Improvement of cultivation technology for spelt in Tatarstan Republic

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Abstract. Variety of wheat – spelt (Triticum dicoccum Schuebl) is an oldest crop which becomes more popular since a modern consumer turns toward healthy food. The article describes influence of agricultural techniques on the yield, grain quality and economic efficiency of cultivation of spelt in the gray forest soil of Tatarstan Republic. In recent years, intensive changes of the most important agro-climatic parameters have been observed in the territory of the Republic of Tatarstan. Given the arid natural and climatic conditions, especially in the first half of the growing season of spring wheat, the result for wheat spelt is good from an economic point of view. The observations and analyses during the growing season of 2012, 2013 and 2014 showed that the reliable was obtained by sowing 6 million seeds per hectare and an increase in yield compared to the seeding rate of 4 million was 0.36 tons per hectare. The maximum yield of 0.53 tons per hectare was obtained under control led content of Nitrogen/Phosphate/Potassium with sowing of 3 tons of grain per hectare. On the basis of research in 2016-2018 it was found that the best precursor for spelt is a one-year clover, which provided a spelt harvest of 2.18 tons per hectare. With early sowing, a yield increase of 0.4 t ha. Optimal seeding depth was 4 cm.

1. Introduction

Nowadays production of spelt revives in the republics of Dagestan, Bashkortostan, Karachay-Cherkessia, Tatarstan, Chuvashia, and Krasnodar region and in other regions.

In the XIX and early XX century spelt occupied almost all areas in Tatarstan, and wheat was not grown. In the Tatar language it has its own name Borai. Now, unfortunately, many people are not even familiar with this interesting culture and its valuable features. Modern interest in the spelt is not accidental. Spelt is relatively robust to the growing conditions, it has a large ecological plasticity, very precocious, drought and cold resistant [1-4]. Resistance to disease is considered an important sign of spelt. Spelt grain is characterized by a high protein content of 23.0 % [5-8], it produces cereals with high taste and dietary advantages. According to these indicators, spelt is equal to buckwheat and millet. In recent years, spelt and dishes from it have become so popular that even received the name of "black caviar cereals". Market mechanisms of management can stimulate the production of its grain as a particularly valuable cereal crop. In addition, spelt is an important source of valuable parental forms for hybridization with soft and especially hard wheat [9-12].

Given the distinctive biological properties of spelt and its valuable cereal advantages, it is necessary to begin the revival of crops and selection of spelt in Russia [1].

The main disadvantage of spelt is a relatively low productivity compared to spring wheat, which was the main reason for its exclusion from the cultivation. After the gradual revival of the crop growing on
fields of the Republic of Tatarstan, the yield of the Emmer wheat in an average 2010-2018 amounted to 2.05 t/ha to reflect the substantial changes in climatic conditions in the region (over the last 30 years: the sum of effective t°100 increased from 8700 to 10800C; the amount of precipitation for May-June decreased by 6 %, which in turn leads to the sensitivity of the objects of study to climate fluctuations. For example, high-yielding varieties of spring wheat dramatically reduce their productivity in adverse conditions. This is not a bad result for spelt, comparing with the yield of spring wheat. The table below shows that the average yield of spring soft wheat in the country over the past nine years is 2.17 t/ha, which is not much different from the yield of spelt (Table. 1).

Table. 1 Spring wheat yield in Tatarstan Republic

| Years | Triticum aestivum | Triticum dicoccum Schuebl |
|-------|------------------|---------------------------|
| 2010  | 0.99             | 1.78                      |
| 2011  | 2.79             | 2.14                      |
| 2012  | 2.36             | 2.09                      |
| 2013  | 1.79             | 1.85                      |
| 2014  | 2.04             | 1.96                      |
| 2015  | 2.02             | 1.91                      |
| 2016  | 2.18             | 2.24                      |
| 2017  | 3.06             | 2.31                      |
| 2018  | 2.31             | 2.17                      |
| Average for 9 years | 2.17    | 2.05                       |

The relevance of the topic is that one of the main problems in the production of spelt is the unexplored culture in the climatic conditions of Tatarstan Republic. The lack of theoretical data and practical recommendations makes it difficult to develop a single cultivation technology. Today the spelt is cultivated on traditional grain technology, without taking into account its biological, morphological and physiological features.

In this regard, in order to achieve higher production of spelt, study of culture and development of a single cultivation technology in the Republic of Tatarstan, field experiments were conducted in 2012-2018.

The main purpose of this work was to assess the reaction of the research material to agrotechnological methods of cultivation in specific soil and climatic conditions.

2. Material and methods

2.1. Experimental field

The experiment was carried out in the experimental fields of Kazan State Agrarian University in the gray forest loam typical for the region soil. The arable layer of humus content (according to Tyurin) – 2.9-3.2 %, the amount of absorbed bases – 27 mg.-EQ per 100 g of soil, easily hydrolyzed nitrogen – 79.0-110 (according to Corinfield), mobile phosphorus – 105-190, exchangeable potassium (according to Kirsanov) – 79-149 mg per 1000 g of soil, salt PH – 5.6-5.7. Please follow these instructions as carefully as possible so all articles within a conference have the same style to the title page. This paragraph follows a section title so it should not be indented.

2.2. Object of study

Spelt wheat (middle class). Studies were conducted according to the guidelines of the state variety testing of agricultural plants. The total area of plots 58 m² (35 m × 1.65 m), accounting is 50 m². Accommodation plots for the repeats consistent and randomized, in four replications. Sowing was
carried out in the first decade of May with a seeder SN-16. For the rest the technology of cultivation of spring wheat recommended by economy of Tatarstan Republic was used.

2.3. Weather conditions

Weather conditions during the growing season of wheat in the years of research were different. Temperature and moisture content of the soil as much as possible reflected the characteristics of the forest-steppe region of the Middle Volga region. Some vegetation periods were characterized by sufficient moisture, others by air and soil droughts. Hydrodynamic coefficient of soil (HCS) in 2013, 2014, 2015 ranged from 0.4-0.6, and in 2012, 2016, 2017 and 2018 it was 0.7-0.8. This allowed revealing the reaction of spelt on the action of the studied methods of agricultural technology.

3. Results and discussion

Bioclimatic potential of Tatarstan Republic has big potentials. There are factors that limit the yield and quality of grain, for example lack of moisture and nutrition. Therefore, now there is an urgent need for adaptive crop production in the Republic. To achieve this goal, it is necessary to select new varieties that will be able to use bioclimatic potential to a greater extent. This will allow obtaining stable crop yield with high technological qualities and low cost.

The technology of cultivation of the spelt with high quality grain is important in placing it on the best predecessors: one-year clover, annual herbs (Viya + oats) and winter rye on fertilized fallow. The increase in the yield of 0.36-0.57 t/ha and the increase in the protein content in the grain by 0.4-1.8 % allows increasing net income by 2740-4070 rubles/ha at 2018 prices (table. 2).

Table 2. Yield and quality of wheat spelt depending on from agrotechnical methods of cultivation of

| Agricultural techniques          | Average for years | Yield, t/ha | Weight of 1000 grains, g | Protein content, % | Protein kilos per 1 ha | Filminess of a grain, % | Outcome of pure grains |
|----------------------------------|-------------------|-------------|--------------------------|--------------------|------------------------|------------------------|------------------------|
| Predecessors:                   |                   |             |                          |                    |                        |                        |                        |
| One year clover                  |                   | 2.18        | 34.0                     | 16.8               | 366                    | 25.2                   | 1.63                   |
| Winter ray                       |                   | 1.97        | 33.4                     | 15.4               | 303                    | 25.0                   | 1.48                   |
| Alfa-alfa-oat (to winter)        |                   | 2.09        | 33.6                     | 16.1               | 336                    | 24.9                   | 1.57                   |
| Spring wheat                     |                   | 1.61        | 32.2                     | 15.0               | 242                    | 25.4                   | 1.20                   |
| Nutrient level:                  |                   |             |                          |                    |                        |                        |                        |
| Natural background               |                   | 1.81        | 30.9                     | 14.9               | 270                    | 25.7                   | 1.35                   |
| NPK calculated per 2.5 t/ha      |                   | 1.98        | 33.2                     | 16.3               | 325                    | 25.3                   | 1.48                   |
| NPK calculated per 3.0 t/ha      |                   | 2.34        | 33.7                     | 16.6               | 388                    | 25.5                   | 1.74                   |
| Sowing:                          |                   |             |                          |                    |                        |                        |                        |
| I – early (when soil is ready)   |                   | 2.12        | 34.8                     | 16.0               | 339                    | 24.4                   | 1.61                   |
| II – in 7 days after I           |                   | 1.91        | 34.1                     | 16.1               | 308                    | 24.0                   | 1.45                   |
| III – in 14 days after I         |                   | 1.72        | 32.9                     | 15.3               | 263                    | 24.8                   | 1.29                   |
| Sowing norms, million seeds per ha: |           |             |                          |                    |                        |                        |                        |
| 4                                |                   | 1.85        | 33.9                     | 16.6               | 307                    | 24.7                   | 1.39                   |
| 5                                |                   | 2.02        | 33.0                     | 16.3               | 329                    | 25.0                   | 1.52                   |
| 6                                |                   | 2.21        | 32.6                     | 15.8               | 349                    | 25.1                   | 1.66                   |
| 7                                |                   | 2.17        | 32.2                     | 15.5               | 336                    | 25.3                   | 1.62                   |
| Depth of seeding:                |                   |             |                          |                    |                        |                        |                        |
| 2 cm                             |                   | 2.14        | 32.9                     | 15.7               | 336                    | 24.9                   | 1.61                   |
| 4 cm                             |                   | 2.31        | 33.8                     | 16.5               | 381                    | 24.3                   | 1.75                   |
| 6 cm                             |                   | 2.19        | 33.2                     | 16.2               | 355                    | 24.4                   | 1.66                   |
The change in the level of nutrition by applying the calculated doses of mineral fertilizers did not have any significant impact on the yield. This can be explained by the fact that the meteorological conditions prevailing in the first half of the vegetation of the spelt did not contribute to the full implementation of the introduced macroelements, which caused a shortfall in the estimated grain yield. On average, for 3 years of fertilization increased the yield of wheat spelt in comparison with the natural background of 0.17 t/ha (calculation of NPK 2.5 t/ha) and 0.53 t/ha (NPK – 3 t/ha) and the collection of protein per unit area, respectively: 53-118 kg/ha.

The choice of the optimal sowing period for spring wheat mainly depends on climatic factors: the spring, amounts and distribution of spring and summer precipitation, the reserves of productive moisture in soil. The results show that the sowing of spelt in the first term provides a maximum yield (average for 3 years – 2.12 t/ha). The increase in grain yield depending on the sowing period was 0.21-0.4 tons per hectare. At the early sowing period, the protein content of the spelt grain increased by 0.7 %.

An important element of resource-saving technology and effective spring wheat growing is the observance of optimal norms of its sowing. The optimal seeding rate should contribute to the creation of conditions in the soil for the intensification of photosynthetic processes (leaf area, accumulation of organic matter, etc.) to the formation of the maximum possible yield of better quality and low cost of the product.

The optimal seeding rate of 6 million germinating seeds per hectare established in the experiments provided an increase in yield in comparison with the seeding rate of 4 million 0.36 tons from 1 ha or 19.5 %, at 5 million – 0.19 tons or 9.4 %.

An increase in the seeding rate above this optimal rate either did not give an increase or reduced the yield. The optimal seeding rate established by us in the experiments provided a high-quality harvest of environmentally friendly spelt wheat, an increase in net income by 470 rubles per hectare, an increase in the level of profitability by 12 %.

Seeding should be uniform on gray forest soils of heavy mechanical composition by 4 cm. Deep seeding reduces the yield and quality of grain (table 2).

It was not possible to establish certain regularity about the influence of methods of agricultural technology on the filthiness of wheat spelt in our studies.

4. Conclusion
Under conditions of gray forest soils of Tatarstan Republic one-year clover as a predecessor provides maximum productivity of spelt, as well as application of the calculated norms of fertilizers for 3 tons of grain; early sowing period; the optimal seeding rate (6 million) established in the experiments and the depth of seeding – 4 cm.

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