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Optimization of Barley Bultivation Technology, Ensuring the Improvement of Grain Quality for Brewing

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Abstract

About half of all barley areas are concentrated in the North Caucasus, where grain production has historically specialized in the direction of use for fodder purposes But for brewing it is important not so much the quantity as the quality of grains of barley as a raw material for this industry. This work is devoted to the comparison of the parameters of the timing and density of sowing seeds, taking into account their impact on the technological properties of winter barley grain in the foothills of the KBR. The conducted research allowed to install that such indicators as the mass of grain and the nature of the grain for the better are characterized by the second term of sowing. Comparison of the two varieties by these indicators shows that the Mikhailo variety exceeds the Kozyr variety. There is such a legitimacy that with the increase in the seeding rate per unit area, the value of the mass of thousands of grains decreases. The same legitimacy is observed in the natural mass and extractivity, where the highest rate has a Mikhailo.

Keywords: climatic conditions, grain quality, moisture reserve, seeding rates, sowing time, technological properties, winter barley

INTRODUCTION

Varieties of malting barley are characterized by the duration of the post-harvest ripening period or the period of rest of the seeds [1]. The economic damage here consists in reducing the cost of storing last year's barley, in addition, winter barley grain can be used in the season of the current year and thus get an additional gain in time [2].

Winter barley ripens earlier than spring barley for 12-15 days, which means that it is resistant to drought and some diseases, does not fall under air drought and high air temperature, which adversely affect the formation of high-quality brewing grain [3]. Winter barley exceeds the yield of spring by 19-33%, this increases the economy of crop [4].

Varieties of multi-row winter malting barley have a perspective in the North Caucasus. Because multirow in the same conditions who-delivery forms the lower protein content in grain, the creation of loose spikelets barley varieties with well-executed, large and aligned-ness of the grain will improve the reliability of the production of brewing barley [5, 6].

In this regard, the aim of this work was to compare the parameters of the timing and density of seeds, depending on their size and taking into account their impact on the technological properties of winter barley grain in the pre-mountain zone of KBR.

MATERIALS AND METHODS

Our studies were carried out in 2014-2016 in conditions of a foothill zone of the KBR at ZAO NP "Chegem", "MELT" and the Department "Technology of production and processing of agricultural products" Kabardino-Balkar state agricultural UNIVERSITY.

As the research objects, the varieties of winter barley - Mikhailo and Kozyr approved for use in the North Caucasus region and semi-products at the stages of preparation of beer wort.

The soil of the experimental site is leached black soil, the reaction is neutral. The humus content is 3.1%, hydrolyzable nitrogen 155-165 mg/kg soil (Conferido), mobile phosphorus – 85 (according to Chirikov), exchange potassium – 100 mg/kg soil (according to Chirikov). Agricultural machinery is typical for the zone [7].

Experiment two-factor, randomized by the method of split plots, in four replications, an area m^2 plots 54-55, 60-63 m^2.

Sowing was carried out in an ordinary way according to the scheme: September 20, October 1, October 10, October 20.

Seeding rate was: 4.5; 5.0; 5.5; 6.0 million germinating seeds / ha.

In all terms of sowing and at all rates of sowing, phosphorus and potassium fertilizers were applied-superphosphate and potassium salt of 45 kg d.v. in hectare the autumn before plowing.

RESULTS AND DICUSSION

Sowing of winter barley in the optimal time is possible in the case when there is at least 20-25 mm of productive moisture in the layer up to 30 cm [6, 8].

On average, during the years of research the most favorable conditions for the moisture content in the soil in the layer of 0-30 cm differed in sowing the first and tenth of October, slightly worse when sowing on September 30. Sowing on October 20 by soil moisture was favorable, but such late sowing is unfavorable for the amount of active temperatures (Table 1).

At the first sowing period, the available moisture reserve in the layer of 0-30 cm was somewhat insufficient, which could have an impact on reducing the field germination of seeds. At subsequent sowing dates, the moisture reserve was sufficient, which should ensure the production of good shoots.

In the phase of shoots at the tillering and the termination of the autumn growing season moisture reserves in the soil gradually increased, but the marked peculiarities of continence at sowing at the time survived. The years of the experiments were determined by the amount of precipitation before sowing and by the time of autumn vegetation, which had an impact on the content of productive moisture in the layer of 0-30 cm [9]. The greatest amount of precipitation during this period fell in 2015, and therefore the moisture reserves in the soil in the 0-30 cm layer were the highest.

Our studies have shown that such methods of cultivation technology as sowing time and seeding rates have had a significant impact on the quality of grain. They especially affected the size and chemical composition of grain, which determine its suitability for quality for beer production [8, 10].

We have conducted studies on the technological properties of grains of different varieties of winter barley, depending on the term of sowing (Table 2).

Table 1. Reserve of productive moisture (0-30 cm of soil layer) in the autumn period in the phases of growth and development of winter barley at different sowing dates, mm (m^3 / ha) (Mikhailo variety).

Sowing date	Sow	Seedling	Tillering	The cessation of autumn vegetations
2014 year				
20 September	19.3	20.2	25.4	25.6
1 October	23.1	23.4	31.6	31.9
10 October	36.2	35.5	34.3	34.5
20 October	36.8	36.7	35.9	35.8
2015 year				
20 September	28.5	26.9	28.3	29.4
1 October	32.6	31.8	32.2	34.7
10 October	36.2	36.1	35.9	36.4
20 October	36.4	37.2	36.9	37.1
2016 year				
20 September	19.5	20.9	24.7	26.6
1 October	24.6	24.8	30.6	32.1
10 October	32.5	31.9	34.5	34.1
20 October	36.6	35.9	36.1	35.6

Table 2. Technological properties of grain of different varieties of winter barley depending on the sowing time.

Parameter	Date sowing			
	20 September	1 October	10 October	20 October
1	2	3	4	5
The Grade Of Mikhailo				
2014 year				
Weight of 1000 grains, g	39.2	39.8	40.1	38.8
Gross weight of grain, g/ l	618	620	621	612
Starch content, %	62.5	62.9	63.0	62.0
Extract content, %	77.7	78.6	78.9	77.4
Protein content, %	11.8	11.9	12.1	12.2
Captivating, %	9.0	9.0	9.0	9.1
Color of grain	Straw-yellow			
2015 year				
Weight of 1000 grains, g	41.5	41.7	42.4	40.2
Gross weight of grain, g/ l	628	632	637	625
Starch content, %	65.0	65.2	65.4	62.5
Extract content, %	79.7	80.0	80.2	78.8
Protein content, %	11.4	11.5	11.7	11.6
Captivating, %	8.8	8.8	8.8	9.0
Color of grain	Straw-yellow			
2016 year				
Weight of 1000 grains, g	38.8	39.0	39.4	38.6
Gross weight of grain, g/ l	612	615	619	610
Starch content, %	61.5	61.8	62.5	61.0
Extract content, %	76.4	76.9	77.6	76.1
Protein content, %	12.3	12.2	12.1	12.4
Captivating, %	9.2	9.2	9.1	9.2
Color of grain	Straw-yellow			
The Grade Of Kozyr				
2014 year				
Weight of 1000 grains, g	38.5	38.9	39.2	38.3
Gross weight of grain, g/ l	612	615	617	611
Starch content, %	61.4	61.9	62.4	61.2
Extract content, %	76.2	76.8	77.7	76.1
Protein content, %	12.1	12.2	12.1	12.2
Captivating, %	9.0	9.0	9.0	9.0
Color of grain	Straw-yellow			
2015 year				
Weight of 1000 grains, g	39.7	39.9	40.3	39.6
Gross weight of grain, g/ l	617	619	621	616
Starch content, %	63.2	63.7	64.2	63.1
Extract content, %	77.9	78.1	78.3	77.6
Protein content, %	12.0	12.0	12.0	12.1
Captivating, %	8.9	9.0	9.0	9.0
Color of grain	Straw-yellow			
2016 year				
Weight of 1000 grains, g	38.3	38.6	39.0	38.2
Gross weight of grain, g/ l	611	612	615	610
Starch content, %	61.2	61.5	61.7	61.0
Extract content, %	76.0	76.6	76.2	76.0
Protein content, %	12.2	12.2	12.1	12.2
Captivating, %	9.1	9.1	9.1	9.2
Color of grain	Straw-yellow			

Table 3. Technological properties of grain of different varieties of winter barley depending on seeding rate (2014-2016).

Parameter	The seeding rate, million viable seeds/ha			
	4,5	**5,0**	**5,5**	**6,0**
The Grade Of Mikhailo				
Weight of 1000 grains, g	42,0	40,4	40,3	38,9
Gross weight of grain, g/ l	643	640	638	627
Starch content, %	65,9	65,9	65,0	63,4
Extract content, %	80,0	79,9	79,8	78,4
Protein content, %	11,9	11,9	1,8	12,2
Captivating, %	8,8	8,8	8,0	9,0
Color of grain	Straw-yellow			
The Grade Of Kozyr				
Weight of 1000 grains, g	39.8	39.4	38.8	37.5
Gross weight of grain, g/ l	621	618	614	612
Starch content, %	64.7	64.5	63.8	63.4
Extract content, %	79.2	79.0	78.0	78.0
Protein content, %	11.5	11.8	12.1	12.2
Captivating, %	9.0	9.0	9.0	9.0
Color of grain	Straw-yellow			

These tables show that the timing of sowing barley seeds give a significant impact on the technological properties of the grain. Such indicators as the weight of 1000 grains and the nature of the grain for the better are characterized by sowing the first and tenth of October. The weight of 1000 grains with such a sowing period is not less than 40 grams, and the full – scale mass is 630-637 g/l (2015). Comparison of the two varieties by these indicators shows that the Mikhailo variety exceeds the Kozyr variety by 3-5%.

The results of the analysis show that the starch content in the grain ranges from 62 to 65 percent or more. In the most favorable year for hydrothermal conditions (2015), the starch content was 65.4% (Mikhailo variety).

A similar position is noted for the grain extractivity. The highest percentage of extractivity is observed in the Mikhailo variety, it is equal, depending on the year of research and sowing time from 76.1 to 80.2%.

To compare our studies, we provide data on experiments with seeding rates for the studied varieties (Table 3).

The results of the analysis show that the weight of 1000 barley grains, as one of the indicators of grain quality, is characterized in a better way with more prone planting time . It is 39.8-42.0 grams depending on the variety and seeding rate. There is such a pattern that with the increase in the seeding rate per unit area, the value of the mass of 1000 grains decreases. The same pattern is observed in full-scale mass, where the highest rate is the Mikhailo variety at seeding rate of 4.5 million germinating seeds per 1 ha, that is, the full-scale mass of grain of this option is 643 g/l. And the lowest rate has a Kozyr variety with a seeding rate of 6.0 million germinating seeds per hectare – 612 g/l.

The grain extractivity of the studied barley varieties depending on the seeding rate is expressed by different indicators. So, in particular, the varieties of Mikhailo are characterized by greater extractivity of grain grown at seeding rates of 4.5-5.0 million germinating seeds per hectare. The extractivity of these options at the level of 79-80%.

CONCLUSIONS

Thus, if we compare the requirements of barley plants to soil and climatic conditions with those conditions that were in the years of our research to produce high-quality grain, they generally meet these requirements. Barley grain grown in the pre-mountain zone of the Republic, using those technological methods that provided an increase in productivity by 20-25% and improved technological properties of grain, is quite suitable for the production of beer of high quality.

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