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Determination of Genotypical Differences for Leaf Characteristics in Cowpea (*Vigna unguiculata* L. Walp.) Genotypes

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Abstract: Leaf characteristics of ten cowpea genotypes, including registered Cv. Akkız-86 and Karagöz-86, from diverse locations in Turkey and relationships among leaf characteristics such as length of leaf, petiole, petiolule and terminal leaflet, terminal leaflet width and leaf area were determined. Significant differences were found among genotypes in terms of leaf and petiole length while highly significant differences found for petiolule length. There were no significant differences among genotypes for width and length of terminal leaflet and leaf area. Terminal leaflet length positively and significantly correlated with petiole and petiolule length. Positive and highly significant correlations were found between the other leaf characteristics.

Key words: Cowpea, leaf area, leaf characteristics, correlation

INTRODUCTION

Morphological characteristics of plants are commonly used in the description of varietal differences. Leaves, the photosynthetic organs of the plant, have important effect on plant growth and seed yield. The flat leaf blade is specialized for catching sunlight. Leaves vary greatly from plant to plant and are useful in classification and identification.

Leaf appearance in crop plants is an important process involved in canopy development^[1]. There is wide range among plant genotypes in shape, size and number of leaves produced by plants. Dorchester^[2] determined that leaflet shape could be used as an adequate morphological marker to distinguish soybean cultivars. It was found that these differences in leaf shape could be used to distinguish varieties from one another, especially those having similar seed characters. Sawada^[3] has developed a leaf shape index (aspect ratio) and has shown that this index can describe variations in soybean (*Glycine max* L. Merr.) leaflet shape. It is necessary to correctly evaluate intra- and inter-specific variations for the efficient collection and preservation of genetic resources and leaf shape is one of the important characteristics to be evaluated^[4]. It was reported that leaf area, length, diameter and pod weight were positively correlated with green pod yield per plant^[5]. Cowpea genotypes used in the present study were evaluated for seed yield and yield related characters^[6] and their fresh pod yields^[7] in preceding studies.

This study was conducted to determine genotypical differences in leaf characteristics and relationships among those characteristics in some cowpea (*Vigna unguiculata* L. Walp.) genotypes. The other objective of the study was to contribute to the conservation of natural cowpea genetic resources.

MATERIALS AND METHODS

The field trial was carried out in the experimental area of Faculty of Agriculture, Ondokuz Mayıs University in 2004, Samsun, Turkey. Totally ten cowpea genotypes, including registered Cv. Akkız-86 and Karagöz-86, from diverse location in Turkey were used in the study (Table 1).

The soil of experimental area was heavy clay, slightly acidic, without lime and salt, medium in phosphorus and rich in potassium and organic matter. The study was designed in Randomized Complete Block Design with

Table 1: Cowpea genotypes and their collection sites

| Cowpea genotypes | Collection sites |
|------------------|--------------------------|
| Akkız-86* | Izmir |
| Karagöz-86* | Izmir |
| Dalbahçe | Dalbahçe-Çarşamba/Samsun |
| Doğanca | Doğanca-Bafra/Samsun |
| Durağan | Durağan/Sinop |
| G10 | Manisa |
| G18 | Turgutlu/Manisa |
| Iğdır | Iğdır |
| Kirazlık1 | Kirazlık-Tekkeköy/Samsun |
| Kirazlık2 | Kirazlık-Tekkeköy/Samsun |

*: Registered by Ege University, Faculty of Agriculture, Izmir-Turkey

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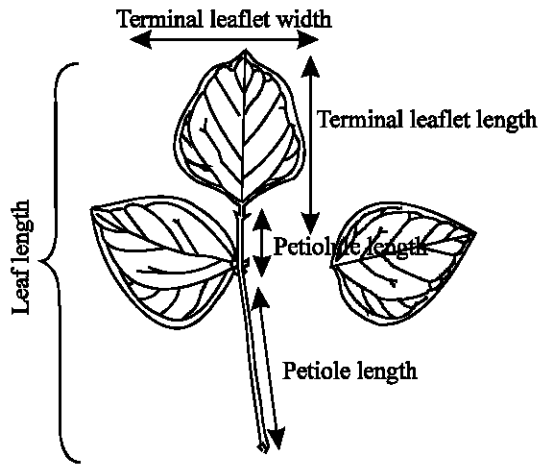


Fig. 1: Leaf parts used to describe cowpea leaf characteristics

three replications. Seeds were sown in plots having four rows of 5 m length with 60 cm inter row spacing by hand on May 24, 2004. Distance between the plants in same row was 10 cm. Plants were irrigated when they required. Ammonium sulphate was applied at the rate of 40 kg N⁻¹ ha.

Cowpea leaves were sampled from randomly selected plants at the full flowering stage. Ten cowpea leaves from each replication for each genotype were collected from the seventh node of the main stem. Leaf length, petiole (leaf stalk) and petiolule (leaflet stalk) length, terminal leaflet width and length were recorded in centimeter. Then, leaf samples were scanned by a flatbed scanner. Delta-T SCAN (Ver. 2.04) image analyzer program was used to determine cowpea leaf area^[8]. Measured leaf parts to determine cowpea leaf characteristics are shown in Fig. 1.

Data on six leaf characteristics was subjected to analysis of variance using the MSTATC Statistical Package Program. Means showing statistically significance were compared by Duncan's Multiple Range Test. Correlation analysis was used to determine relationships among leaf characteristics. In addition, standard error of the mean, standard deviation, range and coefficient of variation for leaf characteristics were also calculated.

RESULTS AND DISCUSSION

Cowpea has a compound leaf with three leaflets attached to leaf stalk. A true cowpea leaf consists of two asymmetrical lateral leaflets and one symmetrical terminal leaflet with longer petiolule than that of lateral ones.

Significant differences ($p < 0.05$) were found among genotypes in terms of leaf and petiole length while highly

significant differences ($p < 0.01$) found for petiolule length (Table 2). Analysis of variance results showed that there were no significant differences among genotypes for width and length of terminal leaflet and leaf area. Standard error of the mean, standard deviation, range and coefficient of variation for leaf length, petiole and petiolule length, width and length of terminal leaflet and leaf area of cowpea genotypes are shown in Table 2.

The highest leaf length determined in Iğdır (26.01 cm), followed by Doğanca (25.64 cm), Durağan (24.79 cm), G18 (24.11 cm), G10 (23.08 cm) and Dalbahçe (22.86 cm). Karagöz-86 had the shortest leaf length (20.84 cm) (Table 2).

Iğdır was at the first rank in terms of petiole length (13.53 cm) (Table 2) and it wasn't statistically different from Doğanca (13.09 cm), Durağan (12.72 cm), G18 (11.71 cm) and Dalbahçe (11.06 cm) for petiole length (Table 2).

Toker *et al.*^[9] evaluated different Mung bean genotypes for agronomic, morphological and phenological characters and they found that petiole length was 7 to 15 cm.

Cowpea genotypes weren't statistically different from the each other for terminal leaflet width length. Terminal leaflet width varied between 6.32 (Kirazlık2 and Karagöz-86) and 7.52 cm (Doğanca). Terminal leaflet length was found between 8.72 cm in Kirazlık2 and 10.40 cm in G10 (Table 2).

Petiolule length highly significantly ($p < 0.01$) affected by genotypes. The highest value obtained from G10 (2.71 cm). Petiolule length of Akkız-86 (1.97 cm), Karagöz-86 (1.94 cm), G18 (2.13 cm) and Kirazlık2 (2.13 cm) highly significantly lower than that the others (Table 2). In another study on Mung bean genotypes, petiolule length was found between 2 and 4 cm^[9].

There was no statistically a difference among cowpea genotypes in terms of leaf area. Leaf area varied between 103.85 cm² in Cv. Karagöz-86 and 141.41 cm² in Doğanca (Table 2). Leaf surface of all cowpea genotypes was blistered. There were anthocyanin pigmentation on petiole in Karagöz-86, Dalbahçe, Durağan, Iğdır, Kirazlık1 and Kirazlık2.

Terminal leaflet length positively and significantly correlated with petiole length ($r = 0.395^*$) and petiolule length ($r = 0.384^*$). Positive and highly significant correlations were found between the other leaf characteristics. Leaf characteristics such as leaf length, terminal leaflet width and terminal leaflet length were the characteristics most strongly correlated with leaf area (Table 3).

Description of cowpea genotypes, especially those having similar seed characters, according to their agronomic and morphological characteristics doesn't

Table 2: Means of leaf characteristics in cowpea genotypes

| Cowpea genotypes | Leaf length (cm) | | | | | Petiole length (cm) | | | | | Terminal leaflet width (cm) | | | | |
|------------------|------------------|-------------------|------|-------------|-------|---------------------|-------------------|------|------------|-------|-----------------------------|-------------------|------|------------|-------|
| | n | $\bar{x} \pm S_x$ | S | range | CV % | n | $\bar{x} \pm S_x$ | S | range | CV % | n | $\bar{x} \pm S_x$ | S | range | CV % |
| Akkız-86 | 28 | 21.74±0.63cd* | 3.35 | 15.50-27.40 | 15.41 | 28 | 10.21±0.43cd* | 2.29 | 5.60-13.90 | 22.45 | 28 | 6.83±0.17 | 0.90 | 5.60-8.60 | 13.18 |
| Karagöz-86 | 28 | 20.84±0.53d | 2.83 | 15.40-26.30 | 13.57 | 28 | 9.71±0.39d | 2.04 | 5.60-13.10 | 20.99 | 28 | 6.32±0.14 | 0.72 | 5.10-7.90 | 11.40 |
| Dalbahçe | 29 | 22.86±0.36a-d | 1.96 | 20.00-27.20 | 8.59 | 29 | 11.06±0.27a-d | 1.43 | 9.20-14.50 | 12.93 | 29 | 6.73±0.13 | 0.70 | 5.80-8.30 | 10.36 |
| Doğanca | 30 | 25.64±0.62ab | 3.38 | 20.40-33.00 | 13.19 | 30 | 13.09±0.44ab | 2.41 | 8.60-17.80 | 18.42 | 30 | 7.52±0.18 | 0.98 | 5.70-10.10 | 13.08 |
| Durağan | 30 | 24.79±0.44a-c | 2.39 | 20.20-29.10 | 9.64 | 30 | 12.72±0.27a-c | 1.47 | 9.50-15.60 | 11.60 | 30 | 7.12±0.17 | 0.95 | 5.40-8.50 | 13.35 |
| G10 | 30 | 23.08±0.72a-d | 3.95 | 15.50-29.00 | 17.13 | 30 | 9.97±0.61d | 3.36 | 3.90-15.40 | 33.68 | 30 | 6.63±0.16 | 0.89 | 5.00-8.20 | 13.45 |
| G18 | 30 | 24.11±0.45a-d | 2.46 | 17.10-28.20 | 10.22 | 30 | 11.71±0.35a-d | 1.92 | 6.00-15.70 | 16.42 | 30 | 6.92±0.14 | 0.75 | 5.60-8.80 | 10.90 |
| Iğdır | 27 | 26.01±0.47a | 2.45 | 21.80-31.90 | 9.41 | 27 | 13.53±0.40a | 2.07 | 9.70-18.00 | 15.30 | 27 | 7.39±0.10 | 0.53 | 6.40-8.40 | 7.12 |
| Kirazlık1 | 30 | 22.38±0.44b-d | 2.39 | 18.10-26.60 | 10.66 | 30 | 10.59±0.33cd | 1.82 | 7.00-14.10 | 17.17 | 30 | 7.08±0.16 | 0.88 | 5.50-9.00 | 12.46 |
| Kirazlık2 | 30 | 21.58±0.42cd | 2.29 | 16.90-25.60 | 10.60 | 30 | 10.72±0.33b-d | 1.82 | 7.60-13.70 | 16.93 | 30 | 6.32±0.14 | 0.75 | 5.10-8.00 | 11.94 |

| Coepea genotypes | Terminal leaflet length (cm) | | | | | Petiole length (cm) | | | | | Leaf area (cm ²) | | | | |
|------------------|------------------------------|-------------------|------|------------|-------|---------------------|-------------------|------|-----------|-------|------------------------------|-------------------|-------|---------------|-------|
| | n | $\bar{x} \pm S_x$ | S | range | CV % | n | $\bar{x} \pm S_x$ | S | range | CV % | n | $\bar{x} \pm S_x$ | S | range | CV % |
| Akkız-86 | 28 | 9.56±0.21 | 1.12 | 7.20-11.50 | 11.66 | 28 | 1.97±0.08c** | 0.44 | 1.30-3.40 | 22.13 | 28 | 125.46±5.53 | 29.25 | 77.63-202.21 | 23.32 |
| Karagöz-86 | 28 | 9.19±0.21 | 1.09 | 7.00-11.30 | 11.89 | 28 | 1.94±0.07c | 0.37 | 1.20-2.70 | 19.31 | 28 | 103.85±4.41 | 23.33 | 72.78-149.49 | 22.46 |
| Dalbahçe | 29 | 9.46±0.15 | 0.79 | 8.40-11.40 | 8.33 | 29 | 2.34±0.07a-c | 0.37 | 1.20-3.10 | 15.88 | 29 | 123.02±4.40 | 23.70 | 85.09-189.92 | 19.27 |
| Doğanca | 30 | 9.85±0.23 | 1.28 | 7.10-12.40 | 13.00 | 30 | 2.69±0.09a | 0.48 | 1.90-3.50 | 18.01 | 29 | 141.41±5.83 | 31.40 | 81.90-205.63 | 22.20 |
| Durağan | 30 | 9.50±0.18 | 1.00 | 8.00-11.90 | 10.55 | 30 | 2.57±0.09ab | 0.47 | 1.50-3.80 | 18.42 | 30 | 130.66±5.21 | 28.54 | 84.69-178.34 | 21.84 |
| G10 | 30 | 10.40±0.14 | 0.79 | 8.80-12.10 | 7.60 | 30 | 2.71±0.12a | 0.65 | 1.60-3.90 | 24.12 | 30 | 128.93±5.09 | 27.86 | 84.75-187.38 | 21.61 |
| G18 | 30 | 10.27±0.18 | 0.98 | 8.10-12.20 | 9.53 | 30 | 2.13±0.08bc | 0.44 | 1.30-2.90 | 20.56 | 30 | 135.75±5.05 | 27.64 | 93.17-187.14 | 20.36 |
| Iğdır | 27 | 9.78±0.20 | 1.04 | 7.80-12.10 | 10.58 | 27 | 2.70±0.10a | 0.51 | 1.60-3.70 | 18.92 | 27 | 140.75±4.29 | 22.28 | 107.20-184.96 | 15.83 |
| Kirazlık1 | 30 | 9.37±0.19 | 1.07 | 7.20-11.40 | 11.37 | 30 | 2.41±0.08a-c | 0.41 | 1.70-3.20 | 17.10 | 30 | 128.34±6.15 | 33.63 | 85.74-194.29 | 26.23 |
| Kirazlık2 | 30 | 8.72±0.19 | 1.04 | 6.90-11.80 | 11.90 | 30 | 2.13±0.08bc | 0.44 | 1.20-3.00 | 20.54 | 30 | 105.81±4.54 | 24.88 | 68.04-158.54 | 23.51 |

n: the number of leaf samples, \bar{x} : mean, S_x : standard error of the mean, S: standard deviation, CV: coefficient of variation, k: significantly at 0.5 probability level, **: significant at 0.01 probability level

Table 3: Correlations among leaf characteristics in cowpea genotypes

| Leaf characteristics | Terminal leaflet width | Terminal leaflet length | Petiole length | Petiole length | Leaf area |
|-------------------------|------------------------|-------------------------|----------------|----------------|-----------|
| Leaf length | 0.821** | 0.657** | 0.943** | 0.658** | 0.821** |
| Terminal leaflet width | - | 0.625** | 0.747** | 0.499** | 0.938** |
| Terminal leaflet length | | - | 0.395* | 0.384* | 0.815** |
| Petiole length | | | - | 0.525** | 0.669** |
| Petiole length | | | | - | 0.497** |

*: Significant at 0.05 probability level, **: Significant at 0.01 probability level

always give consistent and reliable results. Therefore, molecular studies should be conducted in parallel with agronomic and morphological studies to obtain more reliable results.

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