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IMPROVING SOIL MOISTURE CAPACITY WITH POLYMERIC-MINERAL MATERIALS FOR GROWING PLANTS

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Abstract

The amount, quality and cost of growing plants are determined not only by biological traits, but also by environmental factors such as soil moisture capacity. Water, nutrients and air, in addition to light and heat, are required for regular plant development. The authors conducted tests to boost the field moisture capacity of various substrates using polymer-mineral materials (PMM) inserted into them, allowing them to conserve additional water for plant development and survival gathered through precipitation or artificial irrigation.

Keywords: water, soil, polymer-mineral material (PMM), soil moisture capacity.

Introduction

Water content in the soil, as well as meteorological circumstances, have a substantial impact on the viability of cultivated plants [1]. Regular monitoring of soil moisture, plants and the work done with them can be ensured by collecting data from the objects and processes under study and transferring it to application and database servers for processing and making timely management decisions on creating favorable conditions for plants and regulated application of fertilizer, water, heat, light and other vital factors.

It should be noted that plants grow normally in structural soils that have adequate levels of water, fertilizer and air. Aside from traditional approaches, agro-industrial firms have repeatedly attempted to improve the physical and chemical qualities of soil through the use of ameliorants. The authors of this study recommend utilizing PMM to raise the field moisture capacity of the soil by 20-30% in order to greatly minimize the consumption of water and other resources by plants while increasing their viability and productivity.

The fertility of the soil is determined by its structure, porosity, moisture capacity, absorption capacity and the presence of organic and mineral colloidal particles. The more such particles there are, the greater the soil's absorption capacity, and thus the volume of water and salts and gases dissolved in it, which plants ingest through the root system for development.

The plant dies fast if there is a lack of water and air in the soil with enough nutrients. Therefore, the soil receives the necessary amount of water and air, which are located in the pores and occupy up to 40% of its volume depending on the soil. Pores fewer than 3-5 mm in size are generated in the soil to boost agricultural efficiency. At the same time, water is mostly kept in small pores, whereas air is required in large pores for the respiration of plants, their root systems and the microorganisms that live in them.

Plants' water regimes are defined by physical processes running in the soil when water is given to it, such as movement, consumption, moisture conservation, position in different horizons, etc.

The main sources of moisture in the soil in boghara conditions are precipitation (rain, snow and hail), groundwater and rivers. The type of plants, topography, tillage system, winds, air and soil temperature, its filtration and moisture capacity can be boosted by PMM, which slowly dissolves in water, increasing its viscosity and, thus, surface tension, which leads to better water retention in the pores.

Water penetrates into the soil via big pores and is subsequently filtered into the depths via microscopic pores and capillaries due to gravity. The filtration rate in sandy soils is substantially higher than in clay soils. If the soil has a lot of calcareous chemicals, little particles clump together and form huge porous grains that may withstand crushing and water erosion for a long time. Cracks occur between the grains, resulting in clay soils with strong filtering capabilities. The higher the porosity of the soil, the more water and air it can hold. The higher the porosity of the soil, the more water and air it can hold. The maximum amount of water collected in the soil corresponds to the soil water holding capacity criterion (total soil moisture capacity), which must be distinguished from the soil's water-holding capacity (soil field moisture capacity), which is determined by the amount of moisture remaining in it after complete water saturation until the final free squeeze.

Deep tillage, extensive layer loosening and turning, crop rotation, organic and mine fertilizers, limestone treatment of acid soils and gypsum treatment of saline lands are all traditional ways for maintaining soil structure.

Deep tillage, with intensive loosening and layer overturning, is the main cause of negative events, resulting in rapid degradation. Today, in order to retain, improve and raise soil fertility, farmers use low and zero tillage, as well as science-based crop rotation, ameliorants, organic and mine fertilizers.

The authors conducted laboratory experiments with substrates to streamline the mode of water change in them using PMM developed at the Research Institute of Mechanics of Moscow State University, in order to increase the yield of grown plants and reduce their cost in rainfed and greenhouse conditions and also gave recommendations to provide plants with water in arid regions.

In agriculture, plants will be grown in natural rainfed conditions for a long time to come, so the efficient use of solar energy, moisture from precipitation and groundwater are the most important tasks in such regions of the Earth. Solar energy and soil nutrients are abundant, especially in the Republic of Armenia, but water is frequently a concern. In areas where agriculture is practiced without irrigation, natural disasters frequently cause major harm to agriculture, increasing the danger of desertification and crop loss. Processed dacite tuff rich in potassium, as well as organic fertilizers against a background of mineral ameliorants, were utilized to rapidly improve the physical and chemical qualities of soils in the Republic of Armenia. It is important to note that adding PMM to the soil will allow offering plants with more water and air while also slowing or stopping the process of soil degradation.

The high yield of cultivated crops is the most important characteristic of agriculture, which affects their cost and increases competitiveness. Due to the lack of water, the yield of many plant species in rainfed conditions is significantly lower than in irrigated soils.

Boghara is a land in the zone of irrigated agriculture used for cultivation of agricultural crops without irrigation, i.e. using rainfall. Boghara occuies the piedmont plains and the borders of oasis, where drought-tolerant grain, fodder and melon plants are produced [2, 3].

Therefore, in locations where crops are produced without irrigation, the application of PMM will considerably enhance the water regime of feeding of grown plants, potentially leading to a considerable increase in output, particularly by lowering the root system of grown plants.

By chemical composition water-soluble synthetic and natural polymers include such elements as cellulose, gelatinized starches, polyethylene oxides, alginates, polyacrylamides and polymers. Soil moisture is influenced by the type of plant, topography, agricultural system, presence of winds, ambient temperature and other factors. The filtration coefficient is a feature of soil permeability in relation to filtering water, and it equals the water filtration rate at a unit pressure gradient with a linear filtration law. Carboxyvinyl and vinyl alcohol increase the viscosity of water.

The property of the soil to retain water by sorption and capillary forces is called water-holding capacity, which is associated with the formation of productive water reserves in the soil. Plants easily use only 30 % of the field moisture capacity for their nutrition, and when the moisture capacity decreases to 13 %, their wilting begins. In addition, such indicators as evaporation, buoyancy properties of the soil, etc., are important for plants.

Thus, all the physicochemical and biological properties of the soil are important for plant growth, which acquire their best performance in structural soils, where water, air and fertilizers are simultaneously contained in sufficient quantities.

Agrotechnical procedures and the incorporation of artificial structure formers into the soil are used to restore and preserve soil structure. Sowing perennial grasses, tillage in the ripe condition of the plant, liming acidic soils, gypsuming solonetzic soils and applying mineral and organic fertilizers are all agrotechnical approaches for enhancing soil structure.

To prevent signs of soil deterioration in boghara agriculture and to regulate the water and food regimes of cultivated crops, the authors used laboratory research to determine the nature of the impact of PMM on the parameters of the water regime in soil without plants over time.The study's goal is to increase the moisture capacity of the soil and keep an additional amount of water in it from precipitation and groundwater for growing plants without or with a drastically decreased irrigation regime. The effects of introducing PMM into the soil can be used to grow a variety of plants in boghara and greenhouse environments. They will aid in increasing yields and lowering production costs, particularly resource costs, so increasing the competitiveness of agro-industrial firms.

Laboratory and field tests on the cultivation of various plants, conducted by many partner companies and agricultural institutes with PMM in the soil in recent years, indicate the possibility of: increasing their viability and productivity by 20 % or more, reduction by 20 % or more of their fallout, fertilizer consumption, as well as the cost of water supply, electricity, human and other resources [4, 5, 6]. It should be noted that with an increase in the capacity of agricultural machinery, the intensity of agriculture, the depth of land cultivation, the use of enhanced loosening and traditional overturning of the reservoir, conditions are created for significant depletion and degradation of the soil. Therefore, minimal or no tillage, with the use of effective agrotechnical measures, such as science-based crop rotations, use of organic fertilizers and ameliorants, is becoming important.

Thus, PMM is proposed to boost yield while decreasing plant-growing costs [3, 7]. Studies were conducted to increase the field moisture capacity of the soil by injecting PMM into it in various doses in compliance with the Technical Requirements of the customers involved in growing plants. Based on non-plant tests, recommendations on the technology of their laying for growing plants in open ground and greenhouses are made.

Conflict Setting

Various formulations of water-accumulating soil mixtures with additions of H1 and PMM materials were tested, their properties were studied, pilot batches were created for testing, and recommendations were made to agricultural enterprises and agricultural institutes on the technology of laying PMM in the soil, allowing them to retain additional moisture in it, increasing its moisture capacity by 10 – 30%.

The present study presents the outcomes of water retention in soil without a plant to increase its field capacity. The moisture capacity of the substrates was assessed both without and with PMM additions added in different amounts, as well as the dynamics of the decrease in soil moisture content in containers due to filtration and evaporation. The containers were filled with water until full capacity was reached, and then the total amount of water pouring from the perforations at the bottom of the container was studied until the field water capacity was reached.

The experiments indicated the possibility of acquiring an increased volume of water in the substrate with PMM in contrast to the substrate without it, as well as how it varies over time due to evaporation.

To obtain reliable results, studies were carried out with soil without plants indoors at room temperature and humidity (under natural conditions, wind and temperature changes significantly affect the rate of evaporation) in order to exclude the consumption of liquid for the consumption of moisture by plants, i.e. only changes in the collected water in the substrate affecting the dynamics due to evaporation and filtration of water from the container were analyzed. The soil moisture capacity and weight of water in the substrate were determined over time based on the manner and amount of PMM used.

To determine the moisture capacity of the substrate, a container with a mixture of soil with PMM was placed in a bath with water to fill it up to the maximum value to achieve a volume of liquid corresponding to the total moisture capacity of the soil. Previously, the substrate of natural moisture was weighed. The time during which the container was kept in the water bath varied over a wide range: from 15 minutes to 1 day. Next, the container was placed on the surface to drain excess water and reach the field capacity, when the flow of water from the holes in the bottom of the container stops. The difference between the results of measurements of the mass of the "dry" mixture and thus impregnated mixture in the container was determined by the absolute and relative values of the collected water.

After soaking in the bath to field capacity, containers with substrate without PMM and with PMM collected water, which was retained throughout time. The masses of the containers were measured until the balance revealed a mass close to the value corresponding to the masses of the containers before the experiment began (water in the containers evaporates at a rate depending on the temperature and humidity of the air in the room, and the thickness of the substrate layer in it). The tests were carried out multiple occasions.

Below are the measurements of the masses of containers with H1 and PMM.

Options for mixing the substrate with H1 and PMM for laboratory testing:

1. Substrate without PMM and H1, to control the measurements of mixture options.
2. Substrate with H1 in a ratio of 1 to 4 (75 g of H1 and 225 g of the substrate are mixed: the total weight of the mixture is 300 g).
3. Layer of 0.5 cm or 1 cm of H1 was laid on the bottom of the container (layer of H1 more than 2 cm: practically does not let water through).
4. Two-layer laying: layer of substrate mixed with H1 is placed in the bottom of the container, and a substrate without H1 is placed on top.

5. Three-layer laying: bottom and top layers of substrate with H1, and between them a layer of pure substrate.
6. PMM and H1 rods with a diameter of 0.5 to 1.0 cm and a depth of up to 10 cm inside the substrate.

The number of rods and their dimensions are determined by the amount of PMM or H1 introduced into the substrate (1 g of H1 absorbs up to 1.5 g of water, and 1 g of PMM - up to 20 g of water). The larger the diameter of the rod, the slower moisture is absorbed into it. An increase in the number of rods at a fixed diameter leads to an increase in the surface area for water absorption. From above, the rods were covered with a small layer of substrate.

It is important to note that a mixture of the substrate with PMM or H1 can be used repeatedly because the materials are practically washed out of the soil little, their modest concentration should not lead to plant withering due to excess moisture, and pores for air must be left in the substrate.

The amount of water taken up by the substrate is defined as the difference between the mass of the container with the substrate before filling it with water and the mass of the container after filling with water and then settling it to field capacity. The substrate, before watering, was in a state of natural humidity in the room at room temperature. The relative moisture capacity of the substrate in the container is calculated as the ratio of the amount of water to the initial mass of the substrate of natural moisture before it is saturated with water (in %).

Research Results

Experiment №1

A substrate weighing 300 g in a container at room temperature was wetted with water in a bath for 10-15 minutes. After the “extra” water was glassed through the bottom, the container weighed 430 g, that is, we additionally have 130 g of water, compared to the weight before irrigation, which completely evaporated and flowed out of the container in 20 days (the accuracy of measuring weights is 5 g). The results of the experiments are shown in the table 1.

Table 1

Mass of water in a container with soil without H1

Days	0	1	2	3	4	5	6	14	17	18	20
Mass of water in the container, g	130	100	90	85	80	75	70	40	30	20	0
Relative moisture capacity, %	43.3	33.3	30	28.3	26.6	25	23.3	13.3	10	8.33	0

Experiment №2

A substrate weighing 5 kg was deposited in two 225 g containers: one with 5 kg of land and no PMM, and the other with 4.99 kg of land with 10 PMM. The containers were then filled with 3 liters of water, allowed to drain for 15-20 minutes, and the mass was measured (tab. 2).

Table 2

Changes in the mass of water in containers

Days	0	1	4	8
Weight of 1 container	5975	5875	5850	5780
Weight of 2 container with PMM, g	7060	6145	6120	6045

The extra water in the second container fell to 270 g on the second day and then varied little. The large discrepancy on the first day is explained by the poor filtering due to PMM, and once all of the surplus water was gone, the weight of the container began to decrease due to evaporation, but the weight of additional water in the second container with PMM essentially did not change and was equal to 265 g. We have a 265x 100/5000 = 5.3 % increase in soil moisture capacity, and when we compare it to the amount of water left in the first container on the eight day (5780 g – 5225 g = 555g), we see that 265x100/555 = 47.75 % of the water in the second container is more than in the first, and in a month, when the weight of the first container returns to what it was before watering, 265 g of water will remain in the second one. As a result, PMM enables to gather additional water and store it for an extended period of time.

Experiment №3

Experiment with 5 containers weighing 15 g: with clean earth, two containers with earth with PMM, and two containers with earth with H1 (in the first 400 g of earth without material, in the second and third in 400 g of earth added 2 g and 3 g PMM, and in the fourth and fifth added 15 g H1 and 23 g H1, respectively). 200 g of water was poured into the containers, weighed after 15 minutes (tab 3, first column).

Table 3

Changes in the mass of water in containers

Days	1	4	6	10	11	18	24	31	33	36	38
Weight of the first container 505 g	495	490	485	480	475	465	450	430	425	415	405
Weight of the second container 535 g	520	515	510	505	500	485	470	450	440	430	420
Weight of the third container 600 g	600	520	510	505	500	490	475	455	450	440	430
Weight of the fourth container 525g	510	505	500	490	485	475	465	445	435	425	420
Weight of the fifth container 555 g	535	535	530	520	515	500	485	465	450	445	435

On the 36th day of experimentations, all of the water (200 g) in the first container practically evaporated, and the weight of the container began to diminish in the following days due to the evaporation of water that had been in the ground prior to the start of the experiments. On the 36th day all PMM containers had additional water: 15 g, 25 g, 10 g and 30 g, respectively.

Furthermore, the water in the containers continued to drop after 38 days, while the added water remained constant.

The poured water leaves the containers with PMM and H1 more slowly in the early days of the experiment, and the weight difference with the first container was 25 g, 105 g, 15 g and 40 g, respectively. The containers weighed 395 g on the 40th day of the test, 415 g, 425 g, 410 g and 425 g, respectively. The weight in all material containers continued to exceed the initial weight before the test. Thus, after 40 days, the land with PMM and H1 retains the ability to feed the plant due to the additionally collected water. At the same time, 20 g less water remained in the first container than before the start of the experiment.

This fact has been exploited when growing potted plants. On the 40th day, in pots where there was no material, the plants died, and on the 40th day, in pots where there was material, they watered and the plants continued their growth.

Experiment №4

370 g of soil were placed in three containers weighing 5 g each one: the first container contained clean soil of natural moisture, the second contained 0.75 g of PMM, and the third one contained 1.5 g of PMM. The mixtures were stirred and poured with water, 200 g each one, allowed to stand for an hour, then weighed. In the Figure 4. the results of observations are given. The weight of the containers decreased over time due to evaporation and filtration. The main mechanism for reducing the weight of the containers is the evaporation of water from the soil surface. After 1.5 months, the weights of the containers returned to their original values. The water remaining in them, 20 g in the second and 40 g in the third container, increased the soil moisture capacity by 5.4 % and 10.8 %, respectively. To increase the moisture capacity, we can increase the concentration of PMM in the soil.

Experiment №5

Similar results were obtained in containers with peat, to which PMM was added in different volumes (0.2 g, 0.5 g and 0.8 g) and zeolite (powder) (tab 4).

Table 4

Dynamics of mass changes in peat-filled containers

Experimentation schedule		Jan 13	Jan 21	Jan 28	Feb 4	Feb 11	Feb 17	Feb 28
		1st day	8th day	15th day	22nd day	29th day	35th day	46th day
№	Name							
1	Peat	405	390	370	330	285	210	170
2	Peat + Zeolite	430	410	390	350	305	265	200
3	Peat+Powder	430	410	395	355	310	270	205
4	Peat+0.2 PMM	425	400	385	350	305	255	185
5	Peat + 0.5 PMM	425	400	380	345	300	255	185
6	Peat+0.8PMM	445	425	405	370	325	280	215

In this paper, the authors present a new method for increasing the moisture capacity of soil using PMM, which will enable to save an additional volume of water in it due to increased viscosity, as well as various options for its laying, including determining the best amount and mixing recipe.

Polymer-mineral ameliorants are successfully used in practice to improve the physical and chemical properties of soil and increase the yield of agricultural crops; research has been conducted for decades with the goal of using potassium-rich processed dacite tuff (Danilova 2016; Tokmajyan et al. 2018; Galstyan et al. 2020), as well as on the economic and environmental efficiency of organic fertilizers versus mineral fertilizers in eggplant crops (Vartanyan et al. 2021).

Therefore, growing plants without IT-based systems for monitoring vital activity and without artificial irrigation results in non-competitive, if not completely lost, production.

Plant cultivation is crucial for countries in the continental subtropical zone. However, in difficult climatic conditions, various agrotechnical measures must be developed to achieve a high yield at a low cost. Drought, hail and other natural disasters wreak havoc on agriculture, posing the threat of desertification.

Fertility depends on the structure of the soil, porosity, moisture capacity, absorption capacity, on the presence of colloidal particles in it and of organomineral origin (Vartanyan et al. 2020b; Vartanyan et al. 2021; Avanesyan 2022).

In the conditions of rainfed agriculture, establishing the dependence of the yield on the reserves of soil moisture is important for assessing the condition of crops and plantations, for determining the effectiveness of agrotechnical measures.

Only productive moisture, a portion of the soil moisture that ensures the formation of crop yields, i.e. exceeds the moisture content of stable wilt, is very important for agricultural production. Therefore, growing plants without systems for monitoring their vital activity using IT and without artificial irrigation leads to non-competitive production, up to its complete loss.

At the same time, seed germination begins only when the soil warms up to certain positive temperatures. Photosynthesis, respiration, transpiration, assimilation of nutrients and other physiological processes are carried out in plants only in a certain range of ambient temperatures.

Air humidity, as an abiotic factor, has a significant effect on plants. With a deficiency of water vapor saturation, evaporation from the soil surface increases sharply and plant transpiration increases.

Precipitation is the main source of moisture for agricultural land. The fluctuation in the yield of cultivated crops in different regions is largely associated with fluctuations in precipitation during the growing season.

Wind is an abiotic factor of nature; it contributes to the pollination of plants, the transfer of seeds, wild trees and grasses. The negative effect of the wind is to increase unproductive evaporation from the soil surface, which causes soil drought, as well as wind erosion and increased damage to plants during droughts.

It is necessary to automate the activities of agro-industrial enterprises by selecting appropriate sensors, controllers and applied information systems that are appropriate to the target architecture and IT strategy in order to determine the characteristics of the soil and environment, as well as manage the processes of growing plants [8].

In order to prevent soil degradation in rainfed agriculture, regulate the water and food regimes of cultivated crops and reduce production costs, ICT is required that informs and performs certain actions in a timely manner to solve problems, in addition to introducing PMM into the soil to improve the parameters of the water regime and increase yields, plant-growing tasks were assigned.

Humidity sensors, PH meters, dosimeters and executive valves are provided to maintain a comfortable state of plant development and are implemented in the form of the Internet of Things, which turn on according to a set time schedule or at the time of a precedent and transmit information to the data processing center.

Humidity sensors, PH meters, dosimeters and executive valves are provided for maintaining a comfortable state of plant development and are implemented in the form of the Internet of Things, which turn on according to a set time schedule or at the time of a precedent and transmit information to the data processing center.

Depending on the method and amount of the applied ameliorant, the specific and volumetric mass of the soil, porosity, moisture capacity, absorption capacity, humidity, displacement and inaccessible amount of water for plants in the soil, dynamics of changes in humidity during the vegetative period, field germination of seeds and safety of plants during the growing, period are recorded the number and mass of nodule bacteria on the roots of the plant, its mass, biological and total yield.

Traditional forms of land cultivation lead to an increase in the rate of humus splitting, pulverization of the arable layer, destruction of soil aggregates, loss of moisture, increase in the cost of resources for growing plants, etc.

Experiments with PMM were conducted in the Moscow Region when growing flowers, cuttings of fruit trees, in the Krasnodar Territory on the Black Sea coast when planting young apple trees and plums with different amounts of PMM (250 g, 300 g, and 350 g PMM) under a tree and in the Republic of Armenia for the cultivation of winter wheat (100 - 200 PMM per m^2 of soil), where the main source of water is rainfall and wells, as well as in other regions.

The Institute of Mechanics of Moscow State University began to develop such mixtures back in the 80s of the twentieth century. The Kavelast material based on bentonites and polymer additives was tested in the cultivation of various crops in the arid regions of Georgia and Uzbekistan, where small-scale production of the material was established. Experiments have shown that the introduction of 1% kavelast into the soil leads to significant increase in productivity, reduction in the consumption of irrigation water and fertilizers.

However, with the collapse of the USSR work was halted and material production ceased. In recent years, research has resumed, and new materials such as PMM and H1 have been developed for growing plants in open and closed ground, as well as in containers with various substrates.

Conclusions

The amount of water retained in the soil can be controlled by adding a polymer-mineral material (PMM) to the substrate, which reduces the frequency of watering by half or more, and under certain circumstances, even eliminates watering completely during dry

periods. Tests conducted without plants allow us to recommend methods for adding PMM to the substrate to increase its water-holding capacity, as well as the optimal amount for obtaining a specific volume of additional water. Specifically, in soil with a field water-holding capacity of 30%, 2-3 g/kg PMM can be added to increase it by 20-30%, providing an additional 60-90 g of water per kg of soil, which is equal to the volume of water the soil easily releases to the plant without this material.

References

1. Eritsyan SK, Farsiyan NV (2016) Influence of fertilizers consequences and meliorantson winter wheat in the conditions of Askeran region. Bull Sam State Agr Ac 1(3):28-32.
2. Tokmajyan VH, Markosyan AK, Khalatyan AA, Khachatryan NB (2018) The perspectives of providing the storage of irrigation water in the case of using water collecting additives in the ground. Bull of High Techn, Shushi 2(6):9-14.
3. Avanesyan EV (2022) Evaluation of Accumulation of Additional Water Resources in the Substratum Available for Plants. Bull of High Techn 1(19):3-9.
4. Danilova TN (2016) Regulation of the water regime of grainy sandy loam soils and moisture supply of plants with the help of water-absorbing polymers. Agro phys, Yerevan 1:8-16.
5. Galstyan SB, Vartanyan AA, Tokmajyan VH, Gorshkova NE, Tokmajyan HV (2020) The regulation of water regime of field crops and decorative woody plants in natural conditions by applying polymer-mineral raw material. Bull of high techn, Shushi 1(11):11-15.
6. Vartanyan AA, Shakhnazarov AA, Tokmajyan VH, Sarukhanyan AA (2020) Increase of soil moisture storage by applying polymer-mineral material. Bull of high techn, Shushi 1(11):3-10.
7. Vartanyan AA, Markosyan MV, Tokmajyan VH, Galstyan SB (2020) Management of Processes of Growing Winter Crop in Rainfed Conditions Using Innovative Technological Solutions. Bull of High Techn 2(13):3-13.
8. Vartanyan AA, Petrova AA (2021) Design and implementation of a decision support system at an agro-industrial enterprise. Horizons of the economy. Publ house "Econ" 6(65):46-51.

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Հողում պահպանված ջրի քանակը կարելի է կարգավորել ավելացնելով պոլիմերահանքային նյութ (PMM): Այդպիսով հնարավոր կլինի կիսով չափ կամ ավելի նվազեցնում ոռոգման հաճախականությունը, իսկ չորային ժամանակահատվածներում՝ ամբողջությամբ դադարեցնել այն: Բույսերի բացակայության պայմաններում անցկացված փորձարկումները թույլ են տալիս մեզ առաջարկել PMM մելիորանտի կիրառման արդյունավետ մեթոդներ: Մասնավորապես, դաշտում 30% ջուր պահելու ունակություն ունեցող հողին կարելի է ավելացնել 2-3 գ/կգ PMM՝ 20-30%-ով մեծացնելով ջրի կուտակման ծավալը: Այդպիսով, հողի մեկ կգ զանգվածում, լրացուցիչ կկուտակվի 60-90 գ ջուր, ինչը հավասար է այն ջրի այն ծավալին, որը հողը հեշտությամբ տալիս է բույսին, առանց այս նյութի:

Բանալի բառեր. ջուր, հող, պոլիմերահանքային նյութ, հողի խոնավունակություն:

ПОВЫШЕНИЕ ВЛАГОЕМКОСТИ ПОЧВЫ С ПОМОЩЬЮ ПОЛИМЕРНО-МИНЕРАЛЬНЫХ МАТЕРИАЛОВ ДЛЯ ВЫРАЩИВАНИЯ РАСТЕНИЙ

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Количество воды, удерживаемой в почве, можно регулировать, добавляя в субстрат полимерно-минеральный материал (ПММ), который сокращает частоту полива вдвое и более, а при определенных условиях даже полностью исключает полив в засушливые периоды. Испытания, проведенные без растений, позволяют рекомендовать способы внесения ПММ в субстрат для повышения его водоудерживающей способности, а также оптимальное количество ПММ, для получения определенного объема дополнительной воды. В частности, в почву с полевой водоудерживающей способностью 30% можно внести 2-3 г/кг ПММ, чтобы увеличить ее на 20-30%, обеспечивая дополнительные 60-90 г воды на кг почвы, что равно объему воды, который почва легко отдает растению без этого материала.

***Ключевые слова*:** вода, почва, полимерно-минеральный материал (ПММ), влагоемкость почвы.

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