QUALITY OF SPELT AND COLD SEEDS WITH PESTICIDE-FREE CULTIVATION

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Abstract. Under the conditions of the Kaliningrad region, without the use of fertilizers and fungicides, a yield of 32.2 centners / ha of spelled Alkoran and 27.8 centners / ha of naked spelled Gramme 2U was ensured. Using the methods of biological, washout and centrifugation, Berman, ELISA, the authors studied the phytopathological, qualitative and physicochemical state. According to the results of the comprehensive assessment, it was found that spelled is distinguished by its unpretentiousness to soil conditions, cultivation technology, and nitrogen nutrition. Spelled grains of the Alkoran variety are covered with spikelet scales, which protects the grain from the harmful effects of the environment, insects and pathogenic organisms. The difference between filmy spelled and naked spelled in the degree of infection with the fungus Fusarium sp. was established. Considering the bare-grain spelled of the Gramme variety, the Fusarium infestation turned out to be 2 times higher than the filmy spelled of the Alkoran variety.

Keywords: spelled, nematode, seed quality, mycotoxins, phytopathological examination, fungi, bacteria, productivity, pesticide-free technology.

1. Introduction
Spelled, or spelled wheat, is a group of species of the genus wheat (Triticum) with a filmy grain and brittle ears. A little used type of wheat, included in the group of membranous species. Spelled was once the most cultivated cereal in the Mediterranean, Ancient Egypt and Phenicia. Until the 18-19th century, spelled porridge was very popular in Russia. Previously, breeders from different countries, she was widely involved in breeding to improve durum wheat, many new varieties were created with the participation of spelled. Academician N.I. Vavilov first saw in 1926 in Spain. He was surprised by the rare valuable properties of this hulled wheat, the origin of which is still a mystery [1].

The goal is to establish the quality of seeds of spelled winter variety Alkoran and spring spelled variety Gramme 2U by studying the microflora during pesticide-free cultivation in the Kaliningrad region.

The task is to conduct a phytopathological examination of seeds, taking into account the determination of the species composition of microflora and their percentage of infection; determine the physicochemical properties of spelled and spelled seeds.
2. Methods and materials

Specimens from the harvest of 2020, obtained in the experimental field of the Kaliningrad Research Institute of Agriculture, a branch of the Federal Research Center "VIK named after V.R. Williams", were taken as material for the study. And also used the fragments of plants selected in the tillering phase from the experimental field. To determine the contamination of seeds with mycological and bacteriological diseases, the following methods were used: the method of washing and centrifugation, the biological method (sowing on the KGA nutrient medium), and the Berman method. To determine the physicochemical parameters by the ELISA method, an infrared grain analyzer, the Infrascan device, was used. To determine mycotoxins, UNIPLAN - Analyzer of enzyme-linked immunosorbent assay (ELISA) was used.

The phyto-examination was carried out in accordance with GOST 12044 [6]. The first term of the analysis was carried out after 5–8 days, the last - on the 12–14 day. Berman's method was used to investigate the presence of nematodes in plant material. For the study, we took parts of plants (basal necks) of spelled c. Alcoran growing in the field. The sample was placed in a funnel with a fine mesh sieve, and filled with water at room temperature so that the sample was completely covered with water. A rubber tube with a test tube is put on the funnel nose, where nematodes settle during the examination [9]. The sediment study was carried out the next day.

Studies of samples of seeds and plants of spelled variety Alcoran and samples of spelled seeds variety Gremme 2 U were carried out. Preparation of samples for phytoexamination was carried out in accordance with GOST 12044 [6]. The first term of the analysis carried out by the biological method was carried out after 5–8 days, the last - on the 12–14 day.

3. Results and discussion

The When analyzing the contamination of seed material in Petri dishes on a nutrient medium and by the method of washing and centrifugation, we noted the defeat of seeds by fungal pathogens of various genera. The manifestation of some phytopathogenic fungi on spelled and spelled seeds on a nutrient medium, as well as of a bacterial nature (mycelium on or around the seed, softening or browning of the integument, bacterial exudate or colonies). Thus, it became obvious that it was necessary to clarify the composition of microorganisms observed in the analysis of seeds. To do this, we determined the generic affiliation of the main pathogens on the surface of the seed material and their percentage in the pathocomplex by means of microscopy and using reference guides [4, 7]. The data obtained showed that on the seeds of spelled and spelled, a relatively stable community of pathogenic micromycetes was noted, including representatives of at least 3 genera, belonging mainly to the department of anamorphic fungi.

In the process of studying the microflora of grain of two varieties of spelled, the following objects were found:

- Bacteriosis (Fig. 1 a, c)
- Mushrooms of the genus Fusarium (Fusarium sp.), Alternaria (Alternaria sp.), Puccinia (Puccinia sp.),
- Nematode

When plant parts (basal neck) were sown on a nutrient medium (Fig. 1 a), golden-yellow colonies were formed, as evidenced by the presence of a bacterium of the genus Pseudomonas sp. [2]. The same discharge appeared on the seeds of spelled and spelled (Fig. 1, c).
Figure 1. Detection of bacterial diseases in the nutrient medium on plant fragments and seeds.

This genus of putrefactive bacteria can act as an antagonist of soil phytopathogens, forming antibiotics and pseudomonas siderophs, and act as antifugal metabolites [6].

Fungal diseases of the genus Fusarium (Fusarium sp.), Causes Fusarium disease. A phytopathogen parasitizing on cultivated and wild plants of the family of cereals, causes rotting of the roots and base of the stems (Fig. 2).

Figure 2. Fungal diseases of the genus Fusarium (Fusarium sp.) In different stages: a-manifestation of the disease on a nutrient medium; b - pure Fusarium mycelium on a nutrient medium; c - Fusarium ascospore on a fragment of mycelium; d - Fusarium ascospore detected by washing and centrifugation.

The main harm from fusarium infection is the accumulation of mycotoxins, which make the affected grain unsuitable for use for any purpose and cause fusariotoxicosis, poisoning of animals and humans.

The fungus of the genus Alternaria sp. Is the causative agent of Alternaria. A distinctive feature of this genus is the formation of large, multicellular dark-colored conidia with transverse and longitudinal septa (Fig. 3, a). In a Petri dish, it formed a dark cobweb mycelium (Fig. 3, b).
Figure 3. Fungus of the genus Alternaria sp: a - conidia of the fungus of the genus Alternaria sp.; c - pure mycelium of the genus Alternaria sp.

Alternaria infects all agricultural crops without exception. It releases two toxins that, unfortunately, are not hosted in our country (not included in SanPIN) - tenuazonic acid (TeA). Frequent occurrence and a wide range of toxic metabolites produced, not yet standardized in food, but can have a negative effect on the wall of the digestive tract in poultry.

Mushrooms of the genus Puccinia (Puccinia) causing rust of various cultivated and wild plants (winter stage - teliospore, Fig. 4).

Figure 4. The teliospore of the fungus of the genus Puccinia Puccinia sp.

The most susceptible to the influence of the pathogen are early crops of winter and late crops of spring wheat fertilized with nitrogen-containing substances.

When sowing CHA (potato-glucose agar) on a nutrient medium (according to GOST 12044 [6]), we carried out a quantitative analysis of the infection of spelled and spelled seeds with diseases. From the average samples intended for the analysis of seeds for infection with diseases, weighed portions of 50 seeds were isolated (Table 1).

| Culture                        | Seed Disease Percentage |
|--------------------------------|-------------------------|
|                                | Pseudomonas | Fusarium | Alternaria |
| Spelled s. Gramme 2U           | 54,1         | 62,6     | 25,0       |
| Spelta s. Alcoran (collapsed)  | 53,8         | 31,2     | 13,1       |
The infection of spelled has exceeded the infection of spelled for all diseases for one important reason - filminess. An important factor in the structure of spelled is its protection from external conditions, and even from radiation, it is spikelet scales (spelled).

Semi-parasitic and saprophytic fungi of the genus Fusarium sp., Alternaria sp., And the bacterium of the genus Pseudomonas sp. Were most pronounced in all the samples. In the samples of the filmy spelled, the percentage of fungi of the genus Fusarium sp. and Alternaria sp. from the total mass of infected seeds was much less. It should be noted that the infection of grain with various microflora is influenced by the peculiarities in the morphology of spelled ears. Probably, in membranous forms, a greater amount of microflora is deposited on the spikelet and flowering scales. In bare spelled spelled, the pathogenic microflora is mostly populated directly by the grain itself [10]. At the same time, some species of fungi of this genus, infecting weeds, have been proposed as producers of bioherbicides [2]. In our case, infection of spelled and spelled seeds with Alternaria sp. very insignificantly, compared to Fusarium sp., where mycotoxins are absent, 1.25 times less in spelled and 4.7 times less in spelled, this indicates the complete absence of an inhibitor of protein synthesis TeA.

By the method of washing and centrifugation, the telitospores of the fungus of the genus Puccinia, which causes the disease of rust, were also found. It does not destroy the grain, but the harm from it is significant. Rust appears on early winter crops and late spring crops. The treatment of seeds with microelements and feeding of plants with phosphorus-potassium fertilizers at the beginning of the exit into the tube gives a positive effect [5].

During the examination of spelled roots taken from the field on November 9, 2020, a nematode belonging to the genus Panagrolaimus (class of Nematoda, or roundworms (Nematoda), subclass Rhabditia, order of Rhabditida) was found by the Berman funnel method using the Berman funnel method (Fig. 6).

![Nematoda belonging to the genus Panagrolaimus sp.: a - general view, c - esophagus](image)

Figure 5. Nematoda belonging to the genus Panagrolaimus sp.: a - general view, c - esophagus

Nematodes of this genus are often found in decaying plant material and soil [11]. This genus of nematodes does not parasitize living plants. It decomposes soil organic matter with the help of symbiotic bacteria. It also participates in nitrogen mineralization, that is, it participates in the decomposition (i.e. oxidation) of chemical compounds in organic matter, as a result of which the nutrients in these compounds are released in soluble inorganic forms that can be made available to plants.

Analyzing the data on mycotoxins, obtained by ELISA on the UNIPLAN enzyme immunoassay analyzer, we can say that none of the detected fungal diseases of spelled influenced the formation of mycotoxins (Table 2).

| Indicators                          | Spelled s. Gremme | Spelta s. Alcoran |
|-----------------------------------|-------------------|-------------------|
| Aflatoxin (mg / kg, the norm is not more than 0.005) | Less than 0.001   | Less than 0.001   |
| Deoxynivalenol (DON) (mg / kg, the norm is not more than 0.7) | Less than 0.2     | Less than 0.2     |
Due to the structure of spelled grain, mycelium did not penetrate into the grain, where it could possibly decompose protein with the release of NH₃ and other toxic substances. But the presence of fungi does not necessarily imply the presence of mycotoxins and vice versa. The main aflatoxin-producing fungi are toxigenic strains of Aspergillus flavus and Aspergillus parasiticus. The mycotoxins DON and ZEA are produced by the fungus Fusarium graminearum. Ochratoxin a is mainly produced by fungi of the genus Aspergillus. The main reasons for the contamination of grain with mycotoxins after harvest are mechanical damage, damage by insects, which facilitates infection by producer fungi. They can cause tumor formation and death in humans and animals. Mycotoxins affect the processes in the immune system, which makes the body more susceptible to infectious diseases.

Table 3 shows the results of physicochemical indicators performed on an infrared analyzer INFRASCAN. A fairly high protein indicator (14.7%) indicates the value of spelled and spelled, and it is quite applicable as a cereal crop. The indicator of gluten in spelled (27.2%) and spelled (28.9%) is small for the use of spelled in bakery production, but with soft wheat flour it is quite applicable in baking. It is known that all food products that are obtained from spelled: bread, pasta, cereals, - help to strengthen the body's immune system. Its defenses against allergic proteins are strengthened, the body becomes less susceptible to them. That is why the products of real spelled, or dinkel, are primarily provided for children's institutions, sanatoriums and hospitals, and only then they go on sale [1].

**Table 3. Physicochemical indicators on the infrared analyzer INFRASCAN**

| Indicators   | Spelled Gramme 2U | Spelled Alcoran |
|--------------|-------------------|-----------------|
| Moisture (%) | 13,4              | 12,7            |
| Protein (%)  | 14,7              | 14,7            |
| Gluten (%)   | 27,2              | 28,9            |
| Cellulose (%)| 2,9               | 2,9             |

4. Conclusion

Thus, according to the results of the comprehensive assessment, it was found that spelled are distinguished by their unpretentiousness to soil conditions, cultivation technology, and nitrogen nutrition. Spelled grains of the Alcoran variety are covered with spikelet scales, which protects the grain from the harmful effects of the environment, insects and pathogenic organisms. The difference between filmy spelled and naked spelled in the degree of infection with the fungus Fusarium sp. and Alternaria sp. was established. Considering the bare-grain spelled of the Gramme 2U variety, the Fusarium infestation turned out to be 2 times higher than the filmy spelled of the Alcoran variety.

Mushrooms of the genus Puccinia (Puccinia) cause rust of various cultivated and wild plants. Winter stage Puccinia sp. (teliospore), was found only on the spelled of the Gramme 2U variety, the Fusarium infestation turned out to be 2 times higher than the filmy spelled of the Alcoran variety.

The infection of spelled seeds, selected from the weighed portions, exceeded the infection of spelled for all detected diseases (fungi of the genus Fusarium sp., Alternaria sp., Bacteria of the genus Pseudomonas sp.) For one important reason - the filminess. An important factor in the structure of spelled is its protection from external conditions, and even from radiation, it is spikelet scales (spelled).

The nematode Panagrolaimus sp. is a saprophyte and does not damage living plants. Panagrolaimus sp. decomposes dead soil organic matter with the help of symbiotic bacteria and participates in nitrogen mineralization, as a result of which nutrients in these compounds are released in soluble inorganic forms that can be available to plants and in this regard can even be useful [11].
The study of spelled grain of the Alcoran variety and spelled of the Gramme 2U variety for mycotoxins revealed indicators below the maximum permissible norm, which indicates their absence. The results of studies of physical and chemical indicators revealed a high percentage of protein (14.7%), which indicates the value of spelled and spelled, and it is quite applicable as a cereal crop. The indicator of gluten in spelled (28.9%) and spelled (27.2%) is small for use in baking, but with soft wheat flour it is applicable in baking.

Spelled varieties Alcoran and spelled varieties Gramme 2U do not require pesticide protection against weeds and harmful organisms, this proves its seed productivity. So the yield of spelled Alcoran on average for 2 years of environmental tests was 35.2 c / ha, spelled Gramme 2U - 27.8 c / ha in pesticide-free technology. Having an “ancient” set of chromosomes, spelled has natural immunity to the negative effects of the environment in the Kaliningrad region and is suitable for ecological (organic) production.

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