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# COWPEA (*VIGNA UNGUICULATA* L.) – AN ALTERNATIVE CROP FOR DRY AREAS

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**Abstract**

Cowpea is traditionally grown in some regions of Europe. In Bulgaria cowpea is grown in a few regions near the boarders of Turkey and Greece. The cowpea seeds are still maintained on small areas by families and passed down through the generations. Cowpea is a drought tolerant crop, needs low inputs and can be grown under harsh environmental conditions. The only collection of cowpea (V. unguiculata L.) is maintained at the Institute of Plant Genetic Resources (IPGR). The origin of the collection is predominantly from abroad. In recent years, we collected local plant material to enrich the number of accessions with a local origin. Ten accessions originated from Svilengrad and Dimitrovgrad - these regions were evaluated by morphological, agro-biological characteristics and agronomic traits to select the best accessions with early maturity, yield per plant, pod and seed morphology. The characterization was done at the experimental field at the IPGR under dry conditions. Most of the accessions showed medium or late maturity with more than 75 days, only three accessions completed a maturation cycle for 72 days, as follows cat. No A4E0084, A4E0081 and A4E0007. The highest yield per plant was obtained by accessions with cat. No A8E0492 (32.6 g) and cat. No A4E0084 (29.8 g).
**Keywords:** collection, cowpea, characterization, local origin

## INTRODUCTION

Cowpea (Vigna unguiculata L.) is a grain legume crop widely grown in the dry savanna areas as an intercrop with millet, sorghum, maize and groundnut (Boukar et al. 2013). In Bulgaria cowpea is grown from immemorial time in the southern and southeastern parts of the country (Stoilova, 2013). At the Institute of Plant Genetic Resources (IPGR) the collection of 302 accessions of cowpea was maintained of diverse origin, predominantly received from the International Institute of Tropical Agriculture (IITA), Ibadan Nigeria. In order to be better utilized the collections of the plant genetic resources need to be characterized with different aspects, namely morphologically, agro-biologically, resistance to biotic and abiotic stress factors, as well as to analyze the nutritional value of the plant materials (Sinkovic et al. 2019). The previous studies on the diversity of the cowpea accessions from the national cowpea collection showed a great diversity in terms of morphological vegetative characters, beginning and duration of phenological phases, pods and seeds morphology (Stoilova, 2013). Many villages and small towns were depopulated in recent decades, that's why our purpose was to collect and preserve local germplasm still maintained in our country. Ten landraces of cowpea were collected from the regions of Dimitrovgrad and Svilengrad, where the crop is known by its vernacular names such as "Roglyo" and "Bebridja". Cowpea is a multipurpose annual crop grown as vegetable and grains for human consumption, as forage for livestock and for use as a green manure (Rao and Shahid, 2011). The nutritional value of cowpea seeds is similar to those of the common bean seeds. The chemical composition of cowpea seeds were reported as follows: protein ranged between from 17,4 to 31,7%, carbohydrates 35,7-65,7%, fat 1,00 to 3,03, dietary fiber from 19,5 to 35,6% and mineral content from 2,6 to 4,6% (Thangadurai,

2005, Frota et al. 2008). Cowpea seeds are rich in biologically active compounds. The cowpea seeds were reported as a good source of essential fatty acids, as linoleic (n-6) and linolenic (n-3) (Antova et al. 2014). Increasing the occurrences of drought and heat stress and modification of seasoning duration due to climate changes have lead to an enhanced interest by farmers to drought tolerant alternative crops. Cowpea is a drought tolerant crop and it is grown in many countries and regions worldwide during dry summer (Berova et al. 2012). Rivas et al. (2016) reported for a yield production of one ton of grain per ha obtained under dry conditions. The cowpea drought tolerance was explained by the less sensitivity of the leaf gas exchange to water deficit and the rapid recovery of photosynthesis after rehydration. Four accessions of cowpea, two of local and two of foreign origin were studied for their drought tolerance. The study on the drought tolerance of two local and two foreign accessions showed that the plants grown under non–irrigation conditions had earlier flowering and a shorter vegetative cycle compared to the irrigated accessions (Berova et al. 2012).

This study was focused on cowpea landraces with a diversity of morphological characteristics related to the size and the number of pods and seeds which directly influences the plant productivity.

## MATERIALS AND METHODS

The experiment was carried out during 2019-2020, at the Institute of Plant Genetic Resources (IPGR) Sadovo. The Institute is situated in the Thracian plane (South Central Bulgaria) on cinnamonic-forest soil with a neutral pH. The particular climate, mainly with high temperature amplitudes, advice the development and selection of early maturing varieties for all grain legume crops. The vegetative cycle of the plants is strongly affected by high summer temperatures and low air humidity.

The cowpea landraces included in this study originated from Svilengrad and Petrich regions. The evaluation data was collected using the International Cowpea descriptor (IBPGR, 1983). The main quantitative characteristics were: number of days to flowering, days to maturity, plant height (cm), number of pods per plant, number of seeds per pod, total seed weight per plant, seed length, seed wide, seed thickness, 100 seed weight. The qualitative characteristics related to the size, shape and color of seeds. Mean, minimum and maximum values, standard error, standard deviation, coefficient of variation (CV%) were determined for all morphological characters.

## RESULTS AND DISCUSSION

Most cowpea accessions started flowering 55 days after the germination and some of them showed late flowering after 62 days. The duration of the flowering for all accessions was registered between 18 and 22 days. Most accessions matured for a period of 76 days.

There was a considerable variation for all studied characters except for the duration of the flowering and the number of days to maturity (Table 1). The minimal height of the plant measured was 42,8 cm and the maximal to 62,8 cm, the average being 52,8 cm. Eight number of accessions demonstrated erect growth habit and two accessions showed indeterminate type. The most important characteristics for the food legume crops including cowpea (V. unguiculata L.) are the number of pods per plant, the number of seeds per plant, which is related to the production of the accessions, as well as the weight of seeds per plant. The variations in the number of pods/plant, the weight of pods/plant and the weight of 100 seeds were higher among the other morphological characters. The variation in the number of pods per plant was the highest

with 22, 5 (Table 1). The accessions with the highest values were recorded as follows: A7E0735, A8E0542 and A8E0562, varying from 13,8 to 14,0 number of pods/plant. The higher weight of seeds per plant were produced by accessions A8E0562 (31,6 g) and A8E0542 (28,8 g). The biggest seeds size measured as 100 seed weight were registered with accessions with cat. No A9E1105 (28,0 g), cat. No A8E0523 (25,3 g), and the smallest seeds were found with accession cat. No A8E0542 (15,4 g).

**Table 1.** Morphological observation on local cowpea accessions.

| № | Cat. № | Origin | Duration of flowering (days) | Number of days to maturity | h of plant (cm) | Number of pods/pl. | Weight of pods/pl. (g) | Weight of 100 seeds (g) |
|---|---|---|---|---|---|---|---|---|
| 1 | A7E0735 | Kavarna | 18,0 | 76,0 | 52,6 | 14,0 | 21,6 | 16 |
| 2 | A8E0523 | Dabovets | 18,0 | 76,0 | 51,4 | 8,6 | 18,5 | 25,3 |
| 3 | A8E0542 | Yerusalimovo | 18,0 | 76,0 | 62,8 | 14,0 | 28,8 | 15,4 |
| 4 | A8E0551 | Yerusalimovo | 18,0 | 76,0 | 61,8 | 11,2 | 20,9 | 20,0 |
| 5 | A8E0553 | Yerusalimovo | 18,0 | 76,0 | 40,8 | 8,2 | 18,8 | 18,4 |
| 6 | A8E0563 | Kapitan-Andreevo | 22,0 | 76,0 | 42 | 9,4 | 22,1 | 24,6 |
| 7 | A8E0562 | Kapitan-Andreevo | 18,0 | 76,0 | 61,6 | 13,8 | 31,6 | 21,0 |
| 8 | A9E1073 | Haskovo | 22,0 | 76,0 | 46,6 | 8 | 20,0 | 22,3 |
| 9 | A9E1105 | Lyubimets | 18,0 | 76,0 | 59,4 | 10,2 | 25,8 | 28,0 |
| 10 | A9E1230 | Devin | 18,0 | 76,0 | 49,2 | 9,8 | 17,1 | 16,0 |
| | Minimum | | 18,0 | 76,0 | 40,8 | 8,00 | 17,1 | 15,4 |
| | Maximum | | 22,0 | 76,0 | 62,8 | 14,0 | 31,6 | 28,0 |
| | Mean | | 18,8 | 76,0 | 52,8 | 10,7 | 22,5 | 20,7 |
| | Standard Error | | 0,5 | 0,02 | 2,6 | 0,76 | 1,5 | 1,4 |
| | Standard Deviation (St. Dev.) | | 1,7 | 0,04 | 8,3 | 2,4 | 4,7 | 4,4 |
| | Coefficient of variation (CV%) | | 8,97 | 0,05 | 15,7 | 22,5 | 21,1 | 21,1 |

Among the yield components, the pod length, pod width, pod thickness, seed width and seed thickness were presented by low values of the CV (%) for the parameters studied, from 5,94 to 8,08%, respectively. Accessions with cat. No A8E0551, cat. No A8E0563 and cat. No A8E0562 produced the higher number of seeds per pod, as well as the higher weight of seeds per plant (Table 2). The results from the previous studies reported the strong environmental influence on the morphological characters (Stoilova, 2013). Duration of the vegetative cycle almost for all accessions is comparatively medium, which is related to the dry environmental conditions.

The seeds were characterized with different colors: white, cream, beige, brown, black etc. with different color of hilum (Fig. 1). The seeds of the accessions were characterized by a kidney shape.

**Table 2**. Mean, minimum, maximum and CV (%) of reproductive organs.

| № | Cat. № | Origin | Pod length (cm) | Pod width (mm). | Pod thickness (mm) | Number of seeds /pod | Seed length (mm) | Seed width (mm) | Seed thickness (mm) | Weight of seeds/pl. (g) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A7E0735 | Kavarna | 13,6 | 0,9 | 0,7 | 10 | 0,74 | 0,6 | 0,5 | 16,2 |
| 2 | A8E0523 | Dabovets | 14,6 | 0,96 | 0,76 | 8,8 | 1,08 | 0,7 | 0,5 | 16,0 |
| 3 | A8E0542 | Yerusalimovo | 15,8 | 0,94 | 0,66 | 10,6 | 0,74 | 0,7 | 0,52 | 22,8 |
| 4 | A8E0551 | Yerusalimovo | 16,6 | 0,9 | 0,7 | 13,4 | 0,84 | 0,7 | 0,56 | 16,8 |
| 5 | A8E0553 | Yerusalimovo | 15,8 | 0,9 | 0,8 | 10,2 | 0,9 | 0,7 | 0,6 | 15,2 |
| 6 | A8E0563 | Kapitan-Andreevo | 17,4 | 0,96 | 0,78 | 13,0 | 1,04 | 0,7 | 0,6 | 17,5 |
| 7 | A8E0562 | Kapitan-Andreevo | 17,2 | 0,96 | 0,8 | 12,0 | 1,0 | 0,7 | 0,6 | 24,2 |
| 8 | A9E1073 | Haskovo | 17,8 | 0,98 | 0,78 | 10,6 | 0,98 | 0,7 | 0,56 | 15,6 |
| 9 | A9E1105 | Lyubimets | 16,2 | 0,98 | 0,78 | 10,2 | 1,1 | 0,74 | 0,7 | 20,3 |
| 10 | A9E1230 | Devin | 16,2 | 0,8 | 0,7 | 10,6 | 0,72 | 0,56 | 0,5 | 13,6 |
| | Minimum | | 13,60 | 0,80 | 0,66 | 8,80 | 0,72 | 0,56 | 0,50 | 13,58 |
| | Maximum | | 17,80 | 0,98 | 0,80 | 13,40 | 1,10 | 0,74 | 0,70 | 24,24 |
| | Mean | | 16,12 | 0,93 | 0,75 | 10,94 | 0,91 | 0,68 | 0,56 | 17,82 |
| | Standard Error | | 0,40 | 0,02 | 0,02 | 0,45 | 0,05 | 0,02 | 0,02 | 1,10 |
| | Standard Deviation (St. Dev.) | | 1,28 | 0,06 | 0,05 | 1,43 | 0,15 | 0,05 | 0,06 | 3,48 |
| | Coefficient of variation (CV%) | | 7,94 | 5,94 | 6,81 | 13,04 | 16,05 | 8,08 | 11,31 | 19,51 |


**Fig. 1** Cowpea seed color and shape.

All analyzed samples and the results obtained enabled us not only to characterize, but also compare foreign accessions in terms of their productivity and adaptability to the local environments. The morphological characteristics may be used as a base to select the ones of special practical interest or those to be included in a breeding program or to be provided to the farmers for a direct use in the production system.

## CONCLUSION

The present research provided information on the local cowpea (Vigna unguiculata L.) germplasm and the accessions' diversity of morphological characters. Accession A9E1105 from Lyubimets showed a high weight of pods per plant – 25,8 g and a high 100 seed weight-28 g, while accession with cat. No A8E0542 produced the smallest seeds, with 100 seed weight of 15,4 g, accessions with cat. No A8E0562 and cat. No A8E0542 showed high values of weight of seeds/plant 22,4 g and 24,8 g, respectively.

The coefficient of variation (CV%) showed a high variability of the yield components: the number of pods/plant, the weight of pods/plant, the number of seeds/pod, the seed length and the weight of 100 seeds.

The accessions with desirable traits, early flowering and late maturity, high number of pods/plant, number of seeds/plant as well as high weight of seeds per plant will be included in the list for future experimental work.

The evaluation of the phenotypic variability gives us the possibility to select the most suitable of them for achieving the breeding objectives and meet farmers' preferences.

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