

COMMUNICATION

PROCESS PARAMETERS OF GRAIN QUALITY AND BREAD-
MAKING PROPERTIES OF WINTER RYE FLOUR

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ABSTRACT

Research has been conducted in the conditions of the Middle Urals to study the effect of sowing dates on the process and bread-making properties of winter rye grain in 2014-2016 on the basis of the educational and scientific experimental field of the FSBEI HE Perm SATU. The field experiment was conducted on the predecessor of annual grasses for green fodder. For sowing, we used the winter rye variety - Falenskaya 4. Sowing was carried out on seven different days: August 15, 18, 21, 24, 27, 30, and September 2. Process analyzes of grain quality were carried out in the testing laboratory of PermAgroService LLC. In the course of research, it was found that in different years according to meteorological conditions, rye forms grain of the 3-4 quality class and bread of satisfactory quality regardless of the sowing period.

INTRODUCTION

Currently, there is a problem of grain production for high-quality baking flour [5, 6, 16]. Rye bread is not only inferior to wheat bread but even surpasses it in nutritional properties and a positive effect on health [8, 12]. However, sown areas of winter rye are reduced both in our country and in world production [1, 2, 11, 15]. There are many reasons. One of them is untimely sowing and, as a result, the death of plants during overwintering. The influence of sowing dates on the yield and quality of grain of winter crops has been studied by many scientists of our country and abroad [3, 4, 7, 9, 10, 13, 14]. According to these studies, we can conclude that high grain quality is formed at optimal periods but in the specific conditions of the region they are different, and their correct determination is an important challenge.

MATERIALS AND METHODS

Field studies were carried out at the educational-scientific experimental field of the FSBEI HE Perm SATU in 2014-2016. The soil of the experimental plot is soddy, fine podzolic, heavy loamy, moderately cultivated. The predecessor of annual grasses on green fodder. The object of study is winter rye - Falenskaia 4. The predecessor is annual grasses. Soil tillage included disking, plowing, and tandem disk harrowing. Mineral fertilizers (ammonium nitrate, diammonium phosphate) were introduced before pre-sowing cultivation, at the rate of N45P45K45 and together with spring fertilization at a dose of 45 kg/ha of ammonium nitrate. Sowing was carried out on seven different days [Table 1]. Grain harvesting was carried out at the end of wax - the beginning of solid ripeness in a single-phase method.

Table 1: Winter rye sowing dates

Sowing term No.	Planned sowing date	Actual sowing date	
		2014	2015
1 (k)	August 15	August 15	August 14
2	August 18	August 18	August 21*
3	August 21	August 21	August 24*
4	August 24	August 24	August 29*
5	August 27	August 28*	September 4*
6	August 30	September 2*	September 10*
7	September 2	September 8*	September 12*

*Changes in the planned sowing days occurred due to heavy precipitation.

The process parameters of grain were determined in the testing laboratory of PermAgroService LLC. The bread-making properties of the flour were evaluated at the Krasnoufimsk breeding center of FSBSI Ural Scientific Research Institute of Agriculture. For these analyzes, samples of winter rye grain of 2015 and 2016 were used.

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Weather conditions during the filling and ripening period of winter rye grains during the research period varied significantly. In 2015, this period was characterized by lower temperatures and high humidity (HTC= 1.98), which led to lodging of plants and affected the quality of grain. The summer period of 2016 was arid (HTC= 0.23), which contributed to the formation of high-quality grain and its early ripening.

RESULTS

The winter rye grain, which is used for food purposes, is regulated by the national standard of the Russian Federation - GOST R 5349 - 2008 "Rye. Technical specifications". According to this standard, rye is divided into 4 classes, depending on the quality of the grain. Quality indicators include: color, odor, and condition of the grain, number of drops, nature, mass fraction of moisture, weed admixture, Fusarium grains, grain admixture and pest infestation.

Grain nature is one of the important indicators of the process parameters of grain. In 2015, which was unfavorable due to weather conditions for ripening and harvesting grain, its nature varied between 635 - 656 g/l (Table 2). During the first (August 15) and seventh (September 8) sowing dates, the grain nature corresponded to class 4, as it was less than 640 g/l. From the second (August 18) to the sixth (September 2) sowing dates, it corresponded to class 3. In 2016, favorable for the ripening of grain, its nature was higher and was in the range of 685 - 728 g/l. From the first (September 14) to the fifth (September 4) sowing term, it amounted to 706-728 g/l, which corresponds to class 1. Sowing at a later date (September 10 and 12) lead to a decrease to class 2 and amounted to 685 - 686 g/l. On average, over two years, the nature of winter rye grain varied from 660 to 688 g/l and corresponded to GOST classes 2 and 3. Grain of a higher class is formed during medium sowing dates.

Lodging of winter rye is the main indicator of the bread-making properties of grain. In 2015, the indicator was 61 s [Table 2], which corresponds to class 4. In 2016, from the first (August 14) to the fifth (September 4) sowing term, grain developed as class 3 with a lodging value of 81 - 89 s. At late sowing terms, it corresponded to class 4 (68 s).

According to other indicators of the standard (color, odor, pest infestation, weed and grain admixture), the grain corresponded to class 1.

Table 2: Grain process parameters

Sowing term	Nature, g/l			Lodging value, s		
	2015	2016	mean	2015	2016	mean
1 (k)	639	719	679	61	89	75
2	647	728	687	61	84	73
3	654	722	688	61	81	72
4	655	715	685	61	83	72
5	656	706	681	61	77	69
6	641	686	664	61	68	65
7	635	685	660	61	68	65
Mean	647	709	678	61	79	70

The yield of flour does not depend on the sowing date and year of harvest and is 63%.

In appearance, the bread samples differ in the shape of their crust and crumb [Fig. 1,2]. The samples of 2015 have the crust shape closer to flat, the crumb of brown bread with dense undeveloped porosity (2.5 points). In 2016, the crust shape is semi-oval, the crumb has a brown color and good porosity (4 points). The volume of test bread of the studied samples changed slightly over the years [Table 3]. Samples grown at the first sowing term (September 14-15) in both years of research were more than 300 ml in volume.



Fig. 1: Laboratory bread made of the 1st and 3rd term grain of 2015.

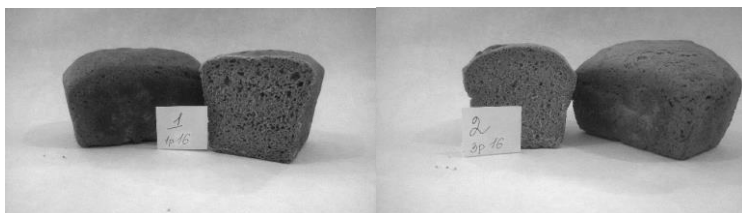


Fig. 2: Laboratory bread made of the 1st and 3rd term grain of 2016.

The bread-making score in 2016 was 3.7 points, that is, the bread had satisfactory qualities. And in the conditions of 2015, it decreased to 2.5 points. The sowing period did not affect this indicator.

Table 3: Flour bread-making properties

Sample		2015		2016		Mean		
		August 15	August 21	August 14	August 24	August 14-15	August 21-24	
Flour yield, %		63	63	63	63	63	63	
Baking assessment	Volume, ml	315	290	324	295	320	293	
		score	3	2.5	3	2.5	3	2.5
	Appearance	Surface, score	3.7	3.7	3.7	3.7	3.7	3.7
		Shape, score	4	4	4	4	4	4
		Crust color, score	3.8	3.8	4	4	3.9	3.9
	Crumb	Porosity, score	2.5	2.5	4	4	3.3	3.3
		Crumb structure, score	3.8	3.8	3.9	3.9	3.85	3.85
		Crumb color, score	4	4	4	4	4	4
	Appearance, score		3.8	3.8	3.9	3.9	3.85	3.85
	Total score, points		2.5	2.5	3.7	3.7	3.1	3.1

CONCLUSION

Thus, the process parameters of Falenskaia 4 winter rye grain in the Middle Urals are more dependent on weather conditions. During years with favorable meteorological conditions, in the phase of grain maturation, grain of classes 3-4 is formed with the following process parameters: grain nature of 685-728 g/l, lodging value 61-89 s. The top-quality grain by its nature is formed during sowing from August 18 to September 4. The milling quality of rye grain does not depend on weather conditions and the sowing period. The bread-making properties of Falenskaia 4 winter rye flour depend only on weather conditions. The total bread-making assessment of flour indicators in a favorable year is 3.7 points.

CONFLICT OF INTEREST
There is no conflict of interest.

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