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VARIABILITY OF THE PHYSICO-MECHANICAL PROPERTIES OF THE ECOTYPES OF NUT FRUITS (*JUGLANS REGIA* L.) IN SLOVAKIA*

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A b s t r a c t. At the present time among the endangered species of plants, there exists elements of flora which can be found in Slovakia. Within the framework of the program "Protection of Endangered Genebank Plants in Slovakia" is the processing, existence and description of individual king nut ecotypes (*Juglans regia* L.). Several agrophysical methods were applied for evaluating and grouping advantageous ecotypes in genebanks. This work presents the results obtained of the dimension and weight characteristics of fruits and shells, together with the determined necessary force for cracking nutfruits. The research was done on 16 selected samples obtained from 11 localities of southern Slovakia.

K e y w o r d s: genebank protection, walnut, fruit, shell, seed

INTRODUCTION

The protection of the natural environment has been one of the most important aspects of human endeavor over the past hundred years in order to ensure a healthy life for the future generation. One remarkable work is the effort to protect diminishing types of flora and fauna. Among the meaningful resounding environmental activities in the whole world and their results, are international negotiations and agreements. The year 1995 was declared by the Council of Europe as the European Nature Conservation Year. One of the important factors interfering with the process of the creation of a natural environment is agriculture. On one hand, is the expansion of cultivation varieties in an effort to secure nutrients for the planet's population, and on the other hand, these production activities put pressure on weaker varieties. With the progress of time, there has been an increase in the number of varieties in the list of endangered species, of which a lot today are permanently existing. Therefore, according to our views, it is very important for scientists in all fields to contribute to the application of methods, procedures and results for protecting the widest spectrum of plants and animal species for future generations. A lot of dedication is given to the problem of the protection of biodiversity at the Slovak University of Agriculture in Nitra.

The king nut belongs to the fruit type with a high nutritious value and wide use. Based on intensive cultivation technology and biological characteristics, it is in the last position in the Slovak fruit industry. The aim of this work is to describe the basic characteristics of the king walnut fruit from the economic point of view and compare the variability of individual characteristics. The chosen collected fruits were obtained from interesting locations in the southern part of Slovakia and serve as a pilot

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sample for spreading the application of the verifying method. The testing of a device and comparison with several agrophysical characteristics from the chosen collection of fruits of freely growing king walnut ecotypes (*Juglans regia* L.) was done in the research. The mentioned results are presentations of the application of familiar agrophysical experiments within the framework of fulfilling the program 'Protection of Endangered Genebank Plants in Slovakia'.

METHODOLOGY

For the research, 16 samples collected from freely growing plants of ecotypes from 11 localities of southern Slovakia (Fig. 1) were used. The samples contained a minimum of 8 and maximum of 20 pieces according to their rareness. The following characteristics were assigned to each fruit [2-4]:

- the dimensions of three planes normal to each other (length, width, thickness), measured with a venire calipers to the precision of 0.01 mm;
- weight, measured with the weighing instrument, Sartorius BA310S to the precision of 0.001 g;
- real volume, measured by immersing in water in a measuring cylinder to the precision of 0.001 l;
- calculated volume for a rotational ellipsoid:

$$V = \frac{4}{3}\pi\left(\frac{lbh}{8}\right) \quad (1)$$

where V is fruit volume, m^3; l - length, m; b - width, m; h - thickness, m;

- weight of the seed, measured with the weighing instrument, Sartorius BA310S to the precision of 0.001 g;
- shell thickness, measured with an measuring accuracy instrument, Somet to the precision of 0.001 mm;
- force required to crack the nut shell at three planes normal to each other, measured with the instrument, Instron 1112.

The evaluation of each experiment to obtain the characteristics was done using statistical methods. It is possible to use the variation coefficient as the comparing criteria:

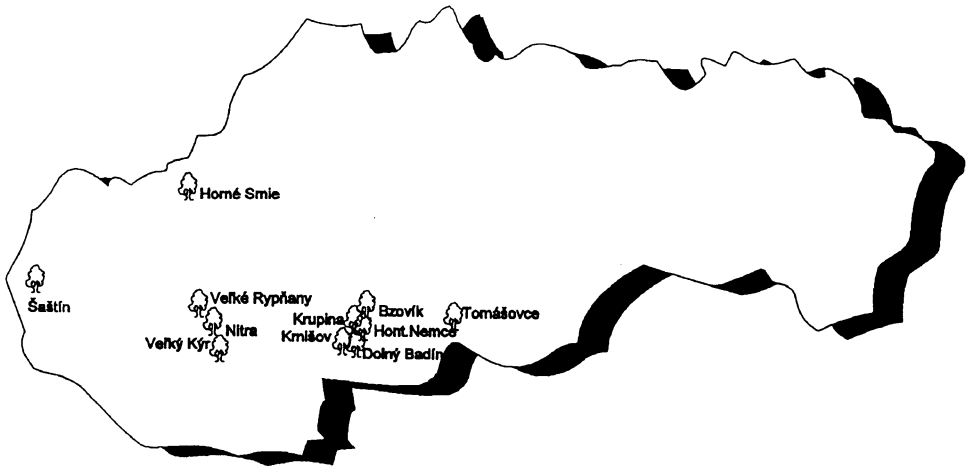

Fig. 1. Territorial distribution of the selected samples.

$$V_k = \frac{s}{x}100 \qquad (2)$$

where V_k is variation coefficient, %; s - standard deviation; x - mean value.

During the evaluation of the uncertainty index, the low degree of the variability value V_k <10 % for the mid-point of the variability 10% <V_k <15% [1] was taken.

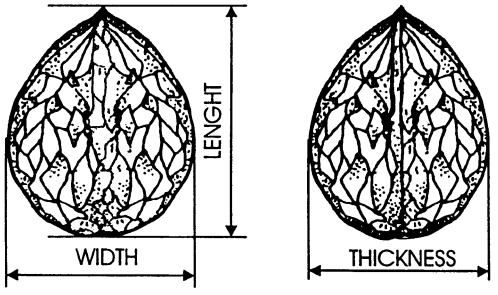

Fig. 2. Schematic specifying fruit dimensions.

RESULTS

The dimensions of the fruits were assigned according to the schematic (Fig. 2). The dimensional characteristics of the tested fruits is shown in Fig. 3. Most of the fruits had a sharply greater length in comparison with the thickness and width. The obtained value indicates a low degree of variability. By comparing values of the fruit volume, it is possible to estimate the uniformity of the shape. The more identical the fruit dimensions, the less the fruit will resemble a rotational ellipsoid. This kind of difference occurs in the case where the experimental value of the obtained volume is sharply different from the value assigned by the calculation (Fig. 4). For the estimated characteristics which can be applied directly for economical effects, it is interesting to note the weight of the seed, a part of the seed weight and the fruit as a whole, the thickness and hardness of the shell. The weight of

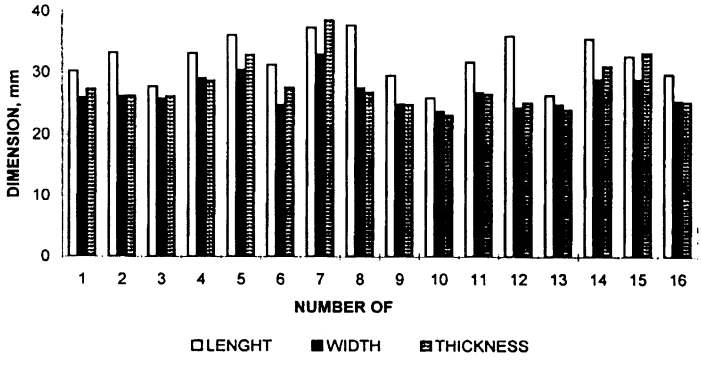

Fig. 3. Dimensional characteristics of the following walnut ecotypes.

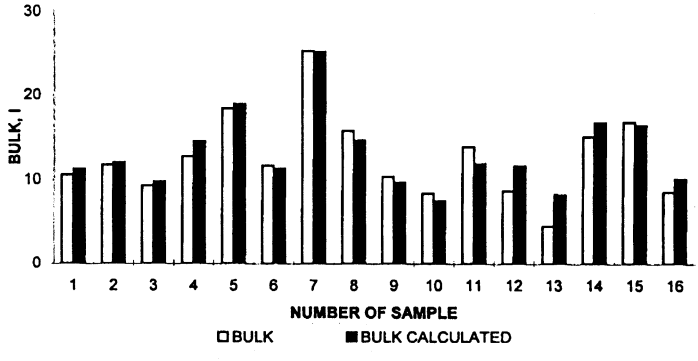

Fig. 4. Volume of fruit of the following walnut ecotypes.

the walnut seed is characterized with a large variability. Part of the seed weight from the whole weight of the walnut fruit is shown in the whole test data. The results are presented in Fig. 5.

The thickness of the shell is very interesting for technological characteristics. The high variability of the following characteristics is characterized by the complex structure of the shell. The results confirmed that there was a difference in shell thickness between each sample until 100% (Fig. 6). With economical utilization, the walnut seed plays an important role from the view of consumers as an 'easy' fruit which can be opened and its seed retrieved. From the view of the application of physical characteristics, the hardness of the walnut fruit was characterized by the force required for cracking. In the test with quasi-statistical loading between parallel slabs, the applied force was impacted on the walnut fruit on three planes normal to each other (Fig. 7). From the results (Fig. 8), it is evident that it is not in all cases that the thickness of the shell is the decisive factor for estimating the shell hardness.

Comparison of samples 2 and 7 with the greatest shell thickness is shown in Table 1. Despite the small difference in the shell thickness of the shown samples, it had a very great difference with respect to economical characteristics - difference in the seed weight and in the required energy for cracking the fruit. With regards to the structure of the fruit, it displayed the same characteristics as that of legume seeds. The force required to crack the fruit was the greatest in the direction of the fruit's thickness.

The application of the agrophysical method of testing can also be used for evaluating non-traditional objects of research. By comparing each of the obtained tested characteristics of the 16 ecotypes of the king walnut, it is possible to state that the walnut fruit samples 1 and 8 were the most interesting from the economic

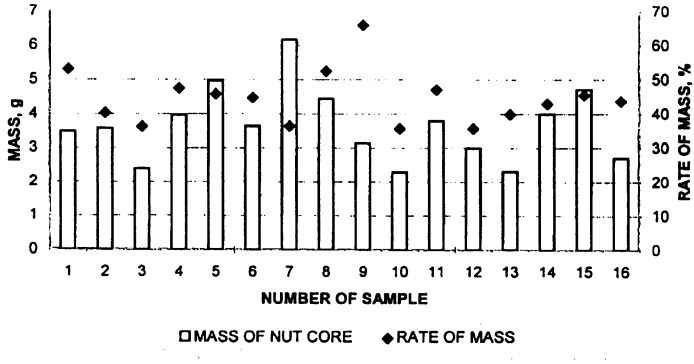

Fig. 5. Weight of seeds and part of seed weight from the whole fruit weight of the following walnut ecotypes.

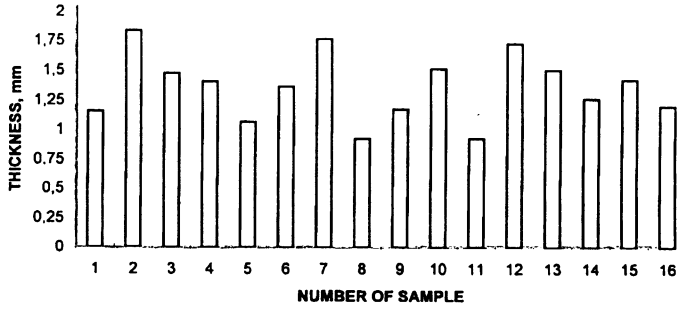

Fig. 6. Shell thickness of the following walnut ecotypes.

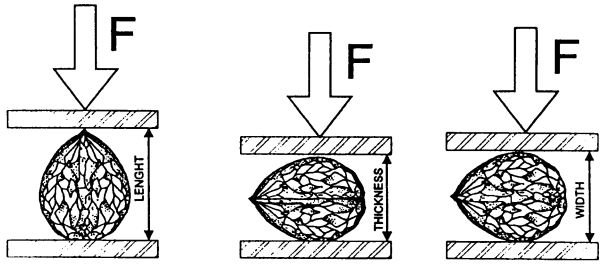

Fig. 7. Schematic of the applied force on the fruit of the following walnut ecotypes.

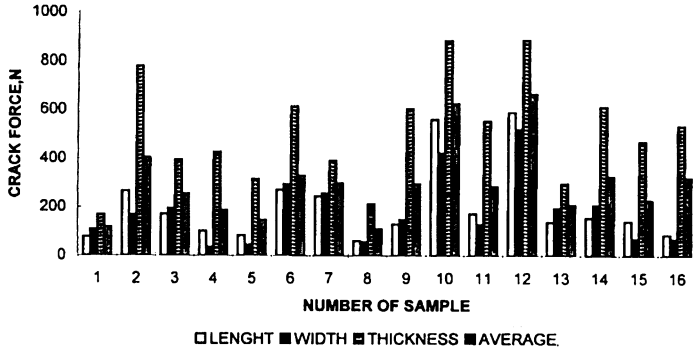

Fig. 8. Required force to crack the fruit of the following walnut ecotypes.

T a b l e 1. Comparison of samples 2 and 7 with the greatest shell thickness

Characteristics	Sample 2	Sample 7
Shape	aligned to an ellipse	more spherical
Mean weight of fruit, g	44	82
Mean weight of seed, g	3.6	6.25
Part of seed weight from the whole fruit weight, %	40	38
Thickness of shell, mm	1.74	1.67
Force in the direction of the fruit's thickness, N	790	395
Mean value of force, N	405	308

point of view. These fruits had a relatively higher seed weight, the highest proportion representing the seed weight from the whole fruit weight and the lowest required cracking force.

CONCLUSION

According to the results, the variability of utility nut fruit properties of the different tested ecotypes is possible to express through the measuring of physico-mechanical properties such as: seed dimensions and weight, shell thickness and force required to crack the nut shell.

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