# STUDIES ON SOME QUALITY COMPONENTS IN A LANDRACE COLLECTION OF CLIMBING BEANS (*PHASEOLUS VULGARIS* VAR. *COMMUNIS*)

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**Abstract**
The study aimed at evaluating a landraces collection of climbing beans regarding some characters that contribute to quality of grains or green pods. The biological material was formed of 56 landraces and 2 varieties of climbing beans from which the grains or green pods can be used in food. The landraces were collected from western and southwestern Romania. The experimentation was performed over three years in a collection-type experience, arranged in three repetitions. As elements of quality we determined: the percentage of husks from beans, boiling coefficient, the percentage of bean total protein, 1000 grain weight, the percentage of sugar in green pods. The experimental data were processed by analysis of variance and applying the t-test for determination of differences from the variety 'Aurie de Bacau' used as a control. The collection includes precious populations for all studied characters, but their number is reduced. For the percentage of grain husks and the protein content of grain, the most populations are below the control variety. For sugar percentage in green pod and the coefficient of boiling, the landraces are similar to control variety. In the collection, there are populations that can be processed by selection or can be used as parents in hybridization programs.

**Keywords:** climbing beans, landraces, quality.

## Introduction

*Phaseolus vulgaris* L. is one of the traditional legumes in many countries in the world, that is why there is a very large number of varieties and landraces. The importance of food is given by the quality of the grains and pods which can be evaluated from various points of view. The study of nutritional value shows great diversity in minerals and organic substances. The lipid content may be 0.57-2.86 g /100 g DW, 18.55-29.69 g /100 g DW protein, 23.40-52.65 g /100 g DW sugar. In addition, there are significant amounts of N, P, K, Mg, Fe, Cu, Zn, Mn, B. Among the cultivated forms, we can also find some low-sugar content, good for diabetics, or others rich in protein (Gouveira Carla et al., 2014). Besides proteins, beans are a major source of dietary fiber and minerals, very useful in human nutrition (Poujola et al., 2007). Lately, cultivated varieties are less and less different in terms of quality. The landraces are more diverse in this respect, but they are about to disappear from culture (Singh, 2001). The studies show that the biochemical composition of bean seeds depends on genetic and environmental factors (Kigel, 1999). In quality study, it is important to know the genetic determinism of each component. The protein content is controlled by additive and non-additive genes. When selecting with a selection rate of 10%, an increase of up to 10.16% can be expected after a selection cycle (Noubissie et al., 2012). The protein content depends on the area from which the germplasm is. In some populations collected from Kosovo, the protein is in a smaller quantity. The accumulation of proteins and minerals varies depending on environmental conditions (Aliuet et al., 2014). To improve the bean quality of beans, the biological material should be well studied. In addition to the study of the biochemical composition, there is a need to study some of the characters related to the boiling process. But, the beans rich in protein and minerals boil harder and remain hard after boiling (Saha et al., 2009). For cooking, it is necessary to study the ability of grains to absorb water. They can be used as indicators: grain hydration coefficient, grain swelling coefficient. These characters have a high heritability and may be imposed on new varieties by choosing the genitors correctly in hybridization programs (Saba et al., 2016). Regarding the cooking skills, the boiling time is important. The swelling and hydration capacity of the beans is correlated with the boiling time. Dried beans can take up to 85 minutes to boil. Swollen beans are boiled much faster, requiring up to 30 minutes (Wani et al., 2017). The mass of 100 grains, the cooking time and the mineral content are correlated and can be used as selection criteria to improve cooking capacity. Some genotypes with a short cooking time (less than 24 minutes) have a high content of potassium, iron, zinc, copper (Dalfollo Ribeiro Nerinéia et al., 2014). The culinary quality elements can also be correlated with morphological characters of pods or grains. The genotype × environment interaction was significant for the characters of the raw pods: length, width, thickness and texture. The interactions between genotype and environment also appear for the characters of dried grains: length, width, thickness, volume, hardness and water absorption (Escribano et al., 1997). Regarding the quality of raw pods, the harvesting period is very important. The highest percentage of sugar is found in 15 days from blooming. At the same harvest period, obtain the highest content of carotene, and ascorbic acid is maximum at 7 days of blooming (Harunor and Hossain, 2014). The study of some varieties of reniform grains has revealed the existence of correlations between different types of sugars from the immature pods. There is a positive correlation between simple glucose and fructose. These studies lead to the recommendation of certain types of pods in different diets (Nienhuis et al., 2016). Studies on water absorption in grains were performed on genotypes of African origin. There are also positive correlations between the grain yield of the pods and the number of pods per plant, or between the shell content of the grains and water absorption (Balcha, 2010). The boiling time is correlated with the grain size. The water absorption is related to grain quality. The hydration index close to 100% indicates that the seeds absorb a quantity of water equal to their weight. This index may exceed 90%. The moisture capacity depends on the hardness of the bean skin (Lioi Lucia et al., 2012).

**Material and methods**

The purpose of the studies was to evaluate the variability for some characters that are quality components of the local garden bean germplasm, in order to find possible genitors, for use in breeding programs or in finding some populations which will be recommended to be grown in the areas of origin. The biological material used is the majority of bean garden landraces. They come from very different pedoclimatic zones in terms of soil and climate. Procurement of local populations was carried out by collecting in the field, from the counties of western and southwestern Romania. The basic points in the collecting activity were the localities with a traditional agriculture. The collection included 58 variants, of which 56 landraces and 2 varieties. The best known climbing beans variety is Aurie de Bacau, an old variety, used as a control. Along with this, we also studied the Juliska variety, from Hungary. The experimentation was organized as a collection field, with parcels sized to provide representative samples for each genotype studied. They were organized in two repetitions per plot. The samples were made up of 50 pods from each plot. The plants were obtained under traditional technological conditions, without any application of chemical fertilizers and without irrigation. The observations on yield quality have targeted both the quality of the grains and the pods. To determine the quality of the grains have been tested shells percentage, the protein content of grain, boiling coefficient, weight of 1000 grains, and for pods quality was determined the percentage of sugar in the raw pods. For all these attributes, were performed three determinations for each repetition. The percentage of shells was determined on samples of 10 g. The percentage of protein was determined using the Kjeldahl system. The boiling coefficient has been set by determining the average boiling time of a grain, each sample was constituted by 10 grains. The weight of 1000 grains was determined on samples consisting of 200 grains. The percentage of sugar in the raw pods was determined using the electronic refractometer. The obtained data were statistically processed by analysis of variance (Ciulca, 2006).

**Results and discussion**

The study of climbing bean landraces has led to some results which highlight a great variability of the collection. The shells percentage has varied within very wide limits, from 4.60% in the Pocola 1 landrace, up to 13.37% in Otelu Rosu 2 landrace. Valuable are the landraces with a low shells percentage, below the 7% limit. Of the evaluated populations, 17 populations showed the shells percentage below 7%. As valuable populations from this point of view, we may also note the landraces Oţelu Roşu 3, Tărcaia 3, Voiteg, Joia Mare 1 and Faget, populations where the shells percentage is below 6% (table 1). Compared to the control variety Aurie de Bacău, variety that has a fairly high shells percentage, it is found that in 15 landraces this character has significantly lower values. From figure 1 it is noted that of the 58 variants, most landraces fall within the limits of 7 and 10% (33 landraces). A percentage of shells above 10% was found in only 7 populations. From the general evaluation we can say that there is a representative set of valuable genotypes for low shell content in the collection. The boiling coefficient expresses the ability of the grains to boil in a shorter or longer time interval. The variability for the boiling coefficient was not very pronounced, the extreme values were 5.36 for the Vinga landrace and 10.56 for the Vinga 3 landrace. Very high values were shown by few populations. Over the boiling coefficient 10 were registered another 3 populations: Becicherecu Mic, Barsa and Sebis. Small values were recorded for Ortisoara and Vanatori 1 landraces (table 1). The control, being cultivated mainly for pods, has a high boiling coefficient. With regard to this character, the landraces are valuable, the vast majority having a boiling coefficient lower than the control; 35 of the landraces are statistically significant. Few landraces had higher boiling coefficient than the control. Regarding the boiling coefficient, in the studied collection, 40 of the landraces showed this character with values between 7 and 9. Low values (under 7) were reported in only 3 landraces, and very high values were reported for 4 landraces. According to estimations, we may observe that the population in the collection is valuable for the boiling coefficient, constituting a useful germplasm for improving this character (figure 2). The protein percentage of grain variability was between 22.10% for the Becicherecu Mic landrace and 28.04% for the Buteni 1 landrace. The most common values were between 24% and 26%. High values, over 27% protein in grain, were also presented for the Julita 1, Olari 1 and Fizis 2 landraces. The Aurie de Bacau variety, used as a control, had a 24.85% protein content in grains; compared to this, there are many superior but also inferior genotypes. Of the superior ones, statistical assurance exists for the differences between the control and other 18 genotypes. The inferior cases are 15. The results do not indicate a very big protein content, compared to the values reported in the literature. The protein content may exceed 30% of grain weight. The genetic variability for quality is very high, just that genes sources have to be searched for (Andrade Silva Camila et al., 2010). Generally, the percentage of protein is within the limits 18.55-29.69 g / 100 g DW (Gouveira Carla et al., 2014). The distribution of genotypes within the limits of variability shows that in the climbing bean collection, 28 of the 58 genotypes have a protein content of 24 - 26%. Populations rich in protein are a few, only 6 genotypes have a content above 27%. Neither those invaluable for this character are numerous, only in 5 cases the protein is below 23%. Although valuable forms are few, the collection is useful for the breeding process (figure 3). The sugar content in raw pods showed a fairly wide variability, the limits of the observed interval being 1.96% for the Julita 2 landrace and 7.29% for the Semlac landrace. In most genotypes, the recorded values were between 3% and 5%. More than 5% sugar content in raw pods was available in the case of the control variety Aurie de Bacau, but also in Paulean 2, Tarcaia 3, Bobda, Vanatori, Bolvasnita, Svinita, Joia Mare 1, Julita 3, Barsa, Cornereva landraces (Table 1).

Table 1. Results regarding the shells percentage, boiling coefficient, protein percentage and sugar percentage in raw pods in climbing bean genotypes

| No. | Genotype | Shells percentage (%) | | Boiling coefficient | | Protein percentage (%) | | Sugar percentagein raw pods (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Average | Difference from the control / significance | Average | Difference from the control / significance | Average | Difference from the control / significance | Average | Difference from the control / significance |
| 1 | Aurie de Bacau | 8.26 | Control | 8.99 | Control | 24.85 | Control | 5.03 | Control |
| 2 | Tarcaia 1 | 6.29 | -1.97$^{000}$ | 8.62 | -0.36 | 23.86 | -0.99$^{0}$ | 4.25 | -0.78$^{00}$ |
| 3 | Tarcaia 2 | 7.86 | -0.40 | 9.53 | 0.54* | 27.36 | 2.51*** | 3.87 | -1.16$^{000}$ |
| 4 | Julita 1 | 8.65 | 0.39 | 9.35 | 0.36 | 27.35 | 2.50*** | 4.05 | -0.98$^{000}$ |
| 5 | Julita 2 | 10.69 | 2.43*** | 8.10 | -0.88$^{0}$ | 21.65 | -3.20$^{000}$ | 3.76 | -1.27$^{000}$ |
| 6 | Julita 3 | 8.95 | 0.69 | 7.46 | -1.53$^{000}$ | 24.85 | 0.00 | 3.89 | -1.14$^{000}$ |
| 7 | Vinga 1 | 10.07 | 1.81*** | 5.36 | -3.63$^{000}$ | 22.07 | -2.78$^{000}$ | 3.02 | -2.01$^{000}$ |
| 8 | Vinga 2 | 6.59 | -1.67$^{000}$ | 7.53 | -1.46$^{00}$ | 26.49 | 1.64*** | 4.07 | -0.96$^{000}$ |
| 9 | Secusigiu | 7.76 | -0.50 | 8.00 | -0.99$^{0}$ | 24.96 | 0.11 | 3.16 | -1.87$^{000}$ |
| 10 | Buteni 1 | 8.86 | 0.60 | 8.25 | -0.73$^{0}$ | 28.04 | 3.19*** | 4.19 | -0.84$^{000}$ |
| 11 | Paulean 1 | 8.76 | 0.50 | 9.47 | 0.48 | 25.72 | 0.87* | 3.13 | -1.90$^{000}$ |
| 12 | Paulean 2 | 8.54 | 0.28 | 7.25 | -1.74$^{000}$ | 26.33 | 1.48** | 5.04 | 0.01 |
| 13 | Sebis 1 | 8.43 | 0.17 | 7.53 | -1.46$^{00}$ | 24.63 | -0.22 | 4.40 | -0.63$^{0}$ |
| 14 | Olari 1 | 7.07 | -1.19$^{00}$ | 8.39 | -0.60$^{0}$ | 27.01 | 2.16*** | 4.30 | -0.73$^{00}$ |
| 15 | Olari 2 | 8.37 | 0.11 | 7.07 | -1.2$^{000}$ | 25.17 | 0.32 | 4.08 | -0.95$^{000}$ |
| 16 | Bata | 10.07 | 1.81*** | 7.86 | -1.2$^{00}$ | 23.67 | -1.18$^{00}$ | 4.19 | -0.84$^{000}$ |
| 17 | Birchis 1 | 6.20 | -2.06$^{000}$ | 9.35 | 0.6 | 26.22 | 1.37** | 4.08 | -0.95$^{000}$ |
| 18 | Birchis 2 | 7.45 | -0.81$^{0}$ | 7.03 | -1.5$^{000}$ | 25.85 | 1.00* | 4.93 | -0.10 |
| 19 | Otelu Rosu 1 | 6.69 | -1.57$^{000}$ | 7.40 | -1.9$^{000}$ | 26.31 | 1.46** | 3.89 | -1.14$^{000}$ |
| 20 | Otelu Rosu 2 | 13.37 | 5.10*** | 8.66 | -0.3 | 23.08 | -1.77$^{00}$ | 3.34 | -1.69$^{000}$ |
| 21 | Otelu Rosu 3 | 5.82 | -2.44$^{000}$ | 7.08 | -1.90$^{000}$ | 25.61 | 0.76 | 4.08 | -0.95$^{000}$ |
| 22 | Caransebes 3 | 6.75 | -1.51$^{000}$ | 8.24 | -0.75$^{0}$ | 25.51 | 0.66 | 3.24 | -1.79$^{000}$ |
| 23 | Ortisoara | 6.81 | -1.45$^{000}$ | 6.88 | -2.10$^{000}$ | 25.81 | 0.96* | 4.30 | -0.73$^{00}$ |
| 24 | Semlac | 5.87 | -2.39$^{000}$ | 9.36 | 0.37 | 23.56 | -1.29$^{00}$ | 7.29 | 2.26*** |
| 25 | Tarcaia 3 | 5.92 | -2.34$^{000}$ | 9.89 | 0.90$^{0}$ | 25.35 | 0.51 | 5.88 | 0.85*** |
| 26 | Voiteg 1 | 5.94 | -2.32$^{000}$ | 8.55 | -0.44 | 25.14 | 0.29 | 3.48 | -1.55$^{000}$ |
| 27 | Voiteg 2 | 7.55 | -0.71 | 7.55 | -1.44$^{00}$ | 23.85 | -1.00$^{0}$ | 4.19 | -0.84$^{000}$ |
| 28 | Ionis 1 | 9.61 | 1.35*** | 9.24 | 0.25 | 24.55 | -0.30 | 3.99 | -1.04$^{000}$ |
| 29 | Becicherecu Mic | 10.36 | 2.09*** | 10.02 | 1.03*** | 22.10 | -2.75$^{000}$ | 2.91 | -1.04$^{000}$ |
| 30 | Bobda | 7.06 | -1.20$^{00}$ | 9.87 | 0.88* | 25.14 | 0.29 | 3.23 | 0.01 |
| 31 | Ionis 2 | 6.48 | -1.79$^{000}$ | 7.65 | -1.34$^{00}$ | 26.83 | 1.98*** | 4.19 | -0.94$^{000}$ |
| 32 | Beius | 10.41 | 2.15** | 9.61 | 0.62* | 24.19 | -0.66 | 4.19 | -2.12$^{000}$ |
| 33 | Fizis 1 | 7.40 | -0.86$^{0}$ | 8.00 | -0.99$^{00}$ | 25.44 | 0.59 | 3.66 | -1.80$^{000}$ |
| 34 | Fizis 2 | 8.81 | 0.55 | 7.99 | -1.00$^{00}$ | 28.01 | 3.16*** | 3.98 | -0.84$^{000}$ |
| 35 | Pocola 1 | 4.60 | -3.66$^{000}$ | 8.24 | -0.75$^{0}$ | 24.65 | -0.20 | 5.25 | -0.84$^{000}$ |
| 36 | Pocola 2 | 9.30 | 1.04** | 8.33 | -0.66$^{0}$ | 27.36 | 2.51*** | 5.04 | -1.37$^{000}$ |
| 37 | Pietrani | 8.47 | 0.20 | 7.98 | -1.01$^{00}$ | 25.47 | 0.62 | 4.09 | -1.05$^{000}$ |
| 38 | Vanatori | 7.26 | -1.00$^{0}$ | 6.96 | -2.02$^{000}$ | 26.29 | 1.44** | 7.19 | 0.22 |
| 39 | Buteni 2 | 7.78 | -0.48 | 7.33 | -1.66$^{000}$ | 26.78 | 1.93*** | 7.16 | 0.01 |
| 40 | Buteni 3 | 9.11 | 0.85* | 9.89 | 0.90* | 24.35 | -0.50 | 5.14 | -0.94$^{000}$ |
| 41 | Barsa | 7.82 | -0.45 | 10.35 | 1.36** | 26.51 | 1.66** | 5.26 | 2.16*** |
| 42 | Cornereva | 7.06 | -1.20$^{00}$ | 8.66 | -0.33 | 25.44 | 0.59 | 4.89 | 2.13*** |
| 43 | Bolvasnita | 8.58 | 0.32 | 8.95 | -0.04 | 23.86 | -0.99$^{0}$ | 3.99 | 0.11 |
| 44 | Svinita | 9.61 | 1.34*** | 7.53 | -1.46$^{00}$ | 24.16 | -0.69 | 6.95 | 0.23 |
| 45 | Begheiu Mic | 7.99 | -0.28 | 7.68 | -1.31$^{00}$ | 25.19 | 0.34 | 4.66 | -0.14 |
| 46 | Carasova | 8.25 | -0.01 | 7.78 | -1.21$^{00}$ | 24.67 | -0.18 | 4.86 | -1.04$^{000}$ |
| 47 | Joia Mare 1 | 5.18 | -3.09$^{000}$ | 8.16 | -0.82$^{0}$ | 25.36 | 0.52 | 3.98 | 1.92*** |
| 48 | Joia Mare 2 | 8.72 | 0.45 | 8.39 | -0.60$^{0}$ | 23.88 | -0.97$^{0}$ | 4.19 | -0.37 |
| 49 | Vinga 3 | 1.20 | 1.94*** | 10.56 | 1.57*** | 25.30 | 0.45 | 2.70 | -0.17 |
| 50 | Nadab | 1.50 | 4.24*** | 9.43 | 0.44 | 22.32 | -2.53$^{000}$ | 4.17 | -1.05$^{000}$ |
| 51 | Sebis 2 | 8.37 | 0.11 | 10.25 | 1.26*** | 24.54 | -0.31 | 3.98 | -0.84$^{000}$ |
| 52 | Vălisoara 1 | 7.03 | -1.23$^{00}$ | 8.63 | -0.36 | 23.75 | -1.10$^{00}$ | 5.29 | -2.33$^{000}$ |
| 53 | Valisoara 2 | 9.81 | 1.54*** | 7.37 | -1.62$^{000}$ | 22.56 | -2.29$^{000}$ | 1.96 | -0.86$^{000}$ |
| 54 | Caransebes 1 | 7.39 | -0.87$^{0}$ | 8.35 | -0.63$^{0}$ | 24.38 | -0.47 | 5.04 | -1.05$^{000}$ |
| 55 | Caransebes 2 | 8.38 | 0.12 | 7.39 | -1.60$^{000}$ | 24.49 | -0.36 | 4.38 | 0.26 |
| 56 | Sacu | 6.81 | -1.45$^{000}$ | 9.25 | 0.26 | 26.01 | 1.16** | 1.96 | -3.07$^{000}$ |
| 57 | Juliska | 10.40 | 2.13*** | 9.83 | 0.84* | 23.63 | -1.22$^{00}$ | 5.04 | 0.01 |
| 58 | Faget | 5.18 | -3.09$^{000}$ | 8.36 | -0.63$^{0}$ | 24.07 | -0.78$^{0}$ | 4.38 | -0.65$^{00}$ |
| | | LSD 5%= 0.75%; LSD 1%= 1.00%; LSD 0,1%= 1.30% | | LSD 5%= 0.52; LSD 1%= 0.90; LSD 0,1%= 1.49 | | LSD 5%= 0.76%; LSD 1%= 1.08%; LS SD 0,1%= 1.82% | | LSD 5%= 0.75%; LSD 1%= 1.00%; LSD 0,1%= 1.30% | |

The control is a valuable variety regarding the presence of sugars in raw pods and the comparison between these reveals that most local landraces are inferior for this character. Following the statistical calculation, we may notice positive differences compared to control only in the case of 5 landraces. In all cases, the differences are very significant. The lower populations in terms of this character are much more numerous and in many cases the differences are statistically assured. Very significant negative differences were recorded for 34 populations. Carrying out an overview of the collection in terms of sugar percentage in raw pods, we may observe that almost half of the evaluated genotypes have a sugar content of between 4 and 5%, a limit quite close to the value recorded in the control variety. Remarkable are the four populations where the sugar percentage exceeds the limit of 6%, of which 3 exceed the limit of 7%. This situation highlights the fact that, in the collection studied, there are valuable forms for breeding the quality of raw pods (figure 4). Similar results have been obtained in the study of some genotypes in Brazil. There are large differences between genotypes in terms of boiling time and shell hardness or water absorption in grains (Marques Correa Mariana et al., 2010).

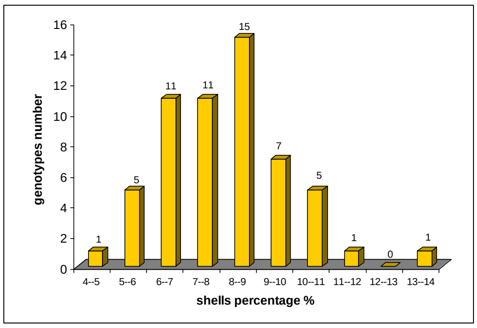


Figure 1. Shells percentage situation for climbing bean collection

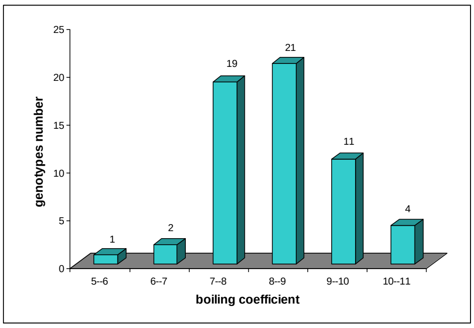


Figure 2. Boiling coefficient situation for climbing bean collection

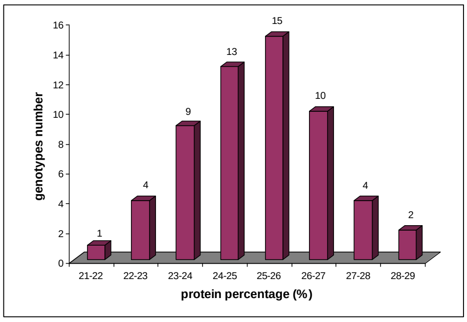


Figure 3. Protein content situation for climbing bean collection

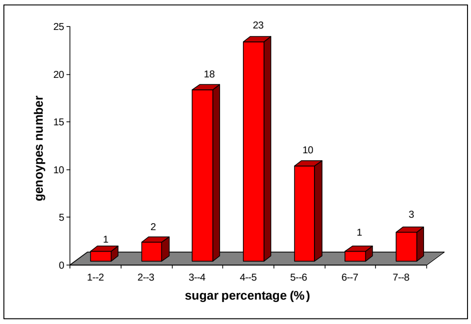


Figure 4. Sugar percentage situation for raw pods for climbing bean collection

In populations studied, the grains are quite large, the weight of 1000 grains variability ranging from 160.67 g in the Nadab landrace and a maximum value of 2032.00 g for the Vinga 2 landrace. The control, Aurie de Bacau, has the weight of 1000 grains of 430 g, value present in several of breedings bean garden varieties. Very big grains were also found at Vanatori 1 (1538.00 g) (Table 1). Studying the values of the weight of 1000 grains as compared to the control variety shows that the majority of studied landraces are above its value with statistically ensured differences. Thus, 22 landraces showed highly significant positive differences. Statistical insurance exists for other 23 populations. Only 14 populations were recorded under the value of the control variety. The results obtained are similar to those obtained in other studies. The quality of the grains and their size varies with the growth conditions. Studies on the Perola variety show that, depending on the crop area, the mass of 100 grains ranges from 17.3 to 33.5 g. Such variations are also found for biochemical content. Between the two, grain size and quality are quite strong correlations (Silveira et al., 2016).

Table 2. Results regarding the weight of 1000 grains in climbing bean genotypes

| no. | Genotype | Average (%) | Difference from the control / significance | No. | Genotype | Average (%) | Difference from the control / significance |
|---|---|---|---|---|---|---|---|
| 1 | Aurie de Bacau | 430.33 | Control | 30 | Bobda | 383.00 | -47.33$^{0}$ |
| 2 | Tarcaia 1 | 506.00 | 75.67*** | 31 | Ionis 2 | 570.33 | 140.00*** |
| 3 | Tarcaia 2 | 535.67 | 105.33*** | 32 | Beius | 373.00 | -57.33$^{00}$ |
| 4 | Julita 1 | 395.00 | -35.33* | 33 | Fizis 1 | 602.00 | 171.67*** |
| 5 | Julita 2 | 441.00 | 10.67 | 34 | Fizis 2 | 535.00 | 104.67*** |
| 6 | Julita 3 | 474.00 | 43.67* | 35 | Pocola 1 | 537.00 | 106.67*** |
| 7 | Vinga 1 | 2032.00 | 1601.67** | 36 | Pocola 2 | 544.33 | 114.00*** |
| 8 | Vinga 2 | 553.00 | 122.67*** | 37 | Pietrani | 487.33 | 57.00* |
| 9 | Secusigiu | 502.00 | 71.67** | 38 | Vanatori | 1538.00 | 1107.67*** |
| 10 | Buteni 1 | 426.33 | -4.00 | 39 | Buteni 2 | 877.00 | 446.67*** |
| 11 | Paulean 1 | 497.00 | 66.67** | 40 | Buteni 3 | 427.33 | -3.00 |
| 12 | Paulean 2 | 621.00 | 190.67*** | 41 | Barsa | 497.00 | 66.67*** |
| 13 | Sebis 1 | 503.33 | 73.00** | 42 | Cornereva | 334.00 | -96.33$^{000}$ |
| 14 | Olari 1 | 399.33 | -31.00$^{000}$ | 43 | Bolvasnita | 875.33 | 445.00*** |
| 15 | Olari 2 | 507.00 | 76.67** | 44 | Svinita | 453.33 | 23.00 |
| 16 | Bata | 444.33 | 14.00 | 45 | Begheiu Mic | 478.00 | 47.67* |
| 17 | Birchis 1 | 494.00 | 63.67** | 46 | Carasova | 401.00 | -29.33 |
| 18 | Birchis 2 | 695.33 | 265.00*** | 47 | Joia Mare 1 | 547.00 | 116.67*** |
| 19 | Otelu Rosu 1 | 581.00 | 150.67*** | 48 | Joia Mare 2 | 440.00 | 9.67 |
| 20 | Otelu Rosu 2 | 502.33 | 72.00** | 49 | Vinga 3 | 174.33 | -256.00$^{000}$ |
| 21 | Otelu Rosu 3 | 646.00 | 215.67*** | 50 | Nadab | 160.67 | -269.67$^{000}$ |
| 22 | Caransebes 3 | 541.33 | 111.00*** | 51 | Sebis 2 | 365.00 | -65.33 |
| 23 | Ortisoara | 712.00 | 281.67*** | 52 | Vălisoara 1 | 435.33 | 5.00 |
| 24 | Semlac | 577.00 | 146.67*** | 53 | Valisoara 2 | 361.00 | -69.33$^{00}$ |
| 25 | Tarcaia 3 | 517.00 | 86.67*** | 54 | Caransebes 1 | 335.33 | -95.00$^{000}$ |
| 26 | Voiteg 1 | 595,.0 | 164.67*** | 55 | Caransebes 2 | 309.00 | -121.33$^{000}$ |
| 27 | Voiteg 2 | 515.00 | 84.67** | 56 | Sacu | 259.00 | -171.33$^{000}$ |
| 28 | Ionis 1 | 490.00 | 59.67** | 57 | Juliska | 351.00 | -79.33$^{00}$ |
| 29 | Becicherecu Mic | 387.00 | -43.33$^{0}$ | 58 | Faget | 398.00 | -32.33$^{0}$ |
| LSD 5%= 30.30 g; LSD 1%= 57.00 g; LSD 0,1%= 85.13 g | | | | | | | |

**Conclusions**

The studied landraces are an important source of genes for the quality amelioration process in beans. The percentage of shells varied within very wide limits. The total value of the collection is mediocre. There are important populations with a low percentage of shells: Pocola, Otelu Rosu 3, Tarcaia 3, Voiteg, Joia Mare 1 and Faget. The weight of 1000 grains ranged from an average of 160.67 g in the Nadab landrace to a maximum of 2032.00 g in the Vinga 1 landrace. Given the great variability of this character, we consider the collection to be valuable for the breeding process. For the boiling coefficient, in the collection there were values close to the one recommended as an improvement objective, some of the collected populations being valuable. Protein is the main biochemical compound in bean grains. The populations very rich in protein are few. From this point of view, the populations: Buteni, Julita 1, Olari 1 and Fizis 2 are remarkable. Even if they were not selected from this point of view, because the local growers had no opportunity to assess this attribute, these populations may be recommended to improve the percentage of protein. The raw pods are a seasonal food rich in vitamins, carbohydrates and a very low protein and fat content. Within genotypes from the collection, the sugar content of the raw pods showed wide variability, almost half of the evaluated populations have a percentage of sugar close to the value recorded in the control variety Aurie de Bacau. The climbing bean collection comprises a great variability for the quality characters studied. Many of the landraces are not valuable for all characters, but we can also find genitors to improve each of the characters studied.

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