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Determination of Yield and Yield Components and Relationship among the Components of Grain Sorghum Cultivars Grown as Main Crop

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Abstract: This research was conducted in the 1998 and 1999 main 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 3589.9-9634.8 kg ha^{-1} in the research. In all the observed characters, statistically significant differences were determined among cultivars. The positive and significant relationships were determined between the grain yields and grain yields per panicle, panicle lengths, plant heights ($p<0.01$). However, the negative and significant relationships were determined between the crude protein percentages and grain yields, panicle lengths, 1000 seed weights ($p<0.01$). As a result, DK 64 and KS 989 were determined as high yielding cultivars under Southeastern Anatolia Region conditions as main crops season.

Key words: Grain sorghum, cultivars, correlation, main 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].

The region has an important potential for livestock with about 4 million sheep, 1.5 million goats and 700.000 cattle[3]. To meet the increasing needs for feed in the region, the sorghum must be produced.

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. During World War II, the grain of waxy varieties was used for extraction of starch to manufacture a satisfactory substitute for minute tapioca. The important use is in the manufacture of starch, glucose, sirup, oil, gluten feeds and other products similar to those produced in the wet-milling of corn. Grain sorghum flour is used for adhesives. The entire plants of sorghum sometimes are chopped, dehydrated, ground and pelleted for feed[4]. 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[5]. 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.

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[6-10]. However, in experiments in other countries, grain yields of 470 to 12816 kg ha^{-1}. 1000 seed weight yields of 24.3 to 34.4 g, grain yields per panicle of 27.0 to 84.4 g. have been obtained, with plants 79.25 to 305.50 cm high and crude protein contents of 8.26 to 13.36%[11-20].

By this research, 24 grain sorghum varieties investigated as main 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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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

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.

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 to 67%) in the 0-150 cm profile[21].

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 ha^{-1} in four-row plots with rows 70 cm apart and 5 m long. Sowing took place on 06 April 1998 (first year) and 10 April 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 seed samples were ground. 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: 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 6341.1 kg ha^{-1} in 1998, 6305.2 kg ha^{-1} in 1999 and the two years average value was 6323.2 kg ha^{-1} (Table 2).

The highest grain yields were from DK 64 in 1998, they were followed by NK Dorado, DK 65 and NK Rubino. In 1999, DK 64 produced the highest yield and this was followed by KS 397, NK Dorado, DK 65 (Table 2).

Averaged over the two years, DK 64 (9634.8 kg ha^{-1}) was gave the highest grain yield, followed consecutively by NK Dorado, KS 397 and DK 65. The lowest yields were obtained from TR Öğrt 77, TR Aldan and TR Beydan (Table 2).

Grain yield per panicle: 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 55.22 g in 1998, 59.60 g in 1999 and the two years average value was 57.41 g (Table 3).

The highest grain yield per panicle values were from DK 64 in 1998, they were followed by TR Akdarı, DK 65 and DK 58. In 1999, DK 64 produced the highest

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

Cultivars	1998	1999	Average
DK 37	6434.6c-g	6180.4d-g	6307.5e-h
DK 39 Y	5718.7d-h	6167.1e-g	5942.9f-ı
DK 41 Y	5270.5e-h	5488.7g	5379.6ıj
DK 48	5838.1d-h	5907.1fg	5872.6g-ı
DK 54	6655.4b-f	6968.7b-e	6812.1c-f
DK 58	5188.9f-ı	5848.2fg	5518.5hıj
DK 64	10154.7a	9115.1a	9634.8a
DK 65	7980.5bc	7268.0bc	7624.2bc
KS 397	7560.5bc	7908.8b	7734.7bc
KS 989	6872.6b-e	7017.3b-e	6945.8b-e
NK Dorado	8160.6b	7460.0bc	7810.3b
NK Ranada	6730.2b-f	6566.8c-f	6648.5d-g
NK Rubino	7835.9bc	7029.6b-e	7432.6bcd
NK XP 3082	5097.1f-ı	5413.0g	5255.1ıj
NK XP 3322	6909.8b-e	6687.7c-f	6798.8c-f
P 8212 Y	5529.2d-h	5954.2fg	5741.7ghı
P 8305	7010.8bcd	7128.2b-e	7069.5b-e
P 8418	7524.5bc	6932.1c-e	7228.3b-e
P 8500	6993.3bcd	7151.4b-d	7072.4b-e
P 8771	6362.7c-g	6505.8c-f	6434.2e-h
TR Akdarı	4897.3g-j	4553.8h	4725.5jk
TR Aldarı	3620.0ıj	3992.7	3806.4l
TR Beydarı	4468.1hıj	4272.2h	4370.1kl
TR ÖĞRT 77	3372.6j	3807.2h	3589.9l
Average	6341.1	6305.2	6323.2
LSD (5%)	1426.0	827.0	813.6
CV (%)	13.69	7.99	11.22

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

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

Cultivars	1998	1999	Average
DK 37	53.75d-h	55.68f-h	54.72h-l
DK 39 Y	61.46b-e	66.50bc	63.98b-e
DK 41 Y	50.33e-ı	52.83g-ı	51.58j-l
DK 48	61.12b-f	67.37b	64.25b-e
DK 54	56.95c-g	63.78bcd	60.36d-h
DK 58	63.72bcd	67.51b	65.61b-d
DK 64	85.10a	100.15a	92.63a
DK 65	66.53bc	67.05bc	66.79bc
KS 397	53.27d-h	60.65c-f	56.96f-j
KS 989	56.73c-g	60.93c-f	58.83e-ı
NK Dorado	50.00f-I	53.73gh	51.87jkl
NK Ranada	49.67ghı	51.54hı	50.60kl
NK Rubino	51.67e-I	57.19e-h	54.43h-l
NK XP 3082	34.00J	39.43k	36.71n
NK XP 3322	49.40ghı	51.36hı	50.38kl
P 8212 Y	50.40e-ı	56.53e-h	53.47ı-l
P 8305	59.45b-g	64.11bcd	61.78c-g
P 8418	60.26b-g	65.37bc	62.82b-f
P 8500	55.01d-h	62.18b-e	58.59e-ı
P 8771	54.34d-h	58.43d-g	56.38g-k
TR Akdarı	69.88b	66.75bc	68.31b
TR Aldarı	41.98ıj	46.81ıj	44.40m
TR Beydarı	44.87hı	42.65jk	43.76m
TR ÖĞRT 77	45.46hı	51.88hı	48.67lm
Average	55.22	59.60	57.41
LSD (5%)	9.333	5.497	5.344
CV (%)	10.28	5.61	8.12

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

yield too and this was followed by DK 58, DK 48 and DK 65 (Table 3).

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

Cultivars	1998	1999	Average
DK 37	28.00a-c	29.38a-d	28.69a-d
DK 39 Y	26.63a-e	27.07c-f	26.85d-g
DK 41 Y	27.43a-d	26.55d-g	26.99d-g
DK 48	25.47b-g	27.40c-e	26.43e-h
DK 54	24.60e-h	25.62e-g	25.11g-j
DK 58	25.37c-g	28.62a-d	26.99d-g
DK 64	23.83f-h	25.73e-g	24.78h-k
DK 65	28.17ab	29.83a-c	29.00a-c
KS 397	27.57a-d	29.50a-c	28.53a-d
KS 989	27.87a-c	30.44ab	29.15ab
NK Dorado	25.90b-f	27.78b-e	26.84d-g
NK Ranada	23.63f-h	24.33f-h	23.98ı-k
NK Rubino	26.93a-e	27.08c-f	27.01d-g
NK XP 3082	26.73a-e	27.57b-e	27.15c-f
NK XP 3322	23.03gh	24.19gh	23.61jk
P 8212 Y	28.07a-c	29.19a-d	28.63a-d
P 8305	28.90a	30.98a	29.94a
P 8418	27.63a-d	28.75a-d	28.19a-e
P 8500	26.53a-e	28.87a-d	27.72b-e
P 8771	27.60a-d	28.43a-e	28.02b-e
TR Akdarı	25.42c-g	23.87gh	24.64h-k
TR Aldarı	18.80ı	22.30h	20.55l
TR Beydarı	22.70h	23.78gh	23.24k
TR ÖĞRT 77	25.04d-h	26.52d-g	25.78f-ı
Average	25.91	27.24	26.58
LSD (5%)	2.261	2.434	1.639
CV (%)	5.31	5.44	5.38

*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 (92.63 g) was gave the highest grain yield per panicle, followed consecutively by TR Akdarı, DK 65 and DK 58. The lowest yields were obtained from NK XP 3082, TR Beydarı and TR Aldarı (Table 3).

Panicle length: The differences between the cultivars with respect to the panicle length were found significant for each year and average of these years. The average panicle lengths were 25.91 cm in 1998, 27.24 cm in 1999 and the two years average value was 26.58 cm (Table 4).

The highest panicle length values were from P 8305 in 1998, they were followed by DK 65, P 8212 Y and DK 37. In 1999, P 8305 was given the highest panicle length too and this was followed by KS 989, DK 65 and KS 397 (Table 4).

Averaged over the two years, P 8305 (29.94 cm) was gave the highest panicle length value, followed consecutively by KS 989, DK 65 and DK 37. The lowest values were obtained from TR Aldarı, TR Beydarı and NK XP 3322 (Table 4).

Plant height: The differences between the cultivars with respect to the plant height were found significant for each year and average of these years. The average plant height was 99.63 cm in 1998, 103.78 cm in 1999 and the two years average value was 101.75 cm (Table 5).

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

Cultivars	1998	1999	Average
DK 37	97.67f-ı	99.75h-j	98.71h-j
DK 39 Y	94.93g-j	97.75ı-l	96.34ı-l
DK 41 Y	105.60c-f	108.42c-g	107.01d-f
DK 48	98.47e-ı	103.68g-ı	101.07g-ı
DK 54	108.27b-e	114.53b-d	111.40cd
DK 58	105.20c-f	104.80f-ı	105.00e-g
DK 64	105.07c-f	112.95c-e	109.01c-e
DK 65	115.73ab	119.84ab	117.79b
KS 397	90.00ı-k	92.69j-l	91.35k-n
KS 989	111.67bc	115.27bc	113.47bc
NK Dorado	96.13f-j	97.97ı-l	97.05h-k
NK Ranada	88.47ı-k	92.45j-l	90.46l-n
NK Rubino	109.07a-c	111.15c-f	110.11cde
NK XP 3082	92.00h-k	96.29j-l	94.15j-m
NK XP 3322	86.47jk	90.66l	88.56mn
P 8212 Y	101.20d-h	104.03g-ı	102.61fgh
P 8305	103.60c-g	107.92d-g	105.76d-g
P 8418	121.67a	125.79a	123.73a
P 8500	103.00c-g	106.83e-h	104.92efg
P 8771	95.00g-j	97.62ı-l	96.31ı-l
TR Akdarı	97.50f-ı	103.85g-ı	100.68ghı
TR Aldarı	88.53ı-k	95.73j-l	92.13k-n
TR Beydarı	91.60h-k	98.63ı-k	95.12ı-l
TR ÖĞRT 77	84.33k	92.04kl	88.18n
Average	99.63	103.78	101.75
LSD (5%)	8.578	6.280	5.245
CV (%)	5.24	3.68	4.50

*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	71.8bc	69.92d-j	70.55b-g
DK 39 Y	67.0c	68.68-j	67.94d-g
DK 41 Y	69.02c	67.45ij	68.24d-g
DK 48	71.57bc	72.67b-h	72.12b-d
DK 54	70.52bc	67.32j	68.92c-g
DK 58	68.73	69.73d-j	69.23b-g
DK 64	76.83ab	77.51ab	77.17a
DK 65	71.17bc	69.49e-j	70.33b-g
KS 397	71.08bc	72.46c-ı	71.77b-e
KS 989	72.45a-c	73.20a-g	72.83bc
NK Dorado	66.53c	68.04h-j	67.29fg
NK Ranada	70.57bc	73.96a-e	72.27b-d
NK Rubino	67.87c	67.08j	67.48e-g
NK XP 3082	67.06c	68.17g-j	67.62e-g
NK XP 3322	65.82c	67.34j	66.58g
P 8212 Y	71.88a-c	70.91c-j	71.40b-f
P 8305	69.02c	71.06c-j	70.04b-g
P 8418	70.92bc	69.77d-j	70.34b-g
P 8500	71.96bc	74.65a-d	73.31bc
P 8771	71.57bc	75.53a-c	73.55b
TR Akdarı	78.61a	77.95a	78.28a
TR Aldarı	72.25a-c	68.68f-j	70.47b-g
TR Beydarı	71.67bc	74.02a-e	72.84bc
TR ÖĞRT 77	71.92a-c	73.59a-f	72.75bc
Average	70.73	71.22	70.97
LSD (5%)	9.539	4.283	3.612
CV (%)	5.11	3.66	4.44

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

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

Cultivars	1998	1999	Average
DK 37	29.11a-c	28.93ab	29.02ab
DK 39 Y	25.09b-f	27.76a-e	26.43b-e
DK 41 Y	23.87e-g	25.78c-f	24.82d-f
DK 48	24.58c-g	25.91c-f	25.25c-f
DK 54	29.55ab	28.17a-c	28.86ab
DK 58	30.73a	29.69a	30.21a
DK 64	27.55a-e	28.25a-c	27.90a-c
DK 65	25.81b-e	26.18b-f	26.00c-e
KS 397	27.49a-e	26.08c-f	26.79b-d
KS 989	20.07g	21.63g	20.85hı
NK Dorado	25.46b-f	25.16e-f	25.31c-e
NK Ranada	25.18b-f	25.26d-f	25.22c-f
NK Rubino	26.50a-e	28.11a-d	27.31b-d
NK XP 3082	21.10fg	24.24f	22.67f-h
NK XP 3322	23.74e-g	24.06f	23.90e-g
P 8212 Y	25.32b-f	27.55a-e	26.43b-e
P 8305	24.35g-g	25.65c-f	25.00d-f
P 8418	24.37d-g	25.81c-f	25.09d-f
P 8500	26.49a-e	27.25a-e	26.87b-d
P 8771	26.36a-e	27.42a-e	26.89b-d
TR Akdarı	29.04a-d	28.50a-c	28.77ab
TR Aldarı	22.83e-g	21.35g	22.09g-ı
TR Beydarı	20.35g	19.85g	20.10ı
TR ÖĞRT 77	26.81a-e	27.49a-e	27.15b-d
Average	25.49	26.09	25.79
LSD (5%)	3.917	2.385	2.263
CV (%)	9.35	5.56	7.65

*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	10.21de	10.22e-g	10.22gh
DK 39 Y	10.23de	10.30e-g	10.27gh
DK 41 Y	10.13de	10.47d-g	10.30f-h
DK 48	11.07b-e	11.26b-e	11.17cd
DK 54	10.99c-e	10.40d-g	10.69d-h
DK 58	10.77c-e	10.76d-g	10.76d-h
DK 64	10.04e	10.20eg	10.12h
DK 65	10.82c-e	10.44d-g	10.63d-h
KS 397	10.41c-e	10.35d-g	10.38e-h
KS 989	11.42bc	11.95bc	11.68bc
NK Dorado	10.87c-e	11.21b-e	11.04c-f
NK Ranada	10.23de	10.88d-f	10.56d-h
NK Rubino	10.50c-e	10.71d-g	10.61d-h
NK XP 3082	10.59c-e	10.70d-g	10.65d-h
NK XP 3322	10.57c-e	9.81g	10.19gh
P 8212 Y	11.11b-e	11.03c-f	11.07c-e
P 8305	11.13b-e	10.56d-g	10.85d-h
P 8418	11.20b-d	11.27b-e	11.24cd
P 8500	11.24b-d	11.15c-e	11.19cd
P 8771	10.40c-e	10.08fg	10.24gh
TR Akdarı	10.40c-e	11.40b-d	10.90d-g
TR Aldarı	12.08ab	12.19ab	12.13b
TR Beydarı	12.61a	12.93a	12.77a
TR ÖĞRT 77	10.68c-e	10.51d-g	10.60d-h
Average	10.82	10.87	10.85
LSD (5%)	0.9106	0.982	0.6249
CV (%)	5.12	4.94	5.03

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

The highest plant height value was from P 8418 in 1998, they were followed by DK 65, KS 989 and NK Rubino. In 1999, P 8418 was given the highest plant height too and this was followed by DK 65, KS 989 and DK 64 (Table 5).

Averaged over the two years, P 8418 (123.73 cm) was gave the highest plant height, followed consecutively by DK 65, KS 989 and DK 54. The lowest values were obtained from TR ÖĞRT 77, NK XP 3322 and NK Ranada (Table 5).

Table 9: Correlation between grain yield, grain yield per panicle, panicle length, plant height, test weight, 1000 seed weight and crude protein percentage

	Grain yields per panicle	Panicle length	Plant height	Test wight	1000 seed weight	Crude protein percentage
Grain yields	0.506**	0.328**	0.419**	0.008	0.187*	- 0.325**
Grain yields per panicle		0.225**	0.459**	0.347**	0.435**	- 0.235**
Panicle length			0.392**	- 0.112	0.224**	- 0.252**
Plant height				0.052	0.131	0.05
Test wight					0.162	0.138
1000 seed weight						- 0.379**

Significance level * = p<0.05; ** = p<0.01

Test weight: The differences between the cultivars with respect to the test weight were found significant for each year and average of these years. The average test weight was 70.73 kg in 1998, 71.22 kg in 1999 and the two years average value was 70.97 kg (Table 6).

The highest test weight value was from TR Akdarı in 1998, they were followed by DK 64, KS 989 and P 8500. In 1999, TR Akdarı was given the highest test weight value too and this was followed by DK 64, P 8771 and P 8500 (Table 6).

Averaged over the two years, TR Akdarı (78.28 kg) was gave the highest test weight, followed consecutively by DK 64, P 8771 and P 8500. The lowest values were obtained from NK XP 3322, NK Dorado and NK Rubino (Table 6).

Thousand 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 25.49 g in 1998, 26.09 g in 1999 and the two years average value was 25.79 g (Table 7).

The highest 1000 seed weight value was from DK 58 in 1998, they were followed by DK 54, DK 37 and TR Akdarı. In 1999, DK 58 was given the highest 1000 seed weight value too and this was followed by DK 37, TR Akdarı and DK 64 (Table 7).

Averaged over the two years, DK 58 (30.21 g) was gave the highest 1000 seed weight value, followed consecutively by DK 37, DK 54 and TR Akdarı. The lowest values were obtained from TR Beydarı, KS 989 and TR Aldarı (Table 7).

Crude protein percentage: 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 10.82% in 1998, 10.87% in 1999 and the two years average value was 10.85% (Table 8).

The highest crude protein percentage value was from TR Beydarı in 1998, they were followed by TR Aldarı, KS 989 and P 8500. In 1999, TR Beydarı was given the highest crude protein percentage value too and this was followed by TR Aldarı, KS 989 and TR Akdarı (Table 8).

Averaged over the two years, TR Beydarı (12.77%) was gave the highest crude protein percentage value, followed consecutively by TR Aldarı, KS 989 and P 8418. The lowest values were obtained from DK 64, NK XP 3322 and DK 37 (Table 8).

Correlations: The positively and significant relationships were determined between the grain yields and grain yields per panicle, panicle lengths, plant heights ($p<0.01$) (Table 9). The grain yield per panicle was positively correlated with grain yield, panicle length, plant height, test weight, 1000 seed weight ($p<0.01$), negative correlated with crude protein percentage. The plant height was positively correlated with grain yields, grain yields per panicle and panicle length ($p<0.01$). The test weight was positively correlated with grain yield per panicle ($p<0.01$). The 1000 seed weight was positively correlated with grain yields ($p<0.05$), grain yields per panicle and panicle length ($p<0.01$). However ($p<0.01$), the negatively and significant relationships were determined between the crude protein percentages and grain yields, grain yields per panicle, panicle lengths, 1000 seed weights ($p<0.01$).

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

According to averaged over the two years, DK 64 (9634.8 kg ha^{-1}), NK Dorado (7810.3 kg ha^{-1}) and (KS 397 7734.7 kg ha^{-1}) had highest grain yields, while TR Öğrt 77 (3589.9 kg ha^{-1}) was the lowest. These findings are showing similarity with some other researches[7,8,10,18].

The highest average crude protein percentage were from TR Beydarı (12.77%), TR Adları (12.13%) and KS 989 (11.68%). These findings are consistent with some other researches[6,11].

According to these findings, DK 64 and KS 989 cultivars should be recommended because their high grain yields and crude protein yield.

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