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INFLUENCE OF PROCESSING FACTORS ON STRUCTURAL ELEMENTS OF RICE YIELD

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Abstract. The main agrochemical indicators of the experimental field in the Lankaran-Astara region having dark gray soils have been presented in the article. The results of the analysis showed that the pH in the tillage layer of the experimental field is 6.12-5.87, in the lower layers, this figure ranged from 5.98 to 6.20.That is, the area has a weakly acidic property. There is no carbonation here as the pH of the experimental field soils is below 6.5. The experimental lands in the Lankaran-Astara region are considered to be of good quality. Because the amount of humus is 3.03-3.14 % in the tillage layer, and 1.63-1.73 % and 1.05-1.06 % in the lower layers. At a depth of 0-30 cm of the analyzed soils, the amount of mobile phosphorus (P_2O_5) varied on average from 30.9 to 34.1 mg per 1 kg of soil, and the exchangeable potassium varied between 317 and 327 mg. The field is moderately supplied with mobile phosphorus and exchangeable potassium. The key causesof the change in the biomorpholoical indicators and yield structural elements of the rice variety "Hashimi" depending on the cultivation factors have been given. Experiments with the “Hashimi” rice variety in the dark-gray soils of the Lankaran-Astara region showed that the biomorhpoıogical indicators and yield structural elements of the plant changed depending on the planting time, and seedling and fertilizer rates. The results obtained with variants planted in the 1st and third decade of May were slightly different. The highest indicator were obtained in the first decade of May, at the rate of 1.7 million seedlings per hectare and nutrition condition $N_{120}P_{80}K_{60}$. A high correlation between the yield structural elements of unfertilized variants has been detected.

Keywords: soil, plant, nitrogen, yield, rice.

INTRODUCTİON

Which is a major staple food for most people on earth and provides more calories for human consumption than any other cereal crop, one of major agricultural commodities is rice [1]. Rice is one of the most important and sustainable foods for more than half of the world population [2]. Due to population growth and improved quality of life, the demand for food will increase by about 50 % or more in 2030 and twofold in 2050 [3]. That global rice production will need to increase by approximately 8–10 million Mg per year or by an annual yield of 1.2–1.5 % in the coming decades to meet forecasted food needs, it is estimated [4].

Nitrogen fertilizers are widely used by farmers to achieve ideal productivity but crop density regulation is often overlooked. In China, only in the Jiangsu Province, large amounts of N,approximately 550 kg N per hectare, were applied for rice cultivation, in a year [5, 6]. Especially in developing countries nitrogen (N) application to agricultural land has increased steeply in recent decades and will continue to increase to meet growing food production requirements [7].

High temperatures disrupt dry matter production, reduce the size of rice grains, adversely affect grain filling, and result in reduced grain yields [8, 9]. Previous studies have shown that plant density has a significant effect on productivity and nitrogen accumulation in rice and other cereals [10].

That increasing rice production corresponds Of particular concern is with an increasing demand for water. Which is approximately 2–3 times greater than the water footprints of other cereal crops, such as wheat or maize, current estimates show that an average of 3000–5000 liters of water is needed for the production of one kilogram of rice [11].

According to researchers, the need for water during the growing season of rice is determined by the physical and chemical properties of the soil and the variety of rice [12].

The increasing scarcity of water threatens the sustainability of food production from irrigated agriculture, worldwide [13, 14].

On earth phosphorus is an essential macronutrient for all life. There is increasing evidence that the P pool changes its abundance, composition and bioavailability during soil development in natural and agricultural ecosystems in soil [15-19].

It should be noted that the planting time, seeding rates, and nutrition conditions of seedlings related to the technology of rice cultivation in the Lankaran-Astara region have not been studied in detail yet.

The researchaimed to develop the cultivation methods following the biological characteristics of rice varieties.

Purpose of the research. Experiments on “Hashimi” variety have been conducted in the field of “Janub Agro” located in the Lankaran region. The main purpose of our research was the development of cultivation methods that would meet the biological characteristics “Hashimi” variety of rice in the Lankaran-Astara region and ensure high yield.

MATERİALS AND METHODS

The research was conducted in 2015 -2016 and 2016-2017 on dark-gray soils of the Lankaran region.A three-factor (2x3x3) field experiment for the study of the main cultivation methods of rice varieties in the Lankaran-Astara region is presented in the following scheme:

The first factor: Planting time of rice seedlings.

The first decade of May; 2)The third decade of May.

The second factor: Nutrition conditions.

Unfertilized soil; 2)Fertilized with $N_{90}P_{60}K_{40}$; 3)Fertilized with $N_{120}P_{80}K_{60}$

The third factor: The rate of seedlings to be planted per hectare (million)

1.0; 2) 1.7; 3) 2.5.

The field experiments were carried out in 4 replication and the rice seedlings were planted in plots with 54 m^2 area. There are several advantages to growing rice using seedlings: cultivation of the soil becomes more intensive; it facilitates the control of weeds and pests and also improves the development of the root system of the rice plant, and tillering.

Every year, soil samples were taken following the methodology [20] to determine the agrochemical parameters of the experimental area without organic and mineral fertilizersbefore sowing and analyzed in the Laboratory of Soil and Plant Analysis of the Research Institute of Crop Husbandry.

Soil analysis: pH of an aqueous solution determined by pH meter; Calcium carbonate ($CaCO_3$) - in calcimeters by the Schebler method; Total humus - by I.V. Tyurin method; Total nitrogen (N) - by Kjeldahl method; Easily hydrolyzed nitrogen - by I.V. Tyurin and Kononova method; mobile phosphorus (P_2O_5), soluble in 1 % ammonium carbonate - by Machigin method; exchangeable potassium (K_2O), soluble in 1 % ammonium carbonate [$(NH_4)_2CO_3$] in a flame photometer [21]. Biomorpholoical indicators and yield structural elements [22].

RESULTS AND DİSCUSSİON

Results of the soil analysis of experimental field showed that in the samples taken at a depth of 0-30 cm, the pH varied within the range of 6.12-5.87, and at a depth of 30-60 cm within the range 5.98-6.20. Thus, considering that pH within the range of 5.5 and 6.5 is weakly acidic so the area has a weak acidic property.

There is no carbonate in the examined soil, and there is generally no carbonate in areas with a pH below 6.5.

Depending on the depthof the analyzed soil, total humus changed diferently. Thus, the average amount of total humus was 3.03-3.14 % (3.045-3.157), at a depth of 30-60 cm, it was1.63-1.73 % (1.618-1.751), while at a depth of 60-90 cm,it was equal to 1.05 %. Such soils are considered to be of high quality.

At a depth of 0-30 cm, total nitrogen changed on average 0.217-0.220 % and gradually decreased in the lower layers.

At a depth of 0-30 cm of the analyzed soils, the amount of mobile phosphorus (P_2O_5) varied on average from 30.9 to 34.1 mg per 1 kg of soil, and the exchangeable potassium varied between 317 and 327 mg. At a depth of 30-60 cm, mobile phosphorus was equal to 21.8-25.1 mg.Thus, the area is moderately supplied with mobile phosphorus and exchangeable potassium.

According to the results of biomorpholoical indicators and yield structural elements study, plantheight was chaned within the range of 117.0-127.4 cm at the rate of 1 million seedlings, panicle length was equal to 22.4-25.5 cm, the number of grains per panicle changed within the range of 86.8 and 115.0, weight of grainsper panicle was chaned within the range of 2.0-2.1 g, and 1000 grain weight was chaned within the range of 24.6-26.0 g in the control plants of the Hashimi variety during the 1st decade of May (figure1).

Table 1 - Biomorpholoical indicators and yield structural elements of the Hashimi variety in 2015-2016 and 2016-2017 vegetation periods

Planting time of seedlings	Seedlings per hectare, mln	Fertilizer rate, kg/ha	Plant height, cm	Panicle length, cm	Number of grains per panicle	Grain weight per panicle, g	1000 grain weight, g
The first decade of May	1.0	Control	117.0-127.4	22.4-25.5	115.0-86.8	2.0-2.1	24.6-26.0
		$N_{90}P_{60}K_{40}$	124.0-133.2	29.2-26.6	127.3-89.7	3.0-2.3	26.4-26.4
		$N_{120}P_{80}K_{60}$	127.5-135.4	31.2-28.7	129.3-92.3	3.4-2.4	27.6-27.6
	1.7	Control	121.8-130.8	25.0-26.7	117.8-89.6	1.8-2.4	25.8-25.3
		$N_{90}P_{60}K_{40}$	130.3-135.4	33.0-26.8	135.2-91.1	2.7-2.5	27.8-26.0
		$N_{120}P_{80}K_{60}$	132.8-137.2	34.5-29.9	135.8-94.7	3.2-2.7	29.0-26.8
	2.5	Control	120.2-126.1	23.8-25.3	115.4-83.7	1.5-2.0	23.8-25.0
		$N_{90}P_{60}K_{40}$	127.2-129.9	30.8-24.9	131.5-87.8	2.2-2.2	25.6-25.5
		$N_{120}P_{80}K_{60}$	130.2-135.0	32.4-28.0	132.8-91.8	2.4-2.3	26.8-26.2
The third decade of May	1.0	Control	115.2-125.2	22.0-25.0	112.4-85.0	1.8-1.9	24.4-25.4
		$N_{90}P_{60}K_{40}$	123.2-128.8	28.8-25.2	125.2-87.0	2.6-2.1	25.8-25.2
		$N_{120}P_{80}K_{60}$	125.6-130.8	30.8-27.0	128.2-90.2	3.2-2.2	26.4-26.4
	1.7	Control	119.0-128.0	24.8-25.7	116.8-86.9	1.6-2.1	25.2-24.9
		$N_{90}P_{60}K_{40}$	129.0-131.1	32.2-26.0	131.8-88.2	2.3-2.3	27.0-25.0
		$N_{120}P_{80}K_{60}$	131.2-133.6	34.2-27.5	133.6-91.8	3.0-2.5	28.2-25.5
	2.5	Control	117.4-124.1	24.6-24.0	114.4-82.2	1.4-1.8	23.2-24.4
		$N_{90}P_{60}K_{40}$	126.4-129.0	30.6-23.6	128.6-84.4	2.0-1.9	24.2-24.6
		$N_{120}P_{80}K_{60}$	127.8-133.7	33.0-25.8	130.8-89.0	2.6-2.0	24.2-24.8

At the rate of 1.7 million seedlings, plant height was changed within the range of 121.8-130.8 cm, panicle length varied between 25.0 and 26.7 cm, number of grains per panicle was 117.8-89.6, weight of grains per panicle was equal to 1.8-2.4 g, and 1000 grain weight was 25.8-25.3 g. When the seedling rate increased to 2.5 million, the structural indicators of the plant were, respectively, 120.2-126.1 cm, 23.8-25.3 cm, 115.4-83.7, 1.5-2.0 g,and 23.8-25.0 g.

The yield structural elements of plants in unfertilized variant were lower in crops planted in the 3rd decade of May compared to those planted in the 1st decade of May (table 1, Figure 2).

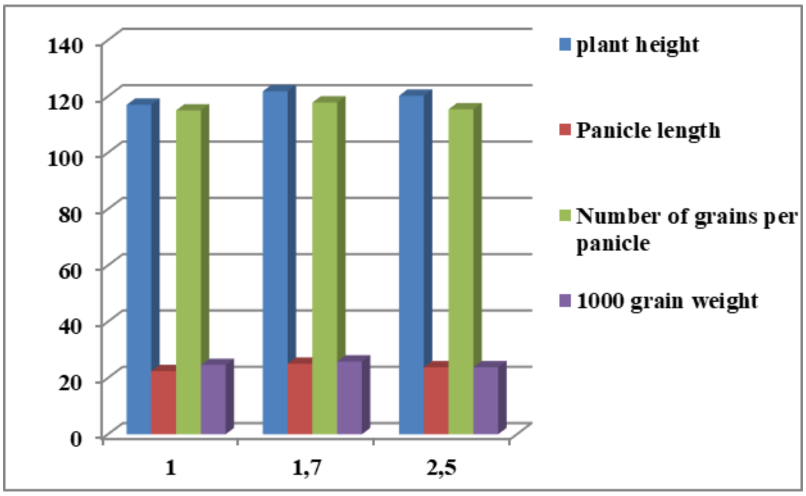

Figure 1 - Biomorpholoical indicators and yield structural elements of the Hashimi variety in unfertilized variant variety planted in the 1st decade of May

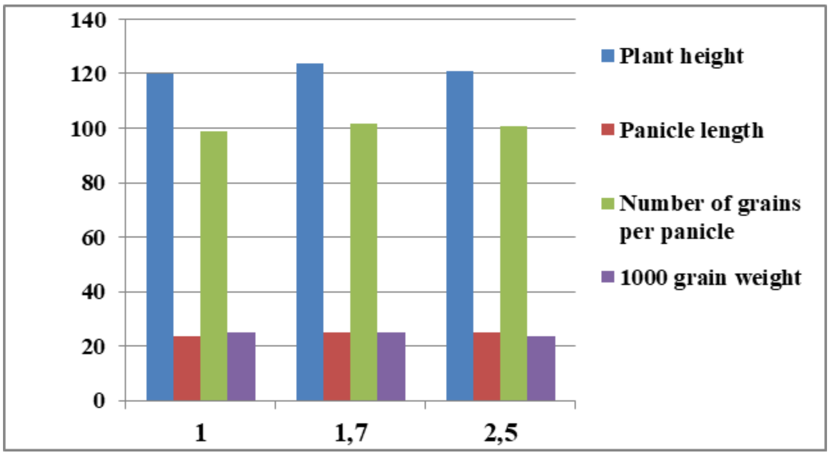

Figure 2 - Biomorpholoical indicators and yield structural elements of the Hashimi variety planted in the 3rd decade of May

Similar patterns were observed in fertilized variants during research conducted in the Lankaran-Astara region. Thus, when planting was performed in the 1st decade of May, using the nutrition condition with$N_{90}P_{60}K_{40}$,at the rate of 1.0 million seedlings, plant height was changed within the range of 124.0-133.2 cm, panicle length varied between 29.2-26.6 cm, number of grains per panicle was changed between 127.3-89.7, weight of grains per panicle was changed within the range of 3.0-2.3 g, and 1000 grain weight was changed within the range of 26.4 g. At the rate of 1.7 million seedlings, these indicators were, respectively, 130.3-135.4 cm, 33.0-26.8 cm, 135.2-91.1, 2.7-2.5 g, and 27.8-26.0 g. When the seedling rate increased from 1.7 mln to 2.5 mln, plant height was changed within the range of 127.2-129.9 cm,panicle length was varied between 30.8-24.9 cm, number of grains per panicle was changed within the range of 131.5-87.8, weight of grains per panicle was changed within the range of 3.0-2.3 g, and 1000 grain weight was equal to 26.4 g.

The results obtained with variants planted in the third decade of May were slightly different. At the nutrition condition $N_{90}P_{60}K_{40}$ and at the rate of 1.0 million seedlings, plant height was changed within the range of 123.2-128.8 cm, panicle length varied between 28.8-25.2 cm, number of grains per panicle was changed within the range of 125.2-87.0, the weight of grains per panicle was changed within the range of 2.6-2.1 g, and 1000 grain weight was changed within the range of 25.8-25.2 g. Whereas, at the rate of 1.7 million seedlings, these indicators were found to be varied between 129.0-131.1 cm, 32.2-26.0 cm, 125.2-88.2, 2.3 g, 27.0-25.0 g, respectively.At the rate of 2.5 million seedlings, these parameters ranged as follows: 126.4-129.0 cm, 30.6-23.6 cm, 128.6-84.4, 2.0-1.9g, 24.2-24.6g, respectively (figure-1). Similar results were obtained at the nutrition condition $N_{120}P_{80}K_{60}$ (table 1).

Table 2 - Correlation between biomorhpoıogical indicators and yield structural elements in the unfertilized variants

Indices	Plant height, cm	Weight of a shrub, g	Weight of grains per shrub g	Tille-ring coeffi-cient	Panicle length,cm	Weight of grains per panicle, g	Num-ber of grains per panicle	Num-ber of single panicles	1000 Grain weight, g
Plant height, cm	1								
Weight of a shrub,g	0.623*	1							
Weight of grains per shrub g,	0.657*	0.984**	1						
Tillering coefficient	0.762**	0.840**	0.847**	1					
Panicle length, Cm	0.743**	0.948**	0.944**	0.791**	1				
Weight of grains per panicle, g	0.652*	0.902**	0.900**	0.907**	0.803**	1			
Number of grains per panicle	0.608*	0.986**	0.968**	0.794**	0.972**	0.850**	1		
Number of single panicles	0.598*	0.992**	0.976**	0.805**	0.942**	0.908**	0.985**	1	
1000 grain weight, g	0.630*	0.991**	0.991**	0.877**	0.931**	0.915**	0.971**	0.980**	1

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

As seen from the table 2, there is a high correlation between the bio-morhpoıogical indicators and yield structural elements of the Hashimi rice variety in the unfertilized variants.

CONCLUSİON

Experiments with the "Hashimi" rice variety in the dark-gray soils of the Lankaran-Astara region showed that the biomorhpoıogical indicators and yield structural elements of the plant changed depending on the planting time, and seedling and fertilizer rates.

The highest indicator were obtained in the first decade of May, at the rate of 1.7 million seedlings per hectare and nutrition condition $N_{120}P_{80}K_{60}$.

REFERENCES

1 Bouman, B.A., Humphreys E., Tuong T.P., Barker, R. Rice and water// Adv. Agron, 2007. - P. 187–237.

2 Fageria N.K. Yield physiology of rice// Plant Nutr.- 2007. - P. 843–879.

3 Banwart S. Save our soils/ /Nature. – 2011. - P. 151–152.

4 Seck, P. A., Diagne, A., Mohanty, S., Wopereis M.C. Crops that feed the world rice// Food Secur., 2012. - P. 7–24.

5 Chen X.P., Cui Z.L., Fan M.S., Vitousek P., Zhao M., Ma W.Q. Producing more grain with lower environmental costs// Nature. – 2014. P. 486–489.

6 Ju X.T., Xing G.X., Chen X.P., Zhang S.L., Zhang L.J., Liu X.J Reducing environmental risk by improving N management in intensive Chinese agricultural systems. - Natl AcadSci USA, 2009. P. 3041–3046.

7 Tilman D., Cassman, K.G., Matson, P.A., Naylor, R., Polasky, S. Agricultural sustainability and intensive production practices// *Nature*. – 2002. P. 671–677.

8 Peng S.B., Huang J.L., Sheehy J.E., Laza R.C., Visperas R.M., Zhong X.H. Rice yields decline with higher night temperature from global warming. - Natl AcadSci USA, 2004. – P. 9971–9975.

9 Sakamoto T., Matsuoka M. Identifying and exploiting grain yield genes in rice. - CurrOpin Plant Biol, 2008. - P. 209–214.

10 Ali EA. Grain yield and nitrogen use efficiency of pearl millet as affected by plant density, nitrogen rate and splitting in sandy soil. Amer-Eurasian// Agri& Environ Sciences. – 2010. – P. 327–335.

11 Bouman, B. A. Water-wise rice production// Proceedings of the International Workshop on Water-wise Rice Production. - Los Baños, Philippines: International Rice Research Institute, 2002. – 356 pp.

12 Dou F., Soriano J., Tabien R.E., Chen K. Soil Texture and Cultivar Effects on Rice (*Oryza sativa*, L.) Grain Yield [Electronic resource]/ Yield Components and Water Productivity in Three Water Regimes. - 2016. - Access mode: https://doi.org/10.1371/journal.pone.0150549, free

13 Gleick P.H. Water crisis: a guide to the world's fresh water resources. - Pacific Institute for Studies in Development: Oxford University Press. - New York, 1996. - 473 p.

14 Postel S. Last Oasis: facing water scarcity. Norton and Company. - New York, 1997. - 239 p.

15 McDowell R. W., Cade-Menun, B., Stewart, I. Organic phosphorus speciation and pedogenesis: analysis by solution ^{31}P nuclear magnetic resonance spectroscopy// Eur. J. Soil *Sci.* - 2007. - P. 1348–1357.

16 Turner B., Condron L., Richardson S., Peltzer D., Allison V. Soil organic phosphorus transformations during pedogenesis// *Ecosystems*. – 2007. - P. 1166–1181.

17 Huang L.M., Zhang G.L., Thompson A., Rossiter D.G. Pedogenic transformation of phosphorus during paddy soil development on calcareous and acid parent materials// Soil Sci. Soc. Am. – 2013. - P. 2078–2088.

18 Vincent A. Soil organic phosphorus transformations in a boreal forest chronosequence// *Plant Soil*. – 2013. - P. 149–162.

19 Turner B., Wells, A., Condron L. Soil organic phosphorus transformations along a coastal dune chronosequence under New Zealand temperate rain forest// Biogeochem. – 2014. – P. 595–611.

20 Dospekhov B.A. Methodology of field experiments. – M: Agro promizdat, 1985. - P. 351.

21 Hajimammadov I.M., Talai J.M., Kosayev E.M. Agrochemical analysis methods of soil, plants, and fertilizers. – Baku: Muallim, 2016. - P. 131.

22 Musayev A.C., Huseynov H.S., Mammadov Z.A. Methodology of field experiments on research work in the field of selection of grain crops. – Baku, 2008. - 87 p.

ТҮЙІН

Т.А. Исламзаде[1]

ӨҢДЕУ ФАКТОРЛАРЫНЫҢ КҮРІШ ӨНІМДІЛІГІНІҢ ҚҰРЫЛЫМДЫҚ ЭЛЕМЕНТТЕРІНЕ ӘСЕРІ

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Мақалада Ленкоран-Астарин аймағының тәжірибе танабының күңгірт-сұр топырақтарында жүргізілген негізгі агрохимиялық зерттеулер нәтижелері келтірілген. Зерттелетін учаске топырағының агрохимиялық көрсеткіштерін талдау нәтижелері топырақ үлгілеріндегі pH әлсіз қышқыл екенін көрсетті, 0-30 см тереңдікте 6,12-5,87 және 30-60 см тереңдікте 5,98 - 6,20 аралығында ауытқиды. Зерттелген топырақтарда карбонаттар жоқ, құнарлы, жыртылу қабатындағы қарашірік мөлшері орта есеппен 3,03-3,14 %-дан (3,045-3,157), 30-60 см тереңдікте 1,63-1,73 %-ға дейін ауытқиды (1,618-1,751), ал 60-90 см тереңдікте ол 1,05 % құрайды (1033-1065). Жылжымалы фосфордың мөлшері (P_2O_5) 1 кг топыраққа орта есеппен 30,9 - дан 34,1 мг-ға дейін, ал алмаспалы калийдің мөлшері 317-ден 327 мг-ға дейін. Тәжірибе жұмыстары зерттелетін аймақтың күңгірт-сұр топырақтарында «Хашими» күріш сұрпымен жүргізілді. Өңдеу әдістеріне байланысты «Хашими» күріш сұрпының құрылымдық элементтерінің өзгеруінің негізгі факторлары анықталды. Күріш дақылының құрылымдық параметрлері егу мерзіміне, көшеттерге және тыңайтқыш нормаларына байланысты өзгергені анықталды. Мамырдың 1-ші және 3-ші онкүндігінде *отырғызылған күріш нұсқаларының* зерттеу *нәтижелері* берілген. Ең жоғары көрсеткіштер мамыр айының бірінші онкүндігінде $N_{120}P_{80}K_{60}$ қоректік режимінде, гектарына себу мөлшері 1,7 млн/данадан алынды. Тыңайтқыштар қолданылмаған нұсқада өнімнің құрылымдық элементтері мен топырақ-климаттық жағдайлар арасындағы жоғары корреляциялық байланыс анықталды.

Түйінді сөздер: топырақ, өсімдік, азот, өнімділік, күріш.

РЕЗЮМЕ

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ВЛИЯНИЕ ФАКТОРОВ ОБРАБОТКИ НА СТРУКТУРНЫЕ ЭЛЕМЕНТЫ УРОЖАЙНОСТИ РИСА

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В статье представлены основные агрохимические исследования, проводимые на темно-серых почвах опытного поля Ленкоранско-Астаринском региона. Результаты анализа агрохимических показателей почвы исследуемого участка показали, что pH в пробах почвы имеет слабую кислотность, колеблется в пределах 6,12-5,87 на глубине 0-30 см и на глубине 30-60 см - в пределах 5,98-6,20. Исследованные почвы не содержат карбонатов, плодородны, количество гумуса в пахотном слое в среднем варьируется от 3,03-3,14 % (3,045-3,157), на глубине 30-60 см 1,63-1,73 % (1,618-1,751), и на глубине 60-90 см составляет 1,05 % (1,033-1,065). Количество подвижного фосфора (P_2O_5) колеблется в среднем от 30,9 до 34,1 мг на 1 кг почвы, а обменного калия - от 317 до 327 мг. В опытах проведены работы на темно-серых почвах исследуемого региона с сортом риса «Хашими». Выявлены основные факторы изменения структурных элементов сорта риса «Хашими» в зависимости от приемов обработки. Установлено, что структурные параметры культуры риса менялись в зависимости от срока посева, рассады и норм удобрений. Представлены *результаты* исследований *вариантов посадки риса* в 1-й и 3-й декаде мая. Самые высокие показатели были получены на посевах в первой декаде мая при норме высева 1,7 млн/шт. рассады на гектар в режиме питания $N_{120}P_{80}K_{60}$. Выявлена высокая корреляционная зависимость между структурными элементами урожая и почвенно-климатическими условиями на варианте без применения удобрений.

Ключевые слова: почва, растение, азот, урожайность, рис.