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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

OPTİMİZATİON OF THE MAİN CULTİVATİON METHODS FOR HASHİMİ AND SHİRUDİ RİCE VARİETİES İN THE LANKARAN-ASTARA ECONOMİC REGİON

Specialty: 3103.07. “Plant growing”

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INTRODUCTION

Relevance and degree of study of the topic. The "State Program for the Development of Rice Growing in the Republic of Azerbaijan for 2018-2025" was approved by Presidential Decree No. 3657 on February 9, 2018. The implementation of this State Program will contribute to preserving and advancing Azerbaijan's rice-growing traditions, reduce dependency on imports, improve living conditions in rice-growing regions, and strengthen the country's agricultural potential. By 2025, under the program, the area of rice cultivation is expected to reach 10,000 hectares, with an average yield of 40.0 centners per hectare, and total rice production will reach 40,000 tons.[1]

According to the State Statistics Committee, in 2020, rice was sown on 3,002 hectares, yielding 9,922.6 tons with an average yield of 32.8 centners per hectare. In the Lankaran-Astara economic region, rice was harvested from 1,190 hectares, producing 4,720.2 tons, with an average yield of 35.9 centners per hectare. In Lankaran region, rice was cultivated on 731 hectares, yielding 2,558.6 tons, with an average yield of 35.0 centners per hectare. In Astara, 205 hectares were cultivated, producing 843.6 tons with a yield of 41.2 centners per hectare, and in Masalli, 254 hectares were cultivated, yielding 868.0 tons with a yield of 34.2 centners per hectare[2].

Spring soil preparation is crucial for obtaining a high-quality yield. New approaches and modernization methods are needed to ensure environmental protection, sustainability, and the productivity of clean resources. The Lankaran-Astara region is one of the key areas for citrus and rice production in Azerbaijan. Our research indicates that the potential for rice cultivation in the country has not been fully explored.[2]

The Lankaran-Astara region holds a key position in our country for the production of citrus fruits and rice. An analysis of our research indicates that the potential for rice cultivation in the country has not been fully explored. Given the importance of rice as a valuable food crop, crucial factors for increasing its yield and nutritional value include

[1] www.e.-qanun.az.

[2] www.stat.gov.az.

determining the optimal transplanting dates, seedling density per hectare, and appropriate rates of mineral fertilizer application.

Research Object and Subject. The research focused on the Hashemi and Shirudi rice varieties, with the aim of determining optimal seedling density and fertilizer rates for different planting times to achieve high and stable yields.

Research Goals and Objectives. Given the relevance of the topic, the primary goal of the research is to develop and establish optimal methods for transplanting, determining the best planting dates, seedling density per hectare, and nutrient conditions that ensure efficient and high rice yields in the irrigated (pseudo-podzolic) clay-yellow soils of the Lankaran-Astara region.

To achieve the research goal, the following tasks are considered essential:

1. Study the agrochemical properties of the soil in the experimental plot;
2. Analyze the soil and climatic conditions of the area and collect literary materials from previous years of research;
3. Study the transplanting dates, seedling density per hectare, and the impact of mineral fertilizers on the structural elements of rice;
4. Assess the impact of planting dates, seedling density per hectare, and mineral fertilizers on rice productivity, quality, and nutrient absorption from the soil;
5. Evaluate the economic efficiency.

Research Methods. The analysis of soil and plant samples in the laboratory was conducted using the following methods:[3]

Soil Analysis:

Calcium carbonate (CaCO3) - measured using the Scheibler method in a calcimeter.

pH in water solution - measured with a pH meter.

Ordinary humus - determined by the I.V. Tyurin method.

Total nitrogen (N) - analyzed using the Kjeldahl method.

Ammonium nitrogen - assessed by the D.P. Konev method.

Nitrate nitrogen - determined using the Grandval-Liau method.

[3] Hajimammadov I.M., Tələi J.M., Kosayev E.M. Methods of the agrochemical analysis of soil, plant and fertilizers. Publishing house "Muallim", Baku-2016. p.131

Available phosphorus (P_2O_5) - extracted with 1% ammonium carbonate, using the Machiga method.

Exchangeable potassium (K_2O) - extracted with 1% ammonium carbonate [$(NH_4)2CO_3$] and measured in a flame photometer.

Plant Analysis:

Nitrogen in grain - determined using the Kjeldahl method.

Phosphorus in plant material - analyzed by A.Shafibekov and Z.Shkapura.

Potassium content - measured using the I.V. Tananyev method.

Statistical analysis was conducted using SPSS 26 software.

The main provisions have been defended.

1. The clay-yellow soils of the Lankaran-Astara economic region (pseudo-podzols) were favorable for producing high-quality yields from the Hashemi and Shirudi rice varieties;
2. The structural elements of the plants were found to be high with a density of 1.7 million seedlings and a fertilizer rate of $N_{120}P_{80}K_{60}$ in plantings carried out in the first decade of May;
3. Rice yield during the first planting time was effective with a density of 1.7 million seedlings and a fertilizer rate of $N_{120}P_{80}K_{60}$;
4. Higher quality indicators for rice were observed in the first decade of May with a density of 1 million seedlings and a fertilizer rate of $N_{120}P_{80}K_{60}$;
5. The nutrient reserves with the harvest increased with a density of 1.7 million seedlings during the first planting time;
6. The highest nutrient uptake by the crop was achieved in the first decade of May with a density of 1.7 million seedlings and a fertilizer rate of $N_{120}P_{80}K_{60}$;
7. A density of 1.7 million seedlings and a nutrient regime of $N_{120}P_{80}K_{60}$ in plantings conducted in the first decade of May were considered economically effective.

Scientific Novelty of the Research: In the course of the research, for the first time in the Lankaran-Astara region, the optimal transplanting dates, seedling density per hectare, and effective rates of mineral fertilizers influencing rice productivity and quality were determined. The study also examined the relationship between grain and straw yields, as well as nutrient uptake and absorption, based on cultivation factors in this region

for the first time. The optimal transplanting date for rice in the region is in the first decade of May, with a recommended seedling density of 1.7 million per hectare. It was found that the impact of the mineral fertilizer rate $N_{120}P_{80}K_{60}$. on the economic efficiency of grain yield was very favorable during this period and at this seedling density.

Theoretical and Practical Significance of the Research:. As a result of analyzing rice planting methods from a scientific perspective, it was established that these methods significantly influence both the productivity and quality of the grain yield. Planting rice in the first decade of May at a density of 1.7 million seedlings per hectare, along with the application of mineral fertilizers at rates of $N_{120}P_{80}K_{60}$, increased the grain yield over three years to an average of 85.6 c/ha for the Shirudi variety. This represented an increase of 15.3 c/ha or 21.8% compared to the control (without fertilizers), while the Hashemi variety yielded 53.7 c/ha, showing an increase of 16.9 c/ha or 46.0%. Additionally, the quality indicators of the grain products also significantly improved compared to the treatments without fertilizers.

Approval and Implementation:

The research results were presented at scientific reporting sessions of the Research Institute of Crop Husbandry (2016-2019), at the conference of young scientists and students on the theme "Innovations and Global Challenges in Modern Biology and Agricultural Sciences," dedicated to the 90th anniversary of Academician Jalal Alirza oglu Aliyev. They were also included in materials from the international scientific-practical conference dedicated to the memory of Yakovlev, titled "Relevant Scientific, Technical, and Environmental Issues of Land Reclamation," as well as the "Soil and Environmental Problems of Agrocenoses and Their Solutions" conference dedicated to "Science Day." Additionally, the results were presented at the international scientific-practical meeting "The Turkic World of the East" and the XXII International Scientific Symposium between the West, the virtual international scientific-practical conference "Relevant Problems of Modern Agricultural and Biological Sciences: Global Challenges and Innovations," and the scientific conference "Heydar Aliyev and Agricultural Policy," dedicated to the 100th anniversary of the national leader Heydar Aliyev. The results were also included in the materials of the practical conference

organized by Lankaran State University and the Institute of Soil Science and Agrochemistry on "The Role of Heydar Aliyev in the Development of Agricultural Science."

Based on the research, 17 articles reflecting the main findings of the dissertation were published (6 of them in journals included in international indexing and abstracting databases). The results obtained from the research were applied in 2019 in the villages of Shikhakaran, Turkekaran, and Kholmili in the Lankaran region on 8.4 hectares of rice fields planted with the Hashemi and Shirudi varieties.

The name of the organization in which the dissertation was written. The dissertation was conducted at the Institute of Crop Husbandry under the Ministry of Agriculture of the Republic of Azerbaijan.

The volume of the structural section of the dissertation should be noted separately from the total volume with a specific sign. The dissertation consists of an introduction, five chapters, a conclusion, a list of 178 cited references, appendices, 7 figures, and 99 tables. In the structure of the dissertation, the title section and table of contents make up 3 pages with 3,652 characters, the introduction is 4 pages with 9,138 characters, the first chapter is 23 pages with 52,278 characters, the second chapter is 8 pages with 16,915 characters, the third chapter is 27 pages with 34,638 characters, the fourth chapter consists of 40 pages with 33,058 characters, chapter V is 42 pages with 72,747 characters, the results section is 2 pages with 3,612 characters, farm recommendations are 1 page with 541 characters, the list of cited literature spans 20 pages with 38,297 characters, and the appendices comprise 35 pages. The total text portion of the dissertation (excluding figures, tables, graphs, results, economic recommendations, appendices, and the list of references) consists of 222,927 characters. The total volume of the dissertation is 202 pages (with a total of 345,908 characters).

MAIN CONTENT OF THE WORK

The introduction provides an overview of the topic and the overall structure of the dissertation.

Chapter I. LITERATURE REVIEW

A review of the literature is presented under the headings: "General information on the significance, origin, and production of rice

plants worldwide," "The influence of growing factors on rice plant productivity and nutrient absorption," and "The effect of growing factors on the structural indicators of rice."

Chapter II. OBJECT AND METHODOLOGY OF RESEARCH

This section covers the soil and climatic conditions of the research area, materials, and research methodology. From 2016 to 2018, field experiments were conducted at the "Cenub Agro" LLC, located in the Siyavar area of the Lankaran region, with rice plants of the "Hashimi" and "Shirudi" varieties on clay-yellow soil types. The experiments followed a 3-factor design (2x3x3) according to the following scheme:

Rice Seedling Planting Time:

First decade of May;

Last decade of May.

Number of Seedlings Planted per Hectare (million units):

1.0;

1.7;

2.5.

Fertilizer Rates:

No fertilizers;

$N_{90}P_{60}K_{40}$;

$N_{120}P_{80}K_{60}$.

The size of the accounting unit for each factor was 54.0 m² (30x1.80 m). Prepared seeds were planted in 4 replicates using the row planting method. As fertilizers, nitrogen-ammonium nitrate (34.7%), simple superphosphate (18.7%), and potassium sulfate (46%) were applied. Phosphorus and potassium were applied 100%, and nitrogen 50% before transplanting the seedlings into the soil, with the remaining 50% of nitrogen applied between the rows as top dressing during the tillering phase. Phenological observations were conducted on 25 plants, and agrotechnical practices were performed according to the accepted methods for the region.

Soil samples were collected using the envelope method from 5 parts of the field before transplanting the rice seedlings, at depths of 0-25 cm, 25-50 cm, and 50-70 cm, to determine the agrochemical characteristics of the experimental plot's soil. The pH of the water solution was rec-

orded as 5.2 at a depth of 0-25 cm, 5.4 at 25-50 cm, and 5.6 at 50-75 cm. The humus, nitrogen, phosphorus, and potassium content was as follows:

In the 0-25 cm layer: 3.12%, 0.17%, 0.28%, and 2.28%, respectively;

In the 25-50 cm layer: 2.55%, 0.15%, 0.25%, and 2.53%, with a downward trend towards lower layers;

In the 50-75 cm layer: 1.56%, 0.12%, 0.18%, and 2.21%.

The available ammonium nitrogen content was 35.3-15.5 mg/kg in the 0-25 cm and 50-75 cm soil layers, while nitrate nitrogen ranged from 7.6 to 3.5 mg/kg. Activated phosphorus levels were 35.6-24.3 mg/kg, and exchangeable potassium varied between 185.5 and 123.6 mg/kg.

Chapter III. THE IMPACT OF SEEDLİNG PLANTİNG TİME, PLANTİNG DENSİTY PER HECTARE, AND NUTRİTİONAL CONDİTİONS ON THE STRUCTURAL ELEMENTS OF RİCE VARİETİES

The effects of seedling planting time, seedling rate per hectare, and nutritional conditions on the structural elements of the rice variety Hashimi were studied during the period of 2016-2018. In the control-fertilizer-free variant, where the planting was done in the first decade of May and the seedling rate was 1.0 million per hectare, at the end of the growing season, the rice height was 125.70 cm, the weight of one plant was 167.17 g, the grain weight per plant was 28.10 g, the tillering coefficient was 20.3, the length of the panicle was 26.10 cm, the weight of grains from the panicle was 2.23 g, the number of grains in the panicle was 119.67, the number of small panicles was 8.70, and the weight of 1,000 grains was 26.17 g. However, as the seedling rate per hectare increased, each of the studied indicators significantly decreased.

Thus, in the control-fertilizer-free variant with a seedling rate of 1.7 million per hectare, at the end of the growing season, the rice height was 122.83 cm, the weight of one plant was 163.30 g, the grain weight per plant was 25.77 g, the tillering coefficient was 17.90, the length of the panicle was 24.40 cm, the weight of grains from the panicle was 2.03 g, the number of grains in the panicle was 116.83, the number of small panicles was 8.53, and the weight of 1,000 grains was 25.30 g.

The lowest values of structural elements were observed in the control-fertilizer-free variant with a seedling rate of 2.5 million per hec-

tare, which can be explained by the fact that each seedling had less feeding area. In this variant, at the end of the growing season, the rice height was 119.90 cm, the weight of one plant was 158.17 g, the grain weight per plant was 22.87 g, the tillering coefficient was 16.00, the length of the panicle was 22.87 cm, the weight of grains from the panicle was 1.73 g, the number of grains in the panicle was 113.93, the number of small panicles was 8.27, and the weight of 1,000 grains was 24.10 g.

The structural indicators of the Hashimi rice variety were observed with a fertilizer norm of $N_{120}P_{80}K_{60}$ and a seedling count of 1.7 million. In the first decade of May, the seedling rate for the Shirudi rice variety was 1.0 million per hectare. In the control-fertilizer-free variant, at the end of the growing season, the height of the rice was 128.47 cm, the weight of one plant was 210.37 g, the grain weight per plant was 48.70 g, the tillering coefficient was 24.30, the length of the panicle was 35.53 cm, the weight of grains from the panicle was 3.50 g, the number of grains in the panicle was 145.40, the number of panicles was 13.47, and the weight of 1,000 grains was 29.43 g. As the seedling rate per hectare increased, each of the studied indicators significantly decreased.

Thus, at the end of the growing seasonin the control-fertilizer-free variant with a seedling rate of 1.7 million per hectare, the height of the rice was 125.53 cm, the weight of one plant was 205.40 g, the grain weight per plant was 45.70 g, the tillering coefficient was 22.17, the length of the panicle was 33.67 cm, the weight of grains from the panicle was 3.27 g, the number of grains in the panicle was 141.60, the number of panicles was 13.20, and the weight of 1,000 grains was 28.37 g.

The lowest values of structural elements were noted in the control-fertilizer-free variant with a seedling rate of 2.5 million per hectare, which can be explained by the fact that each seedling had less area for nutrition. In this variant, at the end of the growing season, the height of the rice was 122.83 cm, the weight of one plant was 198.53 g, the grain weight per plant was 42.70 g, the tillering coefficient was 19.67, the length of the panicle was 31.83 cm, the weight of grains was 3.0 g, the number of grains in the panicle was 138.40, the number of panicles was 12.63, and the weight of 1,000 grains was 27.37 g.

Chapter IV: THE IMPACT OF SEEDLİNG PLANTİNG TİMİNG, SEEDLİNG DENSİTY PER HECTARE, AND NUTRİTİONAL CONDİTİONS ON THE YİELD AND QUALİTY OF RİCE VARİETİES

The planting time for the Hashimi rice variety is in the first decade of May, with a seedling count of 1.0 million per hectare. In the control fertilizer-free variant, the three-year average yield of rice is 33.9 h/ha. With a fertilizer norm of $N_{90}P_{60}K_{40}$, the yield increases to 42.7 s/ha, which is 8.8 s/ha or 26.0% higher than the control fertilizer-free variant. The highest yield observed was in the $N_{90}P_{60}K_{40}$ variant, reaching 51.0 s/ha, which is 17.1 s/ha or 50.4% more than the fertilizer-free (control) variant (see Figure 1).

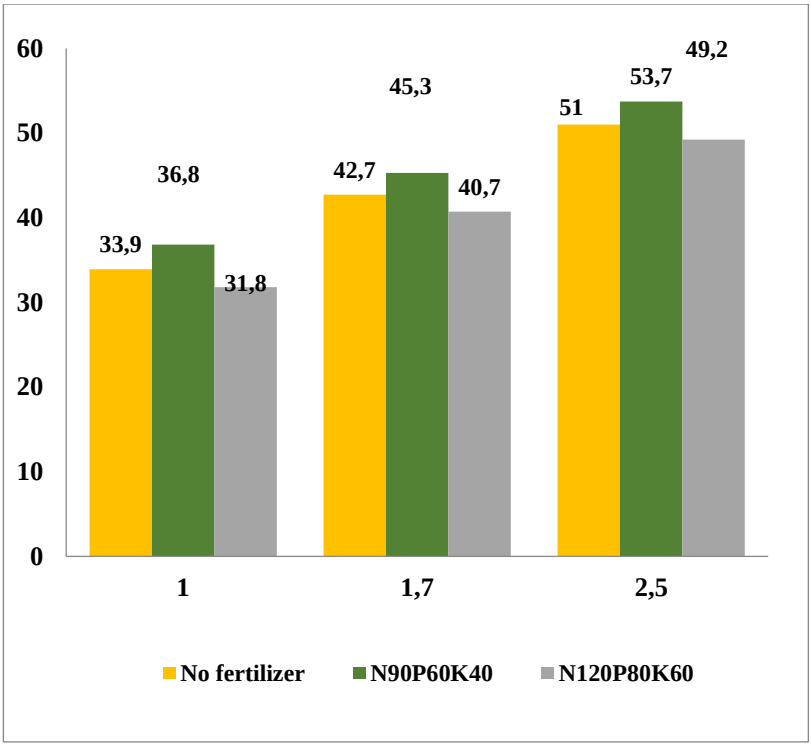

Figure 1: Yield of the Hashimi Rice Variety in the First Decade of May

As seen in Figure 1, the highest grain yield was achieved with a seedling count of 1.7 million per hectare. In this case, the three-year average yield in the fertilizer-free control variant was 36.8 s/ha, while with the $N_{90}P_{60}K_{40}$ mineral fertilizer norm, this indicator increased to 45.3 s/ha. This represents an increase of 8.5 s/ha or 23.1% compared to the fertilizer-free control variant. With the $N_{90}P_{60}K_{40}$ variant, the rice yield reached 53.7 h/ha, which is 16.9 h/ha or 46.0% higher than the fertilizer-free control variant.

The statistical analyses of the planting time, seedling density, and fertilizer norms on the yield of the Hashimi rice variety are presented in Table 1.

Table 1

Analysis of Variance for the Effects of Planting time, Seedling Density, and Fertilizer Factors on the Yield of the Hashimi Rice Variety

Dependent Variable: Yield (Hashimi Rice)

Factors	Sum of Squares (Type III)	df	Mean Square	F(Value)	Significance Value	Partial Eta
Edited Model	3023.606a	17	177.859	69.673	0.000	0.971
Intersection	93616.714	1	93616.714	36672.489	0.000	0.999
Seedling density	212.627	2	106.314	41.646	0.000	0.698
Sowing time	71.185	1	71.185	27.885	0.000	0.436
Nutrition	2735.580	2	1367.790	535.805	0.000	0.967
Seedling density * Sowing time	0.189	2	0.095	0.037	0.964	0.002
Seedling density * Nutrition	0.645	4	0.161	0.063	0.992	0.007
Sowing time* Nutrition	1.736	2	0.868	0.340	0.714	0.019
Seedling density * Sowing time* Nutrition	1.643	4	0.411	0.161	0.957	0.018
Error	91.900	36	2.553			
Total	96732.220	54				
Adjusted Total	3115.506	53				
a. R Squared = 0.971 (Adjusted R Squared = 0.957)						

As seen in Table 1, while the seedling density, planting time, and nutritional conditions individually influence rice yield, the combinations of seedling density*nutritional conditions, seedling density*planting time, planting time*fertilizer norm, and seedling density*planting time*planting time all have significance values greater than 0.5. This indicates that these factors do not have a significant effect on the yield of the Hashimi rice variety.

In the control treatment without fertilizers at a seedling density of 2.5 million per hectare, the grain contained 8.55% protein, 78.90% starch, 4.52% ash, 86.53% vitreousness, and a natural weight of 544.10 g/l. In the treatment with mineral fertilizers at the rates of $N_{90}P_{60}K_{40}$, the grain contained 8.64% protein, 82.43% starch, 4.58% ash, 90.10% vitreousness, and a natural weight of 548.10 g/l. The highest amounts of the studied indicators were observed in the $N_{120}P_{80}K_{60}$ treatment, where the grain contained 8.69% protein, 86.03% starch, 4.68% ash, 90.90% vitreousness, and a natural weight of 553.07 g/l (Table 2).

When seedlings were planted with a seedling density of 1.0 million per hectare in the control treatment without fertilizers, were as follows: protein in grain was 8.52%, starch was 79.30%, ash was 4.56%, vitreousness was 85.70%, and the natural weight of the grain was 548.73 g/l. In the treatment with mineral fertilizers at the rates of $N_{90}P_{60}K_{40}$, the grain contained 8.59% protein, 82.57% starch, 4.72% ash, 88.87% vitreousness, and a natural weight of 551.03 g/l. The highest values for the studied indicators were recorded in the $N_{120}P_{80}K_{60}$ treatment, where the grain contained 8.65% protein, 87.33% starch, 4.79% ash, 91.70% vitreousness, and a natural weight of 557.63 g/l.

Figure 2 shows that in the first decade of May, the three-year average yield of the Shirudi rice variety, based on the control treatment without fertilizers with 1.0 million seedlings per hectare, was 68.2 s/ha. In the $N_{90}P_{60}K_{40}$ mineral fertilizer treatment, this figure increased to 74.7 s/ha, representing an increase of 6.5 s/ha or 9.5% compared to the control treatment without fertilizers. The highest yield was observed in the $N_{120}P_{80}K_{60}$ treatment at 82.1 s/ha, which is 13.9 s/ha or 20.4% higher than the control treatment.

Table 2

Quality Indicators of the Hashimi Rice Variety (Average of 3 Years)

Planting time	Seedling density per Hectare (Million Units)	Nutritional Conditions	Grain nitrogen content %	Protein %	Starch %	Ash %	Vitreousness %	Grain Natural Weight (g/l)
First decade of May	1,0	No fertilizers	1,39	8,70	83,87	4,65	91,40	555,90
		$N_{90}P_{60}K_{40}$	1,41	8,78	88,47	4,82	93,53	561,50
		$N_{120}P_{80}K_{60}$	1,42	8,90	92,37	4,97	97,30	568,83
	1,7	No fertilizers	1,38	8,65	82,03	4,59	88,30	550,43
		$N_{90}P_{60}K_{40}$	1,39	8,72	84,63	4,71	91,57	556,80
		$N_{120}P_{80}K_{60}$	1,41	8,81	89,57	4,85	93,23	561,70
	2,5	No fertilizers	1,37	8,55	78,90	4,52	86,53	544,10
		$N_{90}P_{60}K_{40}$	1,38	8,64	82,43	4,58	90,10	548,10
		$N_{120}P_{80}K_{60}$	1,40	8,69	86,03	4,68	90,90	553,07
Third decade of May	1,0	No fertilizers	1,36	8,52	79,30	4,56	85,70	548,73
		$N_{90}P_{60}K_{40}$	1,37	8,59	82,57	4,72	88,87	551,03
		$N_{120}P_{80}K_{60}$	1,38	8,65	87,33	4,79	91,70	557,63
	1,7	No fertilizers	1,35	8,46	76,70	4,52	83,83	542,37
		$N_{90}P_{60}K_{40}$	1,36	8,52	80,13	4,70	87,37	547,23
		$N_{120}P_{80}K_{60}$	1,38	8,61	83,10	4,78	89,50	549,73
	2,5	No fertilizers	1,34	8,40	72,50	4,43	81,30	537,70
		$N_{90}P_{60}K_{40}$	1,35	8,46	75,53	4,48	83,83	540,27
		$N_{120}P_{80}K_{60}$	1,36	8,52	79,90	4,55	88,17	551,67

In seedling density of 1.7 million per hectare, the three-year average grain yield in the control (without fertilizers) treatment was 70.3 s/ha, which increased to 77.7 s/ha with the $N_{90}P_{60}K_{40}$ mineral fertilizer norm, indicating an increase of 7.4 s/ha or 10%. The highest yield in the $N_{120}P_{80}K_{60}$ treatment was 85.6 s/ha, which is 15.3 s/ha or 21.8% higher than the control (without fertilizers) treatment.

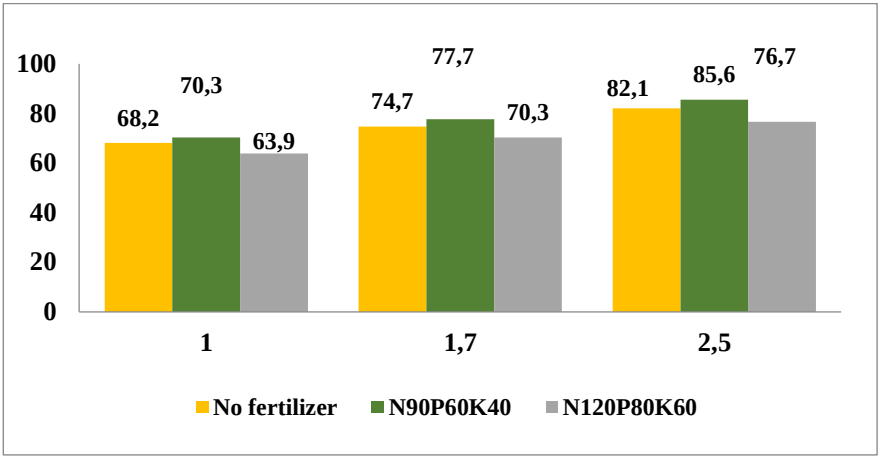

Figure 2. Yield of the Shirudi Rice Variety in the First Decade of May

When the seedling density is 2.5 million per hectare, in the control (without fertilizers) treatment is 63.9 s/ha, and with the $N_{90}P_{60}K_{40}$ mineral fertilizer norm, the yield increases to 70.3 s/ha, which is 4 s/ha or 10.0% lower than the control (without fertilizers) treatment. The highest yield in the $N_{120}P_{80}K_{60}$ treatment was 76.7 s/ha, which is 12.8 s/ha or 20.0% higher than the control treatment.

The statistical analyses of the effects of planting time, seedling densitys, and fertilizer norms on the yield of the Shirudi rice variety are presented in Table 3. As shown in Table 3, the significance value of the effects of seedling density, planting time, and fertilizer norm on yield is less than 0.05. This indicates that these factors individually have an effect on the yield of the Shirudi variety. However, in the combinations of seedling density * planting time, seedling density * nutrition, planting time* nutrition, and seedling density * planting time* nutrition, the significance value is greater than 0.05, indicating that these factors do not have a combined effect on yield.

The effects of the planting time, seedling density per hectare, and nutritional conditions on the quality indicators of the Shirudi rice variety were also studied in our research. The results of the study are presented in Table 4.

Table 3

Analysis of variance (ANOVA) for the effects of planting time, seedling density, and fertilizer factors on yield in the shirudi variety

Dependent variable: yield (shirudi)

Factors	Sum of Squares (Type III)	df	Mean Square	F(Value)	Signif-icance Value	Partial Eta Squared
Adjusted Model	2467,288[a]	17	145,135	31,671	0,000	0,937
Intersection	286089,449	1	286089,449	62429,606	0,000	0,999
Seedling density	558,051	2	279,026	60,888	0,000	0,772
Planting time	137,282	1	137,282	29,957	0,000	0,454
Nutrition	1761,397	2	880,699	192,183	0,000	0,914
Seedling density * Planting time	2,681	2	1,341	0,293	0,748	0,016
Seedling density * Nutrition	4,311	4	1,078	0,235	0,917	0,025
Planting time* Nutrition	1,613	2	0,807	0,176	0,839	0,010
Seedling density * Planting time* Nutrition	1,952	4	0,488	0,107	0,980	0,012
Error	164,973	36	4,583			
Total	288721,710	54				
Adjusted total	2632,261	53				
a. R Squared = ,937 Adjusted R Squared ,908						

Similar to the Hashimi variety, the planting time, seedling density per hectare, and nutritional conditions significantly increased the quality indicators of the Shirudi rice variety compared to the control treatment without fertilizers. According to the research findings, the quality indicators of the Shirudi variety are lower than those of the Hashimi variety, while the yield is higher in the Shirudi variety.

Table 4

Quality Indicators of the Shirudi Rice Variety (Average of 3 Years)

Period	Seedling density per Hectare (Mln Units)	Nutritional Conditions	Grain Nitro-gen (%)	Protein (%)	Starch (%)	Ash (%)	Glassiness (%)	Grain Natural Weight (g/l)
First decade of May	1,0	No fertilizers	1,38	8,60	82,10	4,63	89,13	548,57
		$N_{90}P_{60}K_{40}$	1,39	8,68	86,17	4,82	92,37	554,87
		$N_{120}P_{80}K_{60}$	1,41	8,79	89,80	4,92	95,70	560,73
	1,7	No fertilizers	1,36	8,51	80,17	4,59	87,00	544,60
		$N_{90}P_{60}K_{40}$	1,38	8,61	83,47	4,66	89,77	550,57
		$N_{120}P_{80}K_{60}$	1,39	8,68	88,23	4,79	92,00	555,13
	2,5	No fertilizers	1,35	8,44	76,67	4,47	85,00	554,10
		$N_{90}P_{60}K_{40}$	1,36	8,53	80,10	4,56	87,23	545,90
		$N_{120}P_{80}K_{60}$	1,37	8,58	83,23	4,63	89,37	548,57
Tird decade of May	1,0	No fertilizers	1,37	8,54	81,33	4,60	86,93	545,13
		$N_{90}P_{60}K_{40}$	1,38	8,63	84,40	4,81	90,43	551,80
		$N_{120}P_{80}K_{60}$	1,39	8,70	88,43	4,88	94,37	557,23
	1,7	No fertilizers	1,35	8,48	78,30	4,55	84,40	541,40
		$N_{90}P_{60}K_{40}$	1,37	8,54	81,53	4,58	88,23	549,13
		$N_{120}P_{80}K_{60}$	1,38	8,62	85,80	4,69	91,40	553,93
	2,5	No fertilizers	1,34	8,39	75,13	4,45	84,43	535,27
		$N_{90}P_{60}K_{40}$	1,36	8,49	78,10	4,52	87,03	540,93
		$N_{120}P_{80}K_{60}$	1,37	8,57	81,53	4,57	90,77	546,00

Chapter V. THE EFFECT OF PLANTİNG TİME, SEEDLİNG DENSITY PER HECTARE, AND NUTRİTİONAL CONDİTİONS ON THE GRAİN AND STRAW YİELD OF RİCE VARİETİES, THE UPTAKE OF NUTRİENTS FROM SOİL, THEİR UTİLİZATİON, AND ECONOMİC EFFİCİENCY

İn this chapter, the effect of cultivation factors on the grain and straw yield of the Hashimi and Shirudi rice varieties, the uptake of nutrients, their utilization, and economic efficiency is studied.

As seen in Table 5, in the control treatment without fertilizers for the Hashimi rice variety, during the first decade of May, with a seedling density of 1.0 million per hectare, the total nitrogen in the dry matter of rice grain was 1.39%, total phosphorus was 0.66%, total potassium was 0.35%, and the amount of nitrogen taken from the soil with the grain yield was 47.17 kg/ha, phosphorus was 22.55 kg/ha, and potassium was 11.87 kg/ha.

In the Hashimi variety, when a seedling density of 1.7 million per hectare was used in the control treatment without fertilizers, the total nitrogen content in the rice grain was measured at 1.38%, total phosphorus at 0.64%, and total potassium at 0.33%. The nitrogen uptake from the soil was 50.80 kg/ha, while phosphorus and potassium uptake were 23.57 kg/ha and 12.17 kg/ha, respectively. When the seedling density was increased to 2.5 million per hectare during the first decade of May in the same control treatment without fertilizers, the total nitrogen in the rice grain was recorded at 1.37%, total phosphorus at 0.61%, and total potassium at 0.32%.

Table 5

Nutrient uptake with grain yield of the Hashimi variety during the first planting time(first decade of May)

Seedling density per Hectare	Nutritional Area	Grain					
		Dry Matter in Air, %			Uptake, kg/ha		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
1,0	No fertilizers	1,39	0,66	0,35	47,17	22,55	11,87
	$N_{90}P_{60}K_{40}$	1,41	0,68	0,37	60,20	28,90	15,73
	$N_{120}P_{80}K_{60}$	1,42	0,69	0,38	72,67	55,03	19,27
1,7	No fertilizers	1,38	0,64	0,33	50,80	23,57	12,17
	$N_{90}P_{60}K_{40}$	1,39	0,66	0,34	63,07	29,77	15,57
	$N_{120}P_{80}K_{60}$	1,41	0,67	0,36	75,73	36,00	19,17
2,5	No fertilizers	1,37	0,61	0,32	43,60	19,63	10,10
	$N_{90}P_{60}K_{40}$	1,38	0,61	0,33	56,17	24,83	13,47
	$N_{120}P_{80}K_{60}$	1,39	0,63	0,35	68,40	30,90	17,23

The nitrogen uptake from the soil associated with grain yield ranged from 43.60 kg/ha for nitrogen, 19.63 kg/ha for phosphorus, and

10.10 kg/ha for potassium. Comparable results were noted in the plantings carried out during the third decade of May (Figures 3 and 4).

In the Hashimi variety, during the third decade of May, seedlings were planted at a rate of 1.0 million per hectare in a control treatment without fertilizers. Under these conditions, the total nitrogen content in the rice grain was measured at 1.36%, total phosphorus at 0.64%, and total potassium at 0.33%. The nitrogen uptake from the soil was recorded as 43.13 kg/ha for nitrogen, 19.67 kg/ha for phosphorus, and 10.37 kg/ha for potassium.

With varying nutrient conditions, the levels of total nitrogen, phosphorus, and potassium in the grain, as well as their uptake from the soil, increased compared to the control treatment without fertilizers. In a treatment where a seedling density of 1.0 million per hectare was applied using mineral fertilizers at the $N_{90}P_{60}K_{40}$ rate, the rice grain showed total nitrogen at 1.37%, total phosphorus at 0.65%, and total potassium at 0.34%. The nitrogen uptake from the soil was noted to be 54.47 kg/ha for nitrogen, 25.9 kg/ha for phosphorus, and 13.63 kg/ha for potassium.

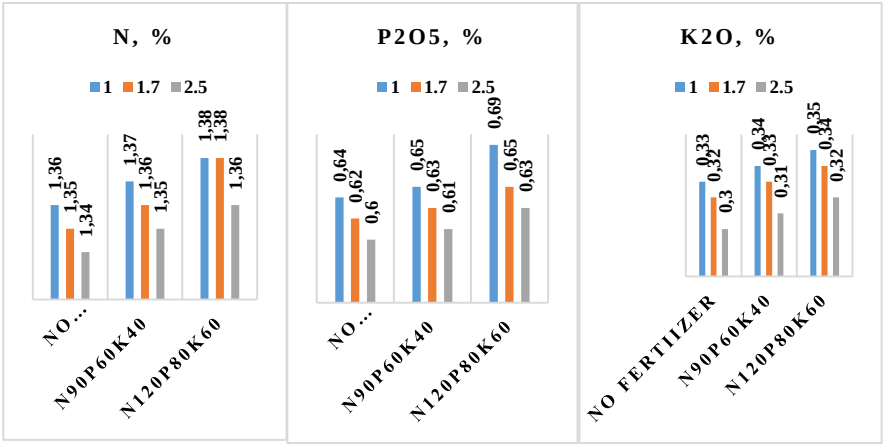

Figure 3. The Amount of Nutrients (N, P_2O_5, K_2O) in the Grain of the Hashimi Rice Variety, % (2nd Planting time)

The highest levels of total nitrogen, phosphorus, potassium, and nutrient uptake from the soil were observed in the treatment with

a seedling density of 1 million per hectare using mineral fertilizers at the $N_{120}P_{80}K_{60}$ rate. In this scenario, the rice grain contained total nitrogen at 1.38%, total phosphorus at 0.69%, and total potassium at 0.35%. The nitrogen uptake from the soil reached 68.6 kg/ha for nitrogen, 32.77 kg/ha for phosphorus, and 17.53 kg/ha for potassium.

During the third decade of May, in the Hashimi variety, when seedlings were planted at a norm of 1.7 million per hectare in the control treatment without fertilizers, the total nitrogen content in the rice grain was 1.35%, total phosphorus was 0.62%, and total potassium was 0.32%. The nitrogen uptake from the soil was measured at 46.27 kg/ha for nitrogen, 21.13 kg/ha for phosphorus, and 10.93 kg/ha for potassium.

Specifically, in the treatment with a seedling density of 1.0 million per hectare using mineral fertilizers at the $N_{90}P_{60}K_{40}$ rate, the rice grain contained total nitrogen at 1.36%, total phosphorus at 0.63%, and total potassium at 0.33%. The nitrogen uptake from the soil was observed to be 58.43 kg/ha for nitrogen, 27.17 kg/ha for phosphorus, and 14.33 kg/ha for potassium.

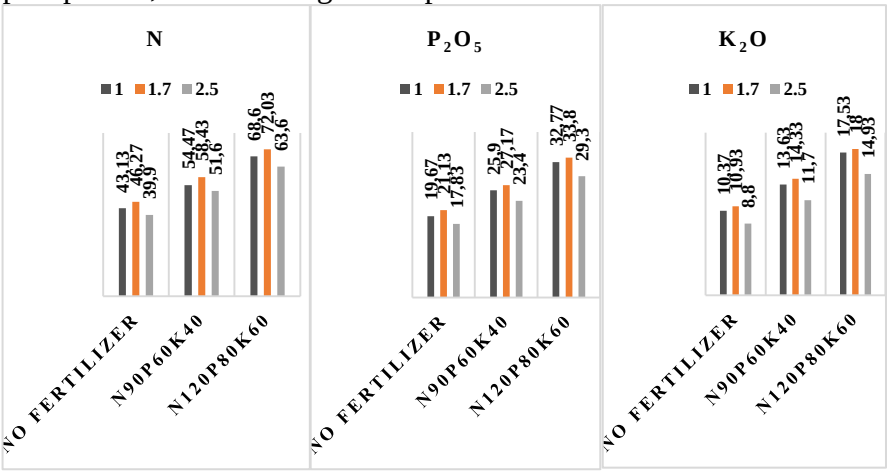

Figure 4. Nutrient Uptake (N, P2O5, K2O) in Hashimi Rice Grain, kg/ha (Second Planting time)

In $N_{120}P_{80}K_{60}$ fertilizer rate, the rice grain contained total nitrogen at 1.38%, total phosphorus at 0.65%, and total potassium at

0.34%. The nitrogen uptake from the soil reached 72.03 kg/ha for nitrogen, 33.8 kg/ha for phosphorus, and 18.0 kg/ha for potassium.

In the control treatment without fertilizers, the rice grain at a seedling density of 2.5 million per hectare contained total nitrogen at 1.34%, total phosphorus at 0.60%, and total potassium at 0.30%. The nitrogen uptake from the soil was 39.9 kg/ha for nitrogen, 17.83 kg/ha for phosphorus, and 8.8 kg/ha for potassium.

In the treatment with mineral fertilizers at the $N_{90}P_{60}K_{40}$ rate, at 2.5 million seedlings per hectare the rice grain contained total nitrogen at 1.35%, total phosphorus at 0.61%, and total potassium at 0.31%. The nitrogen uptake from the soil was recorded as 51.6 kg/ha for nitrogen, 23.4 kg/ha for phosphorus, and 11.7 kg/ha for potassium.

At the $N_{120}P_{80}K_{60}$ mineral fertilizers rate, the rice grain contained total nitrogen at 1.36%, total phosphorus at 0.63%, and total potassium at 0.32%. The nitrogen uptake from the soil was 63.6 kg/ha for nitrogen, 29.3 kg/ha for phosphorus, and 14.93 kg/ha for potassium.

Table 6

Nutrient Uptake of Grain and Straw in the Shirudi Variety (First Decade of May)

seedling density per hectare, in mlns, pc.	Nutrition areai	Grain					
		Dry matter in air, %			Uptake, kg/ha		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
1,0	No fertilizer	1,38	0,63	0,32	93,90	43,27	22,07
	$N_{90}P_{60}K_{40}$	1,39	0,66	0,35	103,70	49,40	26,20
	$N_{120}P_{80}K_{60}$	1,41	0,69	0,40	115,50	56,90	33,13
1,7	No fertilizer	1,36	0,62	0,30	95,63	43,87	20,87
	$N_{90}P_{60}K_{40}$	1,38	0,63	0,33	107,20	49,20	25,93
	$N_{120}P_{80}K_{60}$	1,39	0,66	0,38	119,07	56,80	32,23
2,5	No fertilizer	1,35	0,59	0,28	86,53	38,00	17,73
	$N_{90}P_{60}K_{40}$	1,36	0,61	0,32	95,83	42,87	22,30
	$N_{120}P_{80}K_{60}$	1,34	0,63	0,36	105,37	48,60	27,63

In the Shirudi variety during the first decade of May, when seedlings were planted with a norm of 1.0 million per hectare in the control treatment without fertilizers, the total nitrogen content in the rice grain was 1.38%, total phosphorus was 0.63%, and total potassium was 0.32%. The nitrogen uptake from the soil was measured at 93.90 kg/ha for nitrogen, 43.27 kg/ha for phosphorus, and 22.07 kg/ha for potassium (Table 6).

In the case of the Shirudi variety, during the third decade of May, under the control treatment without fertilizers and with a seedling density of 1.0 million seedlings per hectare, the rice grains contained total nitrogen at 1.35-1.38%, total phosphorus at 0.60-0.62%, and total potassium at 0.29-0.31%. The nitrogen uptake from the soil ranged between 84.0-91.8 kg/ha, phosphorus 37.3-41.2 kg/ha, and potassium 18.0-20.0 kg/ha.

Specifically, for a seedling density of 1.0 million per hectare and with mineral fertilizers at the $N_{90}P_{60}K_{40}$ rate, the rice grains showed total nitrogen of 1.37-1.39%, total phosphorus of 0.62-0.63%, and total potassium of 0.31-0.32%. The nitrogen uptake from the soil ranged from 96.6-102.2 kg/ha for nitrogen, 43.7-46.2 kg/ha for phosphorus, and 21.9-23.5 kg/ha for potassium.

When applying the $N_{120}P_{80}K_{60}$ fertilizer rate, the total nitrogen in the rice grain was observed at 1.38-1.40%, total phosphorus at 0.65-0.66%, and total potassium at 0.32-0.33%. The nitrogen uptake from the soil reached 106.0-111.7 kg/ha for nitrogen, 50.3-52.0 kg/ha for phosphorus, and 24.8-26.3 kg/ha for potassium.

In the control treatment without fertilizers, with a seedling density of 1.7 million per hectare during the third decade of May, the rice grains contained total nitrogen at 1.34-1.37%, total phosphorus at 0.57-0.59%, and total potassium at 0.27-0.28%. The nitrogen uptake from the soil was 88.0-95.3 kg/ha for nitrogen, 37.5-41.1 kg/ha for phosphorus, and 17.7-19.5 kg/ha for potassium.

With the $N_{90}P_{60}K_{40}$ fertilizer application at the same seedling density, the rice grain exhibited total nitrogen of 1.36-1.38%, total phosphorus of 0.60-0.62%, and total potassium of 0.29-0.30%. The nitrogen uptake from the soil ranged from 100.1-106.7 kg/ha for nitrogen, 44.2-48.0 kg/ha for phosphorus, and 21.3-23.2 kg/ha for po-

tassium. The highest quantities of total nitrogen, phosphorus, and potassium were observed with the $N_{120}P_{80}K_{60}$ fertilizer application, where the rice grain contained total nitrogen at 1.36-1.39%, total phosphorus at 0.63-0.65%, and total potassium at 0.31-0.32%. The nitrogen uptake from the soil was 109.2-116.8 kg/ha for nitrogen, 50.6-54.6 kg/ha for phosphorus, and 25.0-27.0 kg/ha for potassium.

When the seedlings of the Shirudi variety were planted with a density of 2.5 million per hectare during the third decade of May under the control treatment without fertilizers, total nitrogen in the rice grains ranged from 1.33-1.36%, total phosphorus from 0.55-0.57%, and total potassium from 0.25-0.26%. The nitrogen uptake from the soil varied between 78.5-83.2 kg/ha for nitrogen, 32.5-35.0 kg/ha for phosphorus, and 14.8-16.0 kg/ha for potassium.

In the case of mineral fertilizers applied at the $N_{90}P_{60}K_{40}$ rate, the rice grains showed total nitrogen at 1.35-1.37%, total phosphorus at 0.58-0.60%, and total potassium at 0.28-0.30%. The nitrogen uptake from the soil was between 89.4-94.8 kg/ha for nitrogen, 38.4-41.5 kg/ha for phosphorus, and 18.5-20.1 kg/ha for potassium. With the $N_{120}P_{80}K_{60}$ fertilizer application, the rice grains contained total nitrogen of 1.36-1.38%, total phosphorus of 0.60-0.63%, and total potassium of 0.30-0.33%. The nitrogen uptake from the soil ranged from 99.7-103.8 kg/ha for nitrogen, 44.0-45.5 kg/ha for phosphorus, and 22.0-24.8 kg/ha for potassium.

The studies also explored the impact of seedling planting time, seedling density per hectare, and nutrient conditions on the economic efficiency of rice varieties. For the Hashimi variety, when seedlings were transplanted in the first decade of May with a density of 1.7 million seedlings per hectare in the control treatment without fertilizers, the total value of the yield was 6033.0 AZN/ha, with 1297.5 AZN/ha spent on agronomic measures, resulting in a net income of 4735.5 AZN/ha. With the application of mineral fertilizers at the $N_{90}P_{60}K_{40}$ rate, the total value of the yield rose to 7422.0 AZN/ha, while total expenses for fertilizers and agronomic measures amounted to 1841.02 AZN/ha, yielding a net income of 5580.98 AZN/ha, which represents a profitability level of 303.15%.

When using the $N_{120}P_{80}K_{60}$ fertilizer rate with the same seed-

ling density, even higher net income was achieved, with the total value of the yield at 8749.5 AZN/ha, total expenses at 2034.69 AZN/ha, resulting in a net income of 6714.81 AZN/ha and a profitability level of 330.01%.

In contrast, for the Hashimi variety planted in the third decade of May with a density of 1.7 million seedlings per hectare under the control treatment without fertilizers, the total value of the yield was 5632.5 AZN/ha, with expenses for agronomic measures at 1297.5 AZN/ha, leading to a net income of 4335.0 AZN/ha. The $N_{90}P_{60}K_{40}$ mineral fertilizer application resulted in a total yield value of 7018.5 AZN/ha, with total expenses of 1841.02 AZN/ha, leading to a net income of 5177.48 AZN/ha and a profitability level of 281.23%. The $N_{120}P_{80}K_{60}$ rate similarly yielded higher net income, with the total value at 8487.0 AZN/ha, total expenses at 2034.69 AZN/ha, net income of 6452.31 AZN/ha, and a profitability level of 317.12%.

For the Shirudi variety planted in the first decade of May with a density of 1.7 million seedlings, the total income from the control treatment without fertilizers was 8055.0 AZN/ha, while agronomic expenses were 1197.30 AZN/ha, resulting in a net income of 6676.3 AZN/ha. With the $N_{90}P_{60}K_{40}$ mineral fertilizer application, the total income was 8862.0 AZN/ha, with expenses of 1740.64 AZN/ha, leading to a net income of 6961.8 AZN/ha and a profitability rate of 399.9%. Using the $N_{120}P_{80}K_{60}$ fertilizer rate yielded even higher net profits, with total income of 9733.0 AZN/ha, total expenses of 1934.49 AZN/ha, and a net income of 7798.5 AZN/ha, resulting in a profitability rate of 403.1%.

Under the control treatment (no fertilizers), for a seedling density of 1.7 million seedlings per hectare, the total income was 7755.0 AZN/ha, with agronomic expenses at 1197.3 AZN/ha, resulting in a net income of 6381.3 AZN/ha. With the $N_{90}P_{60}K_{40}$ mineral fertilizer, total income reached 8604.5 AZN/ha, total expenses were 1740.64 AZN/ha, yielding a net income of 6636.8 AZN/ha and a profitability rate of 381.3%. The $N_{120}P_{80}K_{60}$ fertilizer application provided even greater profits, with total income of 9329.0 AZN/ha, total expenses of 1934.49 AZN/ha, resulting in a net income of 7433.5 AZN/ha and a profitability rate of 384.3%.

Results

1. In the conditions of the Lankaran region of the Lankaran-Astara economic area (pseudopodzol) with clayey-yellow soils, the cultivation of the rice varieties "Hashimi" and "Shirudi" is favorable. To achieve stable, quality, and high yields, the planting of seedlings should be conducted in the first decade of May, with a seedling density of 1.7 million seedlings per hectare and mineral fertilizers at the norm of $N_{120}P_{80}K_{60}$.
2. The timing of seedling planting, the number of seedlings per hectare, and the norms of mineral fertilizers affect the structural indicators of the plants. In both rice varieties, plantings conducted in the first decade of May, with 1.7 million seedlings per hectare and mineral fertilizers at the $N_{120}P_{80}K_{60}$ norm, have proven to be more beneficial.
3. In the plantings carried out in the first decade of May with a seedling density of 1.7 million per hectare and mineral fertilizers at the $N_{120}P_{80}K_{60}$ norm, higher grain and straw yields were obtained compared to sparse and dense plantings. The maximum grain yield averaged over three years was 53.7 quintals per hectare for the Hashimi variety, which is an increase of 16.9 quintals per hectare or 46.0% compared to the unfertilized variant; the straw yield was 92.5 quintals per hectare, which is an increase of 24.1 quintals per hectare or 35.2%. For the Shirudi variety, the average grain yield over three years was 85.6 quintals per hectare, an increase of 15.3 quintals per hectare or 21.8%; the straw yield was 156.4 quintals per hectare, an increase of 43.9 quintals per hectare or 21.8%.
4. The timing of planting seedlings, the number of seedlings per hectare, and the norms of mineral fertilizers have influenced the quality indicators of grain yield. When seedlings were planted in the first decade of May, the quality indicators studied in both rice varieties were high under all three planting densities and nutrition conditions, while they were lower in the third decade of May. The highest indicators were observed when seedlings were planted in the first decade of May with better nutrition conditions, at a norm

of 1.0 million seedlings per hectare and mineral fertilizers at the $N_{120}P_{80}K_{60}$ norm; the lowest indicators were noted at a higher planting density of 2.5 million seedlings per hectare with the same norm.

5. When planting seedlings in the first decade of May, the amounts of total nitrogen, phosphorus, and potassium, as well as the nutrients taken from the soil, increased in both varieties at all three planting densities and mineral fertilizer norms, but significantly decreased in the third decade of May. In both varieties, during the planting time, the high amounts of total nitrogen, phosphorus, and potassium in the grain and straw were observed when seedlings were planted in the first decade of May, at a norm of 1.0 million seedlings per hectare for lower planting density, and a high amount of nutrients taken from the soil was observed at the norm of 1.7 million seedlings per hectare.
6. The time of seedling planting, seedling densitys per hectare, and nutrition conditions significantly increased the nutrient uptake efficiency from fertilizers for the rice varieties Hashimi and Shirudi compared to the unfertilized variant. The highest amounts of nutrients absorbed by the plants were observed in the plantings conducted in the first decade of May, with 1.7 million seedlings per hectare and mineral fertilizers at the $N_{120}P_{80}K_{60}$ norm: for the Hashimi variety, nitrogen was 47.2-50.5 kg/ha or 39.3-42.1%, phosphorus was 21.5-24.6 kg/ha or 27.0-30.7%; for the Shirudi variety, nitrogen was 79.2-84.0 kg/ha or 66.0-70.0%, and phosphorus was 31.9-36.8 kg/ha or 39.9-46.0%.
7. The study of the main cultivation methods for rice varieties shows that the highest economic efficiency for both varieties was achieved in the plantings conducted in the first decade of May, with 1.7 million seedlings per hectare and mineral fertilizers at the $N_{120}P_{80}K_{60}$ norm. Over three years, the net income obtained from the studied cultivation methods was 6714.81 man/ha for the Hashimi variety and 7798.5 man/ha for the Shirudi variety.

Recommendations

1. In the clayey-yellow soils of the Lankaran-Astara region, it is recommended to plant the rice varieties Hashimi and Shirudi in the first decade of May to obtain high grain yields.
2. Planting both varieties at a norm of 1.7 million seedlings per hectare ensures the production of high-quality grain yields.
3. To achieve economically efficient, high grain yields from rice and to maintain soil fertility, it is advisable to apply mineral fertilizers to the soil at the norm of $N_{120}P_{80}K_{60}$.

Scientific publications list related to the dissertation work

1. T. İslamzade, M. Rzayev. Rice productivity in Lankaran-Astara region depending on plant density and nutrition condition in different sowing times // Innovations in Biology and Agriculture to Slove Global Challenges, Dedicated to the 90th Anniversary of Academican Jalal A. Aliyev - 2018, - p. 91.
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3. Tarıverdi Islamzade. Effect of cultivation factors on rice productivity elements depending on the rates and rates of fertilizers in Lankaran-Astara region // Scientific Work. International scientific journal, collection of scientific research theses, - Baku. - 2021, - p. 19-22.
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7. Tarıverdi Islamzade. Effect of cultivation factors on stubble productivity of Hashimi rice variety in Lankaran-Astara region // Nature and Science International scientific journal, - Baku. - 2022, - p.19-24.
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17. Tariverdi İslamzade, Deyanet Baxishov, Alovsat Guliyev, Rıdvan Kızılkaya, Rahila İslamzade, Abdurrahman Ay, Sultan Huseynova, Mirvari Mammadova. Soil fertility status, productivity challenges, and solutions in rice farming landscapes of Azerbaijan // Eurasian Journal of Soil Science, - 2024, 13(1), - p. 70-78.

Defense of dissertation work will be held on 30th october 2024 at 14^{00} at the meeting of the FD 1.29 Dissertation Council operating at the Research Institute of Crop Husbandry under the Ministry of Agriculture of the Republic of Azerbaijan.

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