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The Effect of Mineral Fertilizer Rates on the Stem Height of Rice Varieties

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Abstract

This article presents scientific research on the effect of nitrogen fertilizer rates on the stem height of rice. The experiments were conducted under the conditions of the Khorezm region, providing data on the impact of fertilization norms on plant height in the soil and climate conditions. The findings revealed that plant growth depends on nitrogen nutrition, the amount of oxygen on the soil surface, air temperature, water temperature, and soil thickness. In production conditions, excessive use of nitrogen increases the tendency of plants to lodge. The best results were obtained when nitrogen fertilizers were applied at a rate of 150 kg of pure nitrogen per hectare under optimal conditions.

Key word: Rice, Plant, Variety, Kilogram, Rate, Nitrogen, Fertilizer, Hectare, Day, Period.

INTRODUCTION

Currently, the world's leading rice-producing countries — China, India, Bangladesh, Indonesia, Vietnam, Thailand, and others — produce 502 million tons of rice products. The countries that consume the most rice and rice products are China, India, and Bangladesh. In 2022/2023, China's rice consumption exceeded 154 million tons. On a global scale, per capita rice consumption has remained relatively stable since 2000, reaching 53.9 kilograms per year in 2018/2019.

In recent years, rice cultivation has focused on preparing land for double cropping after grain crops, growing seedlings, introducing water-saving technologies, and using high-efficiency machinery. By conducting multiple agricultural operations in a single field entry, farmers can save fuel, lubricants, and mineral fertilizers while maintaining and improving soil fertility. This approach also enhances the soil's agro-physical and agro-chemical properties and increases humus content through the decomposition of previous crop residues. Special attention is being given to producing low-cost, environmentally friendly products.

In particular, scientifically grounded agro-technologies, such as minimal tillage with combination aggregates during field preparation, are helping to improve soil properties, meet food and fodder demands, and increase rice crop yields. These efforts address urgent challenges in agricultural production.

Research methods:

In the field experiment, soil samples were collected and prepared for agrochemical analysis according to N.I. Savinov (SoyuzNIXI, 1963) [6-7 b.]. Before sowing, soil samples were taken diagonally from the experimental field at a depth of 0–30 cm to determine the mobile forms of nutrient elements (NRK) in the soil. Ammonium nitrogen was measured using Nesler reagent, mobile phosphorus was analyzed by B.P. Machigin, and exchangeable potassium was determined using a flame photometer. The total nitrogen, phosphorus, and potassium were determined by dry ashing (K.Ye. Ginzburg, G.M. Sheglova, Ye.V. Vulfius (1965)), and humus content was determined according to I.V. Tyurin.

When determining the dry mass of plants at different development stages, plants from each variant were selected at the beginning and end of each stage (10 plants each), and their dry mass along with the average difference were calculated. The result was divided by ten to determine the dry mass of one plant at that stage (g).

Field experiments were conducted in the Tashkent region at the scientific elite state farm of the Uzbekistan Rice Research Institute and at the Khorezm branch of the same institute in the Gurlan district of Khorezm region, under soil and climatic conditions.

The field experiments were carried out based on the methodology developed by the Uzbekistan Cotton Research Institute for conducting field experiments (2007). These experiments were conducted in the fields of the scientific elite state farm of the Uzbekistan Rice Research Institute.

Research Results: The growth of plants is a process of the new formation of elements in the organism's structure. Structural elements are understood to be organs, cells, and the submicroscopic components of protoplasm. Growth proceeds with an increase in the mass and size of the plant.

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For normal plant growth, there must be sufficient light, optimal temperature, and availability of water, oxygen, and nutrients. Physiological processes depend on several factors, and studying the individual effect of each factor on growth is complex.

Plant growth occurs within a broad temperature range; however, most flowering plants perish when temperatures exceed 50°C (under Uzbekistan's conditions). The minimum temperature is the one at which plants begin to grow. As the temperature rises, growth accelerates, and when it reaches an optimal temperature, the growth intensity reaches normal levels. However, as the temperature increases further, growth slows down and stops at high temperatures.

Mineral nutrition also affects the growth of plants. If the necessary elements for their growth are not provided, growth may temporarily stop, and later, the plant may even perish. Excessive nitrogen fertilization can stimulate plant growth, prolong the vegetation period, and delay the ripening of fruits.

Since the rice varieties being tested are biologically late-maturing, their plant height is higher compared to other varieties.

Due to the sharply continental climate of the region, rice plants grow slowly in the early stages. After the temperature increases, growth accelerates.

In the control variety UzROS 7/13, where no nitrogen fertilizer was applied, the plant height in the FON-P120K150 variant was 116 cm. In variants where nitrogen fertilizers were applied, plant height increased with the increasing amount of nitrogen. In the N-150 variant, the plant height was 119 cm, 3 cm higher than the control. In the N-180 variant, it was 122 cm, 6 cm higher, and in the N-210 variant, it reached 126 cm, 10 cm higher than the control.

In the Independence variety, in the variant with no nitrogen fertilizer, the plant height was 131 cm. When nitrogen fertilizers were applied in appropriate amounts, the plant height was 131 cm, 134 cm, and 139 cm respectively. Increasing the nitrogen amount resulted in a height increase of 3-8 cm compared to the control.

Among the varieties being studied, the Tarona variety stood out with the tallest plant height. In the variant with no nitrogen, it was 134 cm. When nitrogen fertilizers were applied at 150, 180, and 210 kg per hectare, the plant height was 136 cm, 141 cm, and 147 cm, respectively.

In the case of the Lazurniy variety, which is adapted to the region’s conditions, in the variant with no nitrogen, the plant height was 132 cm. When nitrogen fertilizers were applied at 150, 180, and 210 kg per hectare, the plant height was 135 cm, 139 cm, and 144 cm, respectively.

1st table

"The Effect of Mineral Fertilizer Rates on Rice Variety Stem Height (cm) (Under the conditions of Khorezm Region, 2017/2019)"

Rice varieties	Nitrogen fertilizer rates	Growing stages				
		Germination - Seedling	Seedling - Tillering	Tillering - Booting	Booting - Flowering	Flowering - Ripening
UzROS7/13	No fertilizer ($N_0P_0K_0$)0	11	44	95	99	102
	Fon-$P_{120}K_{150}$	12	45	109	113	116
	N-150	13	45	112	116	119
	N-180	14	46	115	119	122
	N-210	13	47	118	122	126
Mustaqillik	No fertilizer ($N_0P_0K_0$)	12	57	110	115	117
	Fon-$P_{120}K_{150}$	13	58	121	127	131
	N-150	13	59	122	127	131
	N-180	14	62	124	129	134
	N-210	13	63	128	135	139
Tarona	No fertilizer ($N_0P_0K_0$)	12	62	112	118	121

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	Fon-$P_{120}K_{150}$	13	64	119	125	129
	N-150	14	67	127	133	136
	N-180	15	70	134	138	141
	N-210	14	71	138	144	147
Lazurnыy	**No fertilizer ($N_0P_0K_0$)**	10	59	110	116	119
	Fon-$P_{120}K_{150}$	12	63	114	121	125
	N-150	12	66	126	132	135
	N-180	13	66	131	136	139
	N-210	14	67	135	140	143

In the research, it was observed that increasing the nitrogen fertilizer rates in all the studied rice varieties led to higher stem heights. When a higher rate of nitrogen fertilizer was applied to the Independence variety, the plant height increased by 13 cm compared to the control UzROS 7/13 variety, by 21 cm in the Tarona variety, and by 18 cm in the Lazurniy variety.

When studying the stem height of rice varieties under the soil-climatic conditions of Khorezm region, it was found that the vegetation period of plants was longer compared to the conditions in Tashkent region.

Conclusion:

In the research, it was observed that the stem height of the control UzROS 7/13 variety was 4 cm higher than the variety grown in Tashkent region, the Independence variety was 3 cm higher, while the Tarona and Lazurniy varieties were 1-2 cm shorter.

This process was mainly observed in the steppe alluvial soils of Khorezm region, which have a humus content of 0.70-1.2%, with heavy and medium sandy loam texture. The soils are located near groundwater, and after irrigation, the land surface rises, forming a crust that cracks deeply when dried. These soils are moderately saline, which can explain their fertility.

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