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Rice Cultivation by Setting Seedlings Using Land Pre-Saturation with Water

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Abstract: This article describes rice cultivation by setting seedlings using land pre-flooding with water on rice fields of Akdala. Rice cultivation by setting seedlings is a very profitable technology for the commercial farm unit. Because it directly affects the increase in yielding capacity of output, product structure and there is increase of harvest when gathering the harvest by this technology. Technology of seedlings is not only improves rice yielding capacity, but is very effective practical technology for rice fields of Kazakhstan with saline soil and the lack of fresh water. In this regard results of our research work can influence and become the basis for increasing of rice production and improve its yielding capacity in our country.

Key words: Rice % Yielding capacity % Seedlings % Soil

INTRODUCTION

Fertility of the land is the main and decisive factor for cultivation of rice seeds (*Oryza sativa* L.). The reason for this factor is the fact that regions of the Syr Darya and Ili in Kazakhstan were used for setting of rice seeds: salt in the soil, which contains sulfate chloride and chloride sulfate and the soil in environ of river Ili contains ash that is very poisonous for plants [1].

We all know that regardless of salt type if its concentration in the soil is more than standard level this leads to very low development of the crop. In this regard engineering systems used to control salt concentration in the soil were built in regions of Kazakhstan where rice is grown. During initial stages this work showed good results. Unfortunately, in recent years quality of drainage rice fields in Kazakhstan fell sharply and production of rice seeds has decreased dramatically. A process of land fertility reduction, which means salinization, mire formation at rice fields, has begun to develop due to malfunction of engineering systems [2, 3].

Saline land in the vicinity of Akdala differs from other areas that grow rice due to its quality. For example, compared with Japan, Far East major geographic regions of rice cultivation [4]. Over the last two decades humanity has acquired biological knowledge that allows it to tamper with the very nature of creation. We are only at the beginning of a process that will transform our lives and societies to a much larger extent than all inventions of the last decades [5-7].

Rice is perhaps the world's most important food crop [8], being the staple food of over 50% of the world population, particularly in India, China and a number of other countries in Africa and Asia. In Africa, particularly in the 1980s, Egypt and Malagasy Republic account for 62% of all rice produced (Chuta, 1984). Recently, important and major changes have led to structural increases in rice consumption in the West African subregion. Since 1973, regional demand has grown at an annual rate of 6%, driven by a combination of population growth and substitution away from traditional coarse grains [9, 10].

Reduced fertility of land and sharp decrease in the amount of saturation with chemical fertilizers has led in recent years to scarcity of land in the vicinity of rice fields. Nowadays there is return balance of nutrients not only in areas of rice fields, but also in public-irrigated lands in Kazakhstan [11-13].

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Rice cultivation by setting seedlings using soil pre-saturation with water to increase mobility of important plant nutrients in the soil is very profitable technology for the economy [14]. As evidence we present data on the role of seedlings technology in the production of rice suggesting to your attention three years experience in this area.

MATERIAL AND METHODS

Field experiments were conducted in rice fields of LLP Agricultural Company "Otes", Akdala irrigated steppes downstream the river Ili relating to the area of Balkhash. Balkhash area of Almaty region is one of the outlying settlements with unfavorable nature located in arid and semiarid regions. In early April the work on cultivation of rice seedlings begins in the economic center. Field experiments were organized according to well-known scientific methods of soil science, agriculture and plant science due to which yielding capacity was determined and rice cultivation was controlled [11, 15-18].

Prior to setting of rice in small fields the features of process of soil structuring during sowing flooding were investigated as well as field experiments to restore main elements of technology according to cultivation method using rice seedlings were conducted, consisting of two options for 3-crop rotation fields using plots 1, 2, 3 of the above commercial farm unit as to schemes below:

- Traditional technology of rice cultivation;
- Technology of rice cultivation using seedlings by method of pre-flooding of land;
- The area of each plot – 50 m^2;
- Re-investigation – three times;
- Scheme of seedlings setting, 10x5 cm;
- The number of in each seedbed – 4 pieces;
- Age of seedlings – early phase of sprouts germination;
- Irrigation regime – prior to plants setting, flooded grasslands to a depth of 10-15cm after setting – according to irrigation mode of commercial farm unit;
- Main fertilizers – ammonium sulphate and superphosphate were applied in accordance with cartogram of commercial farm unit.

Nowadays more than 1,200 hectares for rice cultivation have been developed in the study area of Almaty region, in the Akdala steppe.

In the vicinity of Akdala two varieties of rice are basically grown. These varieties are "Kuban 3" and "Solnechny". Today these varieties are outdated and have lost their value. Quality varieties provide greater yielding capacity at growing. In accordance with this since 1999 A.I. Sedlovsky, L.K. Mamonov, O.N. Taranov together with scientists in the field of plant physiology, genetics and bioengineering of Science Academy of the Kazakh SSR have been working on enrichment and adaptation of new varieties of rice culture to market demands, have developed new varieties of rice, have been working on their implementation in the production.

As a result of search that took much time and labor in fields of commercial farm unit during the past 7-8 years rice varieties called "Madina" and "Bakanas" were introduced in the output (inventors O.N.Taranov, L.K. Mamonov and Zh.Zh. Aimakov). Currently such released varieties as "Solnechny", "Madina", "Bakanas" are planted in the Akdala steep [14].

In the period 2004-2005 variety "Bakanas" was tested at the plot of released rice varieties, in 2007 inventor's certificate for this variety was issued by the Ministry of Agriculture of the Republic of Kazakhstan. The above intensive rice varieties were the first varieties in the history grown in Akdala steep as a result of long-term work of scientists and specialists of commercial farm unit. It should be emphasized that large water-and cold-resistant leaves of "Bakanas" variety given economic opportunities hold a special position in the farming rotation [14].

The yielding capacity of the product was determined by following parameters: number of plants per 1 m^2, yielding capacity at spikelet formation, grain weight per 1 m^2, weight and number of grains in the main spikelet, weight and number of grains in additional spikelets.

Each indicator was processed using the method of variation statistics. All statistic data are valid for use as evidence.

There were used methods by B.A. Dospehov and E.A. Dmitriev for statistical processing of obtained product from the ground and to show structural indicators of rice products [15, 19]. An analysis by EXCEL program was also done.

RESULTS AND DISCUSSION

Results from Appropriate Rice Varieties with Fertilization Technologies

Yielding Capacity of Rice: Released varieties of rice Solnechny, Madina, Bakanas (Table 1) were used as control samples at rice fields of Akdala. Aluminum hoops 50x50 were exposed before setting in the experimental plots in order to identify amount of germination, ripening and finished products from set seedlings. In the autumn before harvest yielding capacity of grain varieties was found by counting the number of plants inside the hoop. Yielding capacity of Madina and Bakanas varieties was 100 per cent and of Solnechny variety was 75 per cent.

Table 1: Comparative yielding capacity of rice

Option	Replication 1	2	3	Average amount of output, M±m, hwt/ha	Additional output, m hwt/ha	%	$BED_{0.5}$
First grains of 2006 – alfalfa on a two-year crust							
"Solnechny" variety							
Observation	35	32	33	33.3±0.88	-	-	-
Result	63	65	63	63.7±0.66	30.4	91.3	5.3
"Madina" variety							
Observation	29	31	33	31.0±1.15	-	-	-
Result	59	60	62	60.3±0.88	29.3	94.5	7.0
"Bakanas" variety							
Observation	38	36	36	36.7±0.67	-	-	-
Result	68	70	67	68.3±0.88	31.6	86.1	5.3
First grains of 2007 – crops in the crust of a two-year alfalfa							
"Solnechny" variety							
Observation	26.1	28.1	30.1	28.1±0.82			
Result	51.6	56.6	52.6	53.6±1.08	25.5	90.7	9.2
"Madina" variety							
Observation	24.3	25.3	26.3	25.3±0.41			
Result	47.7	47.7	50.7	48.7±0.71	23.4	92.5	5.6
"Bakanas" variety							
Observation	30.8	28.2	33.1	30.7±1.00			
Result	56.5	54	59	56.5±1.02	25.8	84.0	9.7

Biological yielding capacity was identified for all varieties by triple rice re-collection from one square meter of land. Experimentations for all years and all rice varieties have shown that technology of rice cultivation by setting seedlings gives more output than through traditional method.

Yielding capacity of rice using rice cultivation technology by setting seedlings by method of pre-flooding has twofold increased compared with traditional technology. Namely for grains of rice variety Solnechny, set over a cover of two-year alfalfa by technology of land pre-flooding with water, yielding capacity of output was an average of 63.7 hwt/ha and additional output was 30.4 hwt/ha, which was considered the best indicator for 2006. The average amount of output of "Madina" variety was 60.3 hwt/ha, additionally there was gathered 29.3 hwt/ha. The average amount of obtained output of Bakanas variety was 68.3 hwt/ha, additionally there was gathered 31.6 hwt/ha. And in 2007 rice planted on trenched surface of a two-year alfalfa cropped by 4.0-5.5 hwt per one hectare less than in the previous year in both cases.

This fact is scientifically proven pattern, decrease in the interaction of alfalfa with the soil reduces concentration of organic substances in the soil and this situation is inherent in the common technology of rice cultivation.

Despite the fact that total amount of output is reduced, technology of land pre-flooding with water yield better in all varieties than traditional technology. Regardless of the fact that observed output is less than in absolute form (hwt/ha), it is almost equal in the percentage as last year additional output was 86.1 - 94.5% and in the following year it will be 84.0 - 92.5%.

Structural Indicators of Output: During field experiments conducted in Akdala rice field rice varieties "Solnechny", "Madina" and "Bakanas" were particularly distinguished. As mentioned above land pre-flooding with water before setting of seedlings have a direct impact on the growth and development of rice. Structural parameters of rice are weight of a single spikelet, its growth, the number of branches per plant, number of grains on primary and secondary spikelet and their weight (Table 2).

All structural indicators of output are on average twice as much when using traditional technologies. Rice setting using seedlings gives rise to plant from 104-113 cm, while number of germs is 7-10 pieces. The number of grains of the primary spike is from 94-140 pieces. Therefore the weight of grain in the primary spike is up to 4,2-13,2 g. On shared data the output grown by traditional technology is half as much of all indicators in the comparative degree.

Table 2: The impact of technology of pre-flooding of land per rice structure

Option	The number of productive stems, pieces	Main indicators of spike: The number of spikelets, number	The number of grains per spikelet, number	Weight of grains, r	The weight of one plant	Weight of the 1st vegetable grain, g
"Solnechny" variety						
Observation	2.1±0.16	10.3±0.38	94.2±3.4	2.85±0.16	5.4±0.63	5.5±0.53
Result	7.36±2.05	9.96±0.46	94.4±4.43	3.3±0.04	36.0±2.60	27.5±3.64
"Madina" variety						
Observation	2.1±0.17	10.3±0.42	94.2±3.79	3.3±0.05	5.44±0.69	5.6±0.58
Result	7.4±0.45	11.0±0.50	127.7±7.35	4.2±0.26	28.2±1.97	25.6±1.76
"Bakanas" variety						
Observation	2.2±0.4	10.2±0.55	73.8±4.72	2.7±0.15	13.6±2.62	3.9±0.30
Result	8.3±0.18	12.9±0.32	140.6±6.68	4.5±0.22	37.4±2.42	35.3±2.59

Note: Observation – is the traditional technology.

Result is technology of land pre-flooding with water.

When setting rice seedlings vegetation stage of Solnechny variety has decreased by 26 days and of Madina and Bakanas varieties has decreased by 15 days. Use of technology of land pre-flooding with water and setting rice seedlings affected the increase in gathering of grain products. It was found that compared with traditional technology the structure of productions at setting rice seedlings differs by increase in number and yielding capacity, including plant height given number of stems, number of grains per spikelet and spikelet weight. Land flooding with water for two weeks before setting rice seedlings has a direct impact on improving the quality of products structure and at harvest - on increasing the number of products.

CONCLUSION

Additional products of Solnechny variety was 30.4 hwt/ha and of Madina and Bakanas was 29.3 and 31.6 hundred weight per hectare. Setting of rice seedlings showed improving the quality of structural indicators – to give shoots up, the weight and number of grains of one plant increased.

This technology is not only important from the standpoint of increasing rice production using seedlings, but this technology is very important from the practical use for rice steppes of Kazakhstan with inadequate provision of fresh water, saline lands. The technology of cultivation of rice seedlings allowed reducing growing season of Solnechny variety by 26 days and of Madina and Bakanas variety by 15 days. Thus, results of our research work can be basis for increasing the area of rice fields and increasing of rice yielding capacity.

This technology is very effective for small farm units that grow rice in limited quantities. Because it was possible to plant rice seedlings and obtain a large number of products using seedlings technology. It is necessary to develop methods of mechanized rice cultivation using seedlings in our country. It is necessary to start preparation of rice farmers in a new direction as technology of rice cultivation using seedlings helps to develop farming.

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