Dynamics of particle size formation in wheat grain in dependence on pesticides and nutrition background

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Abstract. The paper analyzes the research results on the pesticides and mineral nutrition impact on the 1000 grains mass of spring wheat cultivated in Eastern Siberia. As a previous crop grain was studied as the most frequently used by agricultural producers. Ten varieties from the state register for breeding achievements approved for use in the Krasnoyarsk territory were studied. In the conditions of forest-steppe in the Krasnoyarsk territory the variability of 1000 grains mass on different cultivation backgrounds in soft spring wheat can be from 30 to 43 grams. The indicator for the strength of the influence factor «variety» on the grain size and full weight is 77%. The indicator for the strength of the «background» influence was not revealed.

1. Introduction

The maximum return from modern varieties of spring wheat can be expected only when they are cultivated with elements of intensive technology in crop production. They include: integrated plant protection system, increasing soil fertility, fertilizer system, crop rotation system, use of zoned varieties, improvement of soil treatment system, complex mechanization, etc. Fulfilling these conditions makes a huge contribution to obtaining high grain yield of excellent quality [1].

When cultivating wheat only varieties with a stable hereditary basis of high seed quality indicators should be used. All agrotechnical techniques in intensive technologies should be interconnected organically and aimed at mobilizing the potential of varieties. High-quality products are in high demand on the market; they are encouraged by higher prices and profitable for any economy [2].

In connection with the transition to import substitution, agricultural producers need to provide the Siberian Federal District and the Russian Federation as a whole with highly productive wheat grain of the best quality [3]. Therefore, the purpose of these studies was to determine the intensification effect of the cultivation background on the mass of 1000 grains in soft spring wheat varieties zoned in the Krasnoyarsk territory. The study was aimed at assessing the dynamics of grain mass and grain size in zoned varieties of soft spring wheat depending on the variety, pesticides and the use of mineral nutrition.

2. Methods and results

Research for determining the mass of 1000 grains in soft spring wheat was conducted on the basis of an experimental field in the forest-steppe zone of the Krasnoyarsk territory. Grain was chosen as a previous crop as the most frequently used by agricultural producers. The soil of the experimental site was represented by luvic chernozem, medium-grained, medium-humus, heavy-loam.
Soil analysis for NPK showed a very high content of K, high P, and low N, and therefore ammonium nitrate (34.4 %) was used as a fertilizer in the physical weight of 100 kg/ha in pre-sowing cultivation [4]. Before sowing the seeds were treated with water-suspension concentrate Oplot 0.5 l/t. Seeding was carried out in the second decade of May with a selective mounted pneumatic seeder SSNP-16 with a seeding rate of 5.0 million grains/ha, the method of sowing was ordinary, the depth was 5 cm [5]. The total area of the plot was 12 m², accounting area was 10 m², repeatability was four times, and the method of placing plots was systematic [6].

As a complex of plant protection agents fungicides, herbicides and insecticides were used during the growing season: Puma Super 100, suspension concentrate 0.6 l/ha; Prozaro quantum, emulsion concentrate 0.6 l/ha; Detsis Expert, emulsion concentrate 0.125 l/ha, and the preparation Ultromag Profi 2 l/ha was added to the tank mixture to reduce stress in plants during treatment with pesticides. Harvesting was carried out in the first decade of September [7].

After initial drying and cleaning the mass of 1000 seeds was determined under laboratory conditions according to the state standard 10842-89: from an average grain sample two specific grain weights were separated, the mass of each of which was close to the mass of 500 grains, and it was weighed on a laboratory scale with accuracy to the second decimal point. Whole grains or seeds were selected from the specific grain weights, and the remainder was weighed to the second decimal place. The mass of whole grains was determined by subtracting the weight of the remainder from the weight of the specific grain weights. Whole grains selected from the specific grain weight were counted using a counter according to the instructions attached to the device or manually. Each definition was performed using two parallel specific grain weights [8].

**Table 1.** Mass dynamics of 1000 wheat grains under the influence of a previous crop and ammonium nitrate, g.

| Variety               | Grain | Grain + pesticides | Grain + NH₄NO₃ | Grain + pesticides + NH₄NO₃ |
|-----------------------|-------|--------------------|----------------|-----------------------------|
| «Svirel»              | 40    | 40                 | 35             | 36                          |
| «Pamyati Vavenkova»   | 36    | 37                 | 37             | 36                          |
| «Altayskaya 70»       | 39    | 41                 | 43             | 41                          |
| «Altayskaya 75»       | 30    | 38                 | 33             | 37                          |
| «Krasnoyarskaya 12»   | 38    | 37                 | 37             | 34                          |
| «Novosibirskaya 15»   | 32    | 33                 | 34             | 35                          |
| «Novosibirskaya 16»   | 39    | 34                 | 37             | 39                          |
| «Novosibirskaya 29»   | 35    | 36                 | 35             | 36                          |
| «Novosibirskaya 31»   | 33    | 36                 | 31             | 37                          |
| «Novosibirskaya 41»   | 32    | 30                 | 34             | 35                          |
| M±m                  | 35±1.1| 36±1.0             | 36±1.0         | 37±0.7                      |
| Lim                   | 30-40 | 30-41              | 31-43          | 34-41                       |
| Reliability level, %  | 2.5   | 2.3                | 2.3            | 1.8                         |

To evaluate varieties by weight of 1000 grains the materials of laboratory experiments were processed using mathematical statistics by the standard Excel package [9], obtained data are shown in the table 1.

From the given data we can conclude that the previous grain with the use of fertilizers and with the use of modern plant protection products has the largest variability range in the mass index of 1000 grains by backgrounds– 11-12 grams. The grain background with the use of a full intensification complex is
the most stable in this regard—7 grams. On average the largest grain is formed in the studied varieties against the using background of pesticides and ammonium nitrate together—37 grams.

If we consider the varieties in the context of the highest stability in the indicator and grain size, it is established that the variety «Altayskaya 70» forms the largest grain: from 39 to 43 grams. This value of one from the most important indicators in the crop structure plays a major role in the productivity of this variety. Thus, it should be noted that it has very high mass of 1000 grains on any background, for strong wheat this indicator should not be less than 30 grams [10]. According to the data in figure 1, all varieties on this basis are at the proper level. Varieties «Novosibirskaya 15» and «Novosibirskaya 41» had the lowest mass of 1000 grains on average for all backgrounds: 33 grams.

According to the results of the data dispersion analysis, the variation in the mass of 1000 grains by cultivation backgrounds is not statistically significant (P greater than 0.05). In the background the actual Fisher ratio (1.06) is less than the critical 3.49, so there is 95% of probability that the grain size of the studied varieties does not depend on the background of intensification. It follows that the use of cultivation backgrounds does not have a positive or negative impact on this indicator. It was found that the mass of 1000 grains depends on the variety strongly: the P-value was 0.0003. This indicates that the differences in the size index for varieties are reliable by more than 99.9%. The actual Fisher ratio is 12.52, which is much more than the critical one (3.25), so we understand with 99.9% of probability that

![Figure 1](image-url)
the mass of 1000 grains depends on the varietal characteristics. The indicator for the strength of the influence factor "variety" on the grain size and full weight is 77 %.

3. Conclusion
Based on the research, the following conclusions are formulated:
1. The most complete grain in soft spring wheat varieties zoned in the Krasnoyarsk territory is formed against the background of pesticides and balanced mineral nutrition using. Among the studied varieties the variety «Altayskaya 70» has the highest mass of 1000 grains: 39-43 grams by backgrounds.
2. According to the results of the data dispersion analysis, the variation in the mass of 1000 grains by cultivation backgrounds is not statistically significant, so we can say with 95% of probability that the grain size of the studied varieties does not depend on the background of intensification.
3. It was found that the mass of 1000 grains depends on the variety strongly, since the P-value was 0.0003, which indicates that the differences in the size index for varieties are reliable. The indicator for the strength of the influence factor "variety" on the grain size and full weight is 77 %.

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