ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
Өсімдіктердің биологиясы және биотехнологиясы институтының

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Института биологии и биотехнологии растений

N E W S

OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
of the Institute of Plant Biology and Biotechnology

БИОЛОГИЯ ЖӘНЕ МЕДИЦИНА СЕРИЯСЫ

♦

СЕРИЯ БИОЛОГИЧЕСКАЯ И МЕДИЦИНСКАЯ

♦

SERIES OF BIOLOGICAL AND MEDICAL

4 (328)

ШІЛДЕ – ТАМЫЗ 2018 ж.
ИЮЛЬ – АВГУСТ 2018 г.
JULY – AUGUST 2018

1963 ЖЫЛДЫҢ ҚАҢТАР АЙЫНАН ШЫҒА БАСТАҒАН
ИЗДАЕТСЯ С ЯНВАРЯ 1963 ГОДА
PUBLISHED SINCE JANUARY 1963

ЖЫЛЫНА 6 РЕТ ШЫҒАДЫ
ВЫХОДИТ 6 РАЗ В ГОД
PUBLISHED 6 TIMES A YEAR

АЛМАТЫ, ҚР ҰҒА
АЛМАТЫ, НАН РК
ALMATY, NAS RK

«ҚР ҰҒА Хабарлары. Биология және медициналық сериясы».
ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)
Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.)
Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 01.06.2006 ж. берілген **№5546-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
www:nauka-nanrk.kz / biological-medical.kz

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

«Известия НАН РК. Серия биологическая и медицинская».
ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)
Собственник: РОО «Национальная академия наук Республики Казахстан» (г. Алматы)
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№5546-Ж**, выданное 01.06.2006 г.

Периодичность: 6 раз в год
Тираж: 300 экземпляров

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел. 272-13-19, 272-13-18,
www:nauka-nanrk.kz / biological-medical.kz

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of biology and medicine.
ISSN 2518-1629 (Online),
ISSN 2224-5308 (Print)
Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty)
The certificate of registration of a periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan N 5546-Ж, issued 01.06.2006

Periodicity: 6 times a year
Circulation: 300 copies

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://nauka-nanrk.kz / biological-medical.kz

Address of printing house: ST "Aruna", 75, Muratbayev str, Almaty

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF BIOLOGICAL AND MEDICAL
ISSN 2224-5308
Volume 4, Number 328 (2018), 103 – 111

UDC 633.18

K.N. Zhaylybay, G. Zh. Medeuova, N. K. Nurmash

Kazakh State Women Teachers University, Almaty, Kazakhstan.
E-mail: medeuova.galiya@mail.ru, kelis.zhaylybay@mail.ru

RICE GRAIN QUALITY FORMATION DEPENDING ON THE MINERAL FERTILIZERS DOSAGES

Abstract. Rice grain quality depends on content and combination of reserve constituents: starch and protein. Hull content, fissuring, shape, and size of grain and hulling easiness are very important for the production of cereals. Taste of cereals, its color, transparency (vitreousness), fast and simultaneous boiling, full content of essential amino acids, vitamins, mineral elements and other nutrients in the grain are of importance for consumers. At the background of treatment with phosphoric and potassic fertilizers (P120K80 kg/ha), application of nitrogen fertilizers (No.160-180 kg/ha) in an optimum dosage, contributes to increase in content of protein, starch and the whole berry in cereals. Increase in the dosage of fertilizers up to N240P180K120 kg/ha did not contribute to increasing of protein and starch content in the grain and the whole berry in cereals; on the contrary, it resulted in a decrease of those parameters and in crop yield.

Key words: rice, grain quality, content of starch, protein and whole berry in the rice grain cereal, effect of increasing dosages of fertilizers on content of the above-specified substances in grain.

The problem of rice production increase is indissolubly tied to the problem of rice grain quality improvement. Thus, improvement of vitreousness just by 1% contributes to the reduction of crushed chips in cereals approximately by 1.2 thousand tons. Improvement of the other quality parameters ensures the additional yield of a thousand ton of rice cereal [1, 2].

Rice grain quality depends on content and combination of reserve constituents: starch and protein, since their share on the basis dry grain substance makes approximately 90%. Multiple agroecological characteristics (level of agricultural methods of cultivation, grain harvesting and processing conditions, etc.) have effect on grain quality as well as on physiological and genetic rice varieties' properties.

Rice grain quality depends on many parameters, their properties and characteristics. For example, hull content; fissuring, shape and size of grain as well as hulling easiness are very important for the production of cereals. Taste of cereals, its color, transparency (vitreousness), fast and simultaneous boiling, full content of essential amino acids, vitamins, mineral elements and other nutrients in the grain are of importance for consumers. According to the rates (8.5 kg per a person) scientifically substantiated by the Institute of Nutrition of the RK National Science Academy, the total quantity of rice available in the Republic of Kazakhstan for domestic consumption is equal to 132.6 thousand tons. Rice cultivating farms of Kyzylorda region and Akdalinskiy area supply rice (mainly short-grain type) to the population of Kazakhstan in sufficient quantity. Nevertheless, over the period of 2007-2012, import of rice (including long-grain type) to Kazakhstan is as follows: from Russia - 57.5%, from China, India and other countries - 28.2%.

Grain shape. According to the IRRI (International Rice Research Institute) scale, by the length-to-width ratio, hulled "yellowish-brown" rice grain is sub-divided into the following categories: narrow, long-grain rice - 3.0; medium length - 2.1-3.0; long, wide - 1.1-2.0; round, short - 1.1 and smaller.

Grain of rice varieties cultivated in Kazakhstan mainly belongs to long and wide and round-shape varieties and length to width ratio is 1.6-2.0 [2.3]. Nevertheless, plant selection breeders are currently breeding long-grain rice varieties. Demand for long-grain varieties in the global market is higher; there-

fore, its price is higher to as compared to the round-grain rice varieties. Rice varieties cultivated in Kazakhstan differ by length to width ratio (i.e. shape) and body of grain and belong to the following types (table 1).

Table 1 – Shape and Different Types of Grain of the Rice Varieties Cultivated in Kazakhstan (according to the information of the Kazakh Rice Cultivation Research Institute)

Shape, Type	Hulled Grain Length to Width Ratio	Sub-types	Grain Body	Rice Varieties Characterizing Particular Features of Types and Sub-types
I	3.5 and higher	–	Vitreous	Lazurny
II	2.8 - 3.4	–	Vitreous	–
III	2.3 - 2.7	1	Vitreous	Solnechny
		2	Half-vitreous	Ushtobe
IV	2.2 and lower	1	Vitreous	Avangard, UzROS 7-13
		2	Half-vitreous	Kuban 3, UzROS 59, Marjan, Karakalpakstan
Note: Kazakhstan bred rice varieties: Marjan, Ushtobe, Altynai, Togusken 1.				

Humidity. Humidity content in the grain determines biochemical and microbiological processes that go on in it. This, to a certain degree, has an effect on technological and food quality of grain. If humidity content in grain exceeds 15-16%, it intensifies microbiological processes resulting in self-heating that changes the chemical composition of grain that becomes more yellowish and loses its cooking and technological properties. Further increase of humidity content in grain even more intensifies the above described unfavorable processes [1-4].

Grain Size and Uniformity. This is connected with the weight of 1,000 grains and determines quality and properties of grain. Rubbing of small, feeble, imperfect grain results in an increase in the number of crushed, fragmented, dust fractions. Hull content of immature, feeble grain increases while its vitreousness degrades. The above-specified grain properties change depending on the level of cultivation technique applied as well as harvesting and processing conditions [1-4].

Hull content is determined by the ratio of hull on bloom and head of grain. Structural-and-mechanical properties of grain and its hull content are interrelated and have certain effect on the cereal output. Therefore, increase or decrease of hull content by 1% results in increase or decrease of cereal output by 1.5-2.0%.

Grain vitreousness. These properties of hulled grain change depending on transparency (vitreousness) and texture of endosperm. Increase of vitreousness improves technological and cooking qualities of cereal. Thus, milling of vitreous grains results in reduction of the amount of small (crushed) admixtures; grains do not stick together while boiling; taste and cooking qualities of porridge and pilaw improve and the marketable appearance of the cereal improves. Vitreousness of the rice grain is within the range of 95-98% [1-4].

Fissuring is inherent to rice grains since the starch content in it is greater than that of protein. Grain fissuring rate depends on changes in temperature and environmental humidity. Changes in temperature and relative humidity of air result also in changes in the grain humidity content. Humidity content of unscoured grain is non-uniform; as a result, different pressure areas are formed in the grain. If such pressure rises above the certain level, a crack appears inside a grain, which cannot be seen from outside [1-4]. Number and size of cracks inside rice grains are different: depending on environmental conditions of rice cultivation, harvesting and processing grain fissuring may vary from 5-10% to 60-70% and there may be one or more cracks in grains. As the result, amount of crushed grains upon its dehulling increases and quantity of the whole-berry grain in cereal decreases. For example, if the grain fissuring rate is above 1-2%, output of the whole-berry grain in cereal upon dehulling will reduce by 0.3-0.8% and crushed admixture amount increases.

Yellow grains appear in the environment of increased humidity and environmental temperature. Thus, if grain turns out to be damp, it will result in self-heating and biochemical processes intensification,

which, in turn, leads to appearance of yellow grains. Total nitrogen, inorganic phosphorus and sugar content in such grains is way higher as compared to usual grain. Such grains' endosperm remains yellow, which downgrades its commercial quality.

Red rice. Seed (episperm) and bran covering (pericarpium) of such grains are of red or reddish-brown color. Upon grain dehulling and milling, some of this coating is removed (destroyed). Nevertheless, red color is preserved in many instances. In order to remove red color together with coating, it is necessary to intensify milling process; this, however, increases the amount of crushed grain and reduces the number of whole grain in cereal. Red seed coat (pericarpium) deteriorates the appearance and decreases market value of rice cereal. For example, if there is 1% of red grains in the finished product, the quality cereal output will be reduced by 0.1%. According to the standard, content of red grains in the made cereals shall not exceed 0.5-2%. Red-grain rice is the persistent weed in many areas including Kazakhstan Aral Sea area. It is similar to the cultivated varieties of rice; its seeds shatter upon maturing and preserve germinating ability in soil within several years [1- 5].

Unripe grain impurities. 1/4 of such grains are not well-filled, endosperm texture is mealy, or only central part is vitreous (transparent). In the harvested rice product (i.e. grain) 1/4 part of unripe caryopsis belongs to black dockage and 1/4 part belongs to grain impurity. If there are unripe grains in the harvested rice, output of the extra, first and second class grain upon dehulling reduces significantly since the amount of crushed and fine-cut fraction increases.

Black dockage. This impurity includes mineral and organic particles (soil lumps, flower scales, beetle particles and remains of other small animals), seeds of wild and cultivated plants, grain impurities (mainly peeled and chopped grains). Such black dockage (weedy impurities) usually is moist; they contribute to self-heating of rice grains and deteriorate their quality.

The structure and yield of the whole kernel is one of the important indicators determining the quality of the cereals. Rice processing into cereals consists in removal of surface layers (hull) at the minimum crushing of caryopsis and preservation of their initial shape. As a result of many agroecological factors, cereals output may be within the range of 60-75%, including the whole kernel output of 60-88%. Subject to strict adherence to the technologies of cultivation, timely harvesting and quality dehulling and processing of grain, recognized varieties of rice in the conditions of the Kazakhstan Aral Sea area yield 60-72% of cereals and 75-88% of the whole kernel. For example, upon dehulling and milling the Marzhan variety grain yields 84-88% of the whole kernel in cereals (2, 3).

Energy Value. Rice kernel energy value is determined based on the amount of released thermal energy from burning 1kg or 1g of grain. Nevertheless, we should determine difference of the released thermal power from grain burning from physiological energy value in the oxidizing processes of organism. The physiological energy value is lower. Dehulling and processing of rice grain also has certain effect on its energy value. Upon dehulling and milling of rice grain, aleuronic layer is removed to a certain degree and digestibility of cereal increases but nutritional value (quality) of it decreases. Grain moisture content also has effect on its energy value. For example, grain moisture content increase from 6.2% to 26.4% results in decrease in energy value thereof from 3963 cal/t to 3566 cal/t [1, 2, 4].

Cooking quality of rice grain is determined by the following parameters: taste, color, consistency of porridge, time of boiling, property of moisture retaining, etc. These parameters change. For example, taste of cooked porridge is assessed as very good, good, satisfactory. Cereal may be of white to brownish color. Porridge consistency varies from loose to sticky and boiling coefficient ranges from 4.3 to 5.1 [1, 2, 4]. Technological, cooking and edibility properties of rice cereals depend on chemical composition of grain. Content (quantity) of rice grain and cereals components are as follows:

Chemical Composition	Dehulled Grain, %	Cereal, %
Starch	76.4-77.5	83.7-85.6
Protein	10.5-12.3	8.5-9.6
Fat	2.6-3.1	0.4-0.5
Fibre	1.2-1.4	0.12-0.14
Ash	1.5-1.6	0.4-0.5

Therefore, high quality rice grain properties shall be as follows: fully ripe, uniform grain size, high vitreousness, low hull content, low and uniform moisture content of grain. At the same time, the content of black dockage, amount of grain and red-grain impurities, the level of contamination with yellowing endosperms should be below or at the same level with the basic standard. Such grain dehulling results in the production of high-quality of rice cereals.

Rice grain quality depending on the area of treatment and dosage of mineral fertilizers. In the course of rice plants growth and development, high quality grain formation depends on mutual influence of the physiological and genetic potential of varieties and agroecological factors (treatment areas, dosages, timing and methods of fertilization and irrigation mode) [1-4]. Since the basic substances ensuring high quality of grain - starch and protein, make 90% of the dry solid matter of the grain. Those substances are intensively accumulated in the optimum photosynthesis process conditions [2, 7].

Treatment with optimum doses of mineral, especially nitrogen fertilizers has a significant effect on the formation of grain quality. Thus, at the background of treatment with phosphoric and potassic fertilizers (P120K80 kg/ha), application of nitrogen fertilizers (No.160-180 kg/ha) in an optimum dosage contributes to increasing in the content of protein, starch and the whole kernel in cereals. Increase in the dosage of fertilizers up to N240P180K120 kg/ha did not contribute to increase of protein and starch content in the grain and the whole kern in cereals; on the contrary, it resulted in a decrease of those parameters (table 2) [2, 7].

Table 2 – Rice Varieties' Grain Quality Depending on the Area of Treatment and Dosage of Mineral Fertilizers

Fertilizer Dosage, kg/ha	Number of Sowed Seeds, pcs/m^2	Plant Density before Harvesting, pcs./m^2	In % per Dry Substance of Dehulled Grain			
			Starch	Protein	Total Nitrogen	Protein Nitrogen
Kuban 3 Variety						
N90P90	700	381	74.3	9.34	1.57	1.31
N180P120	100	55	72.2	10.0	1.68	1.38
	300	180	78.6	11.3	1.90	1.68
	500	281	82.6	12.1	2.03	1.76
	700	405	80.0	11.7	1.97	1.70
	900	471	78.2	10.1	1.69	1.58
Dubovskiy 129 Variety						
N90P90	700	323	71.5	11.0	1.84	1.53
N180P120	100	58	78.2	11.1	1.86	1.62
	300	185	77.1	11.3	1.89	1.72
	500	247	79.8	12.2	2.05	1.80
	700	318	81.4	12.9	2.17	1.94
	900	385	81.4	12.3	2.06	1.82
Marzhan Variety						
N90P90	700	324	81.3	11.6	1.97	1.75
N180P120	100	53	78.8	12.0	2.02	1.82
	300	184	79.1	12.6	2.11	1.93
	500	257	78.2	12.2	2.05	1.84
	700	361	75.1	11.8	2.00	1.81
	900	397	73.5	10.6	1.83	1.61

Consequently, with the increasing dosages, especially of nitrogen fertilizers, there has been a decrease in the yield of rice crops and deterioration of rice grain quality, which means that application of high dosages of fertilizers on rice crops is not profitable from an economic and ecological point of view.

Additionally, this results in environmental pollution (contamination of soil, water in collecting and drainage systems and other water reservoirs).

Starch is a nutritious substance located in the endosperm cells and is the main component of cereal (up to 75-80%). Starch consists of the following two polysaccharides: amylose and amylopectin. Amylose content in the rice grain endosperm varies within the range of 10 to 35%, while that of amylopectin - within the range of 65-90%. Nutritious value of the rice grain is determined by the quantity and amylose to amylopectin ratio. The greater the amylose content in grain is, the more water is consumed and the greater is the grain's volume. Therefore, boiling of grains with medium and high content of amylose does not result in softening and sticking [8] It is important for porridge and pilaw cooking.

Starch content in rice grains is greater than in any other cereal crop. Rice starch is easily digested and its nutritious quality is high. Therefore, by the assimilated energy, the grain of rice has an advantage in comparison with the other cereal crops.

In connection with the physiological and genetic characteristics of rice cultivars and the level of cultivation technology, starch content in the husked grain varies within the range of 65-88%. Application of an optimum dosage (N180P120 kg/ha) of fertilizers results in increase of starch content of the medium-growth, narrow-leaved cultivars Kuban 3, Dubovskiy 129 at the plant population of 180-400 pcs/m^2. The highest starch content (80.0-82.6%) was observed at the plant population in agrophytocenosis of 250-350 pcs./m^2. These crops are highly productive agrophytocenoses of Kuban 3 and Dubovskiy 129 cultivars and the taste of these cultivars' grits turned out to be good (table 2).

Subject to treatment with an optimum dosage (N180P120 kg/ha) of fertilizers, starch content in the Marzhan variety grain did not increase as compared with treatment with the minimum dosage (N90P90 kg/ha) and remained at the same level. In the event of thicker agrophytocenosis (700 and 900 seeds sowed), starch content in the above named cultivars' grain decreased. Correspondingly, in the event of thickened crops (360 to 390 plants/m^2), leaves of the large-leaved varieties of rice samples mutually shade each other deteriorate the photosynthesis process of and, as a result, the synthesis of starch and its transportation to the grain decreases (table 2).

In the course of the grain endosperm development and formation, parenchyma cells filling with carbohydrates (which later turn into starch) comes from the outer, surface cells to the inner cells. If the photosynthesis process deteriorates (depressed) or if grain does not ripe, cavities are formed within the endosperm. Upon dehulling of such grains, kernel is destroyed and large crushed pieces are formed [2].

Protein - the second after starch component contained in large amount in grain (cereals) [1-4]. Reserve rice proteins are mainly represented by prolamins and glutenins that are highly-molecular compounds. Proteins are involved in all vitally important functions and processes in organism. Reserve rice is accumulated in the rice grain endosperm and has effect on sprouts formation upon their germination. Protective proteins play certain role in protection against pathogenic microorganisms. Regulatory proteins activate or suppress molecular-and-biochemical and biological processes in the rice plants, etc. [2, 8]. "Biological effectiveness" of rice grain proteins is due to the high content of essential amino acids and their easy digestion and lower tannin content as compared with the other cereal crops. Nevertheless, total content of protein in the rice grain is less than other crops (table 3). Therefore, increase of the protein content in the rice grain is a positive phenomena from the standpoint of rice breeding.

Study of proteins location in the rice grain endosperm is an important process from the evolution and biochemical point of view [2,9]. Our studies' results show that treatment with a minimum dosage (N90P90 kg/ha) of fertilizers, protein accumulates in the grain of Marzhan and Dubovskiy 129 cultivars longer than in Kuban 3 grain. Treatment with an optimum high dosage (N180P120kg/ha) of fertilizers, protein content in the rice cultivars and specimen increases. Nevertheless, response of different cultivars was different. Treatment with an optimum high dosage (N180P120 kg/ha) of fertilizers, high content of protein in the Kuban 3 cultivar grain was observed at the plant population of 250-280 pcs/m^2 and for Dubovskiy 129 cultivar it was 250-320 plants/m^2 (i.e. after seeding of 300, 500 seeds/m^2). These are the highly productive agrophytocenoses of the above named rice varieties (table 2).

Increase in protein content in the Marzhan cultivar grain was observed at the different plant population (sowed 100, 300, 500, 700 seeds/m^2) in agrophytocenosis (table 2). Therefore, it was found that increase of protein content in rice grain happens depending on the physiological and genetic particular features of cultivars and treatment with an optimum dosage of fertilizers (especially nitrogen ones).

Table 3 – Mean Value of Biological Effectiveness of Proteins of Various Cereal Crops (Y.P. Aleshin, 1993)

Parameter	Dehulled Rice	Wheat	Corn	Barley	Millet	Sorgho
Protein, %	8.5	12.3	11.4	12.8	13.4	9.6
Lysin (g/16g of nitrogen)	8.8	2.3	2.5	3.2	2.7	2.7
Thionine (g/16g of nitrogen)	3.6	2.8	3.2	2.0	3.2	3.3
Methionine (g/16g of nitrogen)	3.9	3.6	3.9	3.9	3.6	2.8
Tryptophan (g/16g of nitrogen)	1.1	1.0	0.6	1.1	1.3	1.0
Pure nitrogen absorbency in protein, %	99.0	96.0	95.0	88.0	93.0	84.8
Biological Effectiveness, %	74.0	55.0	61.0	70.0	60.0	59.2
Specific use of proteins, %	73.8	53.0	58.0	62.0	56.0	50.0
Used protein, % (protein % x specific use, protein/100%)	6.3	6.5	6.6	7.9	7.5	4.8
Tannin content in grain, %	0.1	0.5	0.5	0.8	0.7	1.9

Whole kernel is a valuable part of dehulled and milled rice. The number of whole kernels in rice grain largely depends on the genetic and biological characteristics of varieties, on the level of cultivation technologies, the characteristics of harvesting and processing of grain and other agroecological factors [1, 2, 4, 7].

When applying the minimum dosage (N90P90 kg/ha) of fertilizers, the whole kernel in the grain of the KZROS sample was 82.6%, and that of Marzhan variety was 81.8%. Marzhan variety particular feature consists in formation of a large number of the whole kernel in grain and dehulled rice cereal (84.7-88.5%) at the minimum (N90P90 kg/ha) and opt imum (N180P120 kg/ha) dosages of fertilizers and at various thickness of plant population (100, 300, 500, 700 seeds/m^2) (Table 9.5). Due to this particular feature, Marzhan variety covered 65 to 72% of the area under rice crops of Kyzylorda region.

Table 4 – Technological Properties of Husked Rice Grain Depending on the Area of Treatment and Dosage of Mineral Fertilizers

Fertilizer Dosage, kg/ha	Number of Sowed Seeds, pcs/m^2	Cereal Output and Quality, %			Hull Content, %	Vitreousness, %
		Total	Whole Kernel	Crushed Particles		
Kuban 3 Variety						
N90P90	700	72.0	67.8	32.2	20.0	98
N180P120	100	72.0	68.0	32.0	18.0	97
	300	73.2	68.2	31.8	16.0	98
	500	71.6	84.2	15.8	19.0	98
	700	71.6	78.9	21.1	19.0	98
	900	72.2	75.9	24.1	19.0	97
Dubovskiy 129 Variety						
N90P90	700	72.6	66.4	33.6	16.0	95
N180P120	100	72.4	77.2	22.8	18.0	98
	300	72.2	73.3	26.7	17.0	97
	500	72.4	81.1	18.9	16.0	98
	700	72.0	84.0	16.0	16.0	99
	900	72.4	77.7	22.3	17.0	98
Marzhan Variety						
N90P90	700	71.8	81.8	18.2	17.8	97
N180P120	100	72.0	84.7	15.3	17.7	98
	300	72.1	88.5	12.5	17.5	98
	500	72.0	85.6	14.4	17.5	98
	700	72.4	80.5	19.5	18.1	98
	900	72.3	77.2	21.8	18.6	98

Under the conditions of treatment with an optimum dosage (N180P120 kg/ha) of fertilizers, large number of the whole kernel in the grain of Kuban 3 cultivar was formed at the thickness of plant population of 250-280 plants/m^2, that of Dubovskiy 129 at the plant population of 250-320 plants/m^2. At such a density of plant population, starch and protein content increased in the grain of the above specified cultivars at the above specified plant population. This is plant population of highly effective crops of Kuban 3 and Dubovskiy 129 cultivars. With such agrocenoses, the process of photosynthesis of each plant improves; starch and protein accumulate intensively in the grains. As a result, quality of the above named cultivars' grain improves and taste of cereal improves too. However, starch and protein contend of the heavily thickened and thinned crops did not increase with an increase in the fertilizer dosage and the amount of the whole kernel in the grain and in the range of rice varieties decreased (tables 2 and 4).

The quality of the rice grain and the yield of the whole kernel in the crop depend on the protein and starch content in the grain, since 90% of the dry mass of the grain consists of these named substances. Starch and protein content reduction in grain or change in its ratio contributed to reduction of the whole kernel output and increase in the share of crushed fraction (tables 2 and 4).

Therefore, grain quality formation depends on genetic potential and particular features of rice varieties, on optimum plant population and an intensive photosynthesis process in agrophytocenosis. Agrotechnical measures shall be taken in due time and of proper quality. Correct and timely execution of grain harvesting and processing operation also has a significant effect on grain quality.

Effect of dosages, ratios and methods of mineral fertilizers on quality of rice grain. In the course of rice plants growth and development, high quality grain formation depends on interaction and mutual influence of the physiological and genetic potential of varieties and agroecological factors (treatment areas, dosages, timing and methods of fertilization and irrigation mode, etc.) (table 5) [1, 3, 6, 10].

Table 5 – Effect of Dosages and Ratios of Mineral Fertilizers on Rice Grain Quality (Kuban 3 Variety) [6]

Mineral Fertilizers Dosages and Ratios, kg/ha	Protein, %	Starch, %	Hull Content, %	Weight of 1,000 grains, %	Cereal Output and Quality, %		
					Total	Including	
						Whole Kernel	Crushed Particles
Control (without fertilizers)	7.5	62.2	19.4	31.3	70.2	75.4	24.6
N160	8.1	62.7	20.3	29.8	68.3	70.7	29.3
P120	7.6	61.8	19.3	31.7	71.5	77.9	22.1
K80	7.5	61.5	20.7	31.8	70.3	76.8	23.2
N160P120	8.9	75.6	17.9	31.6	73.6	85.1	14.9
N160K80	8.3	66.3	19.0	31.8	72.3	81.5	18.5
P120K80	7.9	62.7	19.5	31.5	71.2	75.9	24.1
N160P120K80	*9.0*	*76.1*	*18.0*	*31.9*	*74.1*	*89.5*	*11.5*
N80P60K40	7.9	64.8	19.3	30.7	70.8	75.3	24.7
N240P60K40	8.9	71.4	19.8	29.3	69.7	71.3	28.7
N80P180K40	8.0	65.6	19.4	30.8	74.1	76.7	23.3
N80P60K120	8.1	65.4	19.5	31.0	70.8	77.1	22.9
N240P180K80	9.1	69.7	19.8	29.7	68.6	79.4	20.6
N240P60K120	8.9	71.3	19.6	29.3	68.7	73.5	26.5
N80P180K120	8.0	66.7	19.5	30.7	70.3	75.8	24.2
N240P180K120	9.1	68.7	19.7	29.4	67.4	80.3	19.7

Treatment of rice with an optimum dosage (N160-180P120K80 kg/ha) of fertilizers at the nitrogen to phosphorus and potassium fertilizers ratio of 1:0.75:0.5 results in increase of protein and starch content in grain, increase of the whole kernel amount and reduction of hull content thus ensuring the best yield of the highest quality grain. Treatment with the high dosage (N240P180K120 kg/ha) did not result in increase in starch content in grain, whole kernel output but resulted in content of crushed fraction (table 5). Increase

in the dosage, especially that of nitrogen fertilizers, or in the event of reduction of the dosage and change in the ratio of applied fertilizers did not result in increase in the crop yield but resulted in deterioration of grain and cereal quality (table 9.6). Treatment of heavily salinized soil with nitrogen and phosphorous fertilizers in the ratio of N : P = 1 : 1 or 1 : 0.8 resulted in high yield of high quality grain. Nevertheless, it is necessary to determine mobile phosphorous content in soil prior to sowing and it is necessary to take the results into account to determine the ratio of applied mineral fertilizers [1, 3, 6, 10]. Efficiency of various applied nitrogen fertilizers (ammonium sulphate, calurea) turned out similar [3,6,10]. Methods of fertilizers application also have effect on formation of grain quality. Thus, nitrogen fertilizer (calurea) local application resulted in increase in protein content in grain by 0.7% and starch content increased by 4%, in improvement of cereal quality: number of the whole kernels increased by 7% and hull content of grain decreased, weight of 1,000 grains increased (table 6).

Table 6 – Effect of Various Types of Nitrogen Fertilizers and Methods of Their Application on Rice Grain Quality (Kuban 3 Variety) [6]

Types and Dosages of Fertilizers, kg/ha	Protein, %	Starch, %	Hull Content, %	Weight of 1,000 Grains, %	Cereal Output, %		
					Total	Whole Kernel	Crushed Fraction
Types of Nitrogen Fertilizers							
P120K90 (background)	6.6	58.3	20.8	27.4	67.9	62.8	37.2
PK + N_A 120	7.4	64.3	19.6	28.1	69.8	72.0	27.4
PK + N_A 120	7.4	65.0	19.7	28.0	69.6	73.0	27.0
PK + N ($_{A+M}$) 120	7.4	64.7	19.8	27.0	69.5	72.8	27.2
Ways of the Nitrogen Fertilizers Application							
P120K90 (background)	6.6	58.3	20.8	27.4	67.9	62.8	37.2
PK + N_M 120 surface	7.4	65.0	19.7	28.0	69.6	73.0	27.0
PK + N_M 120 local	8.1	69.0	18.6	28.8	71.3	80.0	20.0

Therefore, treatment of the area under rice crops with an optimum dosage of nitrogen fertilizers improves crops structure and grain quality, but application of various forms of nitrogen fertilizers did not have effect on the crop yield and cereal quality. Presence of nitrification inhibitors in the nitrogen fertilizers improved structure of the crops but did not have effect on grain quality. Application of nitrogen fertilizers to the rice crops by local and partial methods improved crop structure, quality and technological parameters.

REFERENCES

[1] Aleshin Y.P., Konohova V.P. Quick Reference Book of Rice Grower. M.: Agropromizdat, 1986. 253 p.

[2] Zhailybai K.N. Kurish (monography). Almaty: Fylym, 2015. 351 p

[3] Bakiruly K. Kazakstandagy kurish selektsiyasy. Almaty: Bastau, 2002. 190 p.

[4] Uliano O. Rice Kernel and Its Quality // Rice and Its Quality. M.: Kolos, 1976. P. 20-24.

[5] Vereschagin G.A. Raw Materials for Rice Selection in the Conditions of Kyzylorda Region. Synopsis of a thesis of an agricultural science candidate. Leningrad, 1978. 24 p.

[6] Tautenov I.A., Zhailybai K.N., Baimbetov K.S. Agroecological and Morphophysiological Basics of Mineral Fertilization and Rice Crop Yield. Almaty: Fylym, 2003. 180 p.

[7] Dwivedi J.L., Nanda J.S. Inheritange of amylose content in three crosses of rice // Agr. Sci. 1979. Vol. 49, N 10. P. 753-755.

[8] Ivanova D.I. Immunochemical Study of Water and Salt Soluble Proteins of Rice Kernel in Connection with the Evolution Issues and Taxonomy of Cultural Varieties of Oryza L. // Tr. on appl. bot., gen. and sel. 1979. N 3. P. 135-144.

[9] Yerygin P.S. Fiziologia risa. M.: Kolos, 1981. 208 p.

[10] Zhailybai K.N., Sarsenbayev B.A., Ramazanova S.B., Tautenov I.A., Shermagambetov K. Agroecological and Morphophysiological Basics of Fertilizers Application in Kazakhstan Rice Growing (Recommendations). Almaty: Bastau, 2002. P. 32.

К. Н. Жайлыбай, Ғ. Ж. Медеуова, Н. К. Нұрмаш

Қазақ мемлекеттік қыздар педагогикалық университеті, Алматы, Қазақстан

МИНЕРАЛЬДЫ ТЫҢАЙТҚЫШТАР ДОЗАСЫНА БАЙЛАНЫСТЫ КҮРІШ ДӘНІ САПАСЫНЫҢ ҚАЛЫПТАСУЫ

Аннотация. Күріш дәні сапасы оның құрамындағы қорлық заттар – крахмал, белок мөлшеріне және арақатнасына байланысты. Жарма (крупа) өндірушілер үшін дәннің қауыздылығы, шытынағыштығы, формасы және ірілігі, оңай ақталуы өте маңызды. Тұтынушылар үшін керегі – жарманың дәмділігі, түсі, шынылығы әрі бір мезгілде пісуі, дән құрамында ауыстырылмайтын амин қышқылдары, витаминдер, минералды элементтер, басқада қоректік заттардың толық болуы. Фосфор және калий тыңайтқыштары фонында (Р120К80 кг/га) азот тыңайтқышын қолайлы дозада (N160-180 кг/га) енгізу жарма құрамындағы белок, крахмал, сынбаған ядро мөлшерін арттырады. Тыңайтқыштар дозасын N240P180K120 кг/га деңгейіне дейін көбейту дән құрамындағы белок, крахмал, сынбаған ядро мөлшерін арттырған жоқ, керісінше азайтты, өнім деңгейіде төмендеді.

Түйін сөздер: күріш, дән сапасы, жарма құрамындағы крахмал, белок, сынбаған ядро мөлшері, тыңайтқыштар дозасының күріш дәні сапасына әсері.

К. Н. Жайлыбай, Г. Ж. Медеуова, Н. К. Нурмаш

Казахский государственный женский педагогический университет, Алматы, Казахстан

ФОРМИРОВАНИЕ КАЧЕСТВА ЗЕРНА РИСА В ЗАВИСИМОСТИ ОТ ДОЗ МИНЕРАЛЬНЫХ УДОБРЕНИЙ

Аннотация. Качество зерна риса зависит от количества и сочетания запасных веществ – крахмала и белка. Для производства крупы очень важны пленчатость, трещиноватость, форма и крупность зерна, легкость при обручивании. Для потребителей – вкус крупы, цвет, прозрачность (стекловидность), быстрое и одновременное свариваемость, полное содержание в зерне незаменимых аминокислот, витаминов, минеральных элементов и других питательных ыеществ. На фоне фосфорных и калийных (Р120К80 кг/га) удобрений внесение оптимальной дозы азотных (N160-180 кг/га) удобрений способствует увеличению в зерне белка, крахмала и целого ядра в крупе. Увеличении дозы удобрений до N240P180K120 кг/га не способствовало повышению содержания белка, крахмала в зерне и целого ядра в крупе, а наоборот произошло снижение этих показателей и урожайности.

Ключевые слова: рис, качество зерна, содержание крахмала, белка и целого ядра в крупе зерна риса, влияние возрастающих доз удобрений на содержание выше названных веществ в зерне.

Information about authors:
Medeuova G.Zh. – candidate of Agricultural Science, acting professor (medeuova.galiya@mail.ru);
Zhaylybay K.N. – doctor of Biological Science, Professor (kelis.zhaylybay@mail.ru);
Nurmash N.K. – senior lecturer of the Kazakh State Women Teachers University, Almaty, Kazakhstan

Publication Ethics and Publication Malpractice in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-1629 (Online), ISSN 2224-5308 (Print)

http://www.biological-medical.kz/index.php/ru/

Редактор *М. С. Ахметова, Т. М. Апендиев, Д. С. Аленов*
Верстка на компьютере *Д. Н. Калкабековой*

Подписано в печать 11.07.2018.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
9,2 п.л. Тираж 300. Заказ 4.