Justification main characteristics of separation wheat grains for isolation biological valuable seeds

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Abstract. Today one of the problems of grain separation is separation of grains according to biologically valuable characteristics (germination, growth force, germination energy of grains, their physical, biological and chemical parameters, the amount of protein, gluten, etc.). It is need to justify isolate grain with high biological value, and thereby increase the yield of varieties "Felicia" and "Viola". In this paper, we considered such seed characteristic as variability. It was found that the physical properties and replacement of seeds in the spike (dimensional characteristics, mass, density) have a direct relationship. The backlogs for new studies were identified, and all the data obtained empirically were displayed in the final table and presented in detail in this article.

1 Introduction

There are no technical solutions for the isolation of seeds with high biological properties (germination, growth force, germination energy of grains, their physiological and chemical parameters, the amount of protein, gluten, etc.) at this stage of the technical development of the separation of seeds of grain crops. There is no possibility of a non-invasive method for determining these properties, without destroying the seed or violating its structure. For this reason, there are no separation processes and technical means for isolating biologically valuable seeds. The lack of machines for separating seeds by biological properties raises questions about finding the relationships between the biological characteristics of grains and their physico mechanical properties that can be measured numerically (sizes, mass, density, speed of movement, and other attributes).

A number of research have been carried out in this direction of research [1-4]. Relations between the biological and physico-mechanical properties of seeds are established by seeds sorting according to one or another characteristic of divisibility (size, density, speed of soaring, etc.) and subsequent assessment of biological characteristic (germination, growth force, germination energy, yield, etc.) obtained by sorting the fractions of seeds.

The aim of the research is to substantiate the main signs of the separation of seeds of grain crops, to highlight biologically valuable seed material with increased productivity.

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2 Materials and methods

Analyzing numerous, but scattered information, it seems to us that the relationship of the main most studied properties of seeds can be expressed in the form of generalized schemes-modelš of technologies that simultaneously reflect cardinal factors of their formation. This "scheme" (Figure 1) assumes the existence of a relationship not only between different groups of properties, the nature of the influence of germination and seed size on yield.

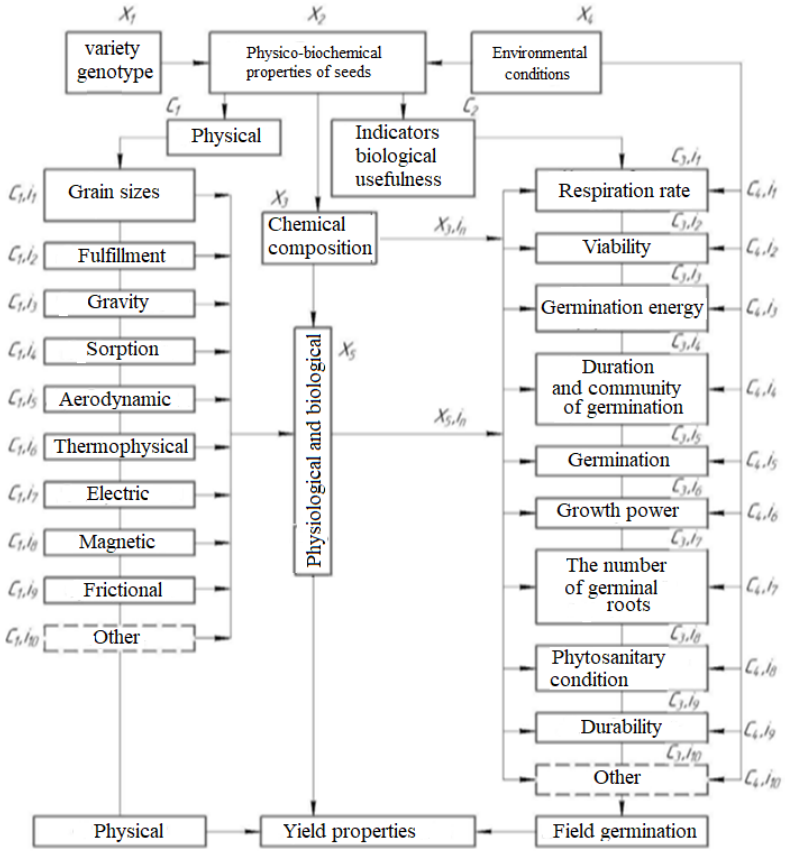

Fig. 1. The structure of the relationship between the identification of cereals seeds based on the physico-biochemical properties of seeds.

There are numerous data indicating both the relationship and its absence between germination and seed size and productivity. The identity of the physical indicators is presented:

$$C_1 \in X_1; X_2; X_3; \dots; X_n;$$
$$C_1 \in C_1 i_1; C_2 i_2; \dots; C_n i_n; \quad (1)$$

The identity of the indicators of biological usefulness is presented:

$$C_2 \in X_2; X_4; X_3$$
$$C_2 \in C_3 i_1; C_3 i_2; \dots; C_3 i_n + C_4 i_1; C_4 i_2; \dots; C_4 i_n$$
$$\sum C_{ур.св} = \sum_{i=5}^{n \to \infty} C i_n \quad (2)$$

where $C_{harv.char.}$ – common characteristic forming harvest seeds property.

This technology determines various types of relationships between different seeds characteristic, taking into account their cultivation conditions and impact on sowing qualities. Especially it should note about relationship between the mass of 1000 field sprouts with the seeds germination (0.75–0.86) and the plants height as original plants (0.86–0.97), i.e. from which seeds were obtained, and in the generation (0.86 - 0.97). The unreliability of this connection is apparently explained by the fact that in wheat the stem length is controlled by at least 15 chromosomes, and the length on the coleoptile is only 6 - 10.

It is much more significant relationship between physical properties and morpho biological properties. A significant effect of the sizes and weight of seeds on the number of germinal roots and the degree of development of seedlings in the heterotrophic period is manifested only in the material grown in contrasting years, when very large, or, conversely, very small and puny kernels are formed.

The degree of conjugation of these properties is estimated as average and lower than average (r = 0.40 - 0.70), and in the years of obtaining comparatively aligned seed sizes, which is observed in one case out of three, it is unreliable.

Researches (2016-2018) of the sizes of 3 spike sectors of winter wheat varieties «Viola» and «Felicia» (Fig. 2) showed the size dependences of the seeds parameters by their thickness with the mass of samples with their density and weight of 1000 grains. The determination of the parameters, in addition to the density of the caryopsis was carried out according to standard methods. Kernels density was determined according to the original methodology. [5]

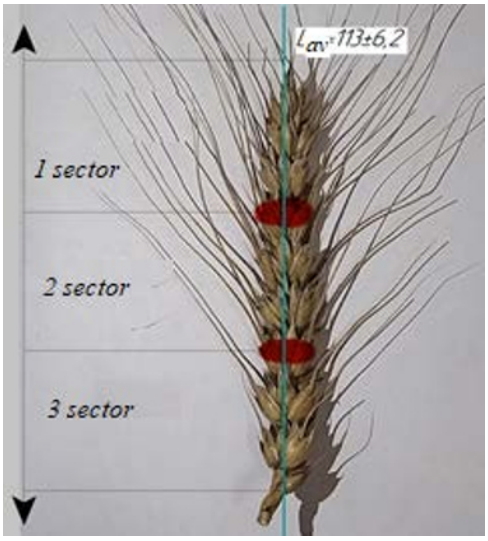

Fig. 2. Dividing by sectors of the spike of wheat variety "Viola"

Laboratory equipment and materials [6-8]:

- Volumetric flask GOST 8.383-80 (Russia) with a volume of 16 ml;
- Laboratory scales with an accuracy of 0.01 g. AND GF grade - 600;
- Fine metal powder, granule size 0.07 mm. density. 3.36 g / sm^3;

Measurement procedure. A flat surface was taken and all dust, small particles removed from it. At this surface, high precision scales are installed with accuracy (0.01 g). Next, a flask of known volume (16 ml.) was placed on the scales.

The flask was weighed and this data was recorded. After the metal powder was poured into the flask, to the very edge, so that it would lie clearly at the level of the flask. The flask with the powder was weighed and the result was also recorded. The mass of the flask was taken from the result and a mass of powder was obtained. (Fig 3.).

$$\Delta m_{np} = m_2 - m_1 \quad (3)$$

where: m_2 is the mass of powder in the flask; m_1 is the mass of the flask.

Fig. 3. Experimental flask with metal powder.

Next, the density of the powder was calculated:

$$P_{pow} = \frac{\Delta m_{pow}}{V} \quad (4)$$

where: Δm_{np} – metal powder mass, kg; V – flask volume.

After that, a kernels was placed in the powder. Under the influence of the Archimedes force, the kernels displaced some powder part and the mass was measured again (Fig. 4):

$$\Delta m_{np1} = m_{21} - m_1 \quad (5)$$

where : m_{21} – mass of powder with kernels in the flask, kg; m_1 – flask mass, kg.

Next, the powder density was calculated:

$$P_{p-k1} = \frac{\Delta m_{p-k1}}{V} \quad (6)$$

where: Δm_{np} – mass of metal powder with kernels; V – flask volume.

After that, by subtracting the density powder from the density of the powder with the kernels, we obtained the values.

$$P_{ker} = \left|P_{p-k1} - P_{pow}\right| \quad (7)$$

The choice of repetition is summarized, and the error was determined based on the experimental research plan [9-10]. The correlation of weight and seed thickness of different groups is characterized by the data in table 1. The correlation between the weight and seeds thickness showed that the regularities describe the variability of seed weight and almost the variability of their thickness. We introduce the terms «valuable seeds» (2nd - 3rd spike sector) and «low-value» seeds (1st sector) From table 1 it is seen that, regardless of the varieties of wheat, the volume and weight of the seed is not a determining factor providing density.

Fig. 4. The moment of putting down the kernels into the flask with powder.

3 Results

The results of the analysis of the relationship of seeds weight and seeds thickness are shown in Table 1.

Table 1. Comparative indicators of the main characteristics of the sectors of the varieties «Felicia» and «Viola»

SECTOR	**SEED PARAMETERS, THICKNESS, mm.**				**SAMPLE MASS, g.**				**MASS 1000 GRAINS, g.**	**DENSITY g/mm* 10^{-3}**	
	b_{max}	b_{min}	b_{av}	σ_b, %	m_{max}	m_{min}	m_{av}	σ_m, %	m_{1000}	P	σ_p, %
VARIETY «FELICIA»											
1	3,36	2,19	2,83	0,147	0,73	0,45	0,61	0,008	40,9	0,19	0,06
2	3,61	1,01	2,87	0,121	1,07	0,64	0,9	0,024	55,0	0,14	0,08
3	3,4	1,91	2,85	0,082	1,55	0,75	0,93	0,066	57,14	0,16	0,02
VARIETY «VIOLA»											
1	3,46	2,23	2,93	0,076	0,94	0,43	0,66	0,034	47,0	0,12	0,03
2	3,47	2,15	3	0,066	1,03	0,66	0,89	0,013	47,14	0,12	0,04
3	3,48	1,82	3,01	0,08	1,07	0,66	0,92	0,023	55,0	0,12	0,04

Table 2. Correlation coefficients of weight and thickness of the first, second and third kernels taken from different places of the spike.

Indicator	**Kernel 1-st sector**	**Kernel 2-nd sector**	**Kernel 3-rd sector**
VARIETY	**«FELICIA»**		
r	0,97	0,99	0,99
m_r	±0,02	±0,03	±0,01
VARIETY	**«VIOLA»**		
r	0,98	0,98	0,98
m_r	±0,01	±0,01	±0,01

4 Conclusion

Seeds with increased or decreased indicators of the density may contain in any fraction of various spike sectors [11-12]. The study of the correlation between the seeds mass and their size showed in Table 2. The correlation coefficient of the seeds mass from its thickness in the kernels of the 2nd and 3rd sector ranged from 0.96 to 0.98.

The studies indicate that the seeds mass are in close positive relationship with its size (according to the dominant feature of the thickness) in these two types of wheat varieties.

This correlation is traced in the kernels of the 2nd and 3rd spike sectors, where the mass of 1000 grains is higher than the first sector one of the main characteristics of sown crops (m_{II} и m_{III} 57,14 g. и 55,0 g.).

We can conclude that it is advisable to sort the varieties "Felicia" and "Viola" by their thickness, in order to isolate seeds with a larger mass, and as a result, biologically valuable, which will increase the sowing, yield qualities.

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