between 18.5% and 23.4%. The highest preservation of camelthorn plants by the end of the growing season (from 490 to 267 plants/m²) was also observed under no-till treatment. The conducted studies confirm that the growth, development, and yield of perennial legumes on the saline soils of the Aral Sea region largely depend on a complex of applied agrotechnical practices, particularly soil tillage methods.

Keywords: Sweet clover, chiseling, growth and development, growing season, soil tillage, harrowing, crop rotation, no-till, plowing.

Вклад авторов

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THE EFFECT OF MINERAL AND ORGANIC FERTILIZERS ON THE YIELD AND QUALITY INDICATORS OF MELILOTUS IN ORYZA CROP ROTATION CONDITIONS

Abstract

Melilotus is a perennial legume plant that is valuable for fodder production due to its drought resistance and ability to accumulate biological nitrogen in the soil. In the rice crop rotation conditions of the Kyzylorda region, where soils are characterized by salinity, melilot can play a key role in increasing the productivity and sustainability of the agroecosystem.

The aim of this study was to investigate the effect of different doses and combinations of organic and mineral fertilizers on the growth, development, productivity, and feed value of sainfoin

in the region's saline meadow-marsh soils. The research methods included field experiments with the application of phosphorus fertilizers at doses of P_{60} and P_{120}, as well as their combinations with organic fertilizers (manure 15 t/ha). Agrochemical analyses of soil and plants were carried out to assess nutrient content. The productivity of sainfoin was assessed by the yield of green mass, hay, and seeds, as well as by the digestible protein content.

The results showed that the application of phosphorus fertilizers at doses of P_{60} and P_{120}, both alone and in combination with manure, significantly increases the yield of sainfoin. The greatest effect was achieved when P60 was applied in combination with manure, which ensured maximum green mass yield of up to 376,6 c/ha and hay yield of up to 87,7 c/ha, as well as digestible protein content of up to 608,4 kg/ha.

The scope of application of the research results includes the development of effective agrotechnical measures to increase the productivity of sainfoin in saline soils of arid zones, which contributes to the improvement of the feed base for livestock and the sustainability of agroecosystems.

Keywords**:** *Melilot; perennial crop; organic-mineral fertilizers; phosphorus; productivity; feed value; saline soils; rice crop rotation.*

Introduction

The rice irrigation systems of the Kyzylorda region are located in the southern region of Kazakhstan, where industrial rice is grown. Many years of rice cultivation without the use of a complex of land reclamation measures to restore and improve the ecological situation in difficult soil and climatic conditions have led to the development of erosion processes in the soil and a sharp decline in fertility indicators. Due to the deterioration of the technical condition of the irrigation and drainage network, the processes of waterlogging and soil salinization are intensifying. For example, at present, for various reasons, more than 60 thousand hectares of irrigated land have been removed from agricultural use [1].

Rice belongs to the category of plants that consume large amounts of essential soil elements such as nitrogen, phosphorus, and others. Therefore, it is recognized as a soil fertility restorer. Its difference from perennial grasses is that it is an antagonist of soil fertility. In this regard, studying the organic composition of soils under ameliorative crops is important for preserving soil fertility, as it is well known that preserving and improving soil fertility has always been a key strategic objective for any state [2,3].

The state's attention may increase due to the rising cost of inorganic nitrogen, the need to combat herbicide-resistant weeds in agricultural crops, and rising prices for livestock products. These legume mixtures allow for the creation of more sustainable pastures that are protected from various seasons, soils, pests, diseases, and management decisions [4].

In their research, scientists Abigail R. Bell and Nicholas G. Smith show that one way to restore degraded land is to use it for grazing livestock. To select the best forage grass species, it is important to understand the impact of soil salinity on the growth and nutritional quality of potential forage grasses. They found a high degree of variability in the response to salinity among perennial grasses, including legumes, which showed high biomass and low sensitivity to soil salinity on each index, but it was found that of all the species studied, hay had the lowest nitrogen concentration. These results suggest that soil salinization may help mitigate the negative impact on forage production and quality, and land managers should carefully consider this issue [5].

Melilot is an important plant in the legume family, with 19 species of annual and biennial plants. Members of the Melilotus family have high seed yields and are more resistant to harsh environmental conditions such as drought, cold, and high salinity than other crops [6].

Fodder crops are extremely important as legumes, as they can perform symbiotic nitrogen fixation with a number of bacterial species [7]. The rate of nitrogen fixation is higher than in other legumes, making it suitable for crop rotation and use as a biological fertilizer for agricultural crops. A comparison of productivity and nitrogen fixation showed a significant advantage of melilotus (Melilotus alba) over alfalfa (Medicago sativa) [8].

Moreover, experiments have shown that yellow sweet clover uses a unique mechanism of salt addition to maintain growth in saline solution conditions, as it accumulates large amounts of Na+ and Cl^- ions. The results obtained allow Emad A. Al Sherif Melilotus indicus to be grown on saline soils, which are widespread and pose a problem for farmers in Egypt and other arid countries around the world. However, the mineral composition of plants can vary significantly depending on the concentration and type of salts in the soil and water. It is important to note that these plants can be managed in such a way that they make a significant contribution to the animal feeding system [9].

The agroecological and phytosanitary role of sainfoin in rice crop rotation is very significant, as the plant has a definite impact on the biological reclamation of saline soils. In this regard, it is recommended to introduce sainfoin into rice crop rotations as a cover crop and fodder crop in the conditions of the Aral Sea region of Kazakhstan. Numerous studies have shown that crop rotation, combined with the application of mineral and organic fertilizers, as well as soil protection and anti-erosion measures, is a powerful reserve for preserving and increasing humus in the arable layers of the soil [10]. One of the main factors in increasing the yield of sweet clover is the use of fertilizers.

According to R.E. Eleshov and A.B. Tursynbayeva, in studies conducted on meadow-saline soils, the highest yield of green mass of sainfoin was obtained when using mineral fertilizers $N_{30}P_{150}K_{90}$ in combination with 20 t/ha of manure. When fertilizers were applied, their yield was 97,3% and 133,5% higher, respectively, compared to the control without fertilizers. When fertilizers were applied, their yield was 97,3% and 133,5% higher, respectively, compared to the control without fertilizers [11].

Materials and methods

The climate of the Kyzylorda region is sharply continental, with hot, dry summers and cold winters, and unstable snow melilotus. The average annual air temperature is 9,8°C. The climate in the region is very dry. The average annual precipitation is 129 mm. In some dry years, only 40–70 mm may fall.

The soil of the experimental site is meadow-boggy, typical for rice crop rotations in the region. It is characterized by low humus content – up to 1%, weak featheriness, and a relatively high dense residue value – 0,6–0,8%. The type of salinity is sulfate, medium salinity. Soil analyses were carried out in the laboratory of the I. Zhakhayev Kazakh Scientific Research Institute of Rice Growing (Figure 1).

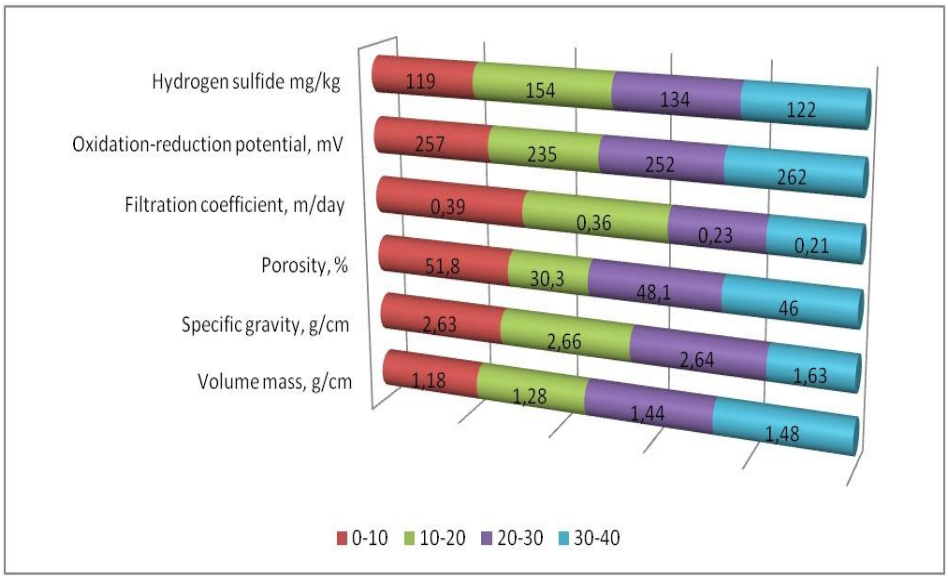

Figure 1 - Physical and water properties of the soil at the experimental site

Soil analyses showed that the specific weight of the 0-10 cm layer was 2,63 g/cm^3, and the porosity was 51,8%. The specific weight of the 20-30 cm layer was 2,64 g/cm^3, and the porosity was 48,1%.

The research was conducted at the scientific and experimental site of the I. Zhakhayev Kazakh Scientific Research Institute of Rice Growing LLP.

In the experiments on the plots, agricultural technology was applied using the technology for growing perennial grasses (clover) without cover and with cover crops, in accordance with the recommendations [12,13].

Melilot is sown in bare soil at a rate of 18-20 kg/ha, to a depth of 2-4 cm. Three to five days after sowing, the soil is tamped down to retain moisture.

During the growing season, watering is carried out. In the first year of clover planting, during the stem elongation and tillering period, and in the second year, when shoots appear (April 10–20), watering is carried out twice, 20–30 days after the first watering.

In the budding phase of the green mass of melilotus at 15-20 cm, they are harvested with a RMH-6harvester.

Statistical processing was carried out using the method of dispersion analysis for single- and multi-factor experiments according to B. A. Dospekhov [14,15].

Research results

The results of three years of research have shown that the use of organic-mineral fertilizers contributes to high yields of sweet clover by creating optimal soil nutrient conditions. It is well known that in most cases there is a directly proportional relationship between growth and crop yield.

Therefore, studying the dynamics of above-ground mass growth characterizes the stages of crop yield formation. Depending on the cultivation techniques used in any agrophytocenosis, weeds develop alongside cultivated plants. They are an inevitable component of agrophytocenosis, competing in certain relationships (Guidelines for conducting field experiments with forage crops).

With optimal moisture at the depth of the seedbed and plow layer, seedlings appear in 6-8 days. The first leaf is simple, rounded in shape, and grows very slowly. At the onset of the 3-4 leaf phenophase of melilotus, the average plant height in the control variant reaches only 3,6 cm. During this period, the application of manure (3,8-4,6 cm) and phosphorus fertilizers (3,9-4,6) does not have a significant effect on plant height, with a difference of only 0,3-1,0 cm (Table 1).

Table 1. Plant growth dynamics depending on the application of organic-mineral fertilizers

Experimental options	Culture	Plantheight, cm				
		3-4 l	5-6 l	6-7 l	7-9 l (branching)	Budformation
Withoutfertilizers (control)	Melilot Echinochloa crus	3,6 4,5	7,8 10,3	12,5 12,6	20,4 24,3	32,4 47,1
Manure 15 t/ha	Melilot Echinochloa crus	3,8 5,2	8,2 11,0	14,1 16,3	25,5 33,8	39,3 61,1
Manure 15 t/ha+P_{60}	Melilot Echinochloa crus	4,6 5,2	9,4 12,3	15,4 15,8	29,0 36,3	41,2 62,0
P_{30}	Melilot Echinochloa crus	4,6 5,4	8,5 10,4	14,1 13,0	23,4 28,2	36,2 50,9
P_{60}	Melilot Echinochloa crus	3,7 6,5	8,4 11,3	13,9 13,6	26,7 28,7	38,6 49,4
P_{90}	Melilot Echinochloa crus	3,9 5,0	7,7 12,5	14,9 15,0	24,6 34,3	37,0 51,3
$P_{60}N_{45}$	Melilot Echinochloa crus	3,9 5,9	8,0 12,1	14,5 16,9	27,9 33,6	37,7 56,0

The growth dynamics of plants (Melilot and Echinochloa crus) at the beginning of vegetation (from germination to the formation of 2-3 true leaves and up to 5-6 leaves) changes insignificantly (1,5–3,3 cm). However, during this period, the root system of sweet clover grows intensively and strengthens, penetrating the soil to a depth of 40 cm. At the same time, there is intense competition

between the rooting sweet clover and specific weeds of the rice crop rotation. Under the conditions of our research, sweet clover crops are heavily infested with echinochloa crus.

Determining the effect of mineral fertilizers on the growth, development, and productivity of melilot.

During the period from the 7-9 leaf stage to the beginning of budding, the growth rate of melilot increases. Thus, in the variants with fertilizer application, the height of melilot plants at the appearance of 7-9 leaves was 3,0-8,6 cm higher than without fertilizer. During this period, higher growth (27,9-29,0 cm) was observed in the variants where $P_{60}N_{45}$ and manure 15 t/ha + P_{60} fertilizer were applied, and the lowest (20,4-24,3 cm) in the plots without fertilizers. During the budding phase, the growth of melilot almost equalized in the variants with fertilizer application and amounted to 36,7 and 41,2 cm, while the difference compared to the control remained and amounted to – 5,3-6,7 cm.

Studies have shown that the application of nitrogen fertilizers and manure promotes intensive growth and increased tillering of weeds, especially echinochloa crus, while phosphorus fertilizers, on the contrary, reduce and slow down their growth rates.

On average, over two years, the height of echinochloa crus on plots where melilot was grown, with 15 t/ha of manure, reached 11,0-12,3 cm in the 5-6 leaf phase, after 10-14 days – 33,8-36,3 cm, and during the budding period of melilot – 61,1-62 cm, while with the application of only P60, respectively: 11,3; 28,7 and 49,4 cm. Fertilizer application accelerates the onset of individual phases of melilot by 2-5 days and echinochloa crus by 3-6 days. The number of melilot plants in plots without fertilizer was 214 at emergence, of which 124 remained per m^2 (Table 2).

Table 2. Herbage density and thinning of melilot depending on the application of organic and mineral fertilizers

Experimentaloptions	Number of plants, pcs/m^2			
	bygermination	inthefirstmowing	at the end of the growing season	% ofdecimation
Withoutfertilizers (control)	214	205	124	42,0
Manure15 t/ha	234	218	141	39,7
Manure15 t/ha +P_{60}	280	267	170	39,3
P_{30}	257	246	156	43,2
P_{60}	279	268	178	36,2
P_{90}	283	270	155	45,2
$P_{60}N_{45}$	285	269	154	46,0

The density of melilot plants in plots without fertilizers was 214 seedlings, of which 124 remained/m^2. The highest density of melilot was preserved (170-178 pcs/m^2) at the end of the growing season of the 1st year of life with the application of 15 t/ha of manure + P_{60}, where the sparsity is 39.3% and P_{60} -36,2%.

In our experiments, the greatest thinning of melilot was noted in a plot without fertilizers – 42,0%. And in the variant where $P_{60}N_{45}$ is added, the depletion rate is 46,0%, the least rarefaction is observed with the addition of P_{60} (36,2%).

Studies have shown that in meadow-marsh saline soils of rice crop rotations, various doses and ratios of organo-mineral fertilizers had a significant impact on the yield of melilot (Table 3).

Table 3. The effect of various fertilizer systems on the yield of the green mass of melilot

Experimentaloptions	Melilotof the 1st year			Melilot of the 2nd year			Intwoyears		
	yield, c/ha	increasein		yield, c/ha	increasein		yield, c/ha	increasein	
		c/ha	%		c/ha	%		c/ha	%
Withoutfertilizers (control)	88,2	St	-	178,5	St	-	266,7	St	-
Manure 15 t/ha	111,7	23,5	26,6	232,9	54,4	30,4	344,6	77,9	29,2

Manure 15 t/ha +P_{60}	122,8	34,6	39,2	253,8	75,3	42,2	376,6	109,9	41,2
P_{30}	104,3	16,1	18,2	233,5	55,0	30,8	337,3	71,1	26,6
P_{60}	111,7	23,5	26,6	251,4	72,9	40,8	345,1	78,4	29,4
P_{90}	112,9	24,7	28,0	255,0	76,5	42,9	367,9	101,2	37,9
$P_{60}N_{45}$	115,9	27,7	31,4	260,1	81,6	45,7	376,0	109,3	41,0
HCP_{05}	31,7	-	-	32,3	-	-	42,1	-	-

In our studies, on the fertilized variants, the yield of the green mass of the 1st year of life of melilot was 104,3 and 122,8 c/ha, while on the variant without fertilizers it amounted to 88,2 c/ha (Figure 2). The vegetative period of the 2nd year of life begins with spring regrowth from the renewal buds located on the root neck. The maximum increase in green mass occurs during the period from the beginning of spring regrowth to the beginning of flowering.

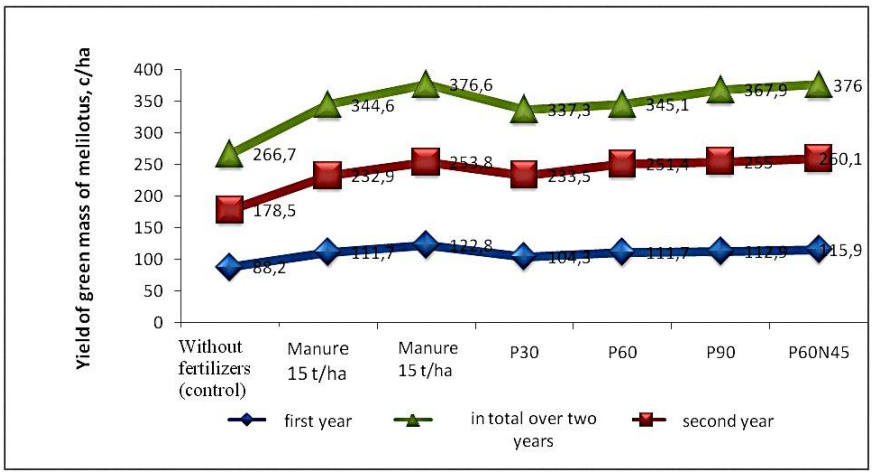

Figure 2 - Dynamics of the yield of the green mass of melilot depending on the application of fertilizers, kg/ha

The yield of the green mass of melilot when applying organic and mineral fertilizers is in the range of 232,9 c/ha and 260.1 c/ha, and in total for 2 years - 337,3 c/ha – 376,6 c/ha. The increase in the yield of the green mass of melilot from fertilizers at the rates of manure of 15 t/ha, manure of 15 t/ha + P_{60}, P_{30}, P_{60} amounted to 77,9,109,9, 71,1 and 78,4 c/ha, respectively, or ranges from 26,6% – 41,2%. The above patterns of changes in the height of standing growth, plant density and the formation of the green mass of melilot is one of the main elements of the yield structure, determines the level of its productivity. The effect of fertilizers on the productivity of melilot is characterized by the height of plants standing before harvesting, the number of plants and the yield of melilot for hay.

It was found that the height of the melilot before harvesting on fertilized varieties was higher and averaged 36,2 - 41,2cm at the 1st mowing, 48,7-56,6cm at the 2nd mowing, and the number of plants, respectively, was 129-131 pcs/m2, while the hay yield for two mowing reached 72,6-87,7 kg/ha. For the variant without fertilizers, these figures were 32,4 and 42,9 cm, 117 pcs/m^2 and 55,7 kg/ha, respectively (Figure 3).


Figure 3 - Phenological observations

A comparative assessment of the studied variants of organo-mineral fertilizers in terms of melilot productivity shows that the application of phosphorous fertilizers in doses of P_{30} и P_{60} provides the highest productivity [16]. In these variants, the yield of melilot for hay is between 72,6 and 85,5 c/ha, which is 16,9-29,8 c/ha more than in the control variant without fertilizers (Table 4).

Table 4. The effect of organomineral fertilizers on the productivity of melilot

Experimentaloptions	Melilot				
	Heightbeforeharvesting, cm		Hayyield, c/ha	Theincrease	
	1 cut	2 cut		c/ha	%
Withoutfertilizers (control)	32,4	42,9	55,7	St	-
Manure 15 t/ha	39,3	51,3	70,2	14,5	26,0
Manure 15 t/ha+P_{60}	41,2	56,6	87,7	32,0	57,4
P_{30}	36,2	48,7	72,6	16,9	30,3
P_{60}	36,7	49,0	85,5	29,8	53,5
P_{90}	37,0	49,2	84,9	29,2	52,4
$P_{60}N_{45}$	37,7	50,5	66,1	10,4	18,7
HCP_{05}				4,7	

Thus, of the studied organo-mineral fertilizers, the application of phosphorous fertilizers in doses of P_{30} and P_{60} provides an increase in melilot productivity by 30,3-53,5%. Therefore, P_{60} doses of phosphorous fertilizers are more effective than other study options. Even the application of manure of 15 t/ha + P_{60}, where the highest yield of 87,7 kg/ha melilot for hay is ineffective compared to P_{60}, since the yield difference between them (2,2 kg /ha) is insignificant, below the value of HCP_{05} = 4,7 kg/ha. Along with the above, it has been established that the application of fertilizers in rice crop rotation on meadow-marsh soils has a great impact on the fodder value of melilot.

Melilot is a nutrient-rich forage crop. Melilot hay is not inferior in total nutritional value and chemical composition to alfalfa hay, and in terms of digestible protein content it is 2 times higher than hay of perennial grasses [17,18]. In order to identify the fodder value of melilot, we determined the nutritional values of the feed and the chemical composition of melilot hay. Samples for their determination were taken in the first year of their life in the budding phase and in the second year - at the beginning of flowering.

The results showed that the volume of collection of feed units and digested protein is directly dependent on the species used in combination with organic fertilizers

In the 1st year, fertilization at a dose of P_{30}, P_{60}, manure of 15 t/ha and manure of 15 t/ha + P_{60} provided the largest collection of feed units in the range of 2378 and 2800 kg/ha, in the 2nd year - 5124-5722 kg/ha. At the control, the content of feed units was 1932 and 3927 kg/ha, respectively, by

year. Due to the application of organic mineral fertilizers, an additional 446-868 were collected in the first year and 1,197-1,795 kg/ha of organic units in the second year.

The following options had a significant impact on the quality and nutritional value of melilot feed: manure 15 t/ha, manure 15 t/ha + P_{60}, P_{30}, P_{60}. The content of digested protein in the 1st year of life of melilot was 266,3, 278,2, 247,3 and 280,2 kg/ha, in the 2nd year of life - 532,9, 591,9, 529,1 and 608,4 kg/ha, respectively.

The variants with the addition of P_{60}+15 t/ha of manure (278,2-591,9) and P_{60} (553,1-608,4) had the strongest effect on the protein content in melilot hay, and in the control without fertilizers, the protein content decreased to 197,1 and 396,6 kg/ha.

Along with the nutritional value of the feed, we have determined the effect of fertilizers on the chemical composition of melilot. According to research data, the chemical composition and quality of melilot hay in the Aral Sea region varies significantly depending on the year of use and the types and norms of fertilizers applied.

In our experiments, the amount of crude protein depending on the fertilizers applied in the first year of life was 15,1–16,1%, and in the second year of life it decreased by 0,6–1,0% (14,5–15,1%).

The fat content by year of use when applying fertilizers to melilot crops in rice crop rotation on meadow-marsh soils varies between 2,2 and 2,7%.

The lowest fiber content was observed in melilot in the first year of life in the $P_{30\text{-}60}$variant (19,9–20,2%) and without fertilizer application (18,6%). The value of nitrogen-free extractive substances in the control variant without fertilizers in the first year of life is 44,6%, in the second year – 42,1%; the use of fertilizers reduces its content by 0,6–3,8%.

Conclusions

The research results have shown that the application of organomineral fertilizers in various doses and ratios affects the yield of melilot on meadow-marsh saline soils of rice crop rotations.

It has been established that the application of nitrogen fertilizers and manure promotes the intensive growth of weeds, especially echinochloa crus, and phosphorous fertilizers, on the contrary, reduce and slow down their growth rates.

It was revealed that the application of phosphorous fertilizers from among the studied organomineral fertilizers in doses of P30 and P60 provides an increase in melilot productivity by 30,3-53,5%. Therefore, P60 doses of phosphorous fertilizers are more effective than other study options.

The results obtained prove that the volume of collection of feed units and digested protein is directly dependent on the types, norms and combination of organic fertilizers. For example, in the 1st year of fertilization at a dose of P_{30}, P_{60}, manure of 15 tons/ha and manure of 15 tons/ha + P_{60}, the collection of feed units amounted to 2378-2800 kg/ha, in the 2nd year - 5124-5722 kg/ha, which indicates an almost two-fold increase three times.

The results of the experiments showed that the following options had an impact on the quality and nutritional value of melilot feed: manure 15 t/ha, manure 15 t/ha + P_{60}, P_{30}, P_{60}. The content of digested protein in the 1st year of life of melilot was 266,3,278,2,247,3 and 280,2 kg/ha, in the 2nd year of life - 532,9, 591,9, 529,1 and 608,4 kg/ha, respectively.

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ВЛИЯНИЕ МИНЕРАЛЬНЫХ И ОРГАНИЧЕСКИХ УДОБРЕНИЙ НА УРОЖАЙНОСТЬ И КАЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ ДОННИКА В УСЛОВИЯХ РИСОВОГО СЕВООБОРОТА

Аннотация

Донник - многолетнее бобовое растение, ценное для кормопроизводства благодаря своей засухоустойчивости и способности накапливать биологический азот в почве. В условиях рисового севооборота Кызылординской области, где почвы характеризуются засоленностью, донник может играть ключевую роль в повышении продуктивности и устойчивости агроэкосистемы.

Целью данного исследования было изучение влияния различных доз и комбинаций органических и минеральных удобрений на рост, развитие, продуктивность и кормовую ценность эспарцета на засоленных лугово-болотных почвах региона. Методы исследования включали полевые эксперименты с внесением фосфорных удобрений в дозах P_{60} и P_{120}, а также их комбинаций с органическими удобрениями (навоз 15 т/га). Для оценки содержания питательных веществ были проведены агрохимические анализы почвы и растений. Продуктивность эспарцета оценивали по урожайности зеленой массы, сена и семян, а также по содержанию переваримого протеина.

Результаты показали, что внесение фосфорных удобрений в дозах P_{60} и P_{120}, как отдельно, так и в сочетании с навозом, значительно повышает урожай эспарцета. Наибольший эффект был достигнут при внесении P_{60} в сочетании с навозом, что обеспечило максимальную урожайность зеленой массы до 376,6 ц/га и сена до 87,7 ц/га, а также содержание переваримого протеина до 608,4 кг/га.

Сфера применения результатов исследований включает разработку эффективных агротехнических мероприятий для повышения продуктивности эспарцета на засоленных почвах засушливых зон, что способствует улучшению кормовой базы для животноводства и устойчивости агроэкосистем.

Ключевые слова: Донник, многолетняя культура, органоминеральные удобрения, фосфор, продуктивность, кормовая ценность, засоленные почвы, рисовый севооборот.

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МИНЕРАЛДЫ ЖӘНЕ ОРГАНИКАЛЫҚ ТЫҢАЙТҚЫШТАРДЫҢ КҮРІШ АЙНАЛЫМЫ ЖАҒДАЙЫНДАҒЫ ТҮЙЕЖОҢЫШҚАНЫҢ ӨНІМДІЛІГІ МЕН САПАЛЫҚ КӨРСЕТКІШТЕРІНЕ ӘСЕРІ

Аңдатпа

Түйежоңышқа құрғақшылыққа төзімділігі мен топырақта биологиялық азотты сақтау қабілетінің арқасында жемшөп өндірісі үшін құнды көпжылдық бұршақ тұқымдас өсімдік. Топырақ тұздылығымен сипатталатын Қызылорда облысының күріш айналымы жағдайында түйежоңышқа агроэкожүйенің өнімділігі мен тұрақтылығын арттыруда шешуші рөл атқара алады.

Бұл зерттеудің мақсаты аймақтың тұзды шалғынды-батпақты топырақтарында түйежоңышқаның өсуіне, дамуына, өнімділігіне және жемшөп құндылығына органикалық және минералды тыңайтқыштардың әртүрлі дозалары мен комбинацияларының әсерін зерттеу болып табылады. Зерттеу әдістеріне фосфор тыңайтқыштарын P_{60} және P_{120} дозаларында қолдану бойынша далалық тәжірибелер, сондай-ақ олардың органикалық тыңайтқыштармен (15 т/га көң) комбинациясы кіреді. Қоректік заттардың құрамын бағалау үшін топырақ пен өсімдіктерге агрохимиялық талдаулар жүргізілді. Түйежоңышқаның өнімділігі жасыл массаның, жемшөптің және тұқымның өнімділігі, сондай-ақ сіңірілетін ақуыздың мөлшері бойынша бағаланды.

Нәтижелер фосфор тыңайтқыштарын P_{60} және P_{120} дозаларында бөлек және көңмен бірге қолдану түйежоңышқа өнімділігін айтарлықтай арттыратынын көрсетті. Ең үлкен әсерге көңмен бірге P_{60} қолдану арқылы қол жеткізілді, бұл жасыл массаның максималды өнімділігін 376,6 ц/га дейін және шөптің 87,7 ц/га дейін, сондай-ақ сіңірілетін ақуыздың құрамын 608,4 кг/га дейін қамтамасыз ететіні қарастырылған.

Зерттеу нәтижелерін қолдану аясында құрғақ аймақтардың тұзды топырақтарында түйежоңышқа өнімділігін арттыру үшін тиімді агротехникалық шараларды әзірлеуді қамтиды, бұл мал шаруашылығы үшін жем-шөп базасын және агроэкожүйелердің тұрақтылығын жақсартуға ықпал етеді.

Кілт сөздер: Түйежоңышқа, көпжылдық дақыл, органоминералды тыңайтқыштар, фосфор, өнімділік, жемшөп құндылығы, тұзды топырақ, күріш ауыспалы егісі.

Author Contributions

R.D. Nurymova - Development of the research concept, formulation of objectives and tasks; design of the experimental methodology; overall scientific supervision and control of the research process; preparation of the initial draft of the manuscript and participation in its editing.

K.A. Myrzabek - Statistical processing and verification of the results; data visualization (tables, graphs, and figures); coordination of the manuscript preparation and communication with the editorial office; editing and final review of the text.

G.T. Daldabayeva - Conducting field experiments, collection and preliminary processing of data; providing access to the experimental site and laboratory equipment; participation in agrochemical analyses.

G.Sh. Ospanova - Processing and interpretation of experimental data; participation in the preparation and editing of the manuscript.

Y.N. Yskak - Systematization and storage of experimental data; preparation of tables and illustrations; assistance in collecting primary data at the I. Zhakhayev Kazakh Rice Research Institute.

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ОРГАНИКАЛЫҚ ТЫҢАЙТҚЫШТАР МЕН РЕГЕНЕРАТИВТІ ӘДІСТЕР АРҚЫЛЫ АУЫЛ ШАРУАШЫЛЫҒЫН ТҰРАҚТЫ ДАМЫТУ ЖОЛДАРЫ

Аңдатпа

Алғышарттар мен мақсат. Бұл мақалада қазіргі заманғы ауыл шаруашылығын экологиялық тұрғыдан тиімді және ұзақ мерзімді тұрақты дамыту мәселелері қарастырылады. Әлемдік климаттың өзгеруі, топырақтың тозуы мен эрозиясы, химиялық заттардың шамадан тыс қолданылуы сияқты ғаламдық сын-қатерлер аясында ауыл шаруашылығының жаңа бағыттары – органикалық тыңайтқыштарды пайдалану және регенеративті агротехнологияларды енгізу өзекті мәселеге айналуда.

Материалдар мен әдістер. Органикалық тыңайтқыштар (биогумус, компост, жасыл тыңайтқыштар және т.б.) топырақтың табиғи құнарлылығын сақтап, ауылшаруашылық дақылдарының сапасын жақсартуға мүмкіндік береді. Бұл тыңайтқыштар экожүйеге зиян келтірмей, жердің микробиологиялық белсенділігін арттыру арқылы ұзақмерзімді өнімділікке қол жеткізуге ықпал етеді [1].

Нәтижелер. Регенеративті ауыл шаруашылығы – бұл тек өнім алуға емес, сонымен қатар топырақ құрылымын қалпына келтіруге, биоалуантүрлілікті сақтауға және экологиялық тепе-теңдікті ұстауға бағытталған кешенді тәсіл. Бұл жүйеде нөлдік немесе аз көлемді жер өңдеу, дақылдарды ауыспалы егу, покровные культуры (жамылғы дақылдар), органикалық мал шаруашылығын егіншілікпен біріктіру сияқты әдістер қолданылады. Мұндай тәсілдер топырақты эрозиядан қорғайды, ылғалдылықты сақтайды, зиянкестерге қарсы биологиялық тепе-теңдік қалыптастырады.

Қорытынды. Қазақстан жағдайында органикалық және регенеративті әдістерді қолдану жер ресурстарын сақтауға, ауыл шаруашылығы өндірісінің тұрақтылығын арттыруға және экологиялық қауіпсіз өнім өндіруге мүмкіндік береді. Аталған бағыттар – агрономия мамандығы бойынша болашақ мамандар үшін аса өзекті, себебі олар тек өндірістік тиімділікті ғана емес, сонымен қатар қоршаған ортамен үйлесімділікті де қамтамасыз етеді. Мақалада осы әдістердің артықшылықтары, іске асыру жолдары және олардың ауыл шаруашылығындағы орны терең талданады. Бұл зерттеу – экологиялық баламаларға негізделген тұрақты ауыл шаруашылығын қалыптастыруға арналған ғылыми-тәжірибелік негіз болып табылады.

Кілт сөздер: *Органикалық тыңайтқыштар; регенеративті ауыл шаруашылығы; тұрақты даму; топырақ құнарлылығы; биогумус; жасыл тыңайтқыштар; ауыспалы егіс; ауыл шаруашылығы өндірісі; экологиялық қауіпсіз өнім.*