43	5.57	-
Sanlıurfa-Ç-18	91.41	9.4	-	-	48.81	49.26	2.04	-
Sanlıurfa-Ç-19	66.04	34.7	-	-	58.35	40.36	1.29	-
Sanlıurfa-Ç-20	29.3	69.08	2.11	-	30.21	60.93	8.93	-
İnci	31.97	60.94	6.89	0.39	4	72.97	23.72	-
Hasan Bey	39.24	56.50	4.45	0	16.63	73.83	9.61	-
Seçkin	15.15	73.57	11.14	0.17	41.18	57.33	1.51	-

The highest and lowest dry weight values were 49.75-29.09 g, wet weight 106.63-57.33 g, water intake capacity 0.57-0.28 g/seed, water absorption index 1.14-0.97%, dry volume 90-70 ml, wet volume 196-147 ml, swelling capacity 0.56-0.27 ml/seed and swelling index 2.58-2.12%. Among the genotypes included in the yield experiment conducted in Şanlıurfa location, the Sanlıurfa-Ç-18 genotype came to the forefront by giving the highest values compared to other genotypes and control varietyies for dry weight, wet weight, water intake capacity, water intake index, dry volume, wet volume and swelling capacity. The average highest and lowest dry weight values in terms of Şanlıurfa average quality values were 51.01-29.70 g, wet weight values were 110.10-59.08 g, water intake capacity were 0.60-0.24 g/seed, water absorption index were 1.44-0.97%, dry volume values were 90.00-71.50 ml, wet volume values were 199.00-150.50 ml, swelling capacity were 0.59-0.29 ml/seed, swelling index were 2.97-2.11% (Table 7 and Table 8). It was determined that the sieve analysis values varied between 71.98-2.21 in the 9 sieve, 76.10-25.49 in the 8 sieve, 39.97-3.03 in the 7 sieve. On the other hand, the highest protein analysis values were from İnci variety (control group) with 25.83% and the lowest value from Sanlıurfa-Ç-2 genotype with 21.38%. When the average sieve analysis values of the chickpea genotypes carried out in Şanlıurfa location are examined for both growing seasons, the values of 74.46-5.71 in the 9 sieve, 68.41-23.82 in the 8 sieve, and 28.19-3.15 in the 7 sieve (Table 9). The highest protein value was Sanlıurfa-Ç-7 genotype with 25.84%, and the lowest value from the Sanlıurfa- Ç-10 genotype with 21.70%. The average highest protein value was obtained from Sanlıurfa-Ç-15 genotype with 24,87%, and the lowest value from Sanlıurfa-Ç-2 variety with 22.15%, for the both growing seasons. Among the varieties included in the yield experiment conducted in Şanlıurfa location, Sanlıurfa-Ç-18 variety came to the forefront by giving the highest values in terms of dry weight, wet weight, water absorption capacity, dry volume, wet volume and swelling capacity compared to other genotypes and control

varieties (Table 10). In the some studies carried out, it has been emphasized that the chickpea plant is rich in vitamins and minerals and has versatile uses (Karakullukcu et al. 2008). Additionally, Long et al. (2012) stated that the criteria affecting the firing quality are hundred grain weight, grain volume, water absorption capacity and seed coat content. The differences among chickpea genotypes may be attributed to differences in their genetic background.

Table 6. Adana location yield experiment sieve values (2014-2015)

Genotypes	2014-2015 Mean Sieve Values (%)			Nitrogen (%)			Protein (%)		
	9 mm	8 mm	7 mm	2014	2015	Mean	2014	2015	Mean
Sanlıurfa-Ç-1	57.13	38.04	4.78	3.95	3.25	3.60	24.74	20.29	22.52
Sanlıurfa- Ç-2	27.10	64.63	8.35	3.59	3.13	3.36	22.47	19.57	21.02
Sanlıurfa-Ç-3	27.67	60.44	11.98	3.90	3.24	3.57	24.39	20.28	22.34
Sanlıurfa-Ç-4	-	-	-	3.77	3.09	3.43	23.58	19.31	21.45
Sanlıurfa-Ç-5	57.25	38.34	4.43	3.79	3.30	3.55	23.70	20.63	22.17
Sanlıurfa-Ç-6	37.12	58.30	4.69	3.83	3.27	3.55	23.93	20.46	22.20
Sanlıurfa-Ç-7	3.17	59.24	37.22	3.78	3.09	3.44	23.66	19.29	21.48
Sanlıurfa-Ç-8	28.46	64.85	6.72	3.87	3.00	3.44	24.24	18.75	21.50
Sanlıurfa-Ç-9	35.74	57.28	7.16	3.76	2.96	3.36	23.54	18.50	21.02
Sanlıurfa-Ç-10	-	--		3.67	0.00	1.84	22.99	-	22.99
Sanlıurfa-Ç-11	66.28	33.21	0.93	3.32	3.01	3.17	20.77	18.84	19.81
Sanlıurfa-Ç-12	56.81	42.25	1.36	3.10	2.83	2.97	19.43	17.71	18.57
Sanlıurfa-Ç-13	59.46	39.78	1.06	3.42	3.09	3.26	21.40	19.32	20.36
Sanlıurfa-Ç-14	34.27	61.18	4.67	3.45	2.96	3.21	21.60	18.52	20.06
Sanlıurfa-Ç-15	46.18	52.62	1.43	3.47	3.16	3.32	21.71	19.77	20.74
Sanlıurfa-Ç-16	20.34	70.42	9.26	3.29	3.00	3.15	20.62	18.72	19.67
Sanlıurfa-Ç-17	39.37	57.68	3.08	3.13	2.70	2.92	19.58	16.86	18.22
Sanlıurfa-Ç-18	70.11	29.33	-	3.35	2.89	3.12	20.9	18.05	19.50
Sanlıurfa-Ç-19	62.20	37.53	-	3.21	2.89	3.05	20.06	18.07	19.07
Sanlıurfa-Ç-20	29.76	65.01	5.52	3.49	3.12	3.31	21.86	19.47	20.67
İnci	17.99	66.96	15.31	3.40	2.93	3.17	21.25	18.32	19.79
Hasan Bey	27.94	65.17	7.03	3.59	3.12	3.36	22.48	19.47	20.98
Seçkin	28.17	65.45	6.33	3.87	3.09	3.48	24.22	19.31	21.77

Table 7. Sanliurfa location yield experiment quality results (2014-2015)

	Genotypes			Dry Weight (100 seed) (g)			Wet Weight (g)			Water intake (g/seed)		
Genotypes	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean	2014	2015	Mean
Sanlıurfa-Ç-1	48	42.13	45.07	96.45	86.07	91.26	0.48	0.44	0.46	1.01	1.04	1.03
Sanlıurfa- Ç-2	37.34	35.72	36.53	77.73	73.11	75.42	0.40	0.37	0.39	1.08	1.05	1.07
Sanlıurfa-Ç-3	43.63	42.64	43.14	90.45	89.32	89.89	0.47	0.47	0.47	1.07	1.09	1.08
Sanlıurfa-Ç-4	45.25	39.26	42.26	93.42	82.7	88.06	0.48	0.43	0.46	1.06	1.11	1.09
Sanlıurfa-Ç-5	49.68	46.67	48.18	101.12	98.04	99.58	0.51	0.51	0.51	1.04	1.10	1.07
Sanlıurfa-Ç-6	-	43.18	-	-	90.94	-	0.00	0.48	0.24	-	1.11	-
Sanlıurfa-Ç-7	30.31	29.09	29.70	60.82	57.33	59.08	0.31	0.28	0.30	1.01	0.97	0.99
Sanlıurfa-Ç-8	38.15	39.77	38.96	80.67	84.15	82.41	0.43	0.44	0.44	1.11	1.12	1.12
Sanlıurfa-Ç-9	37.74	39.6	38.67	77.98	83.23	80.61	0.40	0.44	0.42	1.07	1.10	1.09
Sanlıurfa-Ç-10	39.44	40.57	40.01	79.71	83.46	81.59	0.40	0.43	0.42	1.02	1.06	1.04
Sanlıurfa-Ç-11	40.93	41.38	41.16	81.57	83.44	82.51	0.41	0.42	0.42	0.99	1.02	1.01
Sanlıurfa-Ç-12	51.7	47.03	49.37	104.38	97.07	100.73	0.53	0.50	0.52	1.02	1.06	1.04
Sanlıurfa-Ç-13	41.34	42.44	41.89	81.86	85.05	83.46	0.41	0.43	0.42	0.98	1.00	0.99
Sanlıurfa-Ç-14	43.7	38.65	41.18	86.76	80	83.38	0.43	0.41	0.42	0.99	1.07	1.03
Sanlıurfa-Ç-15	44.24	41.55	42.90	93.00	82.93	87.97	0.49	0.41	0.45	1.10	1.00	1.05
Sanlıurfa-Ç-16	40.14	36.25	38.20	80.49	74.32	77.41	0.40	0.38	0.39	1.01	1.05	1.03
Sanlıurfa-Ç-17	39.46	38.97	39.22	79.39	79.15	79.27	0.40	0.40	0.40	1.01	1.03	1.02
Sanlıurfa-Ç-18	52.26	49.75	51.01	113.84	106.36	110.10	0.62	0.57	0.60	1.18	1.14	1.16
Sanlıurfa-Ç-19	49.23	45.79	47.51	105.46	97.19	101.33	0.56	0.51	0.54	1.14	1.12	1.13
Sanlıurfa-Ç-20	42.72	40.84	41.78	84.16	84.61	84.39	0.37	0.44	0.41	0.86	1.07	0.97
İnci	40.54	39.05	39.80	80.10	81.01	80.56	0.73	0.42	0.58	1.81	1.07	1.44
Hasan Bey	38.88	33.69	36.29	75.76	71.99	73.88	0.67	0.38	0.53	1.71	1.14	1.43
Seçkin	33.59	31.6	32.60	65.57	64.44	65.01	0.51	0.33	0.42	1.51	1.04	1.28

Table 8. Sanliurfa location yield experiment quality results (2014-2015)

	Dry Volume (ml)			Wet Volume (ml)			Swelling Capacity (ml/seed)		
Genotypes	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**	**2014**	**2015**	**Mean**
Sanlıurfa-Ç-1	186	176	181.00	0.49	0.44	0.47	2.32	2.38	2.35
Sanlıurfa- Ç-2	170	163	166.50	0.41	0.37	0.39	2.41	2.42	2.42
Sanlıurfa-Ç-3	180	179	179.50	0.47	0.46	0.47	2.42	2.39	2.41
Sanlıurfa-Ç-4	184	173	178.50	0.49	0.44	0.47	2.40	2.52	2.46
Sanlıurfa-Ç-5	190	188	189.00	0.52	0.51	0.52	2.37	2.38	2.38
Sanlıurfa-Ç-6	-	180	-	-0.5	0.44	-0.03	2.00	2.22	2.11
Sanlıurfa-Ç-7	154	147	150.50	0.31	0.27	0.29	2.35	2.35	2.35
Sanlıurfa-Ç-8	172	174	173.00	0.43	0.44	0.44	2.48	2.47	2.48
Sanlıurfa-Ç-9	170	173	171.50	0.5	0.43	0.47	3.50	2.43	2.97
Sanlıurfa-Ç-10	170	173	171.50	0.4	0.42	0.41	2.33	2.35	2.34
Sanlıurfa-Ç-11	172	173	172.50	0.41	0.42	0.42	2.32	2.35	2.34
Sanlıurfa-Ç-12	198	187	192.50	0.58	0.50	0.54	2.45	2.35	2.40
Sanlıurfa-Ç-13	174	175	174.50	0.42	0.42	0.42	2.31	2.27	2.29
Sanlıurfa-Ç-14	178	170	174.00	0.44	0.41	0.43	2.29	2.41	2.35
Sanlıurfa-Ç-15	183	173	178.00	0.5	0.41	0.46	2.52	2.28	2.40
Sanlıurfa-Ç-16	172	164	168.00	0.41	0.38	0.40	2.32	2.46	2.39
Sanlıurfa-Ç-17	170	170	170.00	0.4	0.37	0.39	2.33	2.12	2.23
Sanlıurfa-Ç-18	202	196	199.00	0.62	0.56	0.59	2.55	2.40	2.48
Sanlıurfa-Ç-19	195	187	191.00	0.41	0.51	0.46	2.32	2.42	2.37
Sanlıurfa-Ç-20	174	175	174.50	0.4	0.44	0.42	2.33	2.42	2.38
İnci	170	171	170.50	0.62	0.42	0.52	2.55	2.45	2.50
Hasan Bey	168	162	165.00	0.57	0.38	0.48	2.50	2.58	2.54
Seckin	158	154	156.00	0.42	0.32	0.37	2.31	2.45	2.38

Table 9. Şanlıurfa location yield experiment experiment sieve values (2014-2015)

	2014 Sieve Values (%)				2015 Sieve Values (%)				2014-2015 Mean Sieve Values (%)		
Genotypes	**9 mm**	**8 mm**	**7 mm**	**6 mm**	**9 mm**	**8 mm**	**7 mm**	**6 mm**	**9mm**	**8 mm**	**7 mm**
Sanlıurfa-Ç-1	44.63	49.38	6.78	0.17	65.5	29.87	3.53	1.27	55.07	39.63	5.16
Sanlıurfa- Ç-2	1.44	66.99	28.16	3.78	28.63	60.14	10.6	0.99	15.04	63.57	19.38
Sanlıurfa-Ç-3	37.44	55.84	7.46	0.23	33.82	57.97	8.54		35.63	56.91	8.00
Sanlıurfa-Ç-4	41.13	54.03	5.35	0.39	25.44	55.88	16.14	2.71	33.29	54.96	10.75
Sanlıurfa-Ç-5	65.28	31.74	2.94	0.29	60.64	34.52	5.05		62.96	33.13	4.00
Sanlıurfa-Ç-6	-	-	-	0	34.62	55.5	9.25	1.42	-	-	-
Sanlıurfa-Ç-7	35.41	61.38	3.61	0	2.21	56.9	39.97	1.18	18.81	59.14	21.79
Sanlıurfa-Ç-8	16.70	65.29	16.72	1.86	30.76	57.39	11.1	0.77	23.73	61.34	13.91
Sanlıurfa-Ç-9	7.63	80.95	11.69	0.19	46.41	48.33	5.26	-	27.02	64.64	8.48
Sanlıurfa-Ç-10	19.82	68.87	11.23	0.21	15.29	54.29	30.47	-	17.56	61.58	20.85
Sanlıurfa-Ç-11	20.75	74.74	4.85	0.64	42.91	52	5.09	-	31.83	63.37	4.97
Sanlıurfa-Ç-12	76.94	22.14	1.45	0	71.98	25.49	3.03	-	74.46	23.82	2.24
Sanlıurfa-Ç-13	27.14	69.59	3.61	0.36	33.31	63.6	3.5	-	30.23	66.60	3.56
Sanlıurfa-Ç-14	40.10	57.22	3.35	0	33.74	56.86	8.28	1.24	36.92	57.04	5.82
Sanlıurfa-Ç-15	5.67	80.57	14.18	0	39.82	52.07	8.11	-	22.75	66.32	11.15
Sanlıurfa-Ç-16	12.06	76.77	11.48	0.42	49.98	46	4.02		31.02	61.39	7.75
Sanlıurfa-Ç-17	23.50	69.27	7.61	0.33	26.86	63.27	9.5	0.79	25.18	66.27	8.56
Sanlıurfa-Ç-18	69.62	28.48	2.43	0.24	63.04	32.29	3.87	1.2	66.33	30.39	3.15
Sanlıurfa-Ç-19	45.17	51.26	3.45	0.47	49.95	42.02	6.79	1.41	47.56	46.64	5.12
Sanlıurfa-Ç-20	34.50	57.75	7.01	0.86	15.77	76.1	7.89	0.46	25.14	66.93	7.45
İnci	10.13	72.48	17.42	0.79	23.24	62.48	14.3	-	16.69	67.48	15.86
Hasan Bey	4.15	79.36	16.30	0.59	12.45	57.46	30.27	-	8.30	68.41	23.29
Seckin	1.36	64.55	33.51	1.71	10.06	67.18	22.86	-	5.71	65.87	28.19

Table 10. Şanlıurfa location yield experiment experiment sieve values (2014-2015)

Genotypes	Nitrogen(%)			Protein (%)		
	2014	2015	Mean	2014	2015	Mean
Sanlıurfa-Ç-1	3.90	3.65	3.78	24.40	22.82	23.61
Sanlıurfa- Ç-2	3.66	3.42	3.54	22.91	21.38	22.15
Sanlıurfa-Ç-3	3.64	3.55	3.60	22.80	22.18	22.49
Sanlıurfa-Ç-4	3.82	3.55	3.69	23.89	22.17	23.03
Sanlıurfa-Ç-5	3.52	3.88	3.70	22.01	24.26	23.14
Sanlıurfa-Ç-6	-	3.80	-	-	23.78	-
Sanlıurfa-Ç-7	4.13	3.47	3.80	25.84	21.67	23.76
Sanlıurfa-Ç-8	3.73	4.05	3.89	23.34	25.34	24.34
Sanlıurfa-Ç-9	3.76	3.90	3.83	23.54	24.36	23.95
Sanlıurfa-Ç-10	3.47	3.88	3.68	21.70	24.26	22.98
Sanlıurfa-Ç-11	3.90	3.95	3.93	24.37	24.70	24.54
Sanlıurfa-Ç-12	3.74	3.91	3.83	23.39	24.41	23.90
Sanlıurfa-Ç-13	3.95	3.70	3.83	24.70	23.12	23.91
Sanlıurfa-Ç-14	3.94	3.98	3.96	24.67	24.89	24.78
Sanlıurfa-Ç-15	3.9	3.99	3.98	24.79	24.95	24.87
Sanlıurfa-Ç-16	3.76	4.09	3.93	23.50	25.56	24.53
Sanlıurfa-Ç-17	3.77	3.78	3.78	23.58	23.61	23.60
Sanlıurfa-Ç-18	4.01	3.88	3.95	25.09	24.22	24.66
Sanlıurfa-Ç-19	3.99	3.84	3.92	24.99	24.00	24.50
Sanlıurfa-Ç-20	3.64	3.94	3.79	22.76	24.64	23.70
İnci	3.82	4.13	3.98	23.93	25.83	24.88
Hasan Bey	3.96	3.81	3.89	24.80	23.82	24.31
Seckin	3.65	3.78	3.72	22.81	23.65	23.23

CONCLUSION

In the study, it was aimed to determine the quality characteristics of 23 chickpea genotypes (20 genotypes and 3 control varieties (Hasanbey, Seçkin, İnci)) grown in different locations. According to the results of the study, the average highest protein analysis values for both growing seasons were obtained from Sanlıurfa-Ç-10 genotype with 22.99% for Adana location. Among the all genotype, Sanlıurfa-Ç-18 genotype came to the forefront by giving the highest values in terms of wet weight, water absorption capacity, dry volume, wet volume, swelling index compared to other varieties. The average protein analysis values were determined in Sanlurfa- Ç-15 genotype with 24.87% for Sanlıurfa location in both growing seasons. Sanlıurfa-Ç-18 genotype came to the forefront by giving the highest values compared to other genotypes for dry weight, wet weight, water absorption capacity, dry volume, wet volume and swelling capacity. In conclusion, In the chickpea breeding studies, adding quality studies to the selection criteria and improving the quality values of the varieties to be submitted for registration will contribute to our country's economic gains.

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