

Biometrical and Biochemical Parameters of Foreign Rice Varieties under Soil-Climatic Conditions of the Khorezm Region, Uzbekistan

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Abstract Rice varieties were grown using the same agrotechnical measures in the field experiments conducted in the soil and climate conditions of Khorezm region. As a result of the conducted research, the productivity of Dongjin, Chokwang, Osmanchik-97 and IR-124 rice varieties, the amount of total protein, the amount of micro and macroelements were determined and compared. It has been established that the Chokwang variety surpasses all varieties in terms of yield, total protein and microelement content. And the grain composition of Osmanchik-97 variety is rich in Na, Mg, P and K elements.

Keywords Rice, Yield, Total protein content, Macro and micro elements, Acclimatization, Soil and climatic conditions

1. Introduction

In recent years, global warming and soil degradation have become serious environmental problems and brought a series of negative influences to agricultural development [1]. The food demand is increasing due to the ever-increasing population, and it is a challenge to produce more cereal in a deteriorating environment [2].

Rice (*Oryza sativa* L.) is one of the most important cereal crops in the world. Rice accounts for 30% of the global irrigated area whilst being a staple food for over 50% of the global population [3,4]. Approximately 75% of rice production comes from lowland rice systems under continuous flooding conditions [5].

Increasing the yield of rice depends on many factors. These include the creation of new high-yielding rice varieties, the cultivation of hybrid rice, the introduction of foreign varieties and the use of proper agro-techniques [6].

In 2021 rice cultivated more than 48883 hectares area of Uzbekistan, the average yield was 6.84 tons per hectare, and the production was 334226 tons. This amount can only minimally satisfy the demand for rice, which is one of the main food products of our country's growing population. According to official informations (FAO STATS, 2023), in 2021 Uzbekistan imported 27584 tons of rice from another

countries [7].

In order to obtain a high yield from rice in our republic, to meet the population's demand for rice products, and to save currency by reducing the amount of rice imported, placing high-yielding varieties resistant to soil and climate conditions, having high-quality grain indicators, developing and introducing highly efficient and resource-efficient agrotechnologies in their cultivation, is one of the most important tasks [8].

During 2021-2022, rice varieties belonging to foreign selection were planted in the experimental field of the Khorezm scientific experimental station of Grain and legumes plants research institute, and their biometric and biochemical indicators were compared.

2. Materials and Methods

Experiment Site. The field experiment was conducted in 2021 and 2022 at the Khorezm scientific experimental station of Grain and legumes plants research institute (41°33'04.2"N 60°43'52.8"E) in Urgench district, Khorezm region, Uzbekistan.

The Khorezm region is located in the northern part of the Turan lowland, occupying part of the left bank of the ancient Amudarya delta and a small part of the Kyzylkum desert on the right bank. It is located in the lower reaches of the Amudarya River and is a large alluvial plain in terms of relief and has an average slope of 0.0003–0.0005. The Khorezm region is divided into two parts in terms of land structure: the large northern part, which is about 100–110 m above sea

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level, and the southern part, which is 120–150 m above sea level. The average annual rainfall in the region is 78–79 mm (the main part of precipitation falls in spring and autumn), and the growing season lasts 200–210 days [9].

The climate is sharply continental with very cold winters (up to -41°C), hot ($+25$ $+30^{\circ}\text{C}$) and very hot summers (up to $+45^{\circ}\text{C}$). The average annual temperature of the oasis is $+13.9^{\circ}\text{C}$, and $+15^{\circ}\text{C}$ in the southern part of the oasis [10]. Due to its location in the desert zone, the climate is dry. Agro-horticultural practices include the cultivation of cotton, rice, wheat, fruits and vegetables with irrigation mainly. Saline groundwater is close to the soil surface and varies at a depth of 0.6-3 meters. There are special irrigation systems and a drainage system to drain the sewage. Such a farming system requires constant control of natural factors for obtaining high yields from crops. Classical methods are used for continuous monitoring [11,12].

Plant Materials. We use in the research, local rice variety Nukus-2 (Uzbekistan) was control and foreign Dongjin and Chokwang (South Korea), Osmanchik-97 (Turkey), IR-124 (International Rice Research Institute) rice varieties were grown and their agronomic and grain biochemical indicators were studied. Biometric parameters of rice varieties such as stem length, panicle length, number and weight of grains per panicle and yield of varieties were determined in the research. The amount of protein, macro and microelements in the grain was analyzed.

Methods. Total protein was determined using the Keldal method. The amount of macro and micro elements in rice grain was determined using the ICP (Inductively Coupled Plasma) method.

3. Results

The plant height of the cultivars grown in the experiments ranged from 57.7 to 88.7 cm (Table 1).

When determining the length of the spike, the longest

spike was found in the Chokwang variety (18.4 cm), while the Osmanchik-97 variety had the shortest spike (13.0 cm) in biometric measurements.

The number of grains in the spike of the varieties was determined, all the varieties recorded a higher result compared to the control.

It was found that the best index of the varieties in terms of grain weight per spike was 4.61 grams in the Osmanchik-97 variety, which was 1.12 grams higher than the control.

Varieties ranked in the following sequence according to productivity: Chokwang 74.0 c/ha, Dongjin 69.4 c/ha, IR-124 68.8 c/ha, Osmanchik-97 66.7 c/ha, control variety Nukus-2 yielded 61.4 c/ha.

Protein and amino acid composition is one of the most important properties of the biological value of grain. Amino acid composition defines the biological significance of nutrition and food products (according to the total amount of non-exchangeable amino acids) as a biochemical criterion [13].

The total protein content of the grain in the varieties was in the range of 7.68-9.29%. The highest rate was observed in the Chokwang variety (9.29%), while the lowest result was found in the IR-124 variety (7.68%).

In our experiments, the amount of macro and microelements in the grain of rice varieties was comparatively studied.

It is known that macro and microelements, as the most important catalysts, participate in various biochemical and metabolic processes in the formation of vital functions in the human body, play an important role in the body's fight against diseases and strengthening the immune system. The human body does not produce the necessary micro and macro elements on its own, and it is recommended to consume them in the form of readymade food or biologically active supplements [14]. More than 76 macro and microelements have been found in the human body. But these elements can be divided depending on how much the body requires. For example, while S, P, Na, K, Ca, Cl and Mg are required in large quantities, Fe, Cu, Zn and Co are relatively less required elements [15].

Table 1. Biometric indicators of varieties

№	Varieties	Plant height, cm	Panicle length, cm	Grains per panicle, pcs	Grain weight in one panicle, grams	Total yield, c/ha
1	Nukus-2	57,7 \pm 2,7	13,8 \pm 0,2	134,5 \pm 2,0	3,62 \pm 0,01	61,4 \pm 3,1
2	Dongjin	62,7 \pm 2,4	16,0 \pm 0,1	138,3 \pm 2,9	4,61 \pm 0,03	69,4 \pm 3,5
3	Chokwang	83,0 \pm 2,2	18,4 \pm 0,2	136,9 \pm 1,1	4,59 \pm 0,03	74,0 \pm 3,9
4	Osmanchik-97	66,6 \pm 2,2	13,0 \pm 0,2	163,8 \pm 2,4	4,48 \pm 0,01	66,7 \pm 3,3
5	IR-124	88,7 \pm 1,9	13,8 \pm 0,2	149,1 \pm 2,1	3,49 \pm 0,06	68,8 \pm 3,5

Table 2. Amount of macroelements in grain of foreign rice varieties, mg/l

Varieties	B	Na	Mg	P	S	K	Ca
Nukus-2	3,925	308,9	1030,4	2193,4	510,1	1769,8	1754,8
Dongjin	2,587	211,0	791,64	777,0	549,8	1370,6	1547,4
Chokwang	1,807	223,3	790,89	1021,1	694,7	1759,0	1392,7
Osmanchik-97	2,718	405,7	1347,6	3698,5	642,5	2706,9	1565,4
IR-124	3,192	375,0	936,8	901,5	624,7	1576,1	1881,1

Table 3. Amount of microelements in grains of foreign rice varieties, mg/l

Varieties	Cr	Mn	Fe	Co	Cu	Zn	Si	Mo
Nukus-2 control	0,737	9,504	35,26	0,012	0,325	2,010	433,1	0,074
Dongjin	0,619	3,713	45,42	0,017	0,466	2,055	429,1	0,059
Chokwang	1,202	7,105	47,22	0,028	0,692	3,827	630,4	0,255
Osmanchik-97	0,823	13,65	47,70	0,022	0,214	3,044	525,9	0,075
IR-124	0,945	4,761	53,68	0,021	0,584	3,077	536,6	0,135

The amount of elements B, Na, Mg, P, S, K and Ca was determined from the macroelements in the varieties (table 2). It was observed that Nukus-2 variety grain contained more B element than other varieties, but S element content was the least.

It was found that the grain composition of Osmanchik-97 variety is rich in Na, Mg, P and K elements. Sulfur and phosphorus are biogenic elements that are necessary for all tissues. Sulfur element was abundant in Chokwang variety. The variety IR-124 has the highest content of Ca, and this variety showed an average result in terms of other macroelements.

The amount of Cr, Mn, Fe, Co, Cu, Zn, Si and Mo among the microelements in the grains of rice varieties was determined. The amount of these microelements in the grain of varieties is presented in Table 3.

As can be seen from Table 3, Chokwang variety was found to have the highest amount of microelements Cr, Co, Cu, Zn, Si and Mo. Mn element was detected in Osmanchik-97 variety and Fe element in IR-124 variety.

4. Conclusions

In experiments conducted in the soil and climatic conditions of the Khorezm region, it was found that all 4 studied rice varieties gave a higher yield compared to the control variety, despite the use of the same agrotechnical measures. Chokwang variety had the highest yield (7.4 tons/ha). It is planned to establish the seed production of this variety and involve it in selection work.

The total protein content of the grain in the varieties was in the range of 7.68-9.29%. The highest rate was observed in the Chokwang variety (9.29%), while the lowest result was found in the IR-124 variety (7.68%).

Among the studied varieties, it was found that the grain composition of "Osmanchik-97" variety is rich in Na, Mg, P and K macroelements.

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