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Achievements of rice breeding with high quality of grain in Russia

Authors :

ZELENSKY G.L.

ZELENSKY O.V.

Kuban State Agricultural University 13 Kalinin st., 350044 Krasnodar, RUSSIA



Tel : +86 12 56 9816

Fax: +86 12 540081

Abstract

Rice breeding work in Russia is aimed to release such varieties, which combine high productivity, excellent quality of grain with resistance to unfavourable environmental conditions. For the last 5-7 years, several varieties have been released, their grain quality meets the demand of modern market. The following are among them : Sprint and Slavyanetz, short-grain variety, Pavlovsky and Kurchanka, medium-grain, and also Snezhinka, long-grain variety. Glutinous variety Viola has been released to produce baby and medicinal food. Besides that, it has been obtained initial stock of new type which plants have erectoid leaves, and the quantity of grains in panicle exceeds 5-6 times as compared to common rice varieties.

Keywords

-  Rice breeding, rice quality
-  Russia

Introduction

Rice is the main irrigated crop in Russia. The demands of Russian population in milled rice as valuable dietetic product increase permanently. Besides that recently, Russian rice has become of more interest for

European countries and the Middle East. That is why active breeding work is carried out in our country concerning release of new rice varieties which are not only highly productive, but are resistant to diseases and unfavourable environmental conditions, have vitreous grain, are tolerant to break and give maximum total milled rice. Such varieties meet the requirements of modern market and they are more profitable economically than varieties with low grain quality.

In world practice of ricegrowing, rice varieties are subdivided into long-grain, middle-grain and short grain varieties. The base of such subdivision is the shape of kernel, which is determined by length to width correlation (l/b).

It is resistant variety character, which doesn't depend upon growing conditions.

Rice Varieties and Grain Quality.

The majorities of rice varieties which are cultivated in Russia, belong to japonica subspecies and come to the group of short-grain varieties. Their main mass is with round kernel (l/b 17-1.9) - Krasnodarsky 424, Spalchik, Liman, Malysh, Slavyanetz, Zernogradsky and with slightly prolonged grain (l/b 2.0-2.2) - Kuban 3, Gorizont, Solnechny, Zernogradsky. Several varieties have transitional form of kernel, from round to prolonged (l/b 2.3-2.5) - Altair, Dalnevostochny, Kurchanka, Salsky. The following middle-grain varieties belong to the separate group : Kulon, Primanychesky, Pavlovsky, Regul, which have longer kernel (l/b 2.6-3.0) and give milled rice very valuable according to the quality and cooking capacity.

Recently, long-grain (l/b 3.5-4.2) rice-variety has been released in our country, such as Izumrud, Nafant, and Snezhinka which pass state varietal test. Milling quality and cooking capacity of milled rice are very high.

Kernel vitreousity is of great importance for getting high quality milled rice. This index has such range as from 60 to 67 % (Zhemchuzhny, Spalchik), and from 95 to 98 % (Kurchanka, Slavyanetz). The vitreousity level depends on varietal character, on weather conditions and following technology at rice maturation period. The low temperature at the period of grain forming, early water discharge from check-plots of flour endosperm. Firmness is a very important varietal character. Firmness of the majority of cultivated varieties in our country has the range from 17.0 to 22.0 %. Total milled rice is closely connected with this index which is from 63.0 to 72.0. Vitreousity and block disintegration of endosperm influence on head rice yield-the main production of rice variety.

The variety should have the following milling quality to be on the list of the most valuable varieties concerning milled rice quality. (Table 1).

Table 1. Demands to valuable varieties concerning their milled rice quality.

Indices	Varieties	
	round-grain	long-grain
Correlation between length and width of grain (l/b), not less	-	3.0
Vitreousity % not less	85.0	90.0
Block disintegration % not less	10.0	5.0
Firmness %, not less	18.0	22.0
Total milled rice, % not less	68.0	64.0
and also head rice yield, % not less	85.0	80.0

Release of high quality varieties, especially long-grain, is connected with several problems. First, high rice productivity has negative correlation with excellent grain quality. Second, long-grain varieties don't have a high yield as short-grain, and they are as usual of late maturity. We don't have early maturity forms of indica subspecies with vegetation period of 100 days in our collection. We have to carry out special breeding work to get such samples. For this purpose we make complex crosses, when we carry out backcrosses and as parent forms we use early maturity short-grain varieties and late maturity long-grain forms obtained from tropical countries.

At the process of breeding work for many years, we released different type of rice varieties which give white

rice of high quality (Table 2).

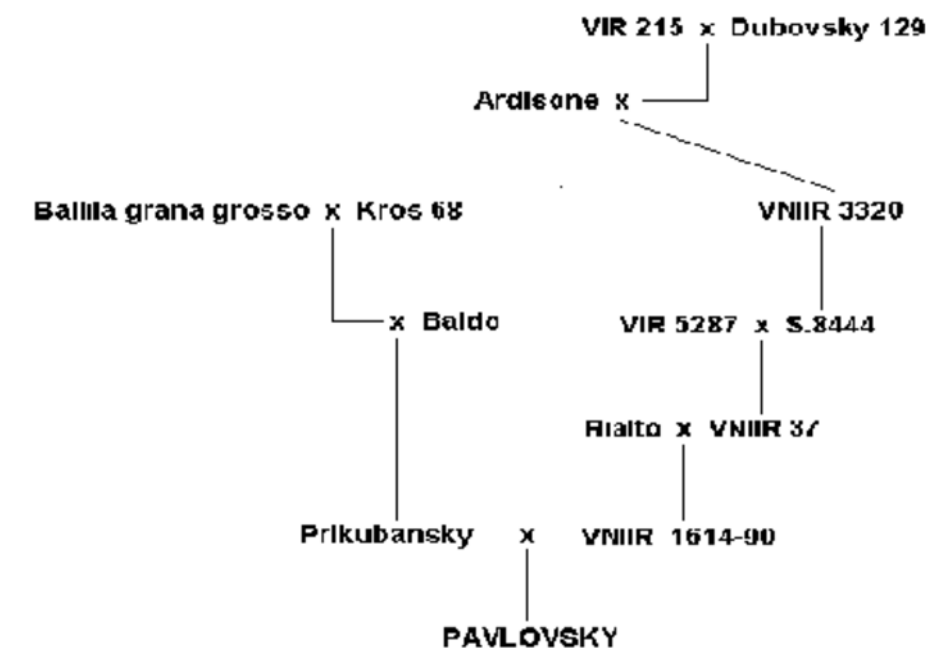
Table 2. Rice varieties concerning milled rice quality.

Variety	Vegetation period, days	Vitreousity, %	Total milled % rice		l/b
			Total	head rice yield	
Sprint	90	90	72	88	1,8
Slavyanetz	115	96	71	90	1,7
Pavlovsky	116	94	71	93	2,6
Kurchanka	120	97	70	97	2,4
Kulon	127	92	69	88	2,6
Snezhinka	120	95	67	95	4,2

All these varieties have different origin, and different methods have been used in their release. For example, Slavyanetz variety was obtained by individual screening from Spalchik variety. The rest ones have been released by hybridisation of different levels of complexity.

Thus, if Kurchanka variety has been released from simple hybrid population (Kulon/Raduga), pedigree of Pavlovsky is more complicated (Fig. 1).

Fig. 1. Pedigree of Pavlovsky variety.



Besides origin, our varieties have a great difference in morphological and biological characters. But two indices unite them - it is a high grain quality and quick growth at germination period. It helps to get shoots from water layer and not to use anti-herbaceous herbicides at the period of cultivation. As a result of it the expenditures for rice growing decrease, the quality of production increases and ecological conditions in rice-growing zones improved.

Besides rice grain of traditional varieties, modern market demands glutinous rice for producing baby and medicinal food. As a result of complex hybridisation and multiple repeated screening, glutinous rice variety Viola has been released. Its grain has wax endosperm, and amilose content doesn't exceed 1,5 %. The index of varieties cultivated in our country is 10-12 times higher. As for yield, percentage of Kernels in panicles, lodging resistance Viola are the same as Spalchik variety and as for protein content and blast resistance they are better. That is why glutinous Viola variety has been sent for state varietal tests. As compared to other varieties cultivated in Russia, Viola has violet flower glumes. This character was introduced by us, specially to make easy seed-production in Viola sowing plants of all other varieties are visible very well and it is easy to remove them during need control.

Grain Quality and Rice Productivity.

As it was said above, high productivity of rice plants doesn't mean excellent grain quality. We have been persuaded of it in our breeding practice. In 1983, in hybrid nursery, we selected the plant with large panicles like sorghum. There were 600 spikelets in five panicles. Grain mass of the main panicles was 14 g. New form was called BZ-600.

It was found a wide spectrum of splitting to several characters. It justified the hybrid origin of BZ-600. Besides those two serious drawbacks have been found : low quality of milled rice because of flour endosperm and dramatic fall of plant productivity with increase of sowing density. That is why BZ-600 have been used only for hybridisation, as donor of productivity, and an interesting breeding material has been created.

In our opinion, this is not the only value of BZ-600 form. It showed that rice biological potential under the conditions of Russia has not been totally used. It is possible to increase variety productivity by the way of breeding. But it is necessary for that, to change morphological type of rice plant in such a way to decrease dramatically plant compatibility at high density. For this purpose, the plants should have height up to 90 cm, high lodging resistance and erectoid leaf disposition. It is exactly such a type of plant, which can carry large panicle with high percentage of kernels, which will not decrease too much in thick sowings. Our breeding practice proves this thesis.

As a result of step-hybridisation (for many years) and replicated screening, we could obtain several breeding lines, each of them had characters which are necessary for creation of plants of new type. On one side, the samples have been obtained with vertical erectoid leaves which supported thick sowings very good. On the other hand, the samples, which have big panicles with high percentage of kernels and good grain quality, have been created. But they have normal leaf disposition. After hybridisation between them, by multiply repeated screening, we could obtain plants which combine erectoidness of leaves with percentage of kernels (Fig. 2).

Fig. 2 Highly productive sample with erectoid leaves



Several plants (the height is 90-92 cm) have the length of panicle 40 cm, and 702 spikelets. The kernel has vitreous endosperm.

Of course, we should change plants of new type (which we obtained) into varieties. But it is not such a labour - consuming task, as obtaining. We hope that we can complete it successfully by usage of not only methods of traditional breeding but biotechnology, in particular, isolated anther cultures.

Conclusion

As a result of breeding work for many years in Russia, several rice varieties have been released. They have good grain quality, which meets the requirements of not only domestic, but also foreign market. Besides that, highly productive initial stock of new type for breeding varieties of 21st century has been released.



Figures and tables summary

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