Prospects for the use of spelt in organic farming

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Abstract. Organic farming is a way to reduce the negative impact of agriculture on nature and humans. It allows for more efficient use of natural resources and providing the population with safe food. Russia has a huge potential for organic agricultural production. Spelt (Triticum dicoccum Schrank) as a grain culture is promising for use in organic farming, for expanding the market of organic products, for manufacturing environmentally friendly bakery products.

Nature protection and environmental management is an urgent socio-economic problem. The long-term use of intensive technologies of crops cultivation, involving the use of mineral fertilizers and highly effective broad spectrum pesticides at high doses cause the depletion of natural resources, the decrease in species diversity of flora and fauna, soil erosion, pollution of environment and the decrease in food raw materials quality. Thus, when using pesticides, a significant part of them is on plants, in soil, enters groundwater, water bodies, food chains, causing deep and often irreversible violations of the normal biological cycle of substances, reducing the productivity of soil ecosystems, which forms a real threat to human health.

Global problems of modern agriculture, measures to reduce the anthropogenic impact on agricultural production have stimulated the development of the so-called organic farming, aimed at harmonizing agricultural practices and the environment. The use of locally-specific soil fertility potential, natural potential of animals, plants, landscapes, limited use of synthetic fertilizers, pesticides and other agricultural chemicals form the bedrock of organic agriculture. According to the International Federation of Organic Agriculture Movements (IFOAM), organic farming is aimed at working with ecosystems, biogeochemical cycles of substances and elements, protects them and gets the effect of their optimization.

In the long term, it should maintain the ecological balance of specific agroecosystems and of the entire planet.

Organic farming is a unified system of agricultural and food production, ensuring optimal, healthy and productive existence of interconnected elements of the ecosystem [1] – soil, plants, animals and people.

The main tasks of organic farming include environmental protection, preservation and improvement of soil fertility, improving product quality, obtaining environmentally friendly food, which is achieved through the use of organic farming methods [2] - the rejection of artificial fertilizers, pesticides and their replacement by animal and plant waste, the use of crop rotation to restore the soil, the use of biological methods of plant protection, etc.
The founder of organic farming is considered A. Howard, who proposed a system of fertilizing the soil with compost from plant residues and manure (“An Agricultural Testament”, 1943). In 1972, the IFOAM (the International Federation of Organic Agriculture Movements) was established to disseminate information on organic agriculture. The beginning of such a movement in Russia was the all-Union program "Alternative agriculture" (1989).

Today, organic farming has received very wide recognition in the world practice of agricultural production. The demand for organic food products is growing steadily. During the period from 2000 to 2016, the world market of organic food has grown more than 3.5 times and will continue to grow by an average of 15.5 % annually according to Grand View Research [3]. Organic products are a guarantee of safety and health benefits by minimizing the content of nitrates, pesticide residues, heavy metals. Organic products are grown in 178 countries on an area of 58.1 million hectares [3,4]. Italy is a leader in the production of organic products. The main consumers of organic products are the United States and the EU [5], where the production of such products is stimulated at the state level.

The production of organic foods in Russia is at an early stage of development. The absence of a legislative framework hindered the development of organic farming for a long time. Now the standards establishing rules of production, storage, realization, marking and voluntary certification of organic production are put into effect. Russia has a huge potential for organic agricultural production. Rich land resources, the low level of chemicals use (192 kg/ha in the EU, 39 kg/ha in Russia), the diversity of flora and fauna facilitate active development of this direction. The acreage of certified organic land in Russia has increased 10 times in recent years, and the market of organic products has grown by more than 60 %. Organic products are produced in Oryol, Omsk, Orenburg, Kaluga, Kursk, Yaroslavl and other regions, in the Stavropol territory.

Not only the good ecological condition of some regions of the country, rich land resources contribute to the development of the organic products market in Russia, but also the use of crops unpretentious to the conditions of cultivation such as spelt.

Spelt (Triticum dicoccum Schrank) refers to the ancient wheat [6], which is a part of the group of hulled species and is the progenitor of modern soft and durum wheat. In ancient times, spelt was one of the most cultivated cereals along with barley, but since the XIX century spelt planting acreage were restricted significantly as a result of the increase in the cultivation of more productive varieties of soft wheat. Currently, the cultivation of spelt is again gaining momentum in Russia (figure 1). Spelt is actively grown [7] in Italy, Spain, India, Turkey, Bulgaria and other countries.

![Figure 1. Regions of spelt cultivation in Russia.](image-url)
Spelt has a number of valuable agricultural properties that allow it to be used in organic farming - unpretentiousness to growing conditions, early ripening, drought resistance, resistance to diseases such as stem rust, loose smut, powdery mildew. Spelt grains in ears are protected by a dense layer of hard husk from pests, adverse external influences, moisture loss, radioactive radiation. Husk content previously considered a draw-back of this crop is an advantage today compared to the standard naked wheat and makes it possible to obtain environmentally friendly vegetable raw materials, the demand for which is growing in recent years.

The vegetation period of spelt is 10-12 days shorter than that of mid-ripening varieties of spring wheat. Seeds germinate at soil temperature +2...+3°C, seedlings tolerate frost to −8 °C. This allows you to wait out the emergence of weeds, especially oat grass, in the spring pre-sowing period, destroy them by pre-sowing treatments and accomplish spelt sowing later. At the same time, spelt, freeing the field early [8], makes it possible to prepare the soil for sow in [9] winter crops better.

Spelt is characterized by high drought resistance, so in dry years it gives higher yields than other crops, including on poor soils.

One of the draw-backs of spelt is known to be the spike brashness during harvesting. However, the spike of spelt breaks only at the firm ripe stage, and earlier harvesting can prevent losses. If spelt is harvested in a separate way at the beginning of the middle dough stage, the spike brashness is not observed.

Spelt attracts more and more attention of healthy diet supporters and is also of interest to the food industry from the standpoint of expanding the raw material base and the range of products, including functional and nutritional food. Figure 2 shows the advantages of spelt, which make it promising for producing of environmentally friendly, functional and enriched food.

![Figure 2. Advantages of spelt grain crops.](image)

Spelt has a rich chemical composition, it contains as compared with wheat more protein and essential amino acids, polyunsaturated fatty acids, fiber, vitamins, minerals, antioxidants and lignans, which help prevent cardiovascular diseases and cancer. Spelt is characterized by a low content of gliadin, in which α-fraction formula the α6-component is poorly represented, which allows the use of spelt in dietary nutrition, including that for patients with certain forms of celiac disease. Spelt is also
known to contain mucopolysaccharides that strengthen the immune system of the human body, and
polyphenolic compounds that have antimutagenic and anticarcinogenic effects.

We have experimentally stated the chemical composition of two-grained spelt (cultivar Runo (Fleece) grown in the Orel region in 2014-2016 in the territory of a farm that has organic certification. This spelt variety was bred by experts of the State Scientific Institution (SSI) Krasnodar research Institute of agriculture named after P.P. Lukyanenko and of the SSI State Scientific Center All-Russian Research Institute of Plant Industry named after N.N. Vavilov. This spelt variety belongs to the hulled tetraploid wheat and is included in the state register of breeding achievements since 2009. Table 1 shows the average chemical composition of spelt and common (soft) wheat.

Table 1. Chemical composition of spelt and common (soft) wheat.

| Parameter Name                      | Spelt Grain | Common (Soft) Wheat Grain |
|-------------------------------------|-------------|---------------------------|
| Water, %                            | 11.00       | 14.00                     |
| Protein, %                          | 14.50       | 11.80                     |
| Fat, %                              | 2.40        | 2.20                      |
| Polyunsaturated fatty acids, %      | 1.30        | 0.40                      |
| Carbohydrates, including:           |             |                           |
| Starch, %                           | 53.90       | 55.50                     |
| Reducing sugar, %                   | 3.02        | 1.09                      |
| Cellulose, %                        | 5.3         | 2.00                      |
| Vitamins, mg:                       |             |                           |
| B1                                  | 0.36        | 0.44                      |
| B2                                  | 0.113       | 0.15                      |
| B5                                  | 1.16        | 1.15                      |
| B6                                  | 0.23        | 0.53                      |
| B9, mcg                             | 45.00       | 37.50                     |
| H, mcg                              | 9.30        | 10.40                     |
| Ash, %                              | 2.10        | 1.70                      |
| Mineral Substances, mg:             |             |                           |
| Magnesium                           | 136.00      | 108.00                    |
| Phosphorus                          | 401.00      | 370.00                    |
| Ferrum                              | 4.40        | 5.40                      |
| Potassium                           | 338.00      | 337.00                    |
| Zinc                                | 3.28        | 2.79                      |
| Manganese                           | 115.00      | 108.00                    |
| Selenium, mcg                       | 11.70       | 29.00                     |

The presented data show that spelt is superior to wheat in protein content, reducing sugars, polyunsaturated fatty acids, dietary fibers, some vitamins (Pantothenic, folic acids and choline) and minerals (magnesium, phosphorus, zinc, manganese).

To assess the technological advantages of this cereal crop, the quality indicators were stated (table 2).

Table 2. Spelt Grain Quality Indicators.

| Parameter Name            | Indicator Values for spelt grain |
|---------------------------|---------------------------------|
|                          | crop year 2015 | crop year 2017 |
| Grain hardness, %         | 55             | 70             |
| Trash content, %          | 1              | 1.5            |
| Grain impurity, %         | 3              | 3              |
| Pest contamination        | -              | -              |
| Moisture content, %       | 11.0           | 10.5           |
### Table 1

| Property                                      | 2015   | 2017   |
|-----------------------------------------------|--------|--------|
| Protein weight content, %                     | 13.9   | 15.0   |
| Crude gluten weight content, %                | 21.0   | 31.0   |
| Gluten quality, standard unit, FDM            | 77.5   | 80.0   |
| Acidic aspect, deg.                           | 5.4    | 5.0    |
| Fat acidity value, mg KOH/1g of fat           | 32.7   | 29.0   |
| Falling number / Hagberg falling, c           | 406    | 380    |

Different weather conditions affected the quality of spelt grain; they differed significantly in protein, gluten and grain hardness. Thus, the harvest of grain spelt in 2015 had an average grain hardness (55 %), the content of crude gluten was 21 %, while its quality was satisfactorily weak (77.5, standard unit, FDM). In 2017, the spelt grain hardness was 70 % (high), the content of crude gluten was 31 %, but its quality was also characterized as satisfactorily weak (80 standard units, FDM). Gluten strongly adhered to the hands in the process of gluten washing, it had a spreadable consistency, blurred quickly with subsequent binning (storing). All these are indicators of the low bread-making properties of flour from such grain. Since the gluten quality is of great importance to bread baking and determines the consumer properties of the product - the volume and crumb vesiculation of the finished bread, this fact must be taken into account when choosing technological methods and methods of dough-making.

Thus, the development of organic farming in Russia is very important. It allows for saving natural resources, protecting the environment, improving product quality, getting environmentally friendly food. Agricultural features of cultivation, the rich chemical composition of spelt are of interest to organic farming and organic production, as well as to the baking industry to produce functional and enriched food.

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