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ХЕРСОНСЬКИЙ ДЕРЖАВНИЙ АГРАРНО-ЕКОНОМІЧНИЙ УНІВЕРСИТЕТБІОЛОГО-ТЕХНОЛОГІЧНИЙ ФАКУЛЬТЕТ
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DETERMINATION OF THE DENSITY OF DIFFERENT FRACTIONS OF SOYBEAN SEEDS

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Today, soybean is a strategic crop for Ukraine grain expoprts of which are over 1 million tons per year. Unlike other markey-oriented crops, soybean helps to improve soil fertility, increase crop yileds within crop rotation. In addition, soybean has universal use and play an important role in improving the economic efficiency of production [1].

Soybean is a valuable universal crop. Soybean is among the important fodder crops in our country. In terms of protein content (35 ... 50%), fat (13 ... 26%), as well as vitamins and certain acids, it takes one of the leading places among other legumes [2]. Modern world trends, growing domestic demand for soybean have necessitated an increase in the production of this crop in Ukraine. Therefore, it will be advisable to address issues related to post-harvest treatment of soybean seeds.

Seeds entering the elevator often differ significantly in their quality. In order to increase it, it is advisable to fraction grain and seeds according to different properties (geometric dimensions, density, etc.).

The purpose of the study is to explore the formation of soybean seed quality depending on the process of its fractioning.

To achieve this purpose, the following study objectives were set:

- to carry out technological assessment of soybean seeds of early and late varieties;
- establish the fractioning process and determine its impact on seed quality;
- develop recommendations for the use of soybean varieties.

The study was conducted in the educational and scientific laboratory “Evaluation of the quality of seeds and products of its processing” [3]. Seed analysis was performed according to the methods described in the standards.

Soybean seeds were grown in the Right Bank Forest-Steppe. The soil of the experimental fields is typical – gray forest, medium loam. Weather conditions, in general and during spring–autumn vegetation in particular, were favorable for the formation of optimal soybean yields.

Sieves with round holes with a diameter of 6.0 mm, 5.5 mm, 5.0 mm, 4.5 mm, 4.0 mm, 4.25 mm, 4.0 mm, 3.37 mm, 3.5 mm, 3.25 mm, 2.5 mm, 2.0 mm, 1.0 mm, scales, divider, carving board, laboratory glasswear, ruler and caliper were used for the study.

The subject of the study is early soybean seeds (vegetation period – 105 days) and late varieties (vegetation period – 120 days).

The object of the study is the processes of formation of soybean seed quality during its fractioning.

The experiments were guided by the methodology of the following standards: Sampling – GOST 10852; DSTU 3355; Determination of the mass of 1000 seeds – GOST 10842-89; Soybeans. Specifications – DSTU 4964:2008 [4].

Since early soybean seeds were characterized by a high content of underdeveloped seeds, our studies were related to the study of their density. Density indicates the degree of maturity and fullness of the seeds. Mature and full seeds have a higher density than unripe ones. The difference in seed density and impurities is used in seed sorting and cleaning. As a result of different density in the grain, self-sorting occurs when moving and shaking. This can be taken into account when cleaning seeds at the elevator.

The physical density of seeds is closely related to nature. The greater the density, the greater the nature [5, 6]. Hence, the grain density is determined by the formula 1:

$$\rho = \frac{m}{V}, \text{ g/cm}^3 \qquad (1)$$

where: m – grain mass, g
v – grain volume, cm^3

As a result of measuring the geometric characteristics of the studied soybean seeds, it was found that the seeds of an early variety are distinguished by large linear values. Thus, the length of the seeds ranged from 5.0 to 7.0 mm, the width, from 4.0 to 7.0, and the thickness, from 2.0 to 4.0, with average values of 6.0, 4.6, and 3.1 mm, respectively. In turn, late-grade soybean grain was inferior in terms of their average linear length, width, and thickness by 8.9 and 32%, respectively.

From formula 4, the volume of early grade soybeans was determined to be 47.91 mm^3 and the volume of seeds of late grade soybeans was 26.52 mm^3.

The mass of 1000 seeds was determined to GOST 10842-89.

where: N – number of grains; $M_{1000\ seeds}$ – mass of 1000 seeds.

For calculations, the following characteristics of soybean seeds were taken:

a) Linear average dimensions of the studied early soybean seeds in a mixture without fractionation: length 6.0 mm, width 4.6 mm, thickness 3.1 mm, volume 47.91 mm^3, weight of 1000 seeds 147.0 g.

b) Linear average dimensions of the studied late-grade soybean seeds in a mixture without fractionation: length 5.5 mm, width 4.2 mm, thickness 2.1 mm, volume 26.52 mm^3, weight of 1000 seeds 127.3 g.

The mass of the grain was determined by the formula 2:

$$m = \frac{M1000\ seeds}{N}, \text{ g} \qquad (2)$$

1) 147.0/1000 = 0.147 g
2) 127.3 /1000 = 0.1273 g

Seed density was set by the formula 9:

1) 0.147/47.91=0.0030 g/mm^3 = 3.0 g/cm^3
2) 0.1273/26.52 = 0.0048 g/mm^3 = 4.8 g/cm^3

Based on formulas 1 and 2, we find the density from formula 3:

$$\rho = \frac{M1000\ seeds}{NV}, \text{ g/cm}^3 \qquad (3)$$

As a result of calculations, it was found that seeds of early variety soybeans have lower density values compared to seeds of late variety (Fig. 1, 2 and 3), which confirms the content of immature seeds in early variety soybeans. It was determined that the seeds of the early variety showed a decrease in density in the sieve fraction ⌀ 4.5 mm. Obviously, unripe seeds were mainly in this fraction. In turn, both varieties showed a trend towards an increase in density value with decreasing seed size.

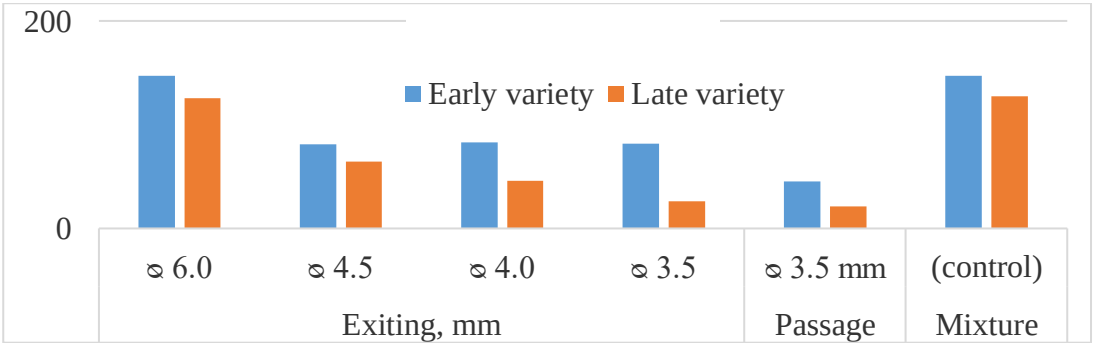

Figure 1. The mass of 1000 seeds, g

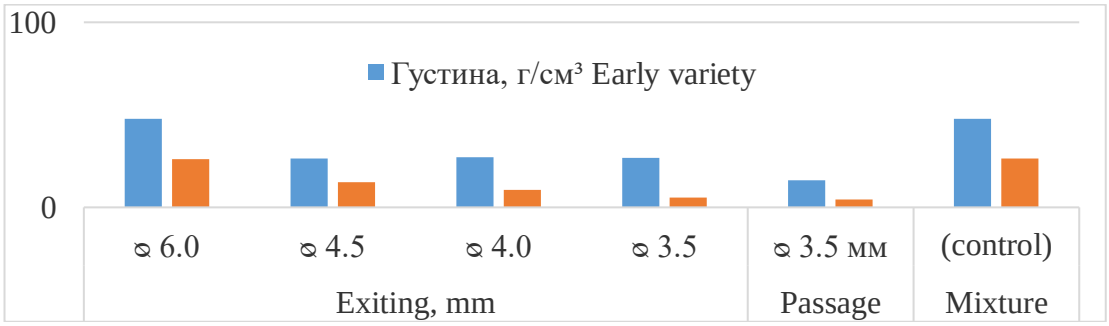

Figure 2. The grain volume, mm³

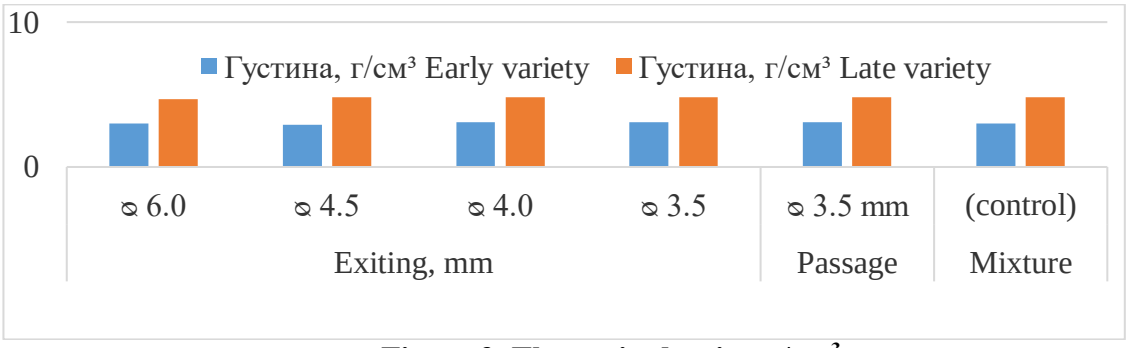

Figure 3. The grain density, g/cm³

Therefore, it can be concluded that with the help of fractionation, self-sorting of seeds during movement and shaking can be prevented and, as a result of effective cleaning, the quality of seeds can be improved.

Conclusions. Based on the analytical review, including the technological process of feed production, it can be concluded that the seed entering the elevator differ in quality. So to improve its quality it is necessary to fraction it. Early soybean seed has lower density values than late soybean seed, which confirms the content of immature seeds in early soybean.

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