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Determination of Yield and Yield Components of Grain Sorghum Cultivars Grown as Second Crop

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Abstract: This research was conducted in the 1998 and 1999 second crop season in the Southeastern Anatolia Region of Turkey. The experimental design was a Completely Randomized Block with three Replications. In the research, were used 24 grain sorghum cultivars to determine high yielding cultivars. The grain yields of the grain sorghum cultivars varied between 3383.8-8248.0 kg ha^{-1} in the research. In all the observed characters, statistically significant differences were determined among cultivars. As a result, DK 64 was determined as high yielding cultivars under Southeastern Anatolia Region irrigated conditions as second crops season.

Key words: Grain sorghum, cultivars, second crop, yield

INTRODUCTION

The grain sorghum takes places fifth between cereals with 42 million ha^{-1} sowing area and 58.5 million tones grain yield production in the world[1]. It is grown to some extent or occasionally grown in all countries of the world except in the cool northwestern part of Europe. In Turkey, grain sorghum takes places seventh between cereals with 3500 ha sowing area and 6700 tones grain yield production[2].

Most of the sorghum grain grown in Asia and the African tropics is used for human food. Elsewhere it is generally fed to livestock or poultry. Considerable grain sorghum replaces corn grits in the brewing and distilling industries and in the manufacture of alcohol[3]. Sorghum is an important component in traditional farming systems in the semi-arid tropics of Africa and Asia, with mean grain yields of 863 and 1157 kg ha^{-1}, respectively[4]. Low soil fertility, poor stand establishment and highly variable drought stress are major production constraints in these areas. The local farmers usually do not have access to irrigation facilities or fertilizer stocks and rely totally on the stress resistance and yield stability of their rainfed crop cultivars.

It's very important to determine most suitable variety and sowing techniques in any region for increase quality and yields. Sorghum are grown in warm and hot regions that have summer rainfall as well as in warm irrigated. The sorghum plant seems to withstand extreme heat better than other crops. This characteristics accounts in large part of the success of sorghum in a dry season and is the reason why it has been called a crop camel. As compared with corn of similar seasonal requirements, sorghum has more secondary roots and a smaller leaf area per plant. Sorghum leaves and stalks wilt and dry more slowly than those of corn, enabling sorghum to withstand drought longer. However, sorghum is also highly productive on irrigated land and in humid sections. Sorghum will tolerate considerable soil salinity.

Sorghum can be grown successfully as a second crop after wheat, barley, chickpea and lentil and it can be grown as a delayed crop because of cold risk and other harmfull of cotton.

In previous studies; the yield and adaptation of different cultivars of grain sorghum were investigated and the results varied widely. Grain yield varied between 3028.3 and 9825 kg ha^{-1}, plants height were 78.88 to 151.86 cm high, with protein contents of 7.0 to 25.0%, 1000 seed weight varied between 21.30 and 27.33 g, grain yields per panicle varied between 26.63 and 74.50, panicle length between 23.64 and 28.07 g[5-9]. However, in experiments in other countries, grain yields of 470-12816 kg ha^{-1}. 1000 seed weight yields of 24.3-34.4 g, grain yields per panicle of 27.0-84.4 g. have been obtained, with plants 79.25-305.50 cm high and crude protein contents of 8.26-13.36%[10-19].

By this research, 24 grain sorghum varieties investigated as second crop to determination of most suitable varieties in the Southeastern Anatolia Region of Turkey.

MATERIALS AND METHODS

This research was been carried out at Dicle University in Diyarbakir (37°54′ N, 40°14′ E altitude 660 m).

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Generally, Mediterranean and East Anatolian continental climates are dominant in this region. The average annual temperature is 15.8°C, rainfall is 481.6 mm and the average relative humidity is about 53.8%. The average temperature can reach 30°C in July and August. The lowest average temperature can be 7°C in December and January. The earliest frost in the region is usually at the end of October and the last frost around end of April.

Most rain falls in winter and there is almost no rainfall from July to September. The highest humidity (70%) occurs in winter, lowest (27%) in summer.

In our region, most of the rainfall is occurred between October and May. So, between May and October due to lack of rainfall, sorghum was irrigated average every 10 days.

The soils of the experimental area were thinly structured alluvial material or limestone. The soil is low in organic material and phosphorus, has adequate calcium and high clay content (49%-67%) in the 0-150 cm profile[20].

Twenty four cultivars of grain sorghum were used in the research. These cultivars and their source institutions/companies and origins are shown in Table 1.

The experimental design was a Completely Randomized Block with four replications.

Seed was sown by hand at 125.000 plants ha^{-1} in four-row plots with rows 70 cm apart and 5 m long. Sowing took place on 25 June 1998 (first year) and 29 June 1999 (second year). The experimental area was fertilized with 150 kg ha^{-1} nitrogen (N) and 100 kg ha^{-1} phosphorus (P) before planting.

For protein analysis, the herbage samples (with stalks and leaves) were ground at the end of the season and mixed equally and a sample taken from this mixture was used for protein analysis. The crude protein percentage was determined with Leco FP-528 protein analyzer.

Analysis of variance was done by using a MSTAT-C statistic program and differences were compared by Duncan's.

RESULTS AND DISCUSSION

Grain yield: As seen in Table 2, the differences between the cultivars with respect to the grain yield were found significant for each year and average of the these years. The average grain yield was 5715.3 kg ha^{-1} in 1998, 6014.6 kg ha^{-1} in 1999 and the two years average value was 5865.0 kg ha^{-1}.

The highest grain yields were from DK 64 in 1998, they were followed by DK 58, DK 54 and DK 48. In 1999, DK 64 produced the highest yield too and this was followed by DK 54, DK 58 and P 8305.

Table 1: Sorghum cultivars that to assure Institutions/Company and their origins

Cultivars	Institution/Company	Origin
DK 37	Monsanto company (DeKalb)	USA
DK 39 Y	Monsanto company (DeKalb)	USA
DK 41 Y	Monsanto company (DeKalb)	USA
DK 48	Monsanto company (DeKalb)	USA
DK 54	Monsanto company (DeKalb)	USA
DK 58	Monsanto company (DeKalb)	USA
DK 64	Monsanto company (DeKalb)	USA
DK 65	Monsanto company (DeKalb)	USA
KS 397	Syngenta Group Company (Northup King)	USA
KS 989	Syngenta Group Company (Northup King)	USA
NK Dorado	Syngenta Group Company (Northup King)	USA
NK Ranada	Syngenta Group Company (Northup King)	USA
NK Rubino	Syngenta Group Company (Northup King)	USA
NK XP 3082	Syngenta Group Company (Northup King)	USA
NK XP 3322	Syngenta Group Company (Northup King)	USA
P 8212 Y	Pioneer Hı-Bred International, Inc	USA
P 8305	Pioneer Hı-Bred International, Inc	USA
P 8418	Pioneer Hı-Bred International, Inc	USA
P 8500	Pioneer Hı-Bred International, Inc	USA
P 8771	Pioneer Hı-Bred International, Inc	USA
TR Akdarı	Mediterranean Agricultural Research Institute/Antalya	TURKEY
TR Aldarı	Mediterranean Agricultural Research Institute/Antalya	TURKEY
TR Beydarı	Mediterranean Agricultural Research Institute/Antalya	TURKEY
TR ÖĞRT 77	Mediterranean Agricultural Research Institute/Antalya	TURKEY

Table 2: The average grain yields (kg ha^{-1}) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	6595.0a-d	6919.5b	6757.3bc
DK 39 Y	6205.3a-f	6398.1b-e	6301.7b-e
DK 41 Y	5742.1b-g	5570.6c-f	5656.3c-f
DK 48	6604.4a-d	6726.7bc	6665.5b-d
DK 54	6892.2a-c	7075.4b	6983.8b
DK 58	6975.0ab	7058.5b	7016.7b
DK 64	8115.9a	8380.1a	8248.0a
DK 65	5085.0b-h	5539.8d-f	5312.4e-g
KS 397	6497.1a-d	7012.8b	6754.9bc
KS 989	6618.6a-d	6803.1b	6710.9bc
NK Dorado	5089.8b-h	5907.9b-f	5498.9d-g
NK Ranada	4796.5c-h	5100.7f-h	4948.6f-h
NK Rubino	4186.4f-h	5128.2f-h	4657.3f-h
NK XP 3082	4285.9e-h	5377.0e-g	4831.5f-h
NK XP 3322	5487.6b-g	5895.3b-f	5691.4c-f
P 8212 Y	6416.5a-e	6648.3b-d	6532.4b-d
P 8305	6325.6a-e	7049.9b	6687.7b-d
P 8418	6213.8a-f	6579.3b-d	6396.5b-e
P 8500	5969.8b-g	6729.9bc	6349.9b-e
P 8771	6585.0a-d	6374.7b-e	6479.9b-e
TR Akdarı	4745.1c-h	4158.6hı	4451.9gh
TR Aldarı	4014.7gh	3758.0ı	3886.4hı
TR Beydarı	4714.6d-h	4395.6g-ı	4555.1f-h
TR ÖĞRT 77	3006.3h	3761.3ı	3383.8ı
Average	5715.30	6014.60	5865.00
LSD (5%)	1785.00	996.30	1009.00
CV (%)	19.01	10.08	7.78

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

Averaged over the two years, DK 64 (8248.0 kg ha^{-1}) was gave the highest grain yield, followed consecutively by DK 58, DK 54 and DK 37. The lowest yields were obtained from TR ÖĞRT 77, TR Aldan and TR Beydan (Table 2).

Table 3: The average grain yields per panicle (g) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	73.93b-g	76.05d-e	74.99d-f
DK 39 Y	81.82b-d	92.28bc	87.05b-d
DK 41 Y	66.09c-h	69.38e-h	67.74e-ı
DK 48	86.42a-c	89.39b-d	87.91bc
DK 54	79.68b-e	81.49c-e	80.59c-e
DK 58	94.31ab	96.70ab	95.50ab
DK 64	103.33a	108.35a	105.84a
DK 65	56.76e-j	59.93f-ı	58.35g-j
KS 397	61.83d-ı	66.78e-h	64.31f-ı
KS 989	78.21b-f	81.46c-e	79.83c-e
NK Dorado	38.55j	47.80ıj	43.18lm
NK Ranada	53.76g-j	56.21h-j	54.98ı-l
NK Rubino	41.50ı-j	43.88j	42.69lm
NK XP 3082	37.70j	43.44j	40.57m
NK XP 3322	55.62f-j	57.75g-j	56.69h-k
P 8212 Y	68.74c-h	70.58e-h	69.66e-h
P 8305	73.24b-g	76.06de	74.65d-f
P 8418	69.99c-h	68.88e-h	69.44e-h
P 8500	66.96c-h	73.97ef	70.47e-g
P 8771	70.63c-h	72.69e-g	71.66e-g
TR Akdarı	70.66c-h	68.15e-h	69.40e-h
TR Aldarı	52.86g-j	56.86h-j	54.86ı-l
TR Beydarı	49.68h-I	50.57ıj	50.13j-m
TR ÖĞRT 77	43.03ıj	44.72j	43.88k-m
Average	65.64	68.89	67.27
LSD (5%)	19.50	13.03	11.57
CV (%)	18.08	11.51	15.00

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

Table 4: The average panicle length (cm) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	25.54ab	28.76ab	27.15ab
DK 39 Y	23.34b-e	26.64a-e	24.99a-e
DK 41 Y	25.39a-c	27.47abc	26.43a-d
DK 48	27.08a	28.34ab	27.71a
DK 54	24.64a-d	24.96b-f	24.80b-e
DK 58	25.65ab	27.89abc	26.77a-d
DK 64	21.21d-f	23.81c-g	22.51e-g
DK 65	25.10a-c	28.18ab	26.64a-d
KS 397	25.98ab	28.11ab	27.04a-c
KS 989	24.30a-d	26.84a-d	25.57a-d
NK Dorado	21.32d-f	22.63efg	21.97f-h
NK Ranada	19.97ef	23.21d-g	21.59gh
NK Rubino	24.25a-d	27.52abc	25.88a-d
NK XP 3082	21.81c-f	26.57a-e	24.19d-f
NK XP 3322	22.99b-e	25.74a-e	24.37c-f
P 8212 Y	26.10ab	29.15a	27.63a
P 8305	25.48a-c	26.17a-e	25.83a-d
P 8418	24.80a-d	26.16a-e	25.48a-d
P 8500	24.81a-d	25.47a-e	25.14a-e
P 8771	25.14a-c	25.80a-e	25.47a-d
TR Akdarı	23.38a-e	25.38a-e	24.38c-f
TR Aldarı	19.04f	20.47g	19.75h
TR Beydarı	22.55b-e	21.19fg	21.87f-h
TR ÖĞRT 77	23.46a-e	25.03a-f	24.25d-f
Average	23.890	25.900	24.900
LSD (5%)	3.089	3.409	2.269
CV (%)	7.87	8.01	7.95

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

Grain yield per panicle: As seen in Table 3, the differences between the cultivars with respect to the grain yield per panicle were found significant for each year and average of the these years. The average grain yields per panicle were 65.64 g in 1998, 68.89 g in 1999 and the two years average value was 67.27 g.

The highest grain yield per panicle values were from DK 64 in 1998, they were followed by DK 58, DK 48 and DK 39 Y. In 1999, DK 64 produced the highest yield too and this was followed by DK 58, DK 39 Y, DK 48.

Averaged over the two years, DK 64 (105.84 g) was gave the highest grain yield per panicle, followed consecutively by DK 58, DK 48 and DK 39 Y. The lowest yields were obtained from NK XP 3082, NK Rubino and TR ÖĞRT 77 (Table 3).

Panicle length: The differences between the cultivars with respect to the panicle length were found significant for each year and average of the these years. The average panicle lengths were 23.89 cm in 1998, 25.90 cm in 1999 and the two years average value was 24.90 cm (Table 4).

The highest panicle length values were from DK 48 in 1998, they were followed by P 8212 Y, KS 397 and DK 58. In 1999, P 8212 Y was given the highest panicle length and this was followed by DK 37, DK 48 and DK 65.

Averaged over the two years, DK 48 (27.71 cm) was gave the highest panicle length value, followed consecutively by P 8212 Y, DK 37 and KS 397. The lowest values were obtained from TR Aldarı, NK Ranada and TR Beydarı (Table 4).

Plant height: As seen in Table 5, the differences between the cultivars with respect to the plant height were found significant for each year and average of the these years. The average plant height was 99.39 cm in 1998, 102.00 cm in 1999 and the two years average value was 100.70 cm.

The highest plant height value was from DK 64 in 1998, they were followed by DK 65, P 8418 and DK 54. In 1999, DK 65 was given the highest plant height and this was followed by P 8418, DK 64 and DK 54.

Averaged over the two years, DK 65 (123.47 cm) was gave the highest plant height, followed consecutively by DK 64, P 8418 and DK 54. The lowest values were obtained from NK XP 3322, TR Aldarı and TR ÖĞRT 77 (Table 5).

Test weight: The differences between the cultivars with respect to the test weight were found significant for each year and average of the these years. The average test weight was 73.55 kg in 1998, 72.29 kg in 1999 and the two years average value was 72.92 kg (Table 6).

Table 5: The average plant height (cm) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	96.07e-h	98.87e-h	97.47ef
DK 39 Y	86.27g-ı	89.80h-k	88.03g-ı
DK 41 Y	95.32eh	100.85d-g	98.08ef
DK 48	105.00c-f	108.93cd	106.97cd
DK 54	120.34ab	122.17a	121.25a
DK 58	96.18e-h	97.70e-h	96.94ef
DK 64	122.50a	123.83a	123.16a
DK 65	121.40ab	125.53a	123.47a
KS 397	93.77f-h	91.37g-k	92.57f-h
KS 989	115.40a-c	118.67ab	117.03ab
NK Dorado	87.67g-ı	89.26h-k	88.40g-ı
NK Ranada	85.27hı	87.13ijk	86.20hı
NK Rubino	99.73d-g	100.88d-g	100.31d-f
NK XP 3082	87.23g-ı	90.45h-k	88.84g-ı
NK XP 3322	78.47ı	83.53k	81.00ı
P 8212 Y	102.27d-f	106.19c-e	104.23c-e
P 8305	109.87a-d	108.80cd	109.34c
P 8418	120.42ab	124.40a	122.41a
P 8500	108.64b-e	111.73bc	110.19bc
P 8771	96.27e-h	97.16e-ı	96.71ef
TR Akdarı	94.73f-h	94.65f-j	94.69fg
TR Aldarı	77.96ı	87.06ı-k	82.51ı
TR Beydarı	105.15c-f	103.53c-f	104.34c-e
TR ÖĞRT 77	79.53ı	85.49jk	82.51ı
Average	99.390	102.000	100.700
LSD (5%)	11.610	8.789	7.185
CV (%)	7.110	5.240	6.220

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

Table 6: The average Test weight (kg) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	63.73f	64.56f	64.13g
DK 39 Y	73.12a-d	71.56de	72.34d-f
DK 41 Y	73.78a-d	69.46e	71.62d-f
DK 48	79.34a	75.47a-d	77.41a-c
DK 54	65.20ef	64.21f	64.71g
DK 58	70.55c-f	70.92de	70.74ef
DK 64	78.21a-c	76.72a-c	77.47a-c
DK 65	66.58d-f	65.08f	65.83g
KS 397	72.54a-e	71.13de	71.84d-f
KS 989	74.99a-c	75.59a-d	75.29a-e
NK Dorado	71.03b-f	69.72e	70.37f
NK Ranada	78.60a-c	77.94ab	78.27ab
NK Rubino	70.95b-f	72.88b-e	71.92d-f
NK XP 3082	73.56a-d	73.86a-e	73.71b-f
NK XP 3322	72.01a-e	71.40de	71.71d-f
P 8212 Y	76.49a-c	72.13c-e	74.31a-f
P 8305	72.79a-e	73.85a-e	73.32c-f
P 8418	74.64a-c	72.98b-e	73.81b-f
P 8500	78.85ab	78.41a	78.63a
P 8771	73.83a-d	71.55de	72.69d-f
TR Akdarı	79.60a	76.91a-c	78.25ab
TR Aldarı	75.48a-c	70.00e	72.74d-f
TR Beydarı	76.59a-c	75.55a-d	76.07a-d
TR ÖĞRT 77	72.76a-e	73.17b-e	72.96c-f
Average	73.550	72.290	72.920
LSD (5%)	6.640	4.288	3.900
CV (%)	5.490	3.610	4.660

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

The highest test weight value was from TR Akdarı in 1998, they were followed by DK 48, P 8500 and NK Ranada. In 1999, P 8500 was given the highest test weight value and this was followed by NK Ranada, TR Akdarı and DK 64.

Averaged over the two years, P 8500 (78.63 kg) was gave the highest test weight, followed consecutively by NK Ranada, TR Akdarı and DK 64. The lowest values were obtained from DK 37, DK 54 and DK 65 (Table 6).

1000 seed weight: The differences between the cultivars with respect to 1000 seed weight were found significant for each year and average of the these years. The average 1000 seed weight was 28.20 g in 1998, 27.10 g in 1999 and the two years average value was 27.65 g.

The highest 1000 seed weight value was from NK Rubino in 1998, they were followed by NK Dorado, P 8771 and DK 58. In 1999, NK Rubino was given the highest 1000 seed weight value too and this was followed by NK Dorado, DK 58 and P 8212 Y (Table 7).

Averaged over the two years, NK Rubino (33.58 g) was gave the highest 1000 seed weight value, followed consecutively by NK Dorado, DK 58 and P 8771. The lowest values were obtained from TR Beydarı, KS 989 and TR Aldarı (Table 7).

Crude protein percentage: As seen in Table 8, the differences between the cultivars with respect to crude protein percentage were found significant for each year and average of the these years. The average crude protein percentage was 11.09% in 1998, 11.10% in 1999 and the two years average value was 11.10 %.

The highest crude protein percentage value was from TR Beydarı in 1998, they were followed by TR Akdarı, TR ÖĞRT 77 and TR Aldarı. In 1999, TR Beydarı was given the highest crude protein percentage value too and this was followed by P 8500, TR Akdarı and TR ÖĞRT 77.

Averaged over the two years, TR Beydarı (13.34 %) was gave the highest crude protein percentage value, followed consecutively by TR Akdarı, TR ÖĞRT 77 and P 8500. The lowest values were obtained from NK XP 3322, DK 58 and NK Rubino (Table 8).

The performance of twenty four sorghum cultivars at second crop season with respect to yield and yield component was determinate in this study.

Data were statistically analyzed to determine if difference existed between hybrids. At the bottom of each table a mean, a LSD, a CV are reported. Duncan's were calculated at the 5% probability level. Differences of among the all characters were found significant for all cultivars.

Table 7: The average 1000 seed weight (g) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	30.42a-e	29.26a-e	29.84bc
DK 39 Y	30.62a-e	29.33a-d	29.98bc
DK 41 Y	26.40e-h	26.49c-h	26.45d-f
DK 48	28.67c-f	27.96b-g	28.31b-e
DK 54	26.83d-h	25.91e-h	26.37d-f
DK 58	31.67a-d	29.93ab	30.80b
DK 64	27.50c-g	28.32b-f	27.91b-f
DK 65	26.58e-h	26.16d-h	26.37d-f
KS 397	26.50e-h	23.97hı	25.24f
KS 989	22.92gh	21.61ı	22.26g
NK Dorado	34.65ab	31.90a	33.28a
NK Ranada	27.33c-g	25.63f-h	26.48d-f
NK Rubino	34.92a	32.25a	33.58a
NK XP 3082	27.40c-g	27.82b-g	27.61c-f
NK XP 3322	29.22c-f	27.41b-g	28.32b-e
P 8212 Y	30.31a-e	29.74abc	30.02bc
P 8305	25.08f-h	27.15b-h	26.12ef
P 8418	25.75e-h	24.92g-h	25.34f
P 8500	30.08b-e	27.60b-g	28.84b-e
P 8771	31.91a-c	28.34b-f	30.12bc
TR Akdarı	29.42c-f	29.16a-e	29.29b-d
TR Aldarı	23.00gh	21.68ı	22.34g
TR Beydarı	22.42h	21.37ı	21.90g
TR ÖĞRT 77	27.25c-h	26.38c-h	26.81d-f
Average	28.200	27.10	27.650
LSD (5%)	4.124	2.830	2.467
CV (%)	8.900	6.360	7.780

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

Table 8: The average crude protein percentage (%) of different cultivars of sorghum and statistical groups*

Cultivars	1998	1999	Average
DK 37	10.57e-g	10.62b	10.60e-g
DK 39 Y	11.35b-f	11.07b	11.21b-g
DK 41 Y	10.70e-g	10.91b	10.81e-g
DK 48	11.36b-f	10.98b	11.17b-g
DK 54	10.70e-g	10.44b	10.57e-g
DK 58	10.65e-g	10.21b	10.43fg
DK 64	10.55e-g	11.01b	10.78d-g
DK 65	10.89c-g	11.26b	11.07b-g
KS 397	10.96c-g	10.46b	10.71d-g
KS 989	11.31b-f	10.98b	11.15b-g
NK Dorado	10.46e-g	11.13b	10.80d-g
NK Ranada	10.99c-g	10.72b	10.86c-g
NK Rubino	10.31fg	10.76b	10.54e-g
NK XP 3082	11.25b-f	11.59b	11.42b-e
NK XP 3322	10.17g	10.39b	10.28g
P 8212 Y	10.74d-g	10.91b	10.83c-g
P 8305	10.62e-g	11.16b	10.89c-g
P 8418	11.48b-e	11.17b	11.33b-f
P 8500	11.45b-e	11.70b	11.57b-d
P 8771	10.93c-g	10.79b	10.86c-g
TR Akdarı	12.19ab	11.69b	11.94b
TR Aldarı	11.77b-d	10.95b	11.36b-f
TR Beydarı	12.77a	13.91a	13.34a
TR ÖĞRT 77	11.91a-c	11.60b	11.76bc
Average	11.090	11.100	11.100
LSD (5%)	0.875	1.306	0.776
CV (%)	4.810	7.160	6.100

*Means shown with the same letter(s) in the same column are not significantly different at 0.05 probability level

According to averaged over the two years, DK 64 (8248.0 kg ha^{-1}), DK 58 (7016.7 kg ha^{-1}) and DK 54 (6983.8 kg ha^{-1}) had highest grain yields, while TR ÖĞRT 77 (3383.8 kg ha^{-1}) was the lowest. These findings are show similarity with Kizil and Tansi[9], Baytekin *et al.*[7], Silantev *et al.*[17] and Saglamtimur *et al.*[6].

The highest average crude protein percentages were from TR Beydarı (13.34%), TR Akdarı (11.94%) and TR ÖĞRT 77 (11.76 %). These findings are consistent with Gangstad[10] and Gençkan[5].

According to these findings, DK 64 should be recommended.

REFERENCES

1. Anonymous 2002. FAO. Production Year Book 2000. Volume 54, Rome.
2. Anonymous, 2002. Summary of Turkish Agricultural Statistics. T.C. State Statistics Institute. Pub. No: 2719, Ankara.
3. Martin, J.H., W.H. Leonard and D.L. Stamp, 1967. Principles of Field Crop Production. Macmillan Publishing Co., Inc. New York.
4. FAO, 1999. FAO Quart. Bull. Statis, 12: 33.
5. Gençkan, M.S., 1983. Forage Crops Farming. Aegean University Agricultural Faculty Publications Number: 467, Izmir.
6. Saglamtimur, T., V. Tansi and H. Baytekin, 1988. An Investigations on determination of some agricultural characters of hybrid grain sorghum cultivars grown as double crop in Cukurova conditions. J. Agric. Fac., Cukurova University, Adana, 3: 18-29.
7. Baytekin, H., Bengisu, G., Gul, I. 1995: The effect of different nitrogen dozes on grain yield and some agricultural characters of grain sorghum grown as double crop under irrigated conditions of Harran Plains. J. Fac. Agric., Harran University, Sanliurfa, 1: 198-211..
8. Emeklier, H.Y. and N.F. Koksoy, 1997. Effect of sowing time and plant density on yield components of Sorghum (*Sorghum bicolor* L. Moench). J. Agric. Sci., 3: 20-28.
9. Kizil, S. and V. Tansi, 1997. The effect of different plant densities on yield of some forage and grain sorghum (*Sorghum bicolor* L.) cultivars as double crops under Cukurova conditions. 2nd Agricultural Congress of Turkey, pp: 347-476.
10. Gangstad, E.O., 1963. Physical and chemical composition of grass sorghum as related to palatability. Crop Sci., 3: 269-270.

11. Niehaus, M.H. and R.C. Pickett, 1966. Heterosis and combining ability in a dialle cross in *Sorghum vulgare* Pers. Crop Sci., 6: 33-36.
12. Hiremath, S.M. and S.R. Parvatikar, 1987. Growth and yield analysis in sorghum identification of genotypes with low leaf area and high dry matter production. Plant Breed. Abstr., 57: 207.
13. Nema, V.P., R.V. Singh, R.S. Rathore and C.L. Parmar, 1987. Response of sorghum varieties to plant population. Indian J. Agron., 32: 102-104.
14. Heyerdahl, R.H., B.A. Golden and P.M. Fowler, 1988. Early-planted grain sorghum hybrid performance trials in Tifton. Georgia 1987. Field Crops Performance Tests. The Georgia Agricultural Experiment Stations, College of Agriculture, The University of Georgia, Research Report, pp: 51.
15. York, J.O., 1988. Grain sorghum performance test in Clay County, Corning, 1987. Arkansas grain sorghum performance tests 1987, Arkansas Agricultural Experiment Station. University of Arkansas, Research Series, pp: 367.
16. Desiderio, E. and A. Ventura, 1992. Fitness of plants and sowing pattern in grain sorghum crop without additional water. Field Crop Abstr., 45: 4457.
17. Silantev, A.N., N.T. Gaiko and V.N. Putintsev, 1992. Productivity of sorghum and related Crop in the steppe zone of western Siberia. Herbage Abstr., 062: 00523.
18. Andrew K.B., L.H. Graeme and G.H. Robert, 2000. Does Maintaining Green Leaf Area in Sorghum Improve Yield under Drought? II. Dry Matter Production and Yield. Crop Sci., 40: 1037-1048.
19. Haussmann, B.I.G., A.B. Obilana, P.O. Ayiecho, A. Blum, W. Schipprack and H.H. Geiger, 2000. Yield and yield stability of four population types of grain sorghum in a semi-arid area of Kenya. Crop Sci., 40: 319-329.
20. Anonymous, 1997. Water and Soil Department (In Turkish). Analysis of Soil Results. Ankara, Turkey.