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Technological Qualities of Grain of Winter Crops Depending on the Sowing Time and Weather Conditions

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ABSTRACT

Grain quality is considered an important indicator of the level of development of grain production in any country. Thus, as a result of analyzing the technological indicators of grain quality, we can summarize that in different meteorological conditions, winter rye forms grains of class 3-4 quality, winter wheat and winter triticale - class 3. Dry development and ripening of the grain (HTC less than 1) ensures grain better in nature and vitreousness compared to over moistened years, but does not affect its classiness. The quality of the grain depends on the correct choice of the sowing time of winter crops. In the present study, the experiments were laid out according to generally accepted methods. To determine the technological qualities of grain, samples of the harvest of 2015 and 2016 were taken. Analyses were carried out in the testing laboratory of Perm Agro Service LLC.

KEY WORDS: WINTER RYE, WINTER WHEAT, WINTER TRITICALE, SOWING TIME, GRAIN QUALITY..

INTRODUCTION

Grain quality is considered an important indicator of the level of development of grain production in any country. There is a problem of insufficient production of bread flour with high technological qualities (Altukhov, 2005; Ismagilov, 2010; Chubenko, 2013). The results of studies by foreign and Russian scientists show that sowing time and weather conditions have a significant impact on crop yields and grain quality (Vasiukov et al., 2008; Kildiushkin et al., 2010; Peremecheva et al., 2007; Tikhonova & Fatykhov, 2013; Schönberger, 2000; Leszynska & Noworolnik, 2002, Pasynkovet al., 2017 Gwamba et al 2019).

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The quality of the grain depends on the correct choice of the sowing time of winter crops. So, when sowing winter wheat at an optimal time (the first decade of September) in Kemerovo, Volgograd, and Kursk regions, there is an increase in the protein and gluten content by 1–2.5% compared with earlier or late periods (Balashov & Malakhova, 2012; Egushova et al., 2012; Lazarev & Kotelnikov, 2015). In Smolensk, Nizhny Novgorod, and Irkutsk regions, the optimal period is the third decade of August (Ziuzina et al., 2013; Sultanov, 2014; Torikov & Ptitsyna, 2017; Shchennikova, and Kokina, 2018). Thus, the optimal sowing time for obtaining quality grain in each region is different, and its establishment is an important task.

MATERIAL AND METHODS

Field studies were carried out in 2014 - 2016 on the educational and experimental field of Perm State Agricultural Academy. The soil of the plot is sod-small podzolic heavy loam, moderately cultivated. Agrotechnical experience corresponds to the scientific system of agriculture recommended for the Cis-Urals (Akmanaev et al., 2012). The precursor is annual herbs

for green fodder. Objects of study - winter rye varieties Falonskaya 4, winter wheat Moskovskaya 39, and winter triticale Izhevskaya 2. The seeding rate of winter rye and wheat is 6 million viable seeds per hectare, winter triticale - 5 million viable seeds per hectare. Sowing was carried out in seven terms (Table 1). The experiments were laid out according to generally accepted methods (Dospechov, 2011). To determine the technological qualities of grain, samples of the harvest of 2015 and 2016 were taken. Analyzes were carried out in the testing laboratory of PermAgroService LLC. The technological qualities of grain were evaluated in accordance with GOSTs (GOST 34023-2016. Triticale. Technical conditions, 2017; GOST R 52554-2006. Wheat. Technical conditions, 2008; GOST R 53049-2008. Rye. Technical conditions, 2011; GOST R 54895-2012, 2013).

Table 1. Sowing time

sowing. term No	Planned sowing term	Actual sowing term	
		Second establishment 2014	third establishment 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 planned sowing time occurred due to heavy precipitation.

Meteorological conditions during the years of research differed in temperature and precipitation. Vegetation period 2014 - 2015 was characterized by moderately warm weather. In the autumn, the drop of average daily air temperature under +5° was observed in the first decade of October. In the winter and spring period of plant development thaw observed, which led to an intensive consumption of nutrients for respiration and created conditions for the plants to dry out. In the first half of the spring-summer period 2015, favorable temperature conditions developed for the development of winter crops, but the grain ripening period was characterized by a lowered background temperature and high humidity with a hydrothermal coefficient (HTC) of 1.98, which affected the quality of grain. Agroclimatic conditions 2015-2016 were favorable for the growth and development of winter crops. The end of the autumn growing season also was in the first decade of October. The winter was relatively warm, and the snow melted early. The spring-summer period was characterized as warm and dry. Since the third decade of April, there was a lack of precipitation, the HTC during the period of maturation was 1.1. This ensured the earlier ripening of winter crops, favorable conditions for harvesting and the formation of higher quality grains.

Table 2. Technological quality of winter rye grain

Sowing term	Nature, g/l		Falling number, s.	
	2015	2016	2015	2016
1 (k)	639	719	61	89
2	647	728	61	84
3	654	722	61	81
4	655	715	61	83
5	656	706	61	77
6	641	686	61	68
7	635	685	61	68
Mean	647	709	61	79

RESULT AND DISCUSSION

In 2015, under unfavorable conditions for grain ripening, the nature of winter rye averaged 647 g/l, which corresponds to the third class of GOST (Table 2). In terms of sowing, the quality varied from the third class, when sowing from the second to the sixth term (641 - 655 g/l), to the fourth class - in the first and seventh terms of sowing (635 - 639 g/l). In terms of the number of fall grain winter rye corresponded only to the fourth class (61 s.). In 2016, under favorable conditions during ripening, the nature of winter rye grain averaged 709 g/l (first class of GOST). According to this indicator, when sown from the first to the fifth term, the grain also corresponded to the first class of GOST for winter rye grain (not less than 700 g/l), while the sixth and seventh term - to the second class (not less than 680 g/l). In terms of the number of falling when sown from the first to the fourth term, the grain corresponds to the third quality class (81 - 89 s.). In other terms - to the fourth class. Thus, the quality of winter rye grain in the Middle Urals is limited by the influence of weather conditions. In terms of the number of falling, it corresponds to the fourth grade. Grain of the third class can be obtained only under favorable weather conditions and sowing time from August 14 to 29.

The quality of winter wheat grain also depends on weather conditions (Table 3). In 2015 it was lower in terms of the nature of the grain, on average, corresponded to the third class of GOST (744 g/l). When sown in the fifth and sixth terms, the grain corresponded to the first class, and in the remaining periods - to the third class. The conditions of 2016 allowed for a larger grain of winter wheat to form. The nature of the terms varied within 794 - 802 g/l, which corresponds to the first class of GOST. In terms of the number of falling, grain of winter wheat in 2015 and 2016 corresponded to the requirements of the first class of GOST, regardless of the sowing period. Grain vitreousness met the requirements of the third class in 2015 and the first class in 2016 when sown from the

first to the sixth term, and to the third class with the seventh term of sowing.

An important parameter of wheat grain quality is the gluten content. The mass fraction of raw gluten varies depending on weather conditions. The highest percentage on average was observed in 2016 - 31%. In 2015, it was 29.6%. The gluten content, depending on the sowing date, varies in different ways and corresponds to 1 - 3 classes of GOST. The qualitative assessment of gluten indicates that all the samples for the studied sowing dates over the years of research corresponded to the second group of quality - satisfactorily weak. The readings of the FDM device were 76-85 units. Thus, the technological quality of grain, regardless of weather conditions and sowing time, is limited by the quality of raw gluten and corresponds to the third class of GOST. According to other indicators in favorable years, the grain of winter wheat meets the requirements of the first class. In 2015, the nature of winter triticale grain for all sowing terms was 556 - 593 g/l, and corresponded to the third class of GOST (Table 4). In 2016, triticale grain was formed under dry conditions, the grain nature obtained was of first class when sown from the second to the fifth term (702 - 713 g/l). In the first and sixth terms, the grain corresponded to the second class, and in the seventh term of sowing - to the third class.

Table 3. Technological quality of winter wheat grain

Sowing term	Nature, g/l		Vitreousness, %		Falling number, s.		Mass fraction of raw gluten, %		FDM. index, un	
	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
1 (k)	735	802	53	65	401	318	33.0	27.0	76	76
2	737	802	55	69	273	299	29.0	27.0	90	80
3	739	801	52	66	260	306	32.0	33.0	80	85
4	748	800	53	72	324	345	26.0	29.0	76	76
5	764	794	56	66	331	351	26.0	32.0	85	85
6	751	794	53	64	311	326	31.0	34.0	85	90
7	736	781	55	58	256	341	30.0	35.0	80	90
Mean	744	796	54	66	308	327	29.6	31.0	81	83

Table 4. Technological quality of winter triticale grain

Sowing term	Nature, g/l		Vitreousness, %		Falling number, s.	
	2015	2016	2015	2016	2015	2016
1 (k)	-	697	-	52	-	68
2	593	709	43	58	61	66
3	592	712	50	65	61	59
4	556	713	53	68	61	66
5	582	702	48	63	61	68
6	566	690	48	65	61	67
7	558	661	50	63	61	63
Mean	492	698	47	62	61	65

Regardless of the year and time of sowing, the vitreousness of winter triticale grain corresponds to the first class of GOST. In 2015, this figure ranged from 43 to 53%; in 2016, the vitreousness of grain was high (52-68%). In terms of the number of falling, the winter triticale grain corresponds to the third class, regardless of weather conditions and sowing time. In 2015 it averaged 61 s., in 2016 - 65 s. Thus, it is possible to obtain third-class triticale grain.

CONCLUSION

Thus, as a result of analyzing the technological indicators of grain quality, we can summarize that in different meteorological conditions, winter rye forms grains of class 3-4 quality, winter wheat and winter triticale - class 3. Dry development and ripening of the grain (HTC less than 1) ensures grain better in nature and vitreousness compared to overmoistened years, but does not affect its classiness.

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