Ecological value of spring wheat varieties in the Irkutsk region

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Abstract. The climatic conditions of the Irkutsk region belong to the risky agriculture zone. This is due to the environmental differences in soil characteristics, temperature conditions, the amount and distribution of precipitation in the regions of the region. Therefore, spring wheat varieties should be available to agrarian producers. These varieties are able to produce high yields with good grain quality due to their biological characteristics. In this regard, spring wheat is being selected in order to create varieties with economically valuable characteristics. At Irkutsk State Agrarian University named after A. A. Yezhevsky the breeding work is conducting to obtain biotypes of the Angara 86 variety and use them in breeding practice. The selected biotypes are included in hybridization with the participation of varieties of Western Siberia and the Krasnoyarsk region. As a result of breeding work, a valuable source material was obtained, which is tested in breeding nurseries.

The Irkutsk region occupies a large territory and stretches from South to North. The climate in the region is sharply continental. However, depending on the geographical location, changes in the relief, number and size of water basins, individual regions of the region differ significantly in agrometeorological terms. Therefore, the entire system of agriculture is based on zonal technology of agricultural crops cultivation, which is based on the biological characteristics of plants, the correct use of arable land in accordance with its fertility and climatic conditions of the region. Consequently, the Irkutsk region is divided into six zones [1]. Each of these zones is characterized by a certain frost-free period, the amount of precipitation and the sum of positive temperatures during the vegetation period. Therefore, for each specific zone, there must be varieties that correspond to agrometeorological conditions, which, due to their biological characteristics, can give a good and stable yield of agricultural products.

In the Irkutsk region, crop production accounts for 42.1%. In the structure of acreage, wheat occupies 34.3%. The share of wheat in all-Russian production is 0.6% [2]. Some indicators of wheat grain production are given in table 1.

Table 1. Key indicators for wheat grain production in the Irkutsk region [2].

| Indicators                                      | 2015  | 2016  | 2017  | 2018  |
|------------------------------------------------|-------|-------|-------|-------|
| Acreage of wheat in farms of all categories    | 230.90| 233.4 | 246.4 | 248.9 |
| Gross wheat harvest in farms of all categories | 352.30| 443.9 | 503.6 | 506.3 |
thousand tons

Wheat yield in farms of all categories, t/ha

|          | 2016 | 2017 | 2018 | 2019 |
|----------|------|------|------|------|
|          | 1.77 | 1.90 | 2.05 | 2.04 |

Grain production per capita (kg):

|                                | Russian Federation | Irkutsk region |
|--------------------------------|--------------------|----------------|
| in the Russian Federation      | 715.3              | 228.1          |
| in the Irkutsk region          | 812.8              | 315.5          |

The analysis of the above table shows that the acreage increases over the years, and the gross grain harvest increases accordingly. Grain yield increases very slowly and especially in 2017-2018. In 2019, wheat in the region was sown on an area of 250.3 thousand hectares. The yield was 1.96 t/ha [2].

In 2020, the Ministry of agriculture of the Irkutsk region plans to produce 1 million tons of grain by increasing the acreage by 20,000 hectares, which will amount to 728 thousand hectares. Under grain crops, the area will increase by 13,000 hectares and will amount to 445.1 thousand hectares. In this regard, elite and original seeds are expected to occupy 23.4% of the area of cereals and legumes. In addition, the system of agriculture and technology of wheat cultivation is being improved. But the crucial importance for achieving this goal will belong to the varieties of spring soft wheat cultivated in the Irkutsk region [1]. 13 varieties of spring wheat of different maturity groups are zoned in the region (table 2) [1, 3-5].

### Table 2. Acreage of spring wheat varieties in the Irkutsk region, thousand ha.

| Variety            | 2016 | 2017 | 2018 | 2019 |
|--------------------|------|------|------|------|
| Early ripening:    |      |      |      |      |
| Tulun 15           | 8.4  | 3.60 | 2.53 | 2.852|
| Iren’              | 97.64| 102.90 | 103.2| 105.580|
| Novosibirskaya 15  | 6.4  | 2.90 | 6.3  | 3.115 |
| Middle ripening:   |      |      |      |      |
| Tulunsky 12        | 36.00| 21.28| 25.8 | 7.958 |
| Selenga            | 13.50| 19.00| 13.1 | 20.693|
| Buryat spinous     | 40.16| 58.50| 47.5 | 53.598|
| Omskaya 32         | 0.20 | 0.40 | 0.03 | 0.682 |
| Novosibirskaya 29  | 1.90 | 1.50 | 1.9  | 1.134 |
| Memory of Yudin    | 3.80 | 8.00 | 8.83 | 10.129|
| Altayskaya 70      | 0.72 | 1.35 | 1.025| 6.483 |
| Yunata             | 0.55 | 4.60 | 3.34 | 0.227 |
| Tulunskaya 11      | 3.2  | 6.50 | 2.17 | 12.109|
| Kanskaya           | -    | -    | -    | 0.011 |
| Total for zoned    | 212.47| 230.93| 215.939| 242.422|
| varieties          |      |      |      |      |
| Non-zoned varieties| 22.52| 15.64| 18.410| 17.581|

Table 2 data shows that of 13 zoned wheat varieties in the Irkutsk region 3 varieties belong to the group of early ripening and 9 to the group of middle ripening, one variety of durum wheat is Yunata. Of 13 varieties 5 are of the Irkutsk selection, or rather the branch of the Irkutsk Research Institute of Agriculture - Tulun Breeding station [1].

Each variety is characterized by complex requirements for growing conditions, and accordingly there are no varieties equally suitable for all zones and areas. Of the varieties listed in the register for cultivation in our region, the largest area is occupied by the variety Iren’. This variety successfully combines precocity, grain quality indicators and relative resistance to environmental conditions of growth. In second place, the Buryat spinous variety and then the Selenga wheat variety. The reason for
this is that the last two varieties (the origin of these varieties is the Republic of Buryatia) are drought-resistant and with high yields. It should be noted that there is an increase in the area under the varieties Memory of Yudin, Tulunskaya 11 and Altayskaya 70 [1].

All categories of agricultural enterprises try to cultivate those varieties of spring wheat that meet the natural and climatic conditions of the economy. Some small enterprises sow non-zoned varieties of spring wheat, and their area varies by year from 6.5 to 13% [2].

In the Irkutsk region, two institutions deal with spring wheat breeding: the Tulun State Breeding Station and the Irkutsk State Agrarian University. In Irkutsk State Agrarian University Sverkunov V. K. started breeding spring wheat in 1949 [6]. In the future, other scientists joined the selection research. As a result the next varieties of spring soft wheat were obtained: Angara 86 (Naumova M. S.) and Studencheskaya (Naumova M. S., Abramov A. G.). The Angara 86 variety was zoned in 1989, and the Studencheskaya variety in 2004 [7, 8].

Table 3 shows the results of the yield of Angara 86 for some variety sections of the Irkutsk region [8-11].

| District       | 1989  | 1994  | 1997  | 2000  |
|----------------|-------|-------|-------|-------|
| Bratsk         | 6.72  | 2.02  | 3.06  | 2.62  |
| Kuitun         | 3.45  | 3.73  | 3.20  | 2.21  |
| Nizhneudinsk   | 5.89  | 3.07  | 2.95  | 4.07  |
| Kachug         | 3.83  | 2.25  | 1.88  | 1.11  |

Table 3 shows that there is no stable yield over the years. This is due to the fact that the region is located in a zone of risky agriculture. According to the annual report the highest yield of the Angara 86 variety was obtained in the state farm "United labor" of the Kachug district of 7.8 t / ha, on an area of 10 hectares.

In production conditions the Studencheskaya variety showed a high yield in the Kuytun, Nizhneudinsk, Kachug districts with a yield of 2.7 to 3.37 t / ha. When seeds were propagated at the Stepnoye farm, the yield of 3.7 t/ha was obtained, the grain glassy content of 60.6%, the content of raw gluten-33.7%, the protein content-16.5%.

Given the above, it can be noted that the varieties Angara 86 and Studencheskaya in adverse conditions, including in the Northern areas of the Irkutsk region, showed good results in yield, therefore, they had high environmental plasticity.

The scientific literature shows that the disproportion of the structural organization of the embryo at the initial stages of ontogenesis has a significant impact on the initial stages of growth of seedlings and on the productivity of soft wheat plants. It is suggested that the Siberian varieties of soft wheat this can also be inherited and fixed in the offspring [12, 13]. Based on the above, biotypes of the Angara 86 variety were obtained as research objects [14]. Morphological indicators of grain development and seed productivity were determined for the obtained biotypes [12, 15, 16]. The results of these studies are shown in table 4.

| Biotype       | Weight of 1000 grains, g. | The average mass of the productive spike, g. | The number of productive stems, m² | Seed productivity g/m² | % |
|---------------|--------------------------|---------------------------------------------|-----------------------------------|------------------------|---|
| control       | 33.58±0.25               | 1.35±0.07                                  | 428                               | 578±2.04               | 100 |
| 1             | 34.56±0.21               | 1.38±0.07                                  | 494                               | 682±5.10               | 118 |
| 2             | 33.58±0.23               | 1.35±0.04                                  | 428                               | 578±1.12               | 100 |
In the Angara 86 variety, the weight of 1000 grains (table 4) exceeded the control parameters of the first, third and fourth biotypes. These same biotypes also retained a larger number of productive stems, which affected seed productivity. Thus, the seed productivity per unit area exceeded the control in the first, third and fourth biotypes by 18; 27 and 39%, respectively. The obtained data indicate that not only the variety, but also its biotypes, in particular the first, third and fourth, can be used as the initial selection material.

We used the studied varieties and biotypes in hybridization and obtained a valuable source material, which is tested in nurseries of the selection process (table 5).

**Table 5.** Indicators of productivity and quality of breeding lines, 2019.

| Variety, line             | Yield, t / ha | Gluten content, % | Protein content, % |
|---------------------------|---------------|-------------------|--------------------|
| Angara 86                 | 2.31          | 31.63             | 15.32              |
| Studencheskaya            | 2.68          | 33.00             | 15.82              |
| Line 15                   | 3.75          | 33.44             | 16.24              |
| Line 12                   | 2.87          | 34.77             | 16.44              |
| Line 11                   | 2.92          | 36.03             | 17.21              |
| Tulunskaya 11 (standard)  | 1.81          | 22.29             | 11.97              |

Table 5 shows that the resulting lines exceeded the yield and quality indicators not only of the standard, but also of the parent varieties.

On the basis of the plastic varieties of spring wheat Angara 86 and Studencheskaya with the participation of the obtained biotypes, the varieties of Western Siberia and the Krasnoyarsk region, a valuable source material for wheat breeding was obtained. Work on the study of these numbers continues with the aim of obtaining a new variety.

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