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Comparison of Some Cowpea (*Vigna unguiculata* L. Walp) Genotypes from Turkey for Seed Yield and Yield Related Characters

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Abstract: In this study, six cowpea genotypes from different locations in Turkey (Dalbahçe, Doğanca, Durağan, Iğdır, Kirazlık 1 and Kirazlık 2) and two registered cultivars (Akkız-86 and Karagöz-86) as control were compared for their seed yield and yield related characters during 2002 and 2003 years. In addition, correlation and path coefficients between seed yield per plant and yield related characters were determined. The highest seed yields per hectare were obtained from Kirazlık 2 (1120.9 kg ha^{-1}), Doğanca (1093.1 kg ha^{-1}), Durağan (1078.6 kg ha^{-1}), Kirazlık 1 (1066.6 kg ha^{-1}), Dalbahçe (993.6 kg ha^{-1}) and Iğdır (922.1 kg ha^{-1}). Seed yields of Akkız-86 and Karagöz-86 were highly significantly lower than the other genotypes. Karagöz-86 was the superior for seed yield per plant (10.70 g $plant^{-1}$). This followed by Doğanca (8.27 g $plant^{-1}$) and the rest of the genotypes were not statistically different from each other for seed yield per plant. Pod length and 100 seed weight showed a positive and highly significant correlation with seed yield per plant. Path analysis results revealed that pod length had the highest direct positive effect on seed yield per plant, followed by 100 seed weight and pods number per plant. On the other hand, seed yield per plant was directly and negatively affected by first pod height and branches number per plant.

Key words: Correlation, cowpea, path analysis, seed yield, *Vigna unguiculata*

INTRODUCTION

Cowpea (*Vigna unguiculata* L. Walp.) is an important food legume and an integral part of traditional cropping systems in the semi-arid regions of the tropics[1]. Cowpea is not only grown for dry seed for human consumption and fodder for animal feed, but is also utilized the leaves and fruits for vegetables. In worldwide, area and production of cowpeas is 9825035 ha and 3721850 tons, respectively. The largest production is in Africa, with Nigeria and Niger predominating[2]. Cowpea sowing area of Turkey was 2900 ha and production was 2000 tons in 2001. Vegetable for fresh pods was 12000 tons for the same year[3]. Cowpea is widely grown in Aegean and Mediterranean regions of Turkey. In the middle Black Sea region, cowpea is cultivated in Sinop and Kastamonu provinces and some villages of Samsun's Çarşamba district to supply only family requirements[4]. There are several research on cowpea in Black Sea region[5-8].

The study was carried out to compare the cowpea genotypes from different locations in Turkey, in terms of seed yield and yield related characters. In addition, correlation and path coefficients between all investigated characteristics were determined.

MATERIALS AND METHODS

The study was conducted at the Agricultural Faculty Experimental Field in Ondokuz Mayıs University, Samsun (41.3°N, 36.3°E), Turkey in 2002 and 2003. The average temperature and total rainfall during the field experiment were 20.77°C and 235.7 mm in 2002 and 20.28°C and 387.3 mm in 2003, respectively. Six cowpea genotypes from different locations in Turkey and two registered cultivars (Akkız-86 and Karagöz-86) as control were used in the study (Table 1). Days to emergence and days to first flowering from sowing and 100 seed weight were established. Plant height, first pod height, number of branches and pods per plant, pod length and number of seeds per pod, dry straw yield per plant and seed yield per plant were determined in ten plants or ten pods randomly selected from each plot. Plants were dried at 80°C for 48 h to determine the dry straw weight per plant. Sowing was performed on 23 May 2002 and 20 May 2003 by hand. Distance between rows and plants in a row were 60 cm

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Table 1: The names and collection sites of cowpea genotypes

Cowpea genotypes	Collection sites
Akkız-86*	Izmir
Karagöz-86*	Izmir
Dalbahçe	Dalbahçe-Çarşamba
Doğanca	Doğanca-Bafra
Durağan	Durağan-Sinop
Iğdır	Iğdır
Kirazlık1	Kirazlık-Tekkeköy
Kirazlık2	Kirazlık-Tekkeköy

*: Registered by Ege University, Faculty of Agriculture

and 10 cm, respectively. The soil of experimental area was heavy clay, slightly acidic, without lime and salt, medium in phosphorus and rich in potassium and organic matter. Ammonium sulphate was applied at the rate of 40 kg N ha^{-1} as a starter dose. Plants were irrigated when they need water.

The study was planned in randomized complete block design with three replications. Combined analysis of variance over years was performed. TARIST and SPSS statistical program were used to carry out statistical analysis. Means showing significance statistically were compared using Least Significance Difference (LSD) Test at 0.05 or 0.01 probability level related to significance level of means. Data for seed yield per hectare were subjected to analysis of covariance to reduce the error sourced from differences in the number of harvested plants. Simple linear correlations and path coefficients between seed yield per plant and yield related characters were also calculated.

RESULTS AND DISCUSSION

Durağan, Iğdır and Kirazlık 2 genotypes had mustard seed coat, while the others had white. The flower colours of Akkız-86 and Karagöz-86 were white. Kirazlık 1 had light purple flowers and the rest of the cowpea genotypes had purple flowers. Cowpea genotypes showed highly significant ($P<0.01$) differences for days to emergence and days to the first flowering time. Days to emergence were varied between 7.67 in Kirazlık 2 and 11.83 days in Karagöz-86. Karagöz-86, Iğdır and Akkız-86 were late emerging genotypes. Elapsed time to first flowering was the longest in Iğdır, Doğanca and Durağan (Table 2).

Highly significant differences ($P<0.01$) were found between genotypes for plant height and first pod height. Plant height was ranged from 126.25 cm in Durağan to 68.77 cm in Kirazlık 2. Doğanca and Durağan which have climbing plant type were the most longest genotypes for first pod height. Means of the genotypes for the first pod height were varied between 43.83 cm in Doğanca and 26.23 cm in Akkız-86. Although Akkız-86 and Karagöz-86 had more the number of branches and pods per plant than the other cowpea genotypes, there were no significant

Table 2: Seed coat, flower colour and means of days to emergence and the first flowering time for cowpea genotypes

Cowpea genotypes	Seed coat colour	Flower colour	Days to emergence	Days to first flowering
Akkız-86	White	White	11.00a	59.67bc
Karagöz-86	White	White	11.83a	60.50b
Dalbahçe	White	Purple	8.17b	55.33c
Doğanca	White	Purple	8.17b	72.33a
Durağan	Mustard	Purple	8.00b	70.33a
Iğdır	Mustard	Purple	11.67a	73.17a
Kirazlık1	White	Light purple	8.67b	59.17bc
Kirazlık2	Mustard	Purple	7.67b	58.00bc
LSD			1.294**	4.714**

**: There are no significant differences ($P<0.01$) among means indicated by the same letters

differences among genotypes for branches and pods number per plant. Karagöz-86 has produced the longest pods (16.06 cm), while Kirazlık 2 has produced the shortest pods (12.62 cm). Karagöz-86 gave the lowest seeds number per pod, although it has more and longer pods than the others. The highest value for the seeds number per plant was obtained from Doğanca (12.29 seeds $plant^{-1}$). Weight of 100 seeds was ranged from 21.84 g in Karagöz-86 to 9.40 g in Iğdır. There was no statistically significant differences among genotypes for the dry straw weight per plant. The greatest seed yield per plant was obtained from Karagöz-86 (10.70 g $plant^{-1}$) due to its high 100 seed weight. This followed by Doğanca (8.27 g $plant^{-1}$) and the rest of the genotypes were not statistically different from each other. Seed yield per hectare ranged from 680.2 kg ha^{-1} in Akkız-86 to 1120.9 kg ha^{-1} in Kirazlık 2. Akkız-86 and Karagöz-86 had highly significantly lower seed yield per hectare than the other genotypes because of their poor emergence in both years (Table 3). Plant density was under optimum density for Karagöz-86 and Akkız-86 cultivars in both year, although their seed were sown in several times.

Simple linear correlations among some morphological characteristics and seed yield per plant in cowpea genotypes are given in Table 4. Plant height showed strong positive correlation with the first pod height and dry straw weight per plant. A positive and significant correlation was found between plant height and the number of seeds per pod. First pod height was positively and highly significantly correlated with the number of seeds per pod and dry straw weight per plant. A negative and highly significant correlation was found between first pod height and the number of branches per plant. The number of pods per plant was increased with increases in the number of branches per plant (Table 4). Hundred seed weight was positively and highly significantly correlated with pod length, while it was negatively and highly significantly correlated with the number of seeds per pod. Pod length and 100 seed weight showed a positive and highly significant correlation with seed yield per plant

Table 3: Means of cowpea genotypes for some morphological characteristics and seed yield per plant and seed yield per hectare

Genotypes	pH	FPH	BN	PN	PL	SN	HSW	SDW	PSY	SY
Akkız-86	68.90c	26.23b	1.28	10.52	12.73fg	10.13cd	12.86c	89.27	5.73b	680.2c
Karagöz-86	81.68bc	29.47b	1.33	10.90	16.06a	9.27d	21.84a	89.77	10.70a	751.2bc
Dalbahçe	71.43c	27.93b	1.12	9.72	13.25de	11.44ab	10.89d	89.89	6.35b	993.6a
Doğanca	108.48ab	43.83a	1.05	8.20	13.91c	12.29a	14.37b	87.20	8.27ab	1093.1a
Durağan	126.25a	40.83a	1.23	9.17	14.93b	11.62ab	11.60cd	89.70	6.33b	1078.6a
Iğdır	75.17c	37.45a	1.18	9.98	13.08d-f	11.06bc	9.40e	88.20	5.52b	922.1ab
Kirazlık1	76.78c	30.23b	1.18	9.75	13.54cd	11.37ab	11.69cd	88.77	7.74b	1066.6a
Kirazlık2	68.77c	29.88b	1.05	9.05	12.62g	9.97cd	12.33c	89.16	6.68b	1120.9a
LSD	29.675**	7.113**	ns	ns	0.628**	1.189**	1.401**	ns	2.817**	22.33**

ns: Non significant, **:There are no significant differences (P<0.01) among means indicated by the same letters. PH: Plant height (cm), FPH: First pod height (cm), BN: Branches number per plant, PN: Pods number per plant, PL: Pod length (cm), SN: Seeds number per pod, HSW: 100 seed weight (g), SDW: Dry straw weight per plant (g plant^{-1}), PSY: Plant seed yield (g plant^{-1}), SY: Seed yield (kg ha^{-1})

Table 4: Simple linear correlations among some morphological characteristics and seed yield per plant

Traits	FPH	BN	PN	PL	SN	HSW	SDW	PSY
PH	0.753**	-0.259ns	0.197ns	-0.122ns	0.360*	-0.225ns	0.615**	-0.150ns
FPH	-	-0.427**	-0.234ns	-0.100ns	0.484**	-0.267ns	0.390**	-0.226ns
BN	-	-	0.320*	0.373**	-0.233ns	0.279ns	-0.351*	0.193ns
PN	-	-	-	-0.057ns	-0.168ns	0.048ns	0.135ns	0.100ns
PL	-	-	-	-	-0.066ns	0.718**	-0.255ns	0.543**
SN	-	-	-	-	-	-0.497**	0.099ns	-0.157ns
HSW	-	-	-	-	-	-	-0.240ns	0.509**
SDW	-	-	-	-	-	-	-	-0.161ns

ns: Non significant, **:There are no significant differences (P<0.01) among means indicated by the same letters. PH: Plant height (cm), FPH: First pod height (cm), BN: Branches number per plant, PN: Pods number per plant, PL: Pod length (cm), SN: Seeds number per pod, HSW: 100 seed weight (g), SDW: Dry straw weight per plant (g plant^{-1}), PSY: Plant seed yield (g plant^{-1})

Table 5: The direct and indirect effects of some morphological characteristics on seed yield per plant

		Indirect effects							
Traits	Direct effects	PH	FPH	BN	PN	PL	SN	HSW	SDW
PH	0.0346	-	-0.1535	0.0347	0.0224	-0.0543	0.0160	-0.0438	-0.0590
FPH	-0.2038	0.0261	-	0.0571	-0.0265	-0.4430	0.0215	-0.0520	-0.0037
BN	-0.1339	-0.0090	0.0869	-	0.0363	0.1657	-0.0104	0.0544	0.0034
PN	0.1134	0.0068	0.0476	-0.0429	-	-0.0254	-0.0075	0.0093	-0.0013
PL	0.4436	-0.0042	0.0203	-0.0500	-0.0065	-	-0.0029	0.1401	0.0024
SN	0.0444	0.0125	-0.0987	0.0312	-0.0190	-0.0291	-	-0.0969	-0.0009
HSW	0.1952	-0.0078	0.0543	-0.0373	0.0054	0.3185	-0.0221	-	0.0023
SDW	-0.0096	0.0213	-0.0795	0.0470	0.0153	-0.1133	0.0044	-0.0468	-

PH: Plant height (cm), FPH: First pod height (cm), BN: Branches number per plant, PN: Pods number per plant, PL: Pod length (cm), SN: Seeds number per pod, HSW: 100 seed weight (g), SDW: Dry straw weight per plant (g plant^{-1}), PSY: Plant seed yield (g plant^{-1})

(Table 4). Simple correlation coefficients indicated that seed yield per plant was correlated significantly and positively with pods per plant, seeds per pod and branches per plant[9]. Seed yield was significantly and positively correlated with branches per plant, inflorescences per plant, pods per plant, pod length, seeds per pod, 100 seed weight and harvest index[10].

Pod length, 100 seed weight and pods number per plant showed positive direct effects on seed yield per plant, first pod height and branches number per plant had the highest negative indirect effects on seed yield per plant. Pod length, 100 seed weight and pods number per plant were the most important yield components because of their positive direct effects on seed yield per plant (Table 5).

Kalaiyarasi and Palanisamy[11] determined that pod length had negative direct effect on seed yield per plant, while Choulwar and Borikar[12] found a positive direct effect for pod length on seed yield per plant. The number of pods per plant and 100 seed weight had positive direct effects on seed yield per plant[13,14]. In contrast to our finding for the number of branches, Chikkadyavaiah[15], Kalaiyarasi and Palanisamy[11,16] found that this variable had direct positive effect on seed yield per plant.

Ombakho and Tyagi[17] informed that seeds per pod, pods per plant and pod length would be the most useful components for selection. The most important yield components were number of pods per plant, 100 seed weight and number of seeds per pod[18]. The number of seeds per pod and 100 seed weight were the main contributing characters towards the seed yield. Pod length contributed indirectly towards seed yield via the number of seeds per pod and 100 seed weight[19]. Vineeta Kumari *et al.*[14] found that selection for higher seed yield should involve early-maturing genotypes with high 100 seed weight and number of clusters and pods per plant.

All genotypes except for Akkız-86 and Karagöz-86 were the superior for seed yield per hectare. Doğanca, Durağan and Iğdır were the most latest genotypes in terms of elapsed time to first flowering, but they completed their flowering period in a short time.

In conclusion, it was determined that Kirazlık 2, Doğanca, Durağan, Kirazlık 1 and Dalbahçe could be recommended as prominent cowpea genotypes for Black Sea Region. In addition to high seed yield, Doğanca had extra advantage due to its large and white seeds.

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