Evaluation of productivity and quality of rice varieties included into State register of breeding achievements approved for use, in production tests in Krasnodar region

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Abstract. In modern economic conditions, commodity producers need rice varieties that meet specific production requirements. The highest yields are provided by rice varieties that are most fully adapted to cultivation conditions, primarily to soil and climatic conditions, as well as to the material and technical level of production, the state of the rice irrigation system, and the requirements for environmental protection. The article presents the results of an industrial assessment in the transitional delta agrolandscape area of the rice cultivation zone of Krasnodar region. Analysis of the yield and technological indicators of the rice grain quality made it possible to identify varieties adapted to the conditions of "Kubris" LLC, Krasnoarmeyskiy district: Alliance, Veles, Favorit, Yubileiny 85. The average yield for three years was 84.1 c/ha, 82.7 c / ha, 73.6 c/ a, 85.9 c/ha, respectively. Compliance with the technology of growing, harvesting and post-harvest processing on the farm allows ensuring a high milling yield within the range of 65-69 % with a head rice content of 48-59 %. Growing these rice varieties on the farm will effectively develop production by realizing the potential of the variety and obtain high-quality rice grits.

Rice is a tropical crop, and its cultivation in European countries is due to a number of soil and climatic characteristics. Rice growing in Krasnodar region is the most northern in the world. The cultivation of this thermophilic crop is limited by heat supply and allows cultivation of varieties with a growing season of no more than 125 days, while in tropical countries rice ripens in 160-180 days and there is the possibility of obtaining 2-3 harvests per year.

In Krasnodar region, a significant part of the rice irrigation systems is located on floodplain and flooded lands in the lower reaches of the Kuban River on waterlogged and saline soils, most of which are unsuitable for rainfed agriculture. These territories can be used exclusively for rice growing, where most of the crop rotation area during the growing season is irrigated in a constant flooding mode.

Rice cultivation technologies in the Kuban are radically different from the countries of Southeast Asia, where the seedling method of crop cultivation, terraced irrigation fields, water supply due to natural precipitation are used. On the contrary, the flat relief and small

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slopes on the territory of Krasnodar region made it possible to build rice irrigation systems of an engineering type with a complex of inter-farm reclamation facilities (pumping stations, main canals) and an on-farm reclamation complex (rice checks, distribution and discharge networks). The production uses the technology of direct sowing of rice seeds into the soil with grain-type seeders, and harvesting is done by combining, both separate and direct. All technological operations for the cultivation of crops are mechanized, which allows in a short time to carry out not only rice sowing and harvesting, but also maintenance work.

In recent years, the intensification of rice growing, accelerated variety change, the introduction of new varieties with high potential yields and resistance to stress factors of the environment for various cultivation technologies, with high grain quality and valuable consumer properties have significantly increased the yield and gross crop yield in the Krasnodar region: 25.0-30.0 c / ha in the 50s of the 60s of the last century up to 64.6 c/ha in 2019, and the gross crop yield currently exceeds 800 thousand tons of rice grain annually in test weight [1,2,3].

In modern economic conditions, commodity producers need rice varieties that meet specific production requirements. Currently, the State Register of Breeding Achievements, admitted for use in production, includes 34 varieties bred by Federal Scientific Rice Centre, but large areas are occupied by varieties: Rapan, Favorit, Sonet, Polevik, Diamant, Victoria. This crop structure does not provide the maximum efficiency of using the genetic potential of the crop in rice growing in terms of yield and variety of products derived from rice. For effective rice production, it is necessary to constantly improve the quality of selection and evaluation of new varieties, replace old ones, carry out a variety change and variety renewal, taking into account the individual characteristics, requirements of varieties and agro-ecological conditions of an individual farm. The highest yields are provided by varieties that are most fully adapted to growing conditions, primarily to soil and climatic conditions, as well as to the material and technical level of production, the state of the rice irrigation system, environmental protection requirements and a number of other aspects. In this regard, production evaluation and testing of rice varieties are carried out in order to identify the most productive of those allowed for use. The results of production tests are the main information base for agricultural producers when choosing competitive varieties that are superior in yield and grain quality that exist in production.

In 2018-2020. an industrial evaluation of rice varieties was carried out in the conditions of a transitional delta agrolandscape area ("Kubris" LLC, Krasnoarmeyskiy district).

The objects of research were rice varieties bred by FSBSI "Federal Scientific Rice Centre": Alliance, Veles, Lenaris, Favorit, Yubileiny 85. The placement of experimental variants is systematic. Plot area - 0.35 hectares. Sowing method - ordinary (with a row spacing of 15 cm), the seeding rate is 7 million germinable grains per 1 hectare. Irrigation regime - shortened flooding. The predecessor is winter wheat. Soil cultivation and its pre-sowing preparation, irrigation regime and care for rice crops were carried out in accordance with the recommendations for rice cultivation in Krasnodar region [4, 5]. Harvesting was carried out by direct combining. The counts and observations were carried out in accordance with the current methods [6]. Statistical data processing was carried out by the method of analysis of variance [7].

The soil of the experimental site is represented by rice alluvial meadow heavy loamy on heavy loams. It was characterized by a low humus content (3.0-3.2%), a neutral reaction of the soil solution (pH_{kcl} 7.1), an increased amount of easily hydrolyzable nitrogen (6.6-6.8 mg / 100 g), a low content of mobile phosphorus (2.5-2.6 mg / 100 g), medium (28.7-29.1 mg / 100 g) - mobile potassium. In soil samples taken in the spring before sowing rice in a layer of 0-20 cm, pH_{kcl} was determined by the potentiometric method, the humus content was determined by the Tyurin method as modified by Simakov, and the content of mobile phosphorus and exchangeable potassium was determined by the Machigin method [8].

In 2018, the weather conditions of the growing season were characterized as unfavorable for the formation of a high yield. A feature of the growing season was an acute shortage of precipitation in the first half of the rice growing season (May - June) against the background of extremely high average daily air temperature, which reached 20.8 ° C in May, 24.6 in June, 26.5 in July, and in August - 27.1 ° C and exceeded the norm for the indicated months by 4.2; 4.4; 3.4 and 4.6 ° and an average of 4.2°C over the period. It rained only in the first decade of May (24.5 mm), however, from the 2nd decade of May to mid-July, the amount of precipitation was only 28.8 mm, while the norm for the period was 117.0 mm. At the same time, the average daily air temperature exceeded the climatic norm by 4.8–7.7 ° C. Such growing conditions had a negative impact on the growth of rice plants and the formation of the yield. The 47.5 mm of precipitation that fell in the 3rd decade of July could no longer affect the level of yield, since the filling of seeds was practically over and the filling of grain began.

The heat supply for the growing season of rice in 2019 exceeded the average long-term values by 296° and amounted to 1079°C. The period of flowering, fertilization and the beginning of the outflow of plastic substances into the generative part was accompanied by an optimal thermal regime and sufficient air humidity, which contributed to obtaining a filled panicle of rice varieties. The amount of precipitation exceeded the norm by 30% and was characterized by unevenness. But thanks to timely agrotechnical methods, rice plants formed a fairly high yield.

The growing season of 2020 was characterized by an increased heat supply in rice and a low amount of precipitation. The weather conditions of the year were noticeably different from the weather conditions of 2019 and from the long-term average indicators in terms of the amount of heat received from April to October. Starting from the first ten days of May, there was a steady excess of the average ten-day air temperatures in relation to the average long-term values. This temperature regime has led to a significant acceleration in the passage of the rice vegetation phases. In particular, the mass heading of rice took place 1-2 weeks earlier than usual. High air temperatures during the flowering and grain filling phases led to a decrease in the yield indicator.

The most productive during the years of testing were rice varieties Alliance, Veles, Favorit, Yubileiny 85. The average yield for three years was 84.1 c/ha, 82.7 c/ha, 73.6 c/ha, 85.9 c/ha respectively. During the study period, in experiments, the average yield of rice varieties in 2018 was 78.5 c/ha, in 2019 - 88.8 c/ha, maximum 101.3 c/ha (Alliance), in 2020 - 76.1 c/ha / ha and 88.2 c/ha (Favorite), respectively (Table 1).

Analysis of the average yield indicates that it generally corresponds to agroecological conditions, primarily soil ones, and hydrotechnical ones are interconnected with anthropogenic ones and can undergo significant changes under their influence.

Table 1. Yield of rice varieties, c/ha

Variety	Yield, c/ha						
	2018	+/- to the standard, c/ha	2019	+/- to the standard, c/ha	2020	+/- to the standard, c/ha	average for years
Favorit (St)	77,1	-	73,5	-	70,1	-	73,6
Alliance	79,4	+2,3	101,3	+27,8	71,5	+1,4	84,1
Veles	77,6	+0,5	90,0	+16,5	80,6	+10,5	82,7
Lenaris	76,5	-0,6	91,5	+18,0	70,0	-0,1	79,3
Yubileiny 85	81,8	+4,7	87,9	+14,4	88,2	+18,1	85,9
Average in experiment	78,5		88,8		76,1		81,1
LSD_{05}	1,69		2,66		1,72		-

The lands of the transitional delta agricultural landscape belong to the I agroecological category - the best for growing crops of rice crop rotations, do not require additional measures to improve fertility [9]. Under these conditions, the biological potential of varieties is realized in compliance with the zonal technologies for growing rice.

Along with the increase in yield, it is important to improve its quality. The total milling yield and the head rice content are complex indicators of the technological qualities of rice. Depending on the varietal characteristics of rice, natural and climatic factors, cultivation technology, harvesting and post-harvest processing, as well as grain processing. As a result of the technological assessment of the studied rice varieties in the production test, it was revealed: the total milling yield of the tested rice varieties varied from 65.97% to 69.15%, including the head rice content - from 40.97% to 68.40% (Table 2)

Table 2. Technological indicators of rice grain quality

| Variety | 2018 | | 2019 | | 2020 | |
| | Milling yield | | Milling yield | | Milling yield | |
	total	head rice	total	head rice	total	head rice
Favorit (St)	69,15	57,92	65,17	48,23	68,30	56,80
Alliance	68,97	55,12	65,57	45,65	66,95	54,22
Veles	68,64	57,67	64,58	49,22	68,40	56,55
Lenaris	67,93	54,70	59,29	40,97	65,97	48,70
Yubileiny 85	68,80	56,55	65,39	43,66	67,80	52,39

High indicators of the head rice content are typical for varieties: Favorit - in 2018, 69.15 % in 2018, 68.30 % in 2020; Veles - 57.67 % in 2018 and 56.55 in 2020; Alliance - 58.96% and 54.22 % in 2020.

Thus, adherence to the technology of growing, harvesting and post-harvest processing on the farm allows for a high milling yield in the range of 65-69% with a head rice content of 48-59 %.

In general, the analysis of the yield of the varieties presented in the production test made it possible to identify varieties adapted to the conditions of Kubris LLC in Krasnoarmeyskiy district of the transitional deltaic agrolandscape: Alliance, Veles, Favorit, possibilities of the variety and to obtain high-quality milled rice. This gives reason to reliably plan an increase in rice production in the near future.

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