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DEVELOPMENT OF A NEW TECHNOLOGY FOR REGULATING THE WATER REGIME OF TRITICALE IN NATURAL CONDITIONS WITH THE APPLICATION OF AMELIORANT AND FERTILIZERS

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Abstract

In order to mitigate the devastating effects of drought on the pebbly dark brown soils of the foothill zone, where, according to the average annual data, 520-560 mm of precipitation falls, and the average annual temperature is 10.80°C, the agronomic and economic efficiency of the application of ameliorative and full (NPK) fertilizers regulating the water regime of the soil has been tested in the sowing of autumn triticale.

Through experimental research, the positive effect of polymer-mineral additive and fertilizers on the hydro-physical properties of the soil and drought resistance of plants was revealed, as a result of which the water regime of plants was improved, and the grain yield of autumn triticale, compared with the tester, increased by 66.7%.

Keywords: soil structure, field moisture, transpiration, triticale, crop elements, yield.

Introduction

The implementation of food self-sufficiency is inextricably connected with the modernization of agriculture, its transfer to an industrial basis, and the increase of production efficiency.

As in the past, so in the current stage of agricultural development, a leading place is given to grain production, which provides the population with food, industry-with raw materials, and livestock-with fodder.

In the conditions of water resources and irrigated lands lost as a result of the war, it is even more important to apply agro-technical measures that create moderate conditions of soil factors of life (water, air, nutrients) for plants that convert solar energy.

In this regard, the choice and implementation of an effective system of soil cultivation, scientifically based crop rotation, the inclusion of autumn crops that use atmospheric moisture more efficiently in the structure of sowing, the correct choice of doses of fertilizers and ameliorants and the dates of introduction into the soil are effective measures against frequent drought, which is the main reason for the decline and loss of yield.

Characterizing the process of soil formation and the factors that determine it, many researchers have brought to the fore the physical properties of the soil and especially its volumetric mass. The more the soil is rich in organic matter, the better its structure is expressed: it has a loose structure and a smaller volumetric mass. Such soil can contain not only nutrients, but also air and water necessary for plant life.

The role of organic fertilizers, the inclusion of leguminous and grain perennial grasses in the crop rotation, mechanical tillage in conditions of moderate humidity in the preservation and improvement of soil structure has long been known. However, the results of soil structure restoration with the above-mentioned means are extremely modest. That is why the search for faster and more effective ways to improve the physical properties of the soil by introducing any ameliorating material into it is very relevant.

In recent years, in order to create an artificial structure, mineral and high molecular materials - polymers, which have the ability to glue soil particles and create structural features - have been used in agricultural practice [1, 2, 3].

As a material that improves soil structure and its hydro-physical properties, both in laboratory and field experiments, the additive (PMM) created by the Moscow State University named after M. V. Lomonosov was studied [4, 5].

On the other hand, the role of mineral fertilizers is known not only as a source of nutrients, but also as a means of increasing the drought resistance of plants [6, 7, 8].

Studies show that in an unstable humidification zone, in a zero tillage system, effective humidity is better maintained not only due to plant residues accumulated on the soil surface, but also due to maintaining soil density within the best limits during vegetation [9, 10].

Conflict Setting

Based on the above, we have set a task to investigate the effect of such agrotechnical measures on the drought resistance and yield of autumn triticale in short-rotation crop rotations under minimal tillage conditions, such as fertilization and the use of an ameliorant (PMM) which improves the water properties of the soil.

Material and method

Research works were carried out in two stages: a) field and vegetation experiments, b) laboratory research. In 2021-2022, one of the two-field crop rotation fields with a short crop rotation, where the crops succeeded each other only in time, was occupied by autumn triticale.

Field and vegetation experiments were set up with 3 replicates. The following versions of fertilization and ameliorant application have been tested:

1. Without ameliorant and fertilization (tester)
2. $P_{90}K_{60}N_{120}$
3. $P_{90}K_{60}N_{90}$
4. PMM 1500 kg/ha
5. PMM 3000 kg/ha
6. PMM 1500 kg/ha + $P_{90}K_{60}N_{120}$
7. PMM 1500 kg/ha + $P_{90}K_{60}N_{90}$
8. PMM 3000 kg/ha + $P_{90}K_{60}N_{120}$
9. PMM 3000 kg/ha + $P_{90}K_{60}N_{90}$

Phosphorus-potassium fertilizers and ameliorant were introduced into the soil in the autumn before sowing, and various doses of nitrogen fertilizers in the spring as a feed.

The main tillage and seed care works were carried out in accordance with the minimum cultivation system requirements. Phenological observations and biometric measurements were made during the vegetation period to investigate field productivity, winter hardiness, general and effective thriving. The dynamics of changes in field moisture were determined at different stages of plant development. The intensity of transpiration was determined by Ivanov's weighting method, the yield data were subjected to mathematical processing by the method of dispersion analysis [11, 12, 13].

Research Results

See Tables 1 and 2 for research data on soil moisture change dynamics and transpiration intensity at different stages of autumn triticale development.

As the data in Table 1 show, the wet and dry masses of the first floor leaves from the spike, their water content by wet and dry masses, and finally the intensity of transpiration are significantly depend on both fertilizer and ameliorant application. The effect of the applied measure is more noticeable in the variants of their joint application.

Table 1

Dependence of some features of the water regime of autumn triticale leaves on fertilization and ameliorant application

N	Variant	Weight of 10 leaves/g/		Water content %		The intensity of transpiration g/m²h
		wet	dry	by wet mass	by dry mass	
1	Tester (st)	2,840	1,139	59,87	149,34	2,149
2	$P_{90}K_{60}N_{120}$	4,770	1,788	62,50	116,77	2,451
3	$P_{90}K_{60}N_{90}$	4,620	1,784	61,37	158,96	2,320
4	PMM 1500 kg/ha	3,830	1,511	60,54	153,47	2,237
5	PMM 3000 kg/ha	3,920	1,553	60,38	152,41	2,241
6	PMM 1500 kg/ha+ $P_{90}K_{60}N_{120}$	6,630	2,335	64,76	183,94	2,562
7	PMM 1500 kg/ha+ $P_{90}K_{60}N_{90}$	6,590	2,324	64,72	183,56	2,549
8	PMM 3000 kg/ha+ $P_{90}K_{60}N_{120}$	6,890	2,449	64,45	181,33	2,551
9	PMM 3000 kg/ha+ $P_{90}K_{60}N_{90}$	6,720	2,394	64,37	180,70	2,562

The research data on the dynamics of field humidity changes depending on the application of ameliorant and fertilizers at different stages of triticale development, given in table 2, show that in the variants of separate application of ameliorant (4,5) the field humidity in the tillage layer exceeded the checking variant by about 3%.

The same indicator, in comparison with the tester, was noticeably higher in the variants of separate application of fertilizers (2,3), which is explained by the fact that mineral fertilizers, in addition to being a source of nutrients, also play a water-regulating role in plants. In options 6, 7, 8, 9, where the ameliorant and fertilizers were applied together, the humidity of the field was significantly higher than both the tester and their separate application variants.

From this, it can be concluded that the ameliorant introduced into the soil regulates the hydro-physical properties of the soil, the fertilizers, affecting some physiological properties that condition the drought resistance of plants, in the 0-15 cm layer of the soil, create moderate water-nutrition conditions, which guarantee a high yield of autumn triticale in conditions of high atmospheric tension (see table 3).

As the presented data show, the application of ameliorant and fertilizers, both separately and in combination, had a significant effect on the grain yield of autumn triticale. According to the data of field experiments, the highest yield was recorded in the 5th variant, where 1500 kg of PMM was introduced into the soil before sowing per hectare and 90 kg of P_2O_5 and 60 kg of K_2O per influencing substance, and 120 kg of nitrogen in the form of nutrition-in spring. The yield of this variant exceeded the checking variant by 68.2%. From the data of the same table, it can also be seen that the efficiency of applying a high (3000 kg/ha) dose of ameliorant decreased. A separate application of this dose (variant 5) increased the yield of triticale compared to the tester by 15.7%, while 1500 kg/ha increased triticale yield by 15.9% (variant 4). The efficiency of a high dose of nitrogen fertilizer (120 kg/ha) introduced into the soil in the form of nutrition is also low-0.5%.

Table 2

Dynamics of change of moisture reserve in triticale sowing depending on fertilization and ameliorant application (%)

N	Variant	Stages of observation					The average
		Before sowing	Thriving, growing	Growing of spikes	Ripening	Before harvesting	
1	Without PMM and (NPK)	22,48	27,24	27,12	26,18	20,28	24,66
2	$P_{90}\ K_{60}\ N_{120}$	22,32	28,82	28,44	28,29	22,78	26,13
3	$P_{90}\ K_{60}\ N_{90}$	22,45	28,79	28,51	28,30	23,03	26,21
4	PMM 1500 kg/ha	21,98	29,72	29,68	29,45	24,33	27,03
5	PMM 3000 kg/ha	22,45	29,78	29,65	29,46	24,14	27,09
6	PMM 1500kg/ha +$P_{90}\ K_{60}\ N_{120}$	21,65	31,15	31,43	32,15	25,18	28,31
7	PMM 1500 kg/ha+ $P_{90}\ K_{60}\ N_{90}$	22,32	31,25	31,45	32,18	25,28	28,49
8	PMM 3000kg/ha +$P_{90}\ K_{60}\ N_{120}$	22,44	31,27	31,25	31,35	26,25	28,51
9	PMM 3000kg/ha+ $P_{90}\ K_{60}\ N_{90}$	21,94	32,17	31,15	31,35	26,35	28,59

Table 3

The effect of fertilizers and ameliorant on the actual yield of autumn triticale

N	Variant	Grain yield by repeats, centner/ha			Average grain yield centner/ha	The deviation of the crop from the tester	
		I	II	III		c/ha	%
1	Tester (st)	39,0	38,0	39,5	38,8	0	0
2	$P_{90}K_{60}N_{120}$	52,5	51,0	51,9	51,8	12,9	33,2
3	$P_{90}K_{60}N_{90}$	53,0	52,0	49,7	51,5	12,7	32,7
4	PMM 1500 kg/ha	43,0	46,5	45,5	45,0	6,2	15,9
5	PMM 3000 kg/ha	46,7	43,0	45,0	44,9	6,1	15,7
6	PMM 1500kg/ha+ $P_{90}K_{60}N_{120}$	66,0	65,5	64,5	65,3	26,5	68,2
7	PMM 1500 kg/ha+ $P_{90}K_{60}N_{90}$	63,5	66,3	64,5	64,7	25,9	66,7
8	PMM 3000kg/ha+ $P_{90}K_{60}N_{120}$	54,0	55,3	53,5	54,2	15,4	39,6
9	PMM 3000kg/ha+ $P_{90}K_{60}N_{90}$	57,2	59,4	58,0	58,2	19,4	50,0

Conclusion

In the post-forest dark brown, medium capacity soils of the foothills zone, in arid conditions, in the minimum tillage system, in the autumn triticale field of scientifically based crop rotation, 1.5 t/ha of ameliorant (PMM), considered as a soil improver, applied to the soil before sowing, and N_{90} applied to the soil in the form of nutrition in the spring in conditions of mineral $P_{90}K_{60}$ background, provides a high yield of triticale grain at low cost.

Reference

1. Kachinsky N.A. Soil, its properties and life (1975) //Moscow.- 290p.
2. Hayrapetyan E.M. Geology (2000) //Yerevan.- 456 p.
3. Galstyan S.B., Aleksanyan V.A. Environmental agriculture (2018) //Stepanakert.- 175p.
4. Galstyan S.B., Vartanyan A.A., Tokmajyan V.H., Garshkova N.E., Tokmajyan H.V. The Regulation of Water Regime of Field Crops and Decorative Woody Plants in Natural Conditions by Applying Polymer-mineral Raw Material, Bulletin of High Technology, Shushi (2020)// N1 (11).- p. 11-15.
5. Vartanyan A.A., Markosyan M.V., Tokmajyan V.H., Galstyan S.B. Management of Processes of growing winter crop in rainfed conditions using innovative Technological solutions //Bulletin of High Technology, Shushi (2020)// N2(13).- p. 3-13.
6. Badalyan V.S., Galstyan S.B. The effect of fertilizers on several anatomical and physiological characteristics of winter wheat, Bulletin of Agricultural Sciences (1987)// N1.- p 20-26.
7. Nebytov V.G., Kolomeichenko V.V. Grain yield depending on weather conditions and fertilizers. Agriculture: (2005) //N2.- p. 24-25.
8. Agafanov E.V, Gromakov A.A., Maksimenko M.V. Application of complex fertilizers and nitrogen fertilization over winter wheat (2012) //Agriculture: N7.- p.16-17.
9. Nikolaev V.A., Mazirov M.A., Zinchenko S.I. Influence of different processing methods on agrophysical properties and structural condition of soil. Agriculture: (2015) //N5.- p.18-20.
10. Petrova L.N., Driger V.K., Kaschaev E.A. Influence of agricultural cultivation technologies on productive moisture content and soil density in crop rotation. Agriculture: (2015) //N5.- p.16-18.
11. Viktorov D.P. Small practice on physiology of plants (1983) //Moscow.- 133p.

12. Likhov A.M., Tulikov A.M. Workshop on agriculture with the basics of soil science (1976) //Moscow.- 190p.
13. Khachatryan A.R. Methods of agronomic research (2002) //Yerevan.- 236 p.

Reference

1. Качинский Н.А. Почва, ее свойства и жизнь (1975) //Москва.- 290с.
2. Հայրապետյան Է.Մ. Հողագիտություն (2000) //Երևան.- 456 էջ:
3. Գալստյան Ս.Բ., Ալեքսանյան Վ.Ա. Հողապահպան երկրագործություն (2018) //Ստեփանակերտ.- 175 էջ:
4. Galstyan S.B., Vartanyan A.A., Tokmajyan V.H., Garshkova N.E., Tokmajyan H.V. The Regulation of Water Regime of Field Crops and Decorative Woody Plants in Natural Conditions by Applying Polymer-mineral Raw Material, Bulletin of High Technology, Shushi (2020)// N1 (11).- p. 11-15.
5. Vartanyan A.A., Markosyan M.V., Tokmajyan V.H., Galstyan S.B. Management of Processes of growing winter crop in rainfed conditions using innovative Technological solutions //Bulletin of High Technology, Shushi (2020)// N2(13).- p. 3-13.
6. Բադալյան Վ.Ս., Գալստյան Ս.Բ. Պարարտանյութերի ազդեցությունն աշնանացան ցորենի անատոմա-ֆիզիոլոգիական մի քանի առանձնահատկությունների վրա, Գյուղատնտեսական գիտությունների տեղեկագիր, (1987)// N1.- էջ 20-26:
7. Небытов В.Г., Коломейченко В.В. Урожайность зерновых в зависимости от погодных условий и удобрения. Земледелие (2005) //N2.- с. 24-25.
8. Агафанов Е.В, Громаков А.А., Максименко М.В. Применение комплексных удобрений и азотной подкормки над озимую пшеницу. Земледелие (2012) //N7.- с.16-17.
9. Николаев В.А., Мазиров М.А., Зинченко С.И. Влияние разных способов обработки на агрофизические свойства и структурное состояние почвы. Земледелие (2015) //N5.- с.18-20.
10. Петрова Л.Н., Дригер В.К., Кащаев Е.А. Влияние технологий возделывания сельскохозяйственных культур на содержание продуктивной влаги и плотность почвы в севообороте (2015) //Земледелие N5.- с.16-18.
11. Викторов Д.П. Малый практикум по физиологии растений (1983) //Москва.- 133с.
12. Лихов А.М., Туликов А.М. Практикум по земледелию с основами почвоведения (1976) //Москва.- 190с.
13. Խաչատրյան Ա.Ռ. Ագրոնոմիական հետազոտությունների մեթոդներ (2002) //Երևան.- 236 էջ:

ԲՆԱԿԱՆ ՊԱՅՄԱՆՆԵՐՈՒՄ ՏՐԻՏԻԿԱԼԵԻ ՋՐԱՅԻՆ ՌԵԺԻՄԻ ԿԱՐԳԱՎՈՐՄԱՆ ՆՈՐ ՏԵԽՆՈԼՈԳԻԱՅԻ ՄՇԱԿՈՒՄ ՄԵԼԻՈՐԱՆՏԻ ԵՎ ՊԱՐԱՐՏԱՆՅՈՒԹԵՐԻ ԿԻՐԱՌՄԱՄԲ

Գալստյան Ս.Բ., Օհանյան Հ.Ա., Մարտիրոսյան Կ.Հ.
Շուշիի տեխնոլոգիական համալսարան

Երաշտի կործանարար հետևանքները մեղմելու նպատակով նախալեռնային գոտու խճագլաքարային մուգ շագանակագույն հողերում, որտեղ միջին տարեկան

տվյալներով թափվում են 520-560 մմ տեղումներ, իսկ տարեկան միջին ջերմաստիճանը կազմում է 10,80C, աշնանացան տրիտիկալեի ցանքում փորձարկվել է հողի ջրային ռեժիմը կարգավորող մելիորանտի և լրիվ (NPK) պարարտանյութերի կիրառման ագրոնոմիական և տնտեսական արդյունավետությունը:

Փորձարարահետազոտական ճանապարհով բացահայտվել է պոլիմերահանքային հավելանյութի և պարարտանյութերի դրական ազդեցությունը հողի ջրաֆիզիկական հատկությունների և բույսերի երաշտադիմացկունության վրա, ինչի արդյունքում բարելավվել է բույսերի ջրային ռեժիմը, և աշնանացան տրիտիկալեի հատիկի բերքը, ստուգիչի համեմատությամբ, ավելացել է 66,7%-ով:

Բանալի բառեր. հողի ստրուկտուրա, դաշտային խոնավություն, տրանսպիրացիա, տրիտիկալե, բերքի տարրեր, բերքատվություն:

РАЗРАБОТКА НОВОЙ ТЕХНОЛОГИИ РЕГУЛИРОВАНИЯ ВОДНОГО РЕЖИМА ТРИТИКАЛЕ В ЕСТЕСТВЕННЫХ УСЛОВИЯХ С ПРИМЕНЕНИЕМ МЕЛИОРАНТА И УДОБРЕНИИ

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С целью смягчения разрушительных последствий засухи на щебнистых темно-коричневых почвах предгорной зоны, где среднегодовое количество осадков составляет 520-570мм, а среднегодовая температура – 10,8°С, на посевах озимой тритикале исследована агрономическая и экономическая эффективность внесения мелиоранта и полных (NPK) удобрений, регулирующих водный режим почвы.

Экспериментально-исследовательским путем было выявлено положительное влияние полимерно-минерального субстрата и удобрений на гидрофизические свойства почвы и засухоустойчивость растений, в результате чего улучшился водный режим растений, а урожайность зерна озимой тритикале, по сравнению с контрольным, увеличилась на 66,7%.

Ключевые слова: структура почвы, полевая влажность, транспирация, тритикале, элементы урожая, урожайность.

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