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EFFECT OF ELECTROMAGNETIC FIELD ON DIFFERENT PERIODS OF COTTON DEVELOPMENT UNDER NORMAL AND WATER SHORTAGE CONDITIONS

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Z.Yu.Ibragimova, Sh.B.Yuldasheva Effect of electromagnetic field on different development periods of cotton in normal and water tank conditions. Monograph.- 2023, 69 pages

The monograph researches scientific proposals and practical recommendations in determining the effect of electromagnetic field on the physiological indicators of cotton under conditions of water shortage.

The monograph is mainly aimed at professors, specialists, scientific staff, graduate students, interested in revealing the effect of EMI treatment on growth, development and productivity of plants grown under normal and water deficit conditions at the flowering stage of some cotton varieties and lines that differ in terms of resistance to agricultural water deficit in the country. intended for students.

Reviewers:

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INTRODUCTION

The ever-increasing demand for agricultural products in the world leads to the widespread use of various methods of increasing crop productivity. Especially in recent years, the active use of various chemical preparations that accelerate the growth and revitalization of crops leads to damage to the soil and a decrease in the quality of the crop. In this place, the development and implementation of modern methods that ensure high and quality harvest from cultivated crops in the agro-industrial system is considered an urgent task.

In all cotton-growing countries in the world, water shortage is one of the abiotic factors that negatively affect productivity, and scientific research in this field is focused on the selection of varieties resistant to these factors, as well as on the management of physiological processes in plants. Electrostimulation in optimal conditions increases the fertility of seeds, accelerates plant growth, increases resistance to negative environmental influences, which can lead to an increase in productivity by 5-20%. The use of electromagnetic pulses (EMI) as a factor that accelerates the growth and development of plants during the pre-sowing treatment of various plants is considered as an important task.

In the years of independence in Uzbekistan, as a result of the implementation of major reforms in the field of agriculture, intensive, fast-ripening and productive varieties of cotton were created, and innovative methods such as drip irrigation and mulching were introduced in the irrigation system. However, due to limited water resources and global climate change in our republic, a number of problems arise in the complete recovery of seed in the spring.

CHAPTER I. MECHANISMS OF INFLUENCE OF ELECTROMAGNETIC FIELD ON PLANT ORGANISMS

§-1.1. Mechanisms of action of the electromagnetic field on living organisms and the effect of magnetic storms

So far, there are more than 30,000 reports on the effects of low-frequency electromagnetic fields (EMM) on biological objects, but their number is increasing year by year, because information on its primary mechanisms of action is not available. There are two types of uncertainty in the effects of ultra-low EMM on organisms, one is the problem known as kT, and the other is the low biological efficiency of ultra-low EMM production (around 70%).

So far, there are more than 30,000 reports on the effects of low-frequency electromagnetic fields (EMM) on biological objects, but their number is increasing year by year, because information on its primary mechanisms of action is not available. There are two types of uncertainty in the effects of ultra-low EMM on organisms, one is the problem known as kT, and the other is the low biological efficiency of ultra-low EMM production (around 70%). [37; 176-c], [38; 176-c].

EMM can be shown to cause biological reactions. Most biochemical reactions and processes are not thermally activated, but enzymes, ligand to receptor and receptor channel complexes, changes in membrane potentials, light quanta through photosensitive molecules, etc., when a very weak energy effect occurs and initiates the process, which in turn may require several times higher energy consumption. The same concept of thermodynamics is not characteristic for living organisms. Many processes occur in living organisms, and they are not in a significantly equal state, so any external extreme influence can change it in the desired direction. An enzyme can accelerate both direct and reverse reactions. These are some autooscillation processes, for example, the autooscillation potential in the membranes of pacemaker cells of the sinusoidal bundle of the heart, which in some pathological conditions become extremely sensitive to external extremely low influences, for example, to magnetic storms or non-contact cardiac pacemakers.

The effects of weak EMM on living organisms are explained by the authors with variations, which are magnetic storms and man-made EMM effects [68; 973-978-c], [71; 103-116-c], [87; 78-79-c], [88; 113-c].

In fact, the difficulty of measuring low-frequency EMM exposure in studies is that the data do not provide information on the induction of EMM constant content, and about the location of constant intermittent intensity in studies. Most researchers do not take into account that the permanent magnetic field of the Earth has a significant effect on the steel structure of the building, when EMM magnetic storms and electrical devices (for example, a magnetic stirrer) have a greater effect on the experimental generator.

Some authors suggest to take into account the "physiological window", in which biological systems become extremely sensitive to low-frequency electromagnetic signals. [145; 922-924-p], [124; 638-641-p], [125; 371-389-p].

Magnetotaxis in bacteria, orientation of animals (insects, birds) has been proven to be carried out by EMM using nanoparticle magnetite (100 nm). Magnetite is in magnetosomes, and it has a magnetic moment. Magnetosomes are found in most living organisms, especially in the brains of animals and humans. It is assumed that low EMM effects on biological organisms may involve molecules that capture iron atoms: bacterio-phytoferritins, ferridoxins, other metalloprotenoid compounds and enzymes. [20; 51-c], [36; 97-c]. The magnetite crystals transmit a torque to the external magnetic field. In this case, their thermal fluctuations kT energy is high compared to EMM with low rotational energy.

Emphasizing the participation of magnetosomes in the effect of EMM, he put forward the idea that the stochastic resonance of magnetosomes occurs at low frequencies (100-200 nTl). According to V. N. Bingi [19; 265-300-c] this idea may solve the kT problem and be an answer to some low-frequency EMM non-resonance effects and geomagnetic variations. According to them, this idea can solve the problems of magnetic biology [19; 265-300-c], [121; 217-238-p].

According to the work of the authors, biologically effective low-frequency EMMs are considered cyclotrons for calcium, magnesium and other biologically important ions and move in the geomagnetic field. In other "resonance" ideas, the main target for EMM is calcium ions.

The protein in the oral cavity behaves as an electron in an atom and emits radiation in the EMM radio frequency range, and the intensity of this radiation changes cyclotron and effective frequencies under the influence of the Earth's permanent magnetic field, and based on it, a biological effect occurs. The authors propose the idea of "magnetic parametric resonance", which opposes Libov's idea of ion oscillations at cyclotron frequencies. [53; 815-825-c], [32; 947-949-c].

Currently, there are only a few studies on the influence of solar activity variations on various physico-chemical systems [12; 71-79-c], [117; p. 161-162]. In particular, in studies [27; 926-929-c] changes in water parameters under the influence of magnetic storms, morphology of phosphate crystals, precipitation of chlorine and acrylonitrile test, turbidity of protein mixtures, volume variations of sulfuric acid in the battery, reactions of changes in amplitude variations of self-oscillation, size of the amplitude of macrofluctuation activity of a number of enzymes, chemical reactions speed, changes in the rate of diffusion of metal ions in gelatin gels, changes in noise parameters of semiconductors. Based on this evidence, it is possible to imagine that magnetic storms have an effect on living organisms [95; 10-14-c], [91; 861-876-c], [60; 119-c].

In fact, there is information about the effect of magnetic storms on the functional state of people. In particular, there is information about cases of increased hypertensive crisis and accidental death under the influence of magnetic storms [59; s. 1-12], [71; s. 103-116], [75; p. 188]. They mainly occur due to acute heart rhythm disorders. Also, magnetic storms are considered a pacemaker affecting the heart rhythm, in which microflora nitrite-reductase activity is stimulated in the oral cavity of a person, and the formation of nitric oxide increases, due to its transfer to the blood, a vasodilator effect occurs, causing a heart attack [50; 772-784-c], [119; p. 427-434].

Little is known about the effects of magnetic storms on plant organisms. There is information that the activity of the 11-year solar cycle is related to the productivity of grain plants. According to him, yield and quality of seeds correspond to the years of high solar activity, and vice versa, cases of indicators falling to the lowest level are shown. Particularly high correlations have also been shown for Earth's compatibility with the EMM. In addition, short-term productivity variations are not only with the 11-year period, but also with quasi-periods: 2.3; 3.2; It is returned to correspond to 5-6 years [104; 773-774-c], [105; 775-782-c], [85; 811-815-c].

According to the authors [64; 41-44,52-c], [65; 587-592-s], [72; 110-c], [73; 136-c] in the meristem of Allium cepa L, large multinucleated cells, even a giant cell and its giant nuclei were formed under the influence of geomagnetic field. According to the authors, an increase in the amount of DNA in polyploid cells is observed in differentiated functional tissues. It is said that the occurrence of such a condition in their meristematic cells can be considered as an adaptation reaction to sudden changes in the Earth's magnetic field. The formation of giant cells and their subsequent death or survival may be the following hypothesis. The geomagnetic state is such a stress state that compensatory structures, i.e., giant nuclei, are formed, then fragment and are absorbed by neighboring cells, and it is important for the additional utilization of assimilation, which is the only endogenous nutrition.

Authors who studied the effects of magnetic storms and low-frequency EMI on wheat grain [23; 63-76], [30; 738-744], [93; 750-758-s] show that both of these effects can affect the germination of grains naturally and artificially at the initial germination of seeds from dormancy, and on the contrary, long-term effects of EMM at later stages can slow down growth while maintaining cell activity.

§-1.2. Effect of EMM on plant organism

The authors treated seeds based on electrostimulation with high-frequency (1.-2450 MHz), low-frequency (about 50 Hz) or unipolar shock discharge, which has a wide spectrum frequency (very low) power of 10...600 kV/m, 2-10 Sec exposure. Even when authors write about the effects of direct electric or magnetic fields on plants, they usually refer to low-frequency alternating fields. Because it periodically causes the movement of the cytoplasm and the movement of charged molecules in the cell. In addition, during processing with a permanent area, it is assumed to move the material to be placed in this area [16; s. 510-587], [35; S. 1806-1810], [122; p. 153-156], [128; p. 41-54].

Several types of low-frequency electromagnets (Mag-30, Biomag-1S, MK37-2, Faust, etc.) were produced in the former Soviet Union and by the RF, and they were recommended as seed growth stimulators.

Scientific sources have enough information about the effect of low-frequency EMM on seed germination and plant growth [18; 677-691-s], [21; s. 40-50], [116; p. 1-10], [118; p. 34-45]. These data provide information on whether stimulation or inhibition of EMM depends on the intensity of EMM and its parameters, as well as the time of exposure. We will touch on them briefly.

Co-authors [80; 45-s], [89; s. 93-99], [117; 161-162-p] studied the effect of low-frequency (30-33 Hz), maximum amplitude of sinusoidal EMM (magnetic induction 30 mTl, which occurs as a result of 7-10 minute rotation of the magnetic rotor) on seeds of different varieties. It was shown that in all cases, the germination of low-fertilizing seeds was reported to increase by 3-60% and 10-300% of shoot mass under the influence of EMM. In seeds with 100% fertility, the mass of sprouts increased by 20%. EMM treatment induced hydrolytic activity of esterase in 100% fertile seeds and no such activity in low-fertilizing seeds. EMM treatment of saturated swollen seeds in all cases resulted in the acceleration of alkalization of the surface of the pulp, resulting in activation under the influence of an electromagnetic field. EMM treatment inhibited mold growth on germinating seeds in all cases. According to the authors' conclusion, the sensitivity of seeds to electromagnetic treatment occurs when the conditions for transition of proteins from the dependent state to water are created and the effect of electromagnetic stimulation on the process is intensified. In turn, the release of proteins enhances the recovery processes in those with low fertility.

It should be noted that in magnetobiology and in general researches related to the effect of low-frequency field on biological objects, such a situation has arisen: in the opinion of most scientists, the effect of electromagnetic field does not raise doubts, and insufficient level of results in production is delaying the development of science. In studies of magnetobiology, it is shown that the non-occurrence of high-level production is caused by temperature, light, ionizing radiation, gravity, EMM backgrounds, and the GMM itself, as well as the physiological state of the object and the properties of its metabolism, are influenced by the correctable factors [89; 93-99], [74; s. 59-80], [83; p. 769-771], [60; 119-s].

According to the authors [54; 94-s], [151; 694-s], [156; 580-s], if geomagnetic field screens using 100 times permalloe screens are used in studies of low-frequency field effects on plant seeds, production is stabilized. In this regard, in studies related to the study of the effects of low-frequency fields, the use of various methods that reduce the influence of external factors reduces the influence of the electromagnetic field background. Alternatively, electromagnetic field induction, which is of higher order than the Earth's magnetic field, can be used.

The authors say [10; 334-c] Gravitropic response (GTR) of 3-day lettuce root depends on the frequency of EMM treatment. Application of different frequencies of Sa+2, K+, IUK+, gibberellin ions, ABK, Su+2 ions compatible with the cyclotron can activate or inhibit root growth. Similar studies confirm the hypothesis of EMM effect resonance on bioobjects [39; 832-849-c], [144; p. 205-216].

§-1.3. Mechanisms of adaptation of cotton plant to adverse conditions

Lack of water as an abiotic factor has a devastating effect on the plant organism due to the adaptation of large areas of land to irrigation. In order to maintain the productivity of plants from the lack of water resources, it is required to develop and introduce new water saving technologies. The land part of the globe is characterized by water shortage or extreme drought in its part [25, 26; s. 500-507], [40; 256-s], [67; p. 27-29]. Such a situation is also a problem for Uzbekistan, because its main land is adapted to irrigation as mentioned above. Accordingly, the development of water-saving technologies is considered urgent, requiring scientists to strengthen research on creating drought-resistant varieties of agricultural plants or increasing the drought resistance potential of existing varieties. In most cases, such studies depend on the level of study of the relationship between genotype and environment, the existence of morphophysiological, biochemical and genetic mechanisms of adaptation of plants to drought.

Plant productivity is a complex phenotypic characteristic, which is based on many physiological, biochemical and genetic processes and their interaction, and their genetic potential is determined by environmental factors.

The selection of agricultural plants requires an organic relationship with the classical methods of selection, approaches the methods of genetics, physiology, biochemistry, biotechnology and other sciences, and can solve problems related to cytology, which establishes the internal structure of plants. Due to the regulation of nuclear and cytoplasmic genes, the biology of plant cell differentiation, morphogenesis and development is determined under the influence of the external environment [14; s. 207-212], [77; pp. 173-183]. The main goal of plant science is to create productive plant varieties with the ability to adapt.

In order to increase the yield of cotton, it is of scientific importance to study the biological characteristics of the plant mainly due to cultivation in different conditions, among them, determining the response of the plant to water shortage and its response in the reproductive phase. In the construction of new plant representatives, it is important to determine the limit of modification variation due to the reaction rate and genetic potential of organisms.

It is difficult to combine drought tolerance with plant productivity at the same time. Potential yield and environmental resistance are controlled by different groups of gene systems, and in this regard, it is required to combine them into one genotype. Estimating the range of variation in extreme conditions and defining adaptations for individual characters allows to determine the potential yield of the variety being created.

As cotton, like other agricultural plants, is subject to genetic laws in the inheritance of characters, the problem of starting material has become extremely relevant in expanding the adaptive potential of cotton. As a source of germplasm, the gene pools of wild and semi-wild cotton become important, and their use allows to solve current tasks. It is noted that the use of interspecies hybridization provides an opportunity to improve yield, technological quality of fiber and resistance to diseases, pests and adverse conditions. Introgressive representatives created with the participation of wild forms are of great importance as gene sources [66; s. 143-145], [45; 40-s], [138; s. 40-44], [146; p. 261-269].

It should be noted separately that the creation of new varieties with high productivity and drought resistance is not determined by the amount of traditional recombinants, but by principle new genetic options (recombinant). Accordingly, the creation of a genotype that is potentially productive and resistant to adverse conditions requires the development of new principled selection methods.

According to the data, the selection effect of creating new combinations of characters is the creation of new embodied quantitative characters through co-adaptation at the expense of traditional methods (achieving separations on a large number of characters through hybridization) and the crossingover process can be interfered with by exogenous factors and new types of recombinations can be achieved (drought, etc.) [42; 587-s], [69; 83-93-s]. In extreme environmental conditions, the emergence of new spectrum recombinants can change the genotypic structure of the population, because such recombinations cannot be achieved under normal conditions and conditions close to it. The method of hybridization and the incorporation of an exogenous factor increase the spectrum of genotypic variability by changing the "traditional way" of the exchange of whole chromosomes and crossing over in the process of recombinogenesis.

If the practice of hybridization is carried out under stressful conditions, the probability of emergence of resistant forms of selective importance among the hybrid representatives increases. In such cases, the selection for resistance is gamete and mu

§-1.4. Physiological-biochemical responses of the cotton plant to the influence of external environmental factors

Drought tolerant plants have high water holding capacity and accordingly, water potential is measured to determine the level of tolerance of a genotype, taking into account water availability [41; 73-c], [140; p. 7-14]. Accumulation of sugars can be considered as a non-specific response to drought and stress conditions [126; p. 1091-1112], [100; 367-c]. Ionizing radiation, laser and plasma beam physical effects on the seed, as well as treatment with trace elements and growth regulators, increase the water storage properties of plants, increase proline and related water retention, and increase their resistance to adverse conditions [47; 58-s], [142; p. 372-380]. Under water deficit conditions, the cellular expression of lea genes changes, which depends on the duration and intensity of stress [107; p. 331-338], [110; p. 227-233].

It is known that growing seeds in osmotically active solutions (sucrose, magnetite, polyethylene glycol), simulating a lack of moisture in the soil, allows the seeds to swell and absorb water from the solution under high osmotic pressure [24; s. 18-22], [94; p. 166-168].

Resistance of plants to high temperature (in drought conditions) is realized due to changes in metabolism: increase in viscosity of cytoplasm and amount of osmotic active substances, synthesis of organic acids and special proteins capable of binding ammonia, which is important because they are not decomposed by heat [115; p. 1158-1242].

The synthesis of low-molecular osmotically active substances (mono- and oligosaccharides, primarily proline, betaine, polyhydric alcohols from amino acids) and various stress proteins, osmotin, dihydrogen, and water and ion-capturing proteins also increases in conditions of water familiarity [111; p. 175-183], [113; p. 374-378], [155; 162-b].

Even a small water deficit affects the metabolism, which in turn affects the growth and development of the plant. Adaptation of plants to adverse conditions is associated with changes in the course of many physiological (transpiration intensity, tissue water balance response, signal functions of systems, lips, etc.) and biochemical (protein synthesis, amino acids, phenolic compounds, etc.) processes. Taking into account the proteins responsible for the vital activity of the cell, which interact between cells and other molecules and ensure the appearance of the character embodied in the genome, that is, the study of various proteins of plant organs allows to understand the mechanisms of plant defense reactions and to know the function of biological systems in different conditions..

Many proteins with different functions form mechanisms of plant resistance to water deficit. They were initially identified as the product of the LEA (late embryogenesis abundant) gene, which expresses the period of seed maturation and drying. Later, LEA proteins were identified in vegetative tissues of plants during water loss under water, salt and low temperature stresses. Most LEA proteins perform the water trapping function of osmolytes. The rest combine with other proteins to form a complex and perform chaperone function, protecting them from degradation. The third uses a biomembrane structure, replacing water in the pre-membrane region. The fourth binds inorganic ions, which are concentrated in the cytoplasm when the cell loses water. Aquaporin stress proteins become part of channel formers and facilitate water transport through the membrane in osmotic dependent conditions. In plants, two types of aquaporins have been identified in the plasmatic and vacuolar membrane [130; p. 109-116], [139; p. 271-273].

Functional proteins responsible for drought resistance include multiple hydrolases, including enzymes of proteolysis, protease inhibitors, and osmotic biosynthesis [126; 1091-1112-c]. Regulatory proteins are synthesized under water stress and are involved in gene expression and signal transduction. The sensitivity of cellular systems to abiotic stress is determined by the photosynthetic apparatus (FA) of plants. Although the physiological, biophysical and biochemical aspects of photosynthesis and photosystems have been thoroughly studied by local and foreign scientists, the laws of the formation of the photosynthesis apparatus and the mechanisms of the physiological-biochemical reaction to unfavorable conditions of the external environment have not been well studied. It is also important to understand the basic laws of the formation of the stress-resistant photosynthesis apparatus, to identify effective ways to increase the resistance of plants to stress factors, which in turn allows to reduce the negative impact on the productivity process [130; p. 109-116], [139; p. 271-273].

Another important environmental factor is verticillium wilt, which has a negative effect on cotton. According to the annual conditions, deaths from this disease reach 30%.

Abiotic (drought, etc.) and biotic (disease resistance) resistance traits are among quantitative traits, controlled by polygenic systems and dependent on the interaction of multiple polygenic genes. The appearance of these signs on the phenotypic surface is carried out at the level of changes in the main physiological processes.

The resistance of plants to diseases often depends on the intensity and speed of defense reactions of cotton, which is manifested in the synthesis of special low-molecular metabolites-phytoalexins. The development of the concept of phytoalexins in plant immunity made it possible to understand plant defense mechanisms in the system of "host-pathogen" pair interaction. Necrotization of tissues, rapid death of the plant part, a widespread reaction in plants are the results of the hypersensitivity reaction. This reaction is associated with the accumulation of phytoalexins, which occurs rapidly in resistant host-plant tissues and, conversely, slowly in recipient tissues.

Another important factor in the selection of drought and wilt-resistant varieties of cotton is to test the initial materials and their hybrids at the limit of resistance. The problem is that the adaptability of plants to unfavorable conditions is determined by the genotype, and its potential is not fully activated. For their activation, there must be a specific harmful factor or other stress.

It has been found by a number of scientists that exposure of the seed to one stressor increases its resistance to other harmful factors. These stressors of different natures cause skipping of the same non-specific chain reactions, which in turn increases resistance to various extreme environmental factors [126; 1091-1112-c].

Scientific sources provide enough information about non-specific reactions of plants to various stress factors [45; 40-s], [57; s. 184], [102; 160-s]. There are general concepts about the mechanisms of the effects of light with different wavelengths (ultraviolet, blue, green, red, long red) on plants [76; 464-s], [56; 512-s]. Also about low-frequency electromagnetic fields [22; pp. 553-559].

According to preliminary results, red light to cotton seeds before sowing [15; 416-423-s], [31; s. 137], [29; 389-s] and exposure to a low-frequency electromagnetic field [88; 113-p] information is given about increasing resistance to adverse environmental conditions, such as saline soil, lack of moisture, harmful insects.

Wilt resistance problems of cotton are also important in issues of increasing resistance of plants to extreme conditions. Based on the physiological-biochemical basis, the induction of resistance to cotton wilt is associated with the creation of one or another artificial intensification, in response to the infection of phytotoxin metabolites-phytoalexin, a number of studies, which are practically absent in undamaged tissues [11; 681-689], [127; p. 281-295], [133; p. 59]. However, the nature of phytoalexins formation by physical factors in low-frequency or ultra-low-frequency electromagnetic waves has been little studied.

Also, in order to determine the importance of the electromagnetic field in the life of living organisms, it is necessary to carry out research on whether the nature of the physical factor, which covers the cellular metabolism and affects the passage of most physiological processes, can affect the resistance of cotton to verticillium wilt [21; 51-c], [92; 745-749-s], [134; 281(a)-p], [148; P. 133-145].

Treatment with various chemical substances of biogenic and abiogenic nature (heavy metal salts, fungal hyphae, protein valipoid-polysaccharide complexes, etc.) allows to accelerate protective reactions in plants, in which seed treatment is carried out by spraying the substance at different stages of development [13; s. 108-110], [147; p. 153-154], [150; 328-s].

Cotton resistance to verticillium wilt is achieved by inducing the biosynthesis of phytoalexin (FA), which provides the synthesis of isohemigoxypol (IGG), which is toxic to the pathogen. The defense against inflammatory stress is the biosynthesis of FA [82; 23-s], [86; s. 19-22], [120; s. 46-50].

Ultraviolet (UVB) irradiation Stress is important in intensifying FA formation, and cotton wilt resistance can be induced by UV irradiation of seedlings and plants [129; p. 299-314], [131; p. 101-106]. But UV radiation (wavelength less than 0.4 μm) has several disadvantages. Firstly, due to the destructive effect of UV-rays on biological macromolecules, not only the pathogen, but also the host-plant element can fall into such destruction. Second, pathogen conidia are exposed to UV-irradiation to detoxify the seed, but plant infection is not inhibited after UV-irradiation. Thirdly, the process of UF-irradiation of seeds or plants is somewhat difficult, and it cannot be said to be harmless to the human body. Therefore, it is considered appropriate to create such a situation, in which the internal reserves of the plant organism against the pathogen should be fully "mobilized" in the form of intensification of FA synthesis. Accordingly, it is necessary to conduct research related to the approach and application of science-based methods to increase the resistance of cotton to verticillium wilt, and the use of harmless and simple methods for human health without macromolecular destruction.

It was found that it is possible to increase the resistance of plants to harmful factors, including short-term exposure to various types of stress factors against pathogens [46; 429-438-s], [45; 40-s], [112; 56-72 p].

The reason for this approach is that the genotype determines the limits of plant resistance to harmful environmental factors. But they are not always activated until the end. In order to activate the resistance of plants to various harmful environmental factors, methods of pre-sowing seed conditioning have been developed. Training against such environmental factors can increase resistance against another environmental factor. Its reason is the occurrence of a chain sequence of non-specific reactions in plant cells under the influence of a stress factor of different nature [8; 592-s], [63; 302-s].

There are studies devoted to electromagnetic training in increasing tolerance of cotton plant to salinity and water deficit [87; 78-79], [96; 47-49-s], but there is no information about its effect on wilt resistance. Accordingly, it would be appropriate to conduct such research. Low-frequency EMMs, which do not affect the heredity of organisms, can make seeds fertile, accelerate plant growth and development, and increase resistance to adverse conditions (including water scarcity); complex physiological, biochemical and genetic processes occur in the adaptation of plants to adverse conditions.

Determination of water potential under field or laboratory conditions is important in determining drought tolerance characteristics of plants. Because by determining the level of resistance, it becomes possible to solve problems related to their watering or other problems. For example, the amount of water potential in the leaves of a corn plant is 6 bar. around 9 bar in water shortage conditions. increases from Most varieties of the cotton plant have a water potential of 12 bar. from 18 bars. up to, and if the plant is not watered in time, it will cause it to die. In drought-resistant cotton varieties, the amount of water potential during irrigation under standard conditions is 14 bar. around, and in conditions of water scarcity it is 24 bar. can reach up to 30 bar in some drought-resistant varieties [106; 15-s], [132; p. 550], [136; p. 37-72].

So far, 54 species of cotton plants belonging to the family Malvaceae, genus Gossypium, are known. According to scientific sources, cotton types are divided into three groups, old and modern, and Australian types are distinguished. There are also cultivated annual and wild perennial cotton plant species.

4 species are mainly used as a cultural representative: medium fiber Mexican cotton - Gossypium hirsutum L., fine fiber Peruvian or Egyptian cotton - Gossypium peruvianum Cav. (G. barbadense L.), herbaceous Asian cotton - Gossypium herbaceum L., arboreal or Indo-Chinese cotton - Gossypium arboreum L. [10; 334-s], [43; C. 40], [44; C. 613-623].

Reaction to temperature. As cotton is a plant of tropical climate, it requires heat. It is very comfortable for the plant to have an average temperature of 25-30°C. Such a temperature of the day creates conditions for the rapid germination of seeds and the growth of the plant. As a result of the gradual spread of the cultural representative to the northern latitudes, it has historically caused the emergence of new varieties that require relatively little heat.

While low temperature has a negative effect on the development of the cotton plant, a low temperature of 20oC and high humidity causes the plants to die. Such a decrease in temperature is observed at the beginning of the spring months, when the temperature is 10-12°C, it can stimulate the germination of seeds, but the cotyledon leaves do not develop and the sprouts begin to die. A temperature of 13-16°C is the minimum temperature for obtaining healthy sprouts. Therefore, sometimes the long duration of low temperature in spring requires replanting of seeds.

For the normal development of the cotton plant, the maximum temperature should be 37°C. At such a temperature, the development of pods, seeds and fiber in it is also accelerated. At a temperature above 37°C, the transpiration process accelerates and the position of the leaf plate changes in relation to the sun, which in turn prevents the leaves from overheating. An increase in temperature, even up to 42-45°C, cannot prevent the development of plants, only the physiological processes taking place in them slow down. Extremely high temperature negatively affects the viability of pollinators and hinders the fertilization process [163; 231-b].

Air temperature is very important for the cotton plant, and the vegetation period of plants is inextricably linked with it.

The sum of effective temperatures should be 80-85°C in order to obtain high fertility from the plant, regardless of the very fast ripening of the variety. In this case, 10°C was taken as a low temperature, the sum of effective temperatures for ripening of very fast varieties was -450°C, and -500°C was taken for medium and late ripening varieties.

Early maturing cultivars require a total of effective temperatures in the range of 13°C to 900°C, medium maturing cultivars up to -950°C and late maturing cultivars up to 1050-1200°C. For early varieties, 50% of pods opening requires a sum of effective temperatures of -650 °C, for mid-ripening varieties - 675-685 °C, and -720-800 °C for late-ripening varieties [17; 535-b], [152; s. 172], [160; 222-s].

Reaction to light. Due to the demonstration of obvious phototropism in the cotton plant, it is considered a light-loving plant. The lack of light on cloudy days or the long duration of such conditions has a negative effect on the growth and productivity of plants. During one hour, 1 m2 of plant surface can collect 1.4-1.5 g of mass in half a day. On cloudy days, the assimilation capacity of the plant decreases by 2-3 times.

According to the authors, a 12-hour reduction in light exposure creates favorable conditions for late-ripening varieties, but it is insignificant for early-ripening varieties. Under natural conditions, the most productive period for cultivated varieties is from 8 am to 6 pm, artificially darkening after 8 am to 6 pm does not affect plants [17; 535-b], [152; s. 172], [160; 222-s].

Reaction to humidity. The drought resistance of the cotton plant is due to its well-developed root system, the ability to absorb water with high pressure and, on this basis, to be able to use it in the necessary conditions compared to other types of plants.

The transpiration coefficient of plants varies from 400 to 800, and in some cases it can be 1.5-2 times higher.

The most water consumption occurs during the flowering period of plants. During this period, there is an increase in the daily maximum dry matter. In some days, the cotton plant needs 100-120 m3 of water per hectare. spends on the field. In the period of maturity, 1 ha. 20-30 m3 of water is consumed per day.

The amount of water affects early ripening, the size of the pods, the completeness of the seeds, the length of the fiber, its yield and quality. Excess moisture has a negative effect on the ripening period and causes the formation of young shoots in plants [17; 535-b], [152; s. 172], [160; 222].

Nutritional characteristics. Although the cotton plant does not require fertile soil conditions, it can respond with good yields when supplemented with nutrients. 30 kg to 70 kg of nitrogen, 10 kg to 20 kg of phosphorus, 30 kg to 80 kg of potassium, in addition to about 50 kg of calcium, 10 kg of sulfur, magnesium, and sodium, About 2 kg of iron, 0.2 kg of boron, 0.05 kg of copper are required [28; 559-563], [55; 336-s].

Depending on the characteristics and cultivation of cotton varieties, from 25 to 50-60% of the harvest is collected at the expense of the accumulated mass in the upper part of the land, the higher the total phytomass, the higher the yield. In such cases, as we noted above, 2 percent less nitrogen, phosphorus, and potassium are used to obtain 1 t of cotton. Consumption of mineral fertilizers varies according to development or vegetation periods [28; 559-563], [55; 336], [100; C.367].

CHAPTER II. RESEARCH OBJECTS, METHODS AND CONDITIONS OF ITS CONDUCT

§-2.1. Research objects

As an object of research, farm varieties Namangan-77, Farovon, Bukhara-8, Bukhara-102, Khorezm-127, Khorezm-150, Ibrat, S-6524, Andijan-37, Sultan, AN-Bayaut-2, Vadiy-28, Navbahor L-494, L-492, L-452, L-453, L-454, L-489, L-466, Mutant-3 L-608 of the cotton genetic collection belonging to varieties and unique scientific object G. hirsutum L. Lines L-620, L-4112 were obtained.

§ 2.2 Research methods

To study the effect of EMM on the seed, 50 seeds were planted in 9 pots. The seeds in three pots were treated with EMM at 40 Hz for 20 min. EMM-treated and three control plants were irrigated with distilled water on outgrowths in pots. The plants in the remaining three pots were given a solution of auxin (IUK) at a concentration of 10-4M. After eight hours, the seeds are placed in Petri dishes or trays with wet filter paper or wrapped in filter paper in a container filled with water (the water should not touch the seeds). The seed was grown in the dark at 26°C.

After three days, the number of germinated seeds was counted to determine the germination energy, and after five days, the number of germinated seeds was counted to determine the germination capacity. Seedlings equal to the length of the seedling and the seed were considered to have germinated.

To determine the strength of growth, seeds were sown 3 cm deep in sand with 60% humidity, and the number of germinated seeds was determined after 5 days [33; C. 245-251], [153; 1984].

To determine the resistance of seeds to dehydration, 50 seeds are grown in a Petri dish using filter papers based on triplicates. For this, filter papers are osmotic at 0.8 MPa (8 bar - 0.3 M), 1.45 MPa (14.5 bar - 0.5 M) and 1.8 MPa (18 bar - 0.6 M) of sucrose solution. dampened by pressure. From the seventh day, germinated seeds are taken into account [90; S.271], [110; P. 227-233].

The amount of water in plant tissue is usually calculated as a percentage of wet mass. In the leaves of plants, depending on the climatic conditions and the stage of ontogenesis, 65-82% of water is determined in relation to the wet mass.

Plants with different drought tolerance differ from each other in terms of water exchange. Water content and dry mass of leaves were determined by weight method [79; C. 10], [90; S. 271].

First, the absolute dry weight of the bag is determined. For this, a clean bag is dried in a drying cabinet with a cover at 100-105oC. Then put pieces of finely cut leaves in the amount of not less than 5 g into the bag, cover it with the bag cover and weigh it on an analytical balance with an accuracy of 10 mg. Then the bag is placed in a drying cabinet heated to 105oC with an open lid for 5 hours. After 5 hours, the beaker is cooled in a desiccator with the lid open and weighed again with the lid closed. The leaf litter water content is calculated as % wet weight, obtained by subtracting the dry weight from the starting plant material weight.

This method is based on the fact that the leaf loses water through the process of transpiration for a short time (1-15 minutes) [90; S.271], [163; 231b]. The change in weight should be measured before the leaf withers. Measurements were made using a torsion balance. To obtain statistically reliable indicators, the transpiration measurement is determined on not less than 10 leaves. During the measurement, air blowing on the leaves should be uniform. In laboratory conditions, this condition is provided by a ventilator. A tent is kept for measurements in the field.

A leaf weighing 400-500mg should be placed on a piece of paper and drawn around with a pencil (to determine the area of the leaf) and quickly weighed on a scale. Weighing one leaf is carried out in 1 minute. The procedure is repeated 10 times, ten leaves are taken and measured. Then, starting from the first leaf, all the leaves are drawn again. Observations are carried out for 10-15 minutes, because when the leaf begins to fade, the stomata close, transpiration decreases. After that, all the leaf areas are measured, the paper cut leaf drawings are compared with the weight of the paper on the 10x10cm area. Transpiration is calculated using the following formula

$$\mathrm{T} = \frac{A \cdot 60 \cdot 10000}{B \cdot S}\ \text{г}/\text{м}^2 \cdot \text{с},$$

Leaf weight reduction during A-experiment in grams, V-experiment duration, C-leaf area in cm2. 10,000 cm2=1m2 and 60'=1 hour.

After that is the average and possible error.

If transpiration is studied 10 minutes before leaf wilting, the water retention capacity of plants is determined by the amount of water lost during 2 hours or more of dehydration. The property of water retention depends on the swelling ability of osmotic and colloidal substances included in plant cells. Under favorable conditions, water retention increases, water loss is 4-6% of the initial amount in 30 minutes. Water retention, according to Arland, is based on a method of measuring the water loss of wilting plants.

20- or 15-day seedlings of cotton leaves are cut. The cut is covered with paraffin at a temperature not higher than 50o. The plants are then weighed on a scale with an accuracy of 10 mg and left in laboratory conditions for 2-3 hours to wilt. It is weighed again and the amount of water evaporated in one hour is calculated as % in relation to the amount of the seedling that provides water evaporation. Water retention capacity of leaves is calculated according to the formula (a) a = (B □ b)/t B. B is the wet weight of the leaves before wilting, b is the wet weight of the leaves after wilting, t is the wilting time (in hours).

Water potential in leaves is determined by the refractometric method according to Maksimov and Petinov [90; S. 271].

This method is based on the selection of a sucrose solution under a certain osmotic pressure, and its concentration does not change even when leaf tissue is deposited into it. In this case, the osmotic potential of the sucrose solution is equal to the pressure of the water potential in the leaf cells.

From experimental plants in the field, 10 pieces of leaves are voluntarily collected and put in polythene bags. Then, in laboratory conditions, 10 cross-sectional particles are taken from each leaf and placed in different concentrations of sucrose solution to determine the water potential in it.

Test tubes are left for 1-2 hours. Then 100 μl of solution was taken from each test tube and sucrose concentration was determined in IRF-454 refractometer. The osmotic pressure of a sucrose solution whose concentration did not change in the presence of disks cut from a leaf was calculated as the water potential of this leaf. The concentration of sucrose solutions was calculated based on the effective conditions of 1 mol (342 g) of sucrose S12N22O11 in 22.4 l solution, osmotic pressure of 101 325 Pa (1 atm). The osmotic pressure in plant tissues is 0.5-2 MPa, (more than 10 MPa in desert plants).

2.1- table

Sucrose concentration and osmotic pressure, refractive index

Sucrose concentration	M	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1,0
	%	3,4	6,7	9,9	13,0	16,1	19,1	23,9	27,3	30,1	34,2
Osmotic pressure of sucrose	MPa	0,27	0,53	0,82	1,12	1,45	1,80	2,18	2,59	3,04	3,52
	Bar	2,7	5,3	8,2	11,2	14,5	18,0	21,8	25,9	30,4	35,2
Refractive index	Unity	1,337	1,343	1,347	1,352	1,357	1,362	1,370	1,376	1,381	1,388

This method is based on the extraction of the leaves with the help of acetone, the fractions of chlorophyll a and b, and the amount of pigments with a spectrophotometer at the appropriate wavelengths. [90; S. 271], [157; C. 365], [158; C.483].

Six leaves are cut, crushed, mixed and three samples of 200 mg are taken on an analytical balance. SaSO3 is added to the samples and ground to a powder. 80% acetone is added little by little and extracted until homogeneous.

The substance is quantitatively transferred to Schott filters marked No. 3 and No. 4 and filtered by vacuum pump into a Bunsen flask, thoroughly washing the pigments with acetone. A 20 ml test tube is placed in the flask for easy extraction of the filtrate. Then the filtrate is taken from the test tube into a 50 ml flask and brought to the required volume and the wavelength (for chlorophyll "a" - E663, or D665, for chlorophyll "b" - E645 or D649) at wavelengths, for chlorophylls a and b extinction in a spectrophotometer (E) and light absorption (D) indicators are determined.

The calculation is made according to the following formulas $C_a = 12{,}7\ E_{663} - 2{,}69\ E_{645}$; $C_b = 22{,}9\ E_{645} - 4{,}63\ E_{663}$; $C = C_a + C_b = 8{,}02\ E_{663} + 20{,}2\ E_{645}$ [90; C. 86-94] ёки $C_a = 11{,}63\ D_{665} - 2{,}39\ D_{649}$; $C_b = 20{,}11\ D_{649} - 5{,}18\ D_{655}$; $C_{a+b} = 6{,}45\ D_{665} + 17{,}72\ D_{649}$ [137; P. 350-382], [55; C. 392].

Ca – chlorophyll a concentration; Sb is the concentration of k chlorophyll b

C is the total concentration of chlorophyll a and b.

Chlorophyll concentration is calculated in mg/l. The formula is used to calculate the concentration of pigments in one gram of wet substance

K —C_a, C_b or $M_{хл} = \frac{K \cdot V}{P}$ C; V — dilution volume; P – sample weight 0,2 г.

The amount of xorophyll can be calculated by knowing the percentage of dry matter in the leaves.

The electrical conductivity of plant leaf tissue is determined by direct exposure to the leaf plate using electrode needles with a frequency of 1 kHz. In order to increase the repeatability of measurements, a clamp system with 16 electrode needles was used (electrodes with gold water flow based on computer technology). In this system, the sum of the electrical resistance between the 16 electrode needles was measured in a measuring bridge device LCR MS5308 Mastech Company (China).

2.1- fig. Measurement of the electrical conductivity of cotton leaves with a multi-needle electrode

§-2.3. Research conditions

Laboratory experiments. In a special room in the building of the Faculty of Biology of the National University of Uzbekistan named after Mirzo Ulugbek, in laboratory conditions, seeds of varieties and lines of plants differing from each other in terms of biomorphological characteristics were treated using an EMI device with a frequency of 4 Hz (1 μTl) for 30 minutes.

Then the seeds of the control and experimental plants were planted in special cups designed for two different irrigation conditions (normal and water deficit).

Control and experimental variant seedlings planted in cups were maintained for 10 days (regular-daily watering, water deficit - 2 percent less), taking into account the development of sprouted seedlings, the amount of water potential in their seedling leaves was determined using a special method.

In order to determine the resistance of seedlings to standard watering and dehydration, 10 seeds of the variety and line plants taken as research objects were planted in special cups, given the same amount of water for hydration (200 ml/g), after germination of the seeds (7-8 days), normal (50 ml/g) and water deficit (20-25 ml/g) conditions were created. During each three days, the rate of germination of seeds and their development were taken into account. The obtained results were statistically analyzed and the amount of water potential in seedling leaves was determined on 20-21 days of development.

Field experiments. The seeds of the variety and line plants taken as research objects in the experimental area were planted under standard and water deficit conditions based on the irrigation system 1-2-1 and 1-1-0, and the appropriate water deficit conditions were artificially created, that is, the irrigation conditions during the pre-flowering and pre-ripening periods of the plants. limitation is implied.

The experimental field is a clear gray soil with a low humus content, which is irrigated before, medium sand according to the granulometric composition, and seepage water is located deep (10.0 and more meters). The terrain is slightly sloping, non-saline, naturally affected by verticillosis. Limited field wet capacity (ChDNS) was taken as equal to 22.5%, the total volume of water used for irrigation in the 1-2-1 scheme, together with seed water, was 4500-5000 m3/ha, and in the 1-1-0 scheme - 2800- It was 3000 m3/ha. The picture is attached.

Fig. 2.3. The period of seed germination

Bio-morphological indicators were determined simultaneously in field conditions in experimental and control variant plants in the periods of plant budding, flowering and maturation, and were subjected to statistical analysis in laboratory conditions. Agrotechnical activities were carried out using the same and generally accepted agrotechnical methods under both standard and water deficit conditions [58; C. -351], [141; P. 62-64].

Mineral fertilizers were given by feeding 3 times before planting, during planting and during the growing season (1st feeding - at the beginning of tillering, 2nd at mass tilling, 3rd at the beginning of flowering). The rate of annual consumption of mineral fertilizers was pure N - 250 kg/ha, P2O5 - 180 kg/ha and K2 O - 115 kg/ha.

Namangan-77, Farovon, Bukhara-8, Bukhara-102, Khorazm-127, Khorazm-150, Ibrat, S-6524, Andijan-37, Sultan agricultural varieties and G. hirsutum L. type as a unique scientific object were taken as research objects. The seeds of L-494, L-492, L-452, L-453, L-454, L-489, L-466, M-3 mutant and L-608, L-620, L-4112 lines of the cotton genetic collection 60 25 1 plot with 25 cells in each row was planted in 2 rows in 2 rows in each row by randomization method in normal and water deficit conditions. Cultivation between the rows and weeding were carried out in combination with irrigation. Pesticides were applied on time. Phenological observations were carried out three times according to the period of vegetation of plants, that is, during the periods of flowering, flowering and maturation of plants, and based on them, calculations were made based on the studied morphological signs. In the process of such calculations, the length of the main stem, the number of joints, the number of fruit branches, and the number of all pods were determined in identical and numbered representatives of plants of each variety and line. 3 - in phenological observations, the number of opened and unopened pods was determined. At the last stage of the vegetation period, the amount of water potential in the leaf plates of plants of varieties and lines developed under both (normal and water deficit) conditions was determined. (Figure 4).

Figure 2.4. Plants developed under normal and water deficit conditions

Bukhara-102, Khorezm-127 varieties (2015), Sultan, Ibrat varieties and L-4112, L-452 lines (2016) developed under normal and water deficit conditions, during the flowering period of the 2nd stage of the vegetation period, the seeds of which were exposed to EMI , Namangan-77, Bukhara-102, Ibrat, L-608, L-4112 lines (2017) were treated with a 4 Hz (10 µTl) EMI device for 10 days before and after treatment. then, and during the 3rd stage of maturation, reports were made according to growth and development, and indicators of control and experimental variant plants were analyzed. The length of the main stem, the number of joints and branches, the number of all pods, the number of opened and unopened pods after the 3rd phenological observation, and the amount of water potential in the leaf plate of the plants taken as the research object were determined.

Figure 2.5. Treatment of cotton by electromagnetic field during flowering period

Chimboy district of the Republic of Karakalpakstan, at the farm "Nurilla-Bazarkhan" headed by A. J. Tazhetdinov, in 2018 and 3 hectares in 2018 and 3 hectares in 2019, Chimboy-5018 seeds were treated with EMI and then planted in the field. Also, in the same order, in the "Sherjonov Murat" farm of the Takhiatash district of the Republic of Karakalpakstan headed by M. Sherjonov, in 2018, on an area of 1 hectare, and in 2019, on an area of 3 hectares, S-4727 seeds were planted on the farm area based on EMI treatment. Biometric measurements were carried out according to their growth and development during the flowering and maturation periods of the vegetation period, along with agrotechnical measures on Chimboy-5018 and S-4724 plants as a control and experiment. 100 samples were collected from control and experimental variant plants with open pods and analyzed according to economic characteristics in laboratory conditions.

The obtained data were processed using ANOVA variance statistics methods. In Microsoft EXCEL 2016, we determined the mean values and the standard error. Numerical indicators obtained based on experiments [34; C. -351] method was statistically processed. In this case, the indicators obtained for each character were analyzed by dispersion. The thesis presents the differences between the average indicators of characters and the indicators of control, experimental variant plants.

CHAPTER III. DEVELOPING A NEW METHOD OF DETERMINING WATER POTENTIAL AND DETERMINING EMM THAT ACCELERATES GROWTH

§ 3.1. Development of a new method for determining the water potential by measuring the electrical resistance of cotton leaves

The concept of "water potential" was introduced in 1960 in order to develop a single and unifying terminology of the characteristics of water movement in the soil-vegetation-atmosphere system [146; S. 922-924].

Currently, water potential is recognized as the most important thermodynamic indicators of plant water absorption, diffusion, and evaporation. This indicator reflects the resistance of the plant to water shortage.

Water potential has a dimension of pressure and its value is measured in atmospheres, bars (1 bar=0.987 atm.) or megapascals (1 MPa=10 atm). Pure water has the greatest water potential. It is conditionally accepted as "0". Solutions soil, plant cells and tissues, atmosphere water potential has a negative value. Water movement across the plant is determined by the water potential gradient; water moves to a potential soil or plant part. [57; 184 p]

There are three groups of methods for determining water potential:

1) compensatory, selection of a solution whose osmotic pressure is equal to the osmotic pressure of the plant;

2) direct measurement of the water vapor pressure on the fabric by means of a psychrometer;

3) method of using a pressure chamber. None of them are perfect and universal. [40; 256 s].

Measurements with the compensatory method and psychometer are carried out in laboratory conditions for several hours. After the development of pressure measuring chambers, it has become relatively simple to determine water potential even in the field, and this indicator is used to evaluate the tolerance of plants to drought, the need for irrigation, and other purposes.

The water potential of plant tissues consists of at least four parts; 1- the osmotic potential determined by the concentration of dissolved osmolytes, 2- the pressure potential determined by the turgor counter pressure of the cell wall, 3- the gravitational potential that forces water to move downward, 4- the matrix potential that occurs during the hydration of proteins and other biocolloids. But the main contribution to the water potential of plant tissues is added through the osmotic potential. [40; 256 s]

Existing water potential measurement methods are laborious and time-consuming. Due to the fact that water potential varies during the day and due to the climatic characteristics of the day, it is sometimes not possible to statistically reliably measure the water potential of different plants at a certain time of the day.

The basis for this is that a method for measuring the water potential of cotton leaves was developed by measuring the electrical resistance between two needle electrodes used to pierce the cotton leaf [Tonkikh et al., 2016]. However, in this method, the electrical resistance between the electrodes depends on whether the electrodes are placed across or across the vessels. Therefore, up to 10 holes per leaf and multiple leaves per plant are required to be statistically significant. Taking these shortcomings into account, a multi-needle system was developed to measure the electrical resistance of the cotton leaf. In this system, 20 needles are pierced at the same time, and the total resistance is measured in the leaf in different directions. By piercing the leaf once and counting the readings of the device within 5 seconds, the resistance of the leaf was reliably measured.

Considering that the electrical conductivity of the leaves depends on the location of the electrode (toward the upper and lower leaf veins), a 20-needle electrode system was developed that pierced the leaf from different places. Comparative measurement of electrical resistance of leaves at a frequency of 1 kHz using LCR MS5308 universal instrument from Mastech (China) and water potential measurement using selected osmotic solutions of sucrose showed that there is a relationship and is represented by a straight line

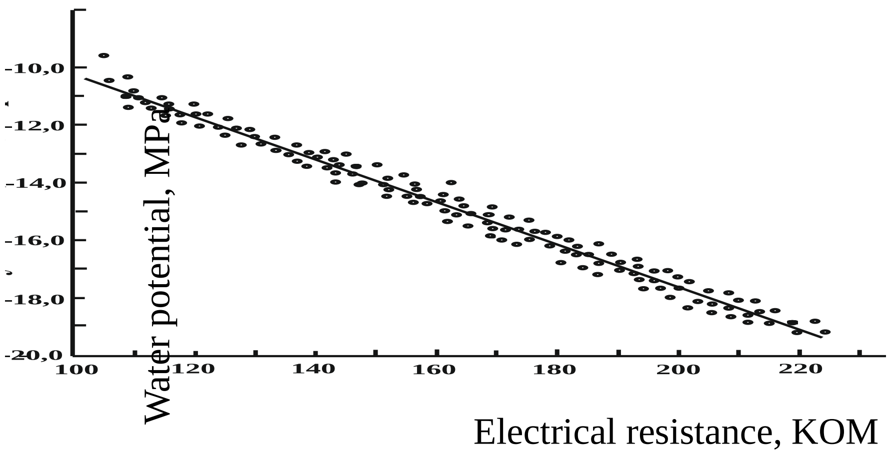
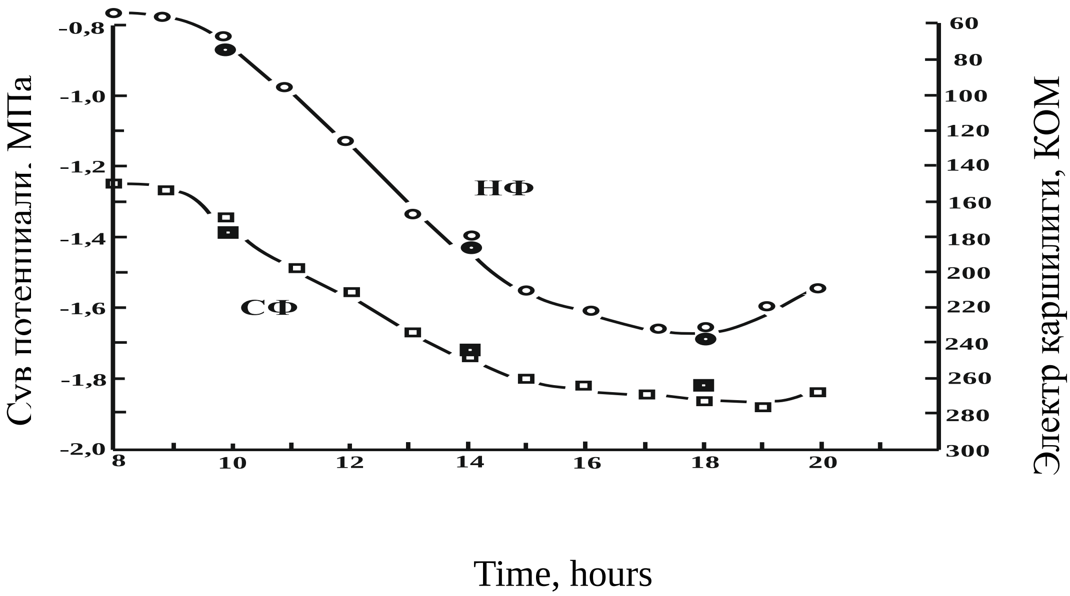


Figure 1. Relationships between the water potential and their electrical resistance of leaves of different varieties of cotton.

This made it possible to measure the water potential with some precision by measuring the electrical conductivity of the leaves, and in addition, it took 30 seconds to measure the electrical conductivity of six leaves of a single plant.

This allows the water potential to be partially accurately measured by measuring the electrical conductivity of the leaves, and one measurement takes 30 seconds. To test the capabilities of the method, we measured the electrical resistance of Sultan cotton cultivar leaves grown under normal (NF) and low (SF) water supply, hourly throughout the day. Based on the figure in graph 1, the water potential was determined using electrical resistance. For control, at 10 hours, 14 hours and 18 hours, 4 leaves were cut from experimental and control plants, and their water potential was determined by refractometric method. The results are shown in Figure 2.



3.2 - picture. Electrical resistance and water potential of leaves of Sultan variety of cotton grown under normal and water deficit conditions.

Colored circles and squares represent refractometrically determined water potential and control seed values with dotted lines. Mean values of 3 experiments ± mean square deviation are presented.

As can be seen from the figure, the water potential of plants decreases in absolute values during the day, and this decrease is increased with water deficit (SF).

Therefore, based on the comparative study of the cotton leaf water potential, it was shown that the time-consuming electrical conductivity measurement can be replaced by the method of measuring the electrical conductivity of leaves at a frequency of 1 kHz. In order to evaluate the water potential during the day, it is necessary to measure it in the morning, and in the evening at 1800 hours to determine the drought resistance of the plants.

§ 3.2. Searching for the most effective electromagnetic fields that accelerate plant growth

The stimulating effect of electromagnetic fields (EMF) as a result of pre-sowing treatment of seeds of various plants has been known for many years, and manuals on this method have been created and included in textbooks [9; 304 pp.]. Various methods of EMM treatment have been recommended in the literature. The seeds are processed by rotating magnets on a stationary and electromotive shaft or by passing them through trays with permanent magnets. The main constant electric and magnetic field is treated with the magnets of the sinusoidal EMM single-phase and three-phase rotating stator motors with a frequency of 50 Hz. The seeds were treated with pulsed EMMs of sinusoidal fields at different frequencies, from low to high frequencies and with different characteristics, etc.

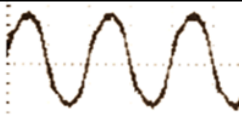
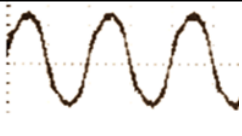
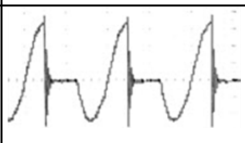
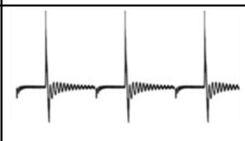
In 2011, the literature devoted to the study of EMM effects on living organisms amounted to 40,000 [8; 592 p.], and now it has reached 45,000. In this diversity, it is difficult to compare the effectiveness of EMM types. Due to the fact that various sources of electromagnetic fields are described in the literature and it is difficult to compare the data of these experiments, in order to choose the most effective of them, the question of experimental study of EMM sources described in the literature arose. Old cotton seeds with a low germination rate were selected for the experiment, because they are more clearly affected by electromagnetic fields.

Similar experiences Lukyanova S.V. i dr. [2016] in S-4727 variety and Khatamov M.M. conducted by [2021] on the variety S-6524. To confirm the data of these authors, we conducted similar experiments on the Sultan cotton variety.

We investigated the effects of four commonly used sources of electromagnetic field and the most commonly used frequency of 50 Hz in a seed germination test (Table 3.1). For comparison, we used frozen seeds in a phytohormone auxin solution.

3.1- table

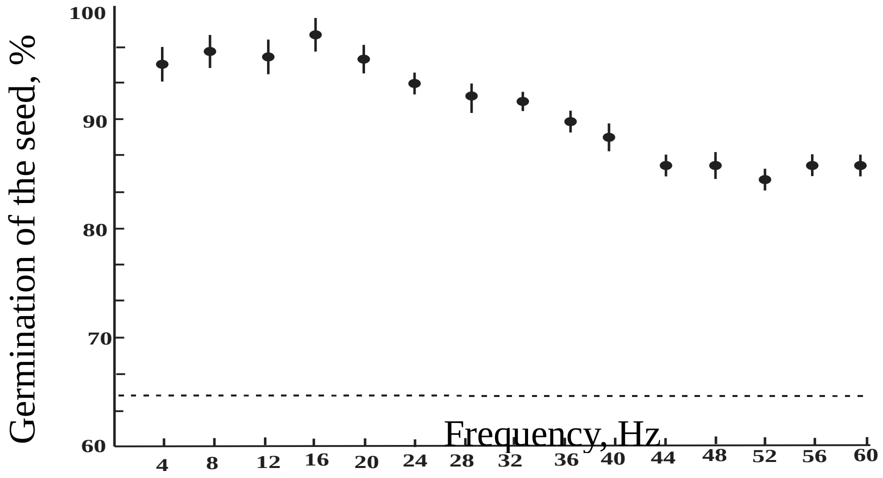
Comparative performance of different types of EMM and indole acetic acid (IAC) on germination of Sultan cultivar of low germination cotton

	Oscillogram EMM	Growth energy,%	Growing up, %	Growing up,%
Control		62,5 ± 2,3	74,8 ± 2,9	43,1 ± 1,8
ISK 100μM		83,4 ± 2,5	92,4 ± 2,5	74,6 ± 2,4
Sinusoidal EMM of a 45 Hz, 1 mTl magnetic stirrer		79,4 ± 1,8	85,5 ± 2,8	65,7 ± 1,6
Sinusoidal EMM of a 50 Hz, 1 mTl inductor		76,3 ± 2,1	83,7 ± 2,6	64,3 ± 2,2
Sinusoidal pulsed EMM of 50 Hz, 0.5 mTl inductor		84,7 ± 2,2	92,2 ± 2,1	70,7 ± 2,3
50 Гц, 10 мкТл Импульсли ЭММ		87,3 ± 2,4	96,3 ± 2,2	74,4 ± 2,5

Reminder. Mean values of 4 experiments ± mean square deviation are presented.

As can be seen from the table, the EMI field turned out to be more effective. Like auxin, it primarily accelerated seed germination and, moreover, affected the sinusoidal field 100 times less intensively (around 10 μT). It is known that sinusoidal fields of low frequency of 50 Hz do not propagate far from the inductor, so the seeds must be located near the inductor. Electromagnetic pulses propagate further from the antenna due to the high pulse filling frequency (5-40 kHz), and therefore the seeds can be placed within a radius of about 1-3 m from the wire that acts as an antenna. The frequency range of 4-20 Hz was found to be the most effective. Since it is easy to tune the 4 Hz frequency by ear and monitor the radiation with a radio receiver on long waves, we used this frequency in the following experiments. Therefore, in this work, the data of the previous authors were confirmed, and it became known that low-frequency electromagnetic pulses are the most effective for treating plants with an electromagnetic field.

Summary. Based on our experiments, it was found that the most effective treatment with pulse EMI at a frequency of 4-20 Hz before planting seeds (Fig. 3).



3.3. picture Dependence of seed germination of Sultan variety of cotton on the impact of pulsed EMM at different frequencies.

The main goal of our research is not only to study the effect of EMM on different developmental periods of plants, but also to study the resistance of plants to dehydration. The water potential in the leaves of the cotton plant is a key indicator in the study of plant drought tolerance..

IV – CHAPTER. EFFECT OF ELECTROMAGNETIC FIELD UNDER NORMAL AND WATER DEFECTIVE CONDITIONS AT DIFFERENT STAGES OF COTTON PLANT DEVELOPMENT

§ 4.1. Effects of low-frequency EMI in laboratory conditions on some physiological characteristics of cultivars and lines grown under two different (normative and water deficit) conditions

It is known that stress (hardening) of seeds before sowing increases the resistance of plants to various negative environmental factors [56; C.-512]. Treatment of cotton seed with electromagnetic field (EMM) before planting can increase the sensitivity of plants to salinity [87; C. 78-79] and to Wilt [96; C.-47-49] was observed to increase the resistance. The purpose of this chapter is to investigate the effect of EMM pre-planting treatment of cotton seeds on plant tolerance to moisture deficit at early stages of development.

There are a number of methods for evaluating drought tolerance of plants. One of them is based on the cultivation of seeds in sucrose solutions with high osmotic pressure to simulate physiological water deficit. By determining the percentage (%) of germinated seeds in solutions with high osmotic pressure, it is possible to determine the relative resistance of varieties to drought at the germination stage.

Plant resistance to water deficit in the developmental stage is evaluated from the rate of development (plant height, number and size of joints, intensity of transpiration, etc.) under normal and water deficit conditions.

Table 4.1 below shows the seed germination of lines and cultivars grown in different sucrose solutions with different osmotic pressures.

Table 4.1

Seedling germination in sucrose solutions with different osmotic pressures simulating moisture deficiency of cotton lines and cultivars exposed to EMI before planting

Research object	Variant	Germination of seeds, %					
		Concentration of sucrose					
		water	0.3 M 8 bars	0.5 M 14 bars	0,6 M 18 bars	0,7 M 22 bars	0,8 M 26 bars
S-6524	N	82,3±2,4	70,4±2,6	61,5±2,5	45,4±2,5	23,7±2,8	5,5±1,6
	T	90,3±3,2	88,1±3,3	82,4±3,4	68,7±3,5	42,1±3,2	22,3±3,3
L-492	N	89,1±2,9	85,3±2,4	78,4±4,3	52,5±4,2	18,5±4,6	2,4±0,4
	T	93,4±3,8	90,6±3,5	85,4±4,3	70,2±5,3	30,3±2,4	13,6±2,4
AN-Bayaut-	N	98,4±1,5	89,3±4,5	80,2±3,5	63,2±4,7	13,7±2,3	2,0±0,3
	T	95,4±2,6	92,8±4,3	88,2±3,2	72,2±4,6	28,6±3,2	8,4±1,7
L-4112	N	96,2±4,4	89,3±4,2	61,4±4,1	22,5±2,3	7,9±1,3	0
	T	97,1±3,2	92,4±3,2	78,4±3,8	52,6±3,4	25,3±2,7	5,3±1,5
Valley-28	N	92,3±2,7	85,4±4,5	53,5±4,4	18,8±2,8	4,1±0,8	0
	T	95,5±3,8	90,4±4,2	72,4±4,1	33,3±2,8	20,3±2,5	4,2±1,2
L-608	N	94,7±4,6	83,3±4,6	34,7±2,8	10,5±1,8	0	0
	T	94,5±4,7	91,5±4,2	62,6±3,7	25,4±2,1	3,2±1,2	0
Baghdad	N	99,3±3,6	82,3±3,2	55,4±4,8	6,2±1,5	0	0
	T	98,4±4,5	93,4±4,5	72,7±3,4	15,7±2,1	0	0

Note: N-control; T-experiment.

It is known from the indicators given in the table that the order of location of the lines and varieties selected as starting material in terms of drought resistance is as follows: S-6524→L-492→AN-Bayaut-2→L-4112→Vadiy-28→L-608→Baghdad. The percentage of seed germination of experimental variant plants obtained from exposure of seeds to EMI was higher in all cases compared to the percentage of control variant plants. Therefore, low-frequency EMI treatment of the seeds of the research lines and cultivars can increase their drought tolerance.

Physiological characteristics of water exchange of seedling leaves of 15-day-old seedlings can serve as an indicator of their drought tolerance, therefore, the effect of these characteristics was studied under optimal (daily watering) and insufficient (daily watering) water supply in laboratory conditions. The experiments were carried out on the most drought-resistant: S-6524, Khorezm-150, and the least resistant, Namangan 77 and Farovon cotton varieties. Table 4.2 presents the results of these experiments.

As shown in the table, seedling height decreases by 9.0-7.0% in drought-resistant S-6524 and Khorezm-150 varieties, and by 52.1-43.3% in drought-resistant Namangan 77 and Farovon varieties.

EMI treatment has been studied to increase seedling height in cotton cultivars. However, this increase is 7.7%-11.0% in drought-resistant varieties S-6524, Khorezm-150, and 10.2-78.9% in varieties with low resistance (Namangan77 and Farovon). In contrast, pre-planting EMI treatment is most effective on low drought tolerant cultivars, leading to increased resistance.

4.2. table

Indicators of water exchange in 15-day cotyledon leaves of some cotton cultivars grown under normal and water deficit conditions.

Varieties	Water conditions	Processing	Wet weight, mg (%)	Dry weight, mg (%)	Water content, (%)	Transpiration rate, mg N2O/ g/h	Water retention, %/h	Water potential, Bar
C-6524	MC	Control	347,9±16,4 100%	58,8±1,5 16,9%	289,1±7,9 83,1%	110,7±2,4	29,2	–12,1±0,5
		EM	349,4±15,3 100%	60,1±1,5 17,2%	289,3±8,2 82,8%	125,5±2,8	28,9	–12,3±0,5
		The difference	1,5	0,3%	0,3%	14,8	0,3	0,2

	CT	Control	268,8±12,6 100%	54,3±1,2 20,2%	214,5±7,2 79,8%	93,4±2,2	22,7	−19,4±0,8
		EM	305,3±14,1 100%	57,1±1,5 18,7%	248,2±7,5 81,3%	87,7±2,6	23,1	−20,9±0,9
		The difference	36,5	1,5%	1,5%	5,7	0,4	1,5
Khorezm -150	MC	Control	310,4±15,3 100%	53,7±1,2 17,3%	256,7±8,5 82,7%	101,8±2,7	29,7	−12,8 ±0,4
		EM	316,6±14,7 100%	55,4±1,1 17,5%	261,2±9,3 82,5%	106,6±2,5	29,5	−12,5±0,5
		The differen ce	6,2	0,2	0,2%	4,8	0,2	0,3
	CT	Control	243,4±11,6 100%	49,9±0,8 20,5%	193,5±5,7 79,5%	74,4±1,7	19,6	−20,4 ±0,8
		EM	284,6±13,5 100%	53,5±1,2 18,8%	231,1±8,4 81,2%	70,2±1,8	20,1	−21,9 ±0,8
		The differen ce	41,2	1,7%	1,7%	4,2	0,5	1,5
Namanga n 77	MC	Control	288,8±13,7 100%	51,4±2,8 17,8%	237,4±7,6 82,2%	129,5±3,2	34,2	−13,7 ±0,5
		EM	300,5±14,6 100%	54,7±3,1 18,2%	245,8±9,4 81,8%	139,7±3,5	33,8	−13,1 ±0,5
		The differen ce	11,7	0,4%	0,3%	10,2	0,4	0,6
	CT	Control	195,2±9,1 100%	45,3±0,7 23,2%	149,9±7,9 76,8%	23,3±0,5	25,3	−16,7 ±0,7
		EM	257,5±12,7 100%	49,7±0,8 19,3%	207,8±9,9 80,7%	17,2±0,4	25,9	−18,6 ±0,8
		The differen ce	62,3	3,9%	3,9%	6,1	0,6	1,9
Prospero us	MC	Control	321,4±12,3 100%	55,6±1,4 17,3%	265,8±10,6 82,7%	155,7±2,8	46,6	−12,0 ±0,5
		EM	327,5±11,4 100%	58,3±1,5 17,8%	269,2±10,3 82,2%	173,5±3,2	45,8	−11,5 ±0,4
		The differen ce	6,1	0,5%	0,5%	17,8	0,8	0,5
	CT	Control	173,0±8,8 100%	44,3±0,8 25,6%	128,7±6,8 76,4%	37,8±0,4	24,4	−15,3 ±0,6
		EM	244,8±10,4	49,7±1,1 20,3%	195,1±8,4 79,7%	25,7±0,3	24,8	−17,8 ±0,7
		The differen ce	71,8	5,1%	3,3%	12,1	0,4	2,5

Mean values ± mean standard deviation from seedling measurements are presented for each cultivar.

Under water deficit conditions, leaf water content, transpiration, water holding capacity, and water potential decrease (in absolute terms, water potential increases) in all cotton cultivars.

Then the amount of water in the leaves of the drought-resistant S-6524 and Khorezm-150 varieties decreases from 83.1-82.7% to 79.8-79.5% (≈3.3%), in the drought-resistant Namangan-77 and Farovon varieties It decreases from 82.2-82.7 to 76.4-76.8% (≈6.1%).

Transpiration of drought-tolerant varieties S-6524 and Khorazm-150 from 110.7 101.8 mg N2O/gr/h to mg/ 93.4- 74.4mg N2O/gr/h (by 15.6-27.0%) , it decreases from 129.5-155.7 mg N2O/gr/h to 23.3-37.8 mg N2O/gr/h (by 82.0-75.7%) in the drought-resistant varieties Namangan77 and Farovon.

Water retention capacity of drought-resistant S-6524 and Khorezm-150 varieties from 29.9%/h to 22.7-19.6%/h (by 22.3-32.9%), drought-resistant Namangan 77 and Farovon varieties decrease from 34.2-46.6% hours to 25.3-24.4% hours (26.0-47.6%).

In the drought-resistant S-6524 and Khorezm-150 varieties, the water potential is from 12.1 - 12.8 bar to 19.4-20.4 Bar (by 60%), in the drought-resistant Namangan 77 and Farovon varieties from 13.7 - 12.0 Bar to 16, It decreases to 7-15.3bar (by 21.9-27.5%).

These data correspond to the data of the scientific literature and can be explained by the increase in the amount of low-molecular osmoprotectors (proline, mono- and disaccharides) in drought-resistant cotton varieties under water deficit conditions.

EMI treatment of the studied cotton cultivars under standard conditions and water deficit did not affect water content in primary cotyledon leaves.

In the studied cultivars, transpiration increased in primary cotyledon leaves grown from EMI-treated seed under normal water conditions, which can be explained by the development of all processes under the influence of EMI. Under conditions of water deficit, transpiration decreases due to the increase in the concentration of osmolytes and the change in the activity of the osmotic apparatus in the studied varieties.

Leaf water holding capacity, i.e. reduced water content, did not reliably change vigor grown from EMI-treated seed within the range of wilting.

The water potential of the leaves of the primary seed is almost the same (12.0-13.7 bar) in standard water conditions in all investigated cultivars and varies within the margin of error when treated with EMM before sowing. This can be explained by the fact that the water potential is related to the soil water potential and the stability of the soil water potential under normal water conditions in laboratory conditions.

In conditions of water shortage in the soil, the water potential of primary seed leaves grown from seedlings treated with EMI before sowing decreased (increased in absolute value), i.e., 1.5 bar ha.) at 1.9-2.5 bar. This situation can be explained by the increased concentration of osmolytes in the leaves.

The amount of chlorophyll in the leaves of Urugpalla. In the development of plants, photosynthesis is defined as the main system and responds quickly to any environmental change. There is conflicting information in the literature about the effect of EMI on the photosynthetic system of plants.

For example Turker M. et al. [149; P. 271-284] showed that growing corn and sunflower plants in a permanent magnetic field with a magnetic induction of 15 mT led to an increase in the concentration of chlorophyll in sunflower and a decrease in corn.

Chvarkova E.A., Tupitsina L.S. [101; C. 627-631] showed that the concentration of chlorophyll A and carotenoids in 5-day-old sprouts increased as a result of treating watercress Lepidium sativum L. with MAG-30 therapeutic apparatus (1-5mTl) for 30 minutes.

We also studied the effect of low-frequency pulse EMI on the chlorophyll content of cotton seed leaves. (Table 4.3).

4.3. table

Amount of chlorophyll a and b in seed leaves of seedlings grown under normal and water deficit conditions (mg/g of dry leaf)

Varieties	Water conditions	Processing	Chlorophyll a mg/g	%	Chlorophyll b mg/g	%	Хл.а+Хл.b
C-6524	MC	Control	12,3±0,3	100%	4,3±0,1	100%	16,6±0,4
		EM	13,5±0,3		4,7±0,1		18,2±0,4
		The difference	1,2±0,6		0,4±0,2		1,6±0,8
	CT	Control	10,8±0,2	87,8%	3,8±0,1	88,4%	14,6±0,3
		EM	12,6±0,3		4,1±0,1		16,7±0,4
		The difference	**1,8**±0,5		0,3±0,2		**2,1**±0,7
Khorezm -150	MC	Control	13,4±0,3	100%	4,2±0,1	100%	17,6±0,4
		EM	15,1±0,4		4,6±0,1		19,7±0,5
		The difference	**1,5**±0,7		0,2±0,2		**2,1**±0,9
	CT	Control	11,7±0,3	87,3%	3,6±0,1	85,7	15,3±0,4
		EM	13,6±0,3		4,1±0,1		17,7±0,4
		The difference	**1,9**±0,6		0,5±0,2		**2,5**±0,8
Namangan-77	MC	Control	9,6±0,2	100%	3,3±0,1	100%	12,9±0,3
		EM	12,0±0,2		3,5 ±0,1		15,5±0,3
		The difference	**2,4**±0,4		0,2±0,2		**2,6**±0,6
	CT	Control	9,0±0,2	93,7%	3,0±0,1	90,9	12,0±0,3
		EM	10,8±0,2		3,4±0,1		14,2±0,3
		The difference	**1,8**±0,4		0,4±0,2		**2,2**±0,6
Prosperous	MC	Control	9,8±0,2	100,0%	3,1±0,1	100%	12,9±0,3
		EM	11,6±0,2		3,3±0,1		14,9±0,3
		The difference	**1,8**±0,5		0,2±0,2		**2,0**±0,6
	CT	Control	9,1±0,2	92,8%	2,8±0,1	90,3	11,9±0,3
		EM	10,9±0,2		3,1±0,1		14,0±0,3
		The difference	**1,8**±0,4		0,3±0,2		**2,1**±0,6

As shown in the table, under conditions of water shortage, the amount of chlorophylls a and b decreased by 6.3-12% and 8.1-14.3%, respectively, these indicators correspond to the literature data [98; P. 483-485].

Treatment of seeds with EMI resulted in increased chlorophyll content in the seed leaves of the grafted cultivars under both normal and water-deficit conditions.

Therefore, treatment of cotton seed with EMI before planting increases the height of seedlings, the dry and raw weight of seed leaves, the reduction of transpiration processes in the conditions of water shortage, the ability of leaves to retain water, the water potential and the amount of chlorophyll. All this increases the resistance to water deficit in the initial stages of plant development.

§ 4.2. Effects of pre-sowing electromagnetic pulse treatment of cotton seed on cotton physiological parameters and yield under normal and water deficit conditions in field experiments.

Many papers have been published and patents have been obtained on the stimulating effects of electromagnetic fields (EMFs) as a result of pre-sowing treatment of seeds of various plants. But the stimulation mechanisms are not explained, for example, the effect of EMI on chlorophyll content was not clear until now.

In this chapter of the work, the development parameters of the field experiment under normal irrigation conditions (irrigation 1:2:1) and under water deficit conditions (irrigation 1:1:0) were compared with 1 μT magnetically induced, 4 Hz pulsed EMI (20 min) from planting some cotton cultivars. the effect of pretreatment was studied.

4.4. table

Indicators of water exchange in 15-day-old seedling leaves of some cotton cultivars grown under normal and water deficit conditions

Varieties	Water conditions	Processing	The height of the stem, cm	%	Dry weight, mg	(%),	Wet weight, mg	(%)	Amount of water, (%)	Transpiration rate, mg H_2O/ 1 g / 1 hour	Water retention, %/h	Water potential, Bar
C-6524	MC	Control	58,4± 2,3	100,0	115,4±6,4	16,7	691,3±36,5	100,0	83,3	264,7±2,4	40,2±2,3	–17,8±0,9
		EM	62,2 ± 2,6		124,1±6,5	17,7	698,4±38,3		82,3	268,5±2,8	42,5±2,2	–18,1±1,0
		The difference	3,8 (6,5%)		8,7		7,1			3,8	2,3	0,3
	CT	Control	46,6±1,7	**79,8**	150,7±7,5	22,2	678,8±32,6	98,2	77,8	136,4±2,2	22,7±1,2	–22,4±1,1
		EM	51,7±1,9		156,9±8,5	23,0	682,3±34,1		77,0	120,7±2,6	19,1±0,9	–24,5±1,2
		The difference	5,1 (10,9%)		6,2		3,5			**-15,7**	**3,6**	2,1
Khorezm-150	MC	Control	75,3±2,3	100,0	140,2±7,2	17,3	810,4±45,3	100,0	82,7	284,8±2,7	45,8±2,5	–18,9 ±1,0
		EM	83,8±2,1		144,6±7,1	17,5	826,6±44,7		82,5	287,6±2,5	46,6±2,4	–19,1±1,0
		The difference	**8,5 (11,3%)**		4,4		16,2			2,8	0,8	0,2
	CT	Control	53,7±1,7	**71,3**	152,4±7,8	20,5	743,4±31,6	91,2	79,5	174,4±2,7	29,6±1,4	–22,1 ±1,1
		EM	55,0±1,8		147,5±7,2	18,8	784,7±33,5		81,2	160,2±2,8	26,1±1,4	–24,5 ±1,2
		The difference	1,3 (2,4%)		4,8		41,3			**-13,8**	**-3,5**	2,4
Namangan-77	MC	Control	89,6±1,7	100,0	148,3±7,3	**18,8**	788,8±33,7	100,0	82,2	329,5±3,2	54,2±2,8	–15,8±0,8
		EM	92,2±1,9		145,7±7,1	18,2	800,5±34,6		81,8	339,7±3,5	51,4±2,5	–16,1±0,9
		The difference	2,6 (2,9%)		2,6		11,7			**10,2**	2,8	0,3
	CT	Control	52,3±1,9	**58,4**	161,3±8,2	**23,2**	695,2±33,1	**88,1**	76,8	143,3±2,5	25,3±1,6	–18,4±1,0
		EM	48,3±2,6		178,8±31,2	24,7	723,5±31,7		75,3	117,2±2,4	17,4±0,8	–21,5±1,1
		The difference	-4,0 (7,6%)		22,4		28,3			**-26,1**	**-7,9**	**3,1**
Prosperous	MC	Control	89,3±2,2	100,0	124,8±6,7	**17,3**	721,4±32,3	100,0	82,7	355,7±2,8	48,6±2,8	–16,1 ±0,8
		EM	100,8±1,4		129,5±6,5	17,8	727,5±31,4		82,2	373,5±3,2	49,5±2,4	–16,5±0,8
		The difference	**11,5 (12,9%)**		4,7		6,1			**17,8**	0,9	0,4
	CT	Control	52,1±2,0	**58,3**	207,5±10,8	**35,6**	583,0±25,8	**77,6**	64,4	157,8±2,4	22,4±1,1	–19,3 ±1,2
		EM	54,3±1,8		221,5±12,1	36,4	608,8±27,4		63,6	125,7±2,3	15,8±0,7	–22,6 ±1,1
		The difference	2,2 (4,2%)		15,0		4,2			**-32,1**	**-6,6**	**3,3**

4.4. As shown in the table, the height of all plants under water deficit conditions is 20-40% lower than that developed under normal water conditions, preplant treatment with EMI reliably increases the height in both cases.

Relative water content decreased in plants grown under water deficit conditions, especially in drought-resistant Namangan-77 and Farovon varieties. EMI treatment of the seed slightly increased leaf water content.

In all studied cultivars, exposure to EMI reduced water deficit and transpiration.

Under normal conditions, plants grown from EMI-treated seeds show a slight increase in transpiration, but to an error degree. Water retention also changes accordingly.

When plants are grown under conditions of water deficit, the water potential of the leaves is in all cases 4-5 bar lower (increased in absolute terms). In drought-resistant varieties, it drops to 24 bar. These indicators correspond to literature data and can be explained by intensive increase of low-molecular osmoprotectors (proline, mono- and disaccharides, etc.) in drought-resistant cotton varieties [52; 25 p.], [98; P. 483-485].

The amount of chlorophyll in plants grown under water deficit conditions is 7-14% lower than in the control. At the same time, seed treatment before planting increases the amount of chlorophylls in all studied varieties (Table 4.5).

4.5. table

Indicators of chlorophyll a and b content (mg/g dry leaves) in cotton leaves developed under normal and water deficit conditions at the flowering stage

Навлар	Water conditions	Processing	Chlorophyll a, mg/g, %		Chlorophyll b, mg/g, %		Xl.a+Xl.b, mg/g
C-6524	MC	Control	10,4±0,3	100%	3,2 ±0,1	100%	13,6±0,4
		EM	11,9±0,4		3,3±0,1		15,2±0,5
		The difference	**1,5**		0,1		**1,4**
	CT	Control	9,8±0,3	94,2%	3,1±0,1	96,8%	12,9±0,4
		EM	11,3±0,4		3,3±0,1		14,6±0,5
		The difference	**1,5**		0,2		**1,7**

Khorezm -150	MC	Control	11,3±0,4	100%	3,2±0,1	100%	14,5±0,5
		EM	12,7±0,5		3,6±0,1		16,3±0,6
		The difference	**1,4**		0,4		**1,8**
	CT	Control	10,7±0,3	94,7%	3,0±0,1	93,7	14,0±0,4
		EM	12,1±0,4		3,5±0,1		15,6±0,5
		The difference	**1,4**		0,5		**1,6**
Namangan-77	MC	Control	11,3±0,4	100%	3,4±0,1	100%	14,8±0,5
		EM	12,8±0,4		3,5 ±0,1		16,3±0,5
		The difference	**1,5**		0		**1,3**
	CT	Control	10,5±0,3	92,9%	3,0±0,1	85,7	13,5±0,4
		EM	12,2±0,4		3,1±0,1		15,3±0,5
		The difference	**1,7**		0,1		**1,8**
Prosperous	MC	Control	10,7±0,3	100,0%	3,2±0,1	100%	13,9±0,4
		EM	11,9±0,4		3,3±0,1		15,2±0,5
		The difference	**1,2**		0,1		0,3
	CT	Control	9,0±0,3	84,1%	3,0±0,1	93,7	12,0±0,4
		EM	10,6±0,3		2,9±0,1		13,5±0,4
		The difference	**1,6**		0,1		**1,5**

§ 4.3. Effect of EMI treatment on cotton plants at flowering stage

In contrast to the effects of EMI on seeds, its effects on different stages of plant vegetative development have been poorly studied. Mainly, the effects of constant electric and magnetic fields, as well as a variable industrial frequency of 50 Hz, have been studied [61; 159-168 b], [159; P. 42-62], [165; pp. 15].

As a result of treatment of some plants with EMI at different stages of vegetative development, changes were observed in the activity of a number of enzymes (catalase, superoxide dismutase, glutathione reductase, glutathione transferase, peroxidase, ascorbate peroxidase, polyphenoloxidase, etc.) and, as a result, photosynthesis (amount and activity of chlorophyll), lipid exchange, amount of amino acids (increase of proline to increase resistance to drought, perception of blue color with cryptochrome (control of rhythm growth and flowering in vinegar), etc. [62; - S. 68-73, - S. 82-85], [165; pp. 15].

As a result, mutations were observed in the stamen hairy cells of the flowers of trade clones under the influence of EMI [162; P. 49-58], papaya Carica papaya pollen grew rapidly and formed long tubes [161; P. 276-277].

As a result, all of these led to an increase in the productivity of plants, for example, the constant treatment of the Fragaria x ananassa plant with sinusoidal EMM at a frequency of 50 Hz and an intensity of 0.1 Tl increased the number of fruits from 25.9 to 27.6 (6.5%), the weight of fruits was 208, increased from 5 g to 246.1 g (18%). A higher EMI intensity reduced the productivity of the tuber [164; P. 135-139].

Table 4.6

Growth rates of cotton plant during flowering stage from 20.07.15 to 29.07.15 after treatment with EMM under normal conditions

Varieties	Work it out work	The height of the stem, cm	The number of joints in the stem, pcs	The number of harvest kings, pcs	Number of pods, pcs	The number of open cells, pcs	1 bag Cotton is heavy gi, g	Cotton weight per plant, g	Fiber output of shi, %
Bukhara 102	Control	49,9±1,6	13,3±0,7	9,1±0,6	4,8±0,3	3,5±0,4	6,1±0,1	29,3±3,5	38,4±0,6
	EMM	51,2±2,1	14,7±0,9	9.7±0,5	5,9±0,4*	4,7±0,3	6,8±0,1*	40,1±3,8*	38,3±0,9
	The difference	1.5=3,0%	1,4=10,5%	0,6=6,6%	1,1±0,7=22,9%*	1,2=34,3%*	0,7=11,8%*	10,8=**36,9**%*	0,2=0,5%
Khorezm 127	Control	60,3±2,2	15,5±0,5	12,1±0,9	8,2±0,4	4,6±0,4	5,3±0,1	43,5±3,7	37,6±0,5
	EMM	61,9±2,8	16,0±0,7	13,2±0,4	9,4±0,5*	5,1±0,5	5,7±0,1*	53,6±4,0	37,7±0,6
	The difference	1,6+2,6%	0,5=3,2%	1,1=9,1%	1,2=14,6%*	0,5=10,9%	0,4=7,5%*	10,1=**23,2**%*	0,6=1,6%

Note: Plant mean values ± standard deviation are given.
Values with statistical significance at R< 0.05 are marked in bold.

In view of these data, this section of our study aims to investigate the effect of pulsed EMI treatment on cotton for 10 days during the first stage of flowering and boll formation. These experiments were carried out for 3 years (2015, 2016, 2017). In cotton plants grown in two types of irrigation systems: under normal water supply conditions (1:2:1 irrigation) and under water deficit conditions (1:1:0

irrigation) on July 20, at the beginning of the flowering phase, wires acting as antennas were placed along the field ditches and magnetic induction from a generator Electromagnetic pulses of less than 1 μT and 4 Hz frequency were transmitted. These pulses were continuously transmitted for 10 days until July 30. Plant development indicators were measured at the beginning of ripening on September 1-10. As an example, Tables 4.6, 4.7, 4.8, 4.9, 4.10 and 4.11 show the results of experiments conducted in 2015, 2016 and 2017

4.7. table

Growth performance of cotton plant during flowering stage from 20.07.15 to 29.07.15 after treatment with EMM under water deficit conditions

Varieties	Work it out work	The height of the stem, cm	The number of joints in the stem, pcs	The number of harvest kings, pcs	Number of pods, pcs	The number of open cells, pcs	1 bag Cotton is heavy gi, g	Cotton weight per plant, g	Fiber output of shi, %
Bukhara 102	Control	40,3±1,5	13,3±0,6	8,9±0,4	3,7±0,3	2,2±0,2	5,1±0,1	18,9±1,2	33,3±0,4
	EMM	43,5±1,7	14,4±0,7	9.1±0,6	4,2±0,3	2,8±0,3	5,7±0,1	23,9±1,5	35,3±0,4
	The difference	3,2=7,9%	1,1=8,3%	0,2=2,2%	0,5=13,5%	0,6=27,3%	0,6=11,8%	5,0=**26,4%***	2,2=6,4%
Khorezm 127	Control	51,2±2,1	15,4±0,7	11,1±0,4	6,0±0,4	3,7±0,3	4,3±0,1	25,8±1,0	32,2±0,7
	EMM	65,2±1,8	16,5±0,6	12,0±0,4	6,2±0,5	4,6±0,5	4,7±0,2	29,1±1,3	33,8±0,6
	The difference	14,0=27,3	1,1=7,1%	0,9=8,1%	0,2=3,3%	0,9=24,3%	0,4=9,3%	3,3=**12,8**%	3,1=10,0%

Note: Plant mean values ± standard deviation are given.
Values with statistical significance at R< 0.05 are marked in bold.

As can be seen from Tables 4, 6, 4.7 and 4.8, treatment with an electromagnetic field during the flowering stage of cotton under conditions of normal water supply leads to an increase in some development indicators. Treatment with EMM under normal water conditions increased yield in Bukhara-102 (25.2-37.3%) and Khorezm-127 (18.1-23.2%) varieties. Other varieties: Ibrat (5.3-25.6%), Namangan-77 (9.2-26.7%), L-4112 (12.1-15.1%) and Sultan (5.7-13 .9%) increased productivity, but the increase in productivity in the same years was not statistically reliable. Treatment with an electromagnetic field in conditions of water scarcity leads to an increase in some development indicators, which resulted in a significant increase in yield of all 6 varieties: Bukhara-102 (by 26.4-32.6%), Khorezm-127 (by 5.8 by -13.3%), Ibrat (by 21.7-24.8%), Namangan-77 (by 12.1-19.4%), L-4112 (by 13.6-26.3%) i Sultan (by 16.3-26.3%).

Thus, for the first time, in statistically reliable experiments, EMM treatment of cotton plants at the flowering stage led to an increase in some indicators of development, water deficit and, finally, an increase in the yield of the plant.

4.8. table

Development from 20.07.16 to 29.07.16 after treatment with EMM at flowering stage of cotton plant under normal conditions кўрсаткичлари

Varieties	Work it out work	The height of the stem, cm	The number of joints in the stem, pcs	The number of harvest kings, pcs	Number of pods, pcs	The number of open cells, pcs	1 bag Cotton is heavy gi, g	Cotton weight per plant, g	Fiber output of shi, %
Bukhara 102	Control	72,1±1,7	19,4±0,3	12,3±0,3	11,8±0,4	6,0±0,2	6,5±0,1	76,7±8,2	38,0±0,6
	EMM	76,2±2,3	19,2±0,8	12,9±0,4	12,8±0,5	6,6±0,3	7,5±0,1	96,0±9,1	38,2±0,9
	The difference	4,1=5,7%	-0,2=1,0%	0,6=0,4%	1,0=8,5%	0,6=10,0%	1,0=15,4%	19,3 = **25,2%**	0,2=0,5%
	Control								
Khorezm 127	EMM	65,6±1,9	15,8±0,3	12,8±0,5	8,9±0,4	5,3±0,3	5,5±0,1	48,0±6,12	37,3±0,5
	The difference	67,2±1,7	17,1±0,4	13,9±0,5	9,7±0,3	5,8±0,2	5,8±0,2	56,7±5,8	37,9±0,6
	Control	1,6=2,4%	1,3=8,2%	1,1=8,6%	0,8=10,0%	0,5=9,4%	0,4=7,4%	8,7 = **18,1**%	0,6=1,6%
	EMM								
Ibrat	The difference	57,5±2,1	16,5±0,3	12,3±0,3	8,4±0,4	5,1±0,4	4,5±0,1	37,8±3,3	37,4±0,8
	Control	67,4±1,9	16,7±0,3	12,7±0,4	10,1±0,5	5,3±0,5	4,7±0,2	47,5±5,4	38,6±0,7
	EMM	1,0=1,7%	0,2=1,2%	0,4=3,2%	1,7=20,2%	0,2=3,9%	0,2=4,4%	9,7=**25,6**%	1,2=3,2%
	The difference								
Namangan 77	Control	67,4±1,5	19,2±0,4	12,8±0,4	12,7±0,4	6,2±0,4	5,1±0,2	64,8±6,7	37,5±0,5
	EMM	69,5±1,7	20,0±0,4	15,0±0,4	13,6±0,4	7,1±0,5	5,2±0,1	70,7±8,5	38,6±0,5
	The difference	2,1=3,1%	0,8=4,2%	1,2=9,4%	0,9=7,1%	0,9=14,5%	0,1=2,0%	6,0=9,2%	1,1=2,9%
	Control								
Sultan	EMM	71,4±1,7	18,6±0,3	13,3±0,3	9,7±0,8	5,2±0,3	4,9±0,2	47,5±4,2	35,4±0,8
	The difference	71,6±2,3	19,1±0,3	13,9±0,4	10,6±0,5	5,8±0,4	5,1±0,2	54,1±5,8	35,9±1,0
	Control	0,1=0,14%	0,5=2,7%	0,6=4,5%	0,9=9,3%	0,6=11,5%	0,2= 4,1%	6,6=**13,9**%	0,5=1,4%
	EMM								
L-4112	The difference	80,3±2,2	18,1±0,3	12,5±0,4	12,5±0,5	7,1±0,2	5,5±0,3	68,7±6,5	39,3±0,9
	Control	81,3±2,1	18,6±0,3	12,4±0,3	13,4±0,5	7,8±0,2	5,9±0,2	79,1±7,0	39,4±0,9
	EMM	1,0=1,2%	0,5=2,8%	-0,1=0,8%	0,9=7,2%	0,7=9,8%	0,4=7,2%	10,4=**15,1**%	0,1=0,2%

Note: Plant mean values ± standard deviation are given. Values with statistical significance at R< 0.05 are marked in bold

4.9. table

Growth performance of cotton plant during flowering stage under water deficit conditions from 20.07.16 to 29.07.16 after treatment with EMM

Varieties	Work it out work	The height of the stem, cm	The number of joints in the stem, pcs	The number of harvest kings, pcs	Number of pods, pcs	The number of open cells, pcs	1 bag Cotton is heavy gi, g	Cotton weight per plant, g	Fiber output of shi, %
Bukhara 102	Control	62,4±2,8	13,1±0,4	12,4±0,4	8,9±0,6	5,9±0,3	5,4±0,2	44,5±5,7	34,4±0,4
	EMM	67,7±3,1	15,1±0,4	14,2±0,3	10,0±0,4	6,7±0,3	5,9±0,2	59,0±6,1	36,6±0,4
	The difference	5,3=8,5%	2,0=15,3%	1,8=14,5%	1,9=21,3%	0,8=13,5%	0,8=14,8%	14,5 = **32,6%**	2,2=6,4%
	Control								
Khorezm 127	EMM	53,3±2,2	15,2±0,4	10,7±0,5	5,9±0,4	4,8±0,3	4,7±0,3	27,7±3,3	31,1±0,7
	The difference	59,4±2,7	15,7±0,4	12,1±0,5	6,4±0,4	5,1±0,4	4,9±0,3	31,4±3,5	34,2±0,7
	Control	6,1=11,4%	0,5=3,3%	1,4=13,1%	0,5=8,5%	0,3=6,3%	0,2=4,2%	3,7 = **13,3**%	3,1=10,0%
Ibrat	Control	52,3±2,5	15,4±0,3	10,1±0,3	7,8±0,4	4,5±0,4	4,3±0,2	33,5±3,7	36,5±0,7
	EMM	55,7±2,8	15,7±0,3	11,7±0,4	9,5±0,4	4,8±0,3	4,4±0,1	41,8±4,5	36,5±0,6
	The difference	3,4=6,5%	0,3=1,9%	1,6=15,8%	1,7=21,8%	0,3=6,6%	0,1=2,3%	8,3=**24,8**%	0,0=0%
Namangan 77	Control	45,3±2,0	16,8±0,4	11,2±0,3	8,3±0,4	5,5±0,4	4,6±0,1	38,2±4,8	36,4±0,6
	EMM	49,6±2,2	18,3±0,4	13,9±0,4	9,7±0,4	6,5±0,5	4,7±0,1	45,6±5,0	36,8±0,5
	The difference	4,3=9,5%	1,5=8,9%	2,7=24,1%	1,4=16,9%	1,0=18,2%	0,1=2,2%	7,4=**19,4**%	0,4=1,1%
Sultan	Control	52,3±4,1	15,4±0,4	11,4±0,3	8,1±0,4	4,6±0,5	4,4±0,2	35,6±3,9	34,3±0,8
	EMM	57,7±4,5	16,9±0,4	12,5±0,3	8,8±0,4	5,2±0,5	4,7±0,2	41,4±4,4	34,7±0,8
	The difference	5,4=10,3%	1,5=9,7%	1,1=10,0%	0,7=8,6%	0,6=13,0%	0,3=6,8%	5,8=**16,3**%	0,4=1,2%
L-4112	Control	55,3±5,5	15,8±0,4	11,2±0,4	9,8±0,5	3,8±0,4	5,2±0,2	51,0±5,1	38,4±0,8
	EMM	66,3±5,9	16,9±0,4	11,8±0,3	11,5±0,5	4,7±0,3	5,6±0,2	64,4±5,7	38,9±0,7
	The difference	11,0=19,9%	1,1=7,0%	0,6=5,3%	1,7=17,3%	0,9=23,7%	0,4=7,7%	13,4=**26,3**%	0,5= 1,3%

Note: Plant mean values ± standard deviation are given. Values with statistical significance at R< 0.05 are marked in bold

4.10. table

Growth rates of cotton plant under normal conditions at flowering stage after EMM treatment from 20.07.17 to 29.07.17

Varieties	Work it out work	The height of the stem, cm	The number of joints in the stem, pcs	The number of harvest kings, pcs	Number of pods, pcs	The number of open cells, pcs	1 bag Cotton is heavy gi, g	Cotton weight per plant, g	Fiber output of shi, %
Bukhara 102	Control	54,1±2,4	16,7±0,4	11,5±0,3	11,3±0,4	5,8±0,2=	6,4±0,1	72,3±8,3	38,3±0,3
	EMM	55,6±1,9	18,1±0,4	13,3±0,4	12,9±0,5	6,2±0,3	7,7±0,1*	99,3±8,8	38,7±1,1
	The difference	1,5=2,7%	1,4=8,4%	1,8=15,6%	1,6=14,1%*	0,4=6,9%	1,3=20,3%*	27,0 = **37,3%**	0,4=1,0%
Khorezm 127	Control	60,3±1,7	15,5±0,3	12,1±0,5	8,2±0,3	4,8±0,2	5,0±0,1	41,0±5,1	34,4±0,5
	EMM	61,9±1,8	16,0±0,3	13,2±0,5	9,4±0,3	5,4±0,2	5,5±0,2	51,7±5,5	38,1±0,6
	The difference	1,6=2,6%	0,5=3,2%	1,1=9,1%	1,2=14,6%	0,6=12,5%	0,5=10,0%	10,7 = **26,1**%	3,7=10,7%
Ibrat	Control	54,5±2,2	16,4±0,3	11,7±0,3	12,7±0,5	6,2±0,4	4,8±0,1	60,9±6,3	37,3±1,2
	EMM	56,9±2,2	17,5±0,4	12,9±0,3	12,1±0,4	6,4±0,4	5,3±0,2	64,1±6,8	40,6±0,8
	The difference	2,4=4,4%	1,1=6,7%	1,2=10,2%	-0,6=-4,7%	0,2=3,2%	0,5=10,4%	3,2=5,3%	3,24=8,7%
Namangan 77	Control	64,6±1,8	18,1±0,3	13,1±0,3	12,4±0,4	6,9±0,4	4,7±0,2	58,3±6,1	36,2±0,5
	EMM	69,2±2,5	20,3±0,4	15,5±0,4	14,5±0,4	7,5±0,5	5,1±0,1	73,9±7,8	39,5±0,5
	The difference	4,6=7,1%	2,2=12,1%	2,3=17,5	2,1=16,9%	0,6=8,7%	0,4=8,5%	15,6=**26,7**	3,34=9,2%
Sultan	Control	56,1±2,4	17,9±0,4	12,6±0,3	12,4±0,5	7,5±0,3	5,1±0,2	63,2±6,2	38,4±0,6
	EMM	63,1±2,2	20,1±0,4	15,1±0,3	13,1±0,5	8,7±0,5	5,1±0,2	66,8±6,8	36,1±1,1
	The difference	7,0=12,5%	2,2=12,3%	2,5=19,8%	0,7 =5,6%	1,2=16,0%	0	3,6=5,7**%**	-2,3=-6,0%
L-4112	Control	52,7±2,4	16,4±0,3	11,7±0,3	11,7±0,5	6,3±0,2	5,7±0,3	66,7±6,8	40,0±0,9
	EMM	57,2±2,1	19,6±0,3	12,0±0,3	12,9±0,5	7,0±0,2	5,8±0,2	74,8±7,7	38,2±0,9
	The difference	4,5=8,5%	3,2=19,5%	2,3=19,6%	1,2=10,2%	0,6=9,5%	0,1=1,7%	8,1=**12,1**%	-1,8=-4,5%

Note: Plant mean values ± standard deviation are given. Values with statistical significance at R< 0.05 are marked in bold

4.11. table

Development performance of cotton plant under water deficit conditions after EMM treatment at flowering stage from 20.07.17 to 29.07.17

Varieties	Work it out work	The height of the stem, cm	The number of joints in the stem, pcs	The number of harvest kings, pcs	Number of pods, pcs	The number of open cells, pcs	1 bag Cotton is heavy gi, g	Cotton weight per plant, g	Fiber output of shi, %
Bukhara 102	Control	50,1±2,3	11,6±0,3	10,6±0,3	8,3±0,5	5,6±0,2	5,6±0,2	46,5±5,4	34,6±0,4
	EMM	53,2±2,4	14,4±0,4	13,4±0,3	10,1±0,3	7,2±0,3	6,1±0,1	61,6±6,4	38,6±0,5
	The difference	2,1=4,2%	3,8=32,7%	2,8=26,4%	1,8=21,7%	1,6=28,6%	0,5=8,9%	15,1 = **32,4%**	3,9=11,3%
Khorezm 127	Control	51,2±2,3	15,4±0,5	11,1±0,4	6,0±0,3	4,3±0,2	4,3±0,2	25,8±3,2	32,2±0,8
	EMM	60,2±2,5	16,4±0,4	12,1±0,5	6,2±0,3	4,4±0,2	4,4±0,2	27,3±3,3	37,3±0,7
	The difference	9,0=17,6%	1,1=7,1%	1,0=9,0%	0,2=3,3%	0,1=2,3%	0,1=2,3%	1,5 = **5,8%**	5,1=15,8%
Ibrat	Control	50,1±2,4	15,8±0,3	11,2±0,4	7,7±0,4	5,6±0,4	4,6±0,2	35,4±3,3	36,6±0,6
	EMM	54,9±2,5	15,1±0,3	14,6±0,3	9,8±0,4	6,7±0,4	4,4±0,1	43,1±4,3	36,4±0,6
	The difference	4,8=9,6%	-0,7=-4,4%	2,4=21,4%	2,1=27,3%	1,1=19,6%	-0,2=-4,3%	7,7=**21,7**%	-0,2=-0,5%
Namangan 77	Control	40,2±1,9	16,4±0,4	11,5±0,4	8,1±0,3	5,7±0,4	4,4±0,1	35,6±4,1	36,1±0,6
	EMM	46,7±2,4	20,7±0,3	15,7±0,3	9,5±0,4	6,5±0,5	4,2±0,1	39,9±4,7	38,2±0,5
	The difference	6,5=16,2%	4,3=26,2%	4,1=35,6%	1,4=17,3%	0,8=14,0%	-0,2=-4,5%	4,3=**12,1**%	2,1=5,8%
Sultan	Control	40,4±2,1	14,3±0,3	13,3±0,3	8,4±0,4	5,7±0,6	4,2±0,1	35,3±3,2	35,2±0,8
	EMM	47,8±2,5	17,8±0,4	15,5±0,3	9,7±0,4	6,8±0,6	4,6±0,2	44,6±4,5	34,7±0,8
	The difference	7,4=18,3%	3,5=24,5%	2,2=16,5%	1,3=15,5%	0,5=8,7%	0,4=9,5%	9,3=**26,3**%	-0,5=1,4%
L-4112	Control	44,1±2,3	15,1±0,2	13,1±0,3	8,9±0,5	6,2±0,2	5,2±0,2	46,3±4,7	37,3±0,6
	EMM	48,0±2,2	18,3±0,4	15,3±0,3	10,5±0,5	7,3±0,2	5,2±0,2	54,6±5,3	35,9±0,7
	The difference	3,9=8,8%	3,2=21,2%	2,1=16,0%	1,6=18,0%	1,1=17,7%	0,0	6,3=**13,6**%	-1,4=-3,7%

Note: Plant mean values ± standard deviation are given. Values with statistical significance at R< 0.05 are marked in bold

§-4.4. Effect of low frequency EMI on economically important traits of cotton cultivars and lines developed under normal and water deficit conditions.

The problem of fiber supply based on white gold-cotton, which is the pride of our independent republic, is of strategic importance [151; 231-b], [61; 159-168-b]. Accordingly, the attention of the scientific research carried out on the dissertation was focused on the study of the changes occurring in economically important signs by using additional new methods. In the analyzes in laboratory conditions, the characteristics of resistance to water shortage conditions of a number of varieties and genetically pure prospective lines cultivated in the farms of our republic were studied using the method of exposure to low-frequency electromagnetic waves. Among the economically important characters of varieties and line plants, fiber output and its index, the weight of cotton in 1 boll, and the yield of one plant were statistically analyzed.

Table 4.12 shows the fiber yield and fiber index of the Namangan-77 variety, which was taken as a standard variety, and the varieties grown in a number of farms. The analytical results presented in this table show the average values of cultivar plants for both characters and the differences between them..

Table 4.12

Fiber yield and fiber index indicators of cultivars grown under normal and water deficit conditions with EMI on the their seeds

Varieties	Fiber yield X ± m (%)						Fiber index X ± m (г.)					
	normative conditions			water shortage			normative conditions			water shortage		
	H	T	The difference	H	T	The difference	H	T	The difference	H	T	The difference
Naman - 77	36,20±0,51	39,54±0,48	3,34	36,11±0,63	38,23±0,57	2,12	6,44±0,09	7,58±0,10	1,14	4,71±0,11	6,85±0,12	2,14
Prosperous	36,42±0,72	38,73±0,59	2,31	37,14±1,07	39,11±0,76	2,03	6,31±0,21	7,27±0,14	0,96	5,87±0,24	7,11±0,31	1,24
Bukhara - 8	37,20±0,63	43,65±0,56	6,45	41,33±0,75	40,18±0,61	-1,15	8,45±0,29	10,15±0,23	1,70	7,65±0,12	9,44±0,40	1,76
Bukhara-102	38,29±0,31	38,74±1,08	0,35	34,66±0,45	38,59±0,52	3,93	7,96±0,12	7,78±0,21	-0,18	7,36±0,27	7,03±0,34	-0,33
Khorezm-127	34,40±0,47	38,11±0,60	3,71	32,17±0,81	37,29±0,67	5,12	5,76±0,24	6,54±0,32	0,78	4,75±0,19	5,56±0,28	0,81
Khorezm-150	37,86±0,53	37,79±0,72	-0,25	37,16±0,58	36,69±0,64	-0,47	5,95±0,17	6,25±0,25	0,30	6,34±0,31	5,52±0,23	-0,82
Example	37,35±1,17	40,59±0,79	3,24	36,61±0,67	36,45±0,59	-0,16	7,63±0,24	7,45±0,19	-0,18	5,91±0,26	5,72±0,17	-0,19
S-6524	37,36±0,81	38,36±1,08	1,0	35,38±0,71	36,18±0,82	0,80	6,48±0,26	6,77±0,17	0,29	6,36±0,23	6,18±0,21	-0,18
Andijan-37	40,71±0,89	38,31±0,91	-2,40	39,86±0,62	35,38±0,73	-4,48	6,45±0,25	6,13±0,22	-0,33	6,97±0,28	5,50±0,19	-1,43
Sultan	38,37±0,59	36,07±1,14	-2,30	35,18±0,79	34,74±0,81	-0,44	6,37±0,19	6,02±0,15	-0,35	6,40±0,30	5,70±0,26	-0,70

Among the cultivars whose seeds were exposed to EMI under conditions of water shortage, the high indicators in terms of fiber yield were standard Namangan-77 (T-38.23+0.57, N-36.11+0.63), Faravon (T-39.11+076 , N-37.14+1.07), Bukhara-102 (T-38.59+0.52, N-34.66+0.45), Khorezm-127 (T-37.29+0.67 . (T-40.59+0.79, N-37.25+1.17), S-6524 (T-38.36+1.08, N-37.36+0.81) were observed. The difference between them is significantly higher. Also, according to the fiber index, the differences in standard irrigation conditions were as follows: Namangan-77 experimental variant compared to the control 1.14 g, Farovon experimental variant 0.96 g compared to the control, Bukhara-8 experimental variant 1, 70 g., Khorazm-127 experimental variant is 0.78 g compared to the control, Khorazm-150 experimental variant is 0.30 g compared to the control, and S-6524 experimental variant is 0.29 g compared to the control reached, the fiber index indicators of Bukhoro-102, Ibrat, Andijon-37 and Sultan varieties were relatively high in control options compared to the experimental option. The following results were observed in the cultivar plants grown under water deficit conditions: the differences between the experimental variant and the control variant were 2.14, 1.24, 1.76 and 0.81 g in the standard Namangan-77, Farovon, Bukhara-8, and Khorezm-127 varieties. and the superiority of the experimental variant compared to the control variant was not observed in Bukhara-102, Khorezm-150, Ibrat, S-6524, Anjijon-37 and Sultan varieties. In order to find out the completeness of the obtained results, the variability of characters such as fiber yield and index under the influence of low-frequency electromagnetic waves was studied in several lines of the cotton genetic collection belonging to the G. hirsutum L. species. The obtained results are presented in Table 4.13 below.

Table 4.13

Fiber yield and fiber index indicators of genetic collection line plants developed under normal and water deficit conditions by exposure to EMI.

Lines	Fiber yield X ± m (%)						Fiber index X ± m (г.)					
	normative conditions			water shortage			normative conditions			water shortage		
	N	T	N	T	N	T	N	T	N	T	N	T
L-494	39,87±0,67	39,59±0,58	-0,28	39,95±0,69	39,04±0,72	-0,91	6,44±0,14	6,34±0,19	-0,10	6,48±0,17	6,45±0,24	-0,03
L-492	42,60±0,74	43,02±0,63	0,42	44,00±0,91	43,37±0,83	-0,63	6,13±0,22	8,30±0,17	2,17	7,78±0,21	8,21±0,27	0,43
L-608	43,64±0,69	42,38±0,66	-1,26	36,64±0,73	40,70±0,67	4,06	8,48±0,25	6,75±0,23	-1,73	6,79±0,19	6,31±0,31	-0,48
L-620	36,82±0,59	36,76±0,98	-0,06	37,61±0,75	43,09±0,61	5,48	5,86±0,16	6,06±0,25	0,20	6,19±0,11	8,03±0,28	1,84
L-452	41,44±0,81	43,11±0,60	1,67	40,17±0,84	43,09±0,74	2,92	6,40±0,21	7,54±0,19	1,14	7,14±0,14	8,89±0,22	1,75
L-453	46,27±0,73	47,31±0,77	1,04	45,59±0,58	47,33±0,82	1,74	9,80±0,19	10,26±0,14	0,46	8,93±0,22	9,31±0,18	0,38
L-454	46,20±1,04	47,08±0,79	0,88	45,62±0,74	46,37±0,91	0,75	9,66±0,23	9,88±0,21	-0,22	8,66±0,24	9,18±0,19	0,52
L-489	42,56±0,81	43,31±0,98	0,75	41,89±0,71	44,25±0,86	2,36	7,48±0,26	7,77±0,17	0,29	7,50±0,16	8,62±0,21	1,12
L-4112	40,07±0,91	38,24±0,89	-1,83	37,35±0,65	35,96±0,77	-1,39	6,32±0,22	6,89±0,14	0,57	6,05±0,28	5,89±0,19	-0,16
Mutant -3	39,58±0,67	38,97±0,94	-0,61	37,65±0,82	38,54±0,92	0,89	5,87±0,15	6,05±0,09	0,23	5,41±0,23	5,78±0,23	0,37

As can be seen from Table 4.13, in the lines of the genetic collection L-492, L-452, L-453, L-454, L-489, the indicators of fiber yield under normal conditions were observed based on the superiority of the experimental variant over the control variant, while the experimental variant under water deficit conditions L-608 (difference-4.06g), L-620 (5.48g), L-452 (2.92g), L-453 (1.74g), L-454 (0.75g) .), was observed in L-489 (2.36g) and Mutant-3 (0.89g) lines.

The results obtained according to the fiber index are as follows: superiority of the experimental variant over the plants of the control variant under normal irrigation conditions L-492 difference-2.17g.) L-620 (0.20g.), L-452(1.14g.), L-453 (0.46g.), L-489 (0.29g.), L-4112 (0.57g.) and Mutant-3 (0.23g.), while the fiber index in plants of the genetic collection line developed under water deficit the following indicators were observed: L-492 (difference-0.43g), L-620 (1.84g), L-452 (1.75g), L-453 (0.38g), L-454 (0.52g), L-489 (1.12g) and Mutant-3 (0.37g) (Table 4.13).

Therefore, according to the results of the research, among cultivars under conditions of water shortage, the experimental variant has a significant advantage over the control in terms of fiber output in the Bukhara-102 and Khorezm-127 varieties (difference-3.93 and 5.12 g), and among the genetic collection lines, the control superiority compared to variant plants was observed in L-608 and L-620 lines (difference-4.06 and 5.48 g), and under these conditions, a significant difference according to the fiber index was observed in Namangan-77, Farovon and Bukhoro-8 varieties (difference-2.14 , 1.24 and 1.76 g), and L-620, L-452 and L-489 lines (difference-1.84, 1.75 and 1.12 g) were observed.

Table 4.14 below shows the average values of the weight of cotton per boll and the yield of 1 plant of cultivars developed under normal and water deficit conditions, and the differences between experimental and control variant plants.

Table 4.14.

The seed was developed under normal and water deficit conditions by exposure to EMI the weight of cotton in 1 boll and the yield of cotton in 1 plant in variety plants

Material	Weight of cotton in 1 bag X ± m (G.)						Productivity of one plant X ± m (G.)					
	normative conditions			water shortage			normative conditions			water shortage		
	N	T	The differen ce	N	T	The differen ce	N	T	The differen ce	N	T	The differen ce
Naman - 77	4,71±0,19	5,14±0,11	0,43	4,36±0,15	4,22±0,14	-0,14	51,81±0,1	56,54±0,1	4,34	52,32±0,2	59,08±0,1	7,24
Prosperous	5,48±0,14	6,07±0,13	0,59	5,31±0,17	5,76±0,11	0,45	60,28±0,1	85,36±0,2	25,08	63,36±0,1	74,88±0,2	9,72
Bukhara - 8	7,91±0,16	7,35±0,17	-0,56	5,57±0,12	5,89±0,18	0,42	80,85±0,3	94,92±0,1	14,07	72,41±0,3	70,68±0,2	-1,83
Bukhara-102	6,38±0,12	7,69±0,15	1,31	5,65±0,19	6,10±0,14	0,45	76,76±0,1	92,28±0,2	15,54	79,1±0,3	85,4±0,2	6,3
Khorezm-127	5,09±0,15	5,49±0,21	0,40	4,30±0,16	4,44±0,18	0,14	61,08±0,1	65,88±0,2	4,80	51,6±0,2	56,64±0,2	5,04
Khorezm-150	5,40±0,17	5,11±0,23	-0,29	4,70±0,21	4,72±0,19	0,02	64,80±0,3	66,43±0,1	1,57	56,4±0,2	56,64±0,3	0,20
Example	4,83±0,14	5,32±0,19	0,49	4,64±0,17	4,38±0,13	-0,26	57,96±0,2	63,84±0,2	5,86	55,68±0,2	61,32±0,2	5,37
S-6524	5,30±0,16	5,14±0,17	-0,16	4,47±0,15	4,85±0,21	0,38	63,6±0,2	61,8±0,2	2,80	58,11±0,1	63,05±0,2	5,86
Andijan-37	4,73±0,22	5,05±0,12	0,32	4,72±0,18	4,93±0,17	0,21	61,49±0,3	71,56±0,3	10,07	56,64±0,2	59,16±0,2	2,84
Sultan	5,15±0,19	5,07±0,16	-0,08	4,18±0,13	4,63±0,16	0,45	61,8±0,1	60,84±0,2	1,96	58,52±0,2	64,82±0,1	6,30

The analysis of the results obtained according to the weight of cotton in one boll showed that among the plants of the variety exposed to EMI, the experimental variant plants of the Bukhara-102 variety were 1.31 g compared to the plants of the control variant. were dominant, the indicators of the weight of cotton in one boll of the cultivars grown under water shortage conditions were found to be superior to the experimental variant over the control variant in all 8 cultivars, except Namangan-77 and Ibrat. The results obtained on the productivity of one plant are as follows: in standard conditions, the superiority of the experiment on the productivity of one plant in the Bukhara-102 variety compared to the control is 25.08 g., in the Bukhara-102 variety 15.54 g. and 14.07 g in the Bukhara-8 variety. was 2-5 g. was determined to be No significant differences were observed in plants grown under water deficit conditions.

The results of the study of the plants of the lines exposed to EMI with some lines of the cotton genetic collection belonging to the G. hirsutum L type in both conditions (normal and water deficit) are as follows: under normal conditions, the significant superiority of the experimental variant plants compared to the control variant plants is mainly L-492 (N- 4.79±0.21 g., T-5.30±0.12 g.), L-620 (N-4.37±0.16 g., T-5.07±0.22 g.), in L-453 and L-4112 lines (N-5.49±0.15 g., T-5, 53±0.18 g. and N-5.71±0.26, T-5.75 ±0.18 g.), the difference between experimental and control options in Mutant-3 line was 0.48 g. (N-6.07 ±0.16 g., T-6.55±0.15 g.) organized. (Table 4.14).

Table 4.15.

Genetically developed by applying EMI to the seed under normal and water deficit conditions weight of cotton in 1 bag and yield of cotton in 1 plant in collection line plants.

Material	Weight of cotton in 1 bag X ± m (G.)						Productivity of one plant X ± m (G.)					
	normative conditions			water shortage			normative conditions			water shortage		
	N	T	The difference	N	T	The difference	N	T	The difference	N	T	The difference
L-494	4,87±0,14	4,84±0,17	0,01	4,67±0,19	5,02±0,21	0,35	53,57±0,2	62,92±0,2	9,35	46,7±0,16	47,29±0,1	0,6
L-492	4,79±0,21	5,30±0,12	0,51	5,08±0,21	5,03±0,23	-0,05	47,90±0,2	58,3±0,18	10,40	60,96±0,1	61.4±0,22	0,54
L-608	5,92±0,22	5,01±0,15	-0,91	4,91±0,19	4,53±0,16	-0,38	55,11±0,1	65,12±0,2	10,1	58,92±0,1	63,42±0,1	4,50
L-620	4,37±0,16	5,07±0,22	0,70	4,32±0,11	4,67±0,18	0,35	48,7±0,15	60,84±0,2	12,14	51,84±0,3	56,04±0,2	5,80
L-452	6,84±0,19	6,71±0,21	-0,13	6,47±0,14	6,99±0,22	0,52	75,2±0,22	80,52±0,3	5,30	77,64±0,2	83,88±0,3	6,24
L-453	5,49±0,15	5,53±0,18	0,04	4,94±0,22	4,89±0,19	-0,05	65,88±0,1	66,36±0,1	1,53	59,28±0,2	68,46±0,2	9,17
L-454	5,95±0,22	5,72±0,21	-0,23	5,41±0,16	5,34±0,22	-0,07	62,92±0,1	65,45±0,3	3,47	64,08±0,3	64,92±0,2	0,84
L-489	5,87±0,23	5,54±0,17	-0,33	5,24±0,19	4,82±0,21	-0,42	70,44±0,3	72,02±0,1	2,82	73,36±0,2	72,3±0,2	1,06
L-4112	5,71±0,26	5,75±0,18	0,04	5,19±0,23	5,15±0,17	0,4	68,52±0,1	74,75±0,3	6,23	72,66±0,1	77,25±0,1	5,21
mutant-3	6,07±0,16	6,55±0,15	0,48	5,41±0,27	5,67±0,24	0,26	72,84±0,1	78,6±0,3	6,24	84,98±0,3	91,7±0,1	6,72

Note: N-control; T-experiment.

The gross productivity of cultivars and lines grown under normal and water deficit conditions under the influence of seed EMI was also studied. According to him, there are significant differences in the yield of plants under standard conditions: Farovon (5.23 g.), Namangan (4.13 g.), S-6524 (4.14 g.), Khorezm-150 (3.24 g.), Bukhara -102 (2.61 g), Ibrat (2.02 g.) and Andijan -37 varieties were observed, and in conditions of water shortage S-6524 (8.32 g.), Khorezm-150 (5.16 g.), Khorezm-127 (5.40 g.), Ibrat (4.07 g.), Farovon (3.92 g.) and Namangan-77 varieties were observed.

The following results were obtained on the productivity of plants of the line developed under standard conditions: L-452 (F-12.24 g.), L-492 (F-10.32 g.), L-489 (F-5.41 g.), L-620 (F-4.92 g.) Mutant-3 (F-5.13 g.) and L-454 (F-1.08 g.) were detected. In the conditions of water scarcity, the order of placement according to the superiority of the experiment over the control is as follows: L-620 (F-10.20 g.), L-452 (F-6.65 g.), L-608 (F-6.12 g.), L-492 (F-4.92 g), L-494 (F-2.04 g), L-4112 (F-1.92 g), Mutant-3 (F-0.94 g .) and in the L-453 line (0.61 g.).

So, as can be seen from the obtained results, the effect of low-frequency magnetic waves on the economically important signs of plants of the variety and genetic collection line is of special importance, and the most significant cases of it are positive changes in all four signs studied mainly in Namangan-77, Farovon, Bukhara- 102, Khorezm-127, Khorezm-150 and S-6524 varieties and genetic collection lines L-492, L-608, L-620, L-452, L-453, L-489 and Mutant-3 lines, and the remaining variety and average indicators were formed on the basis of low or superiority of the control compared to the experimental variant plants for the studied characters in the line plants. Accordingly, it can be noted that the state of biological fertility of the studied experimental object can embody not only the efficiency of the method used, but also its genotypic conditions. Because the results of the initial 1st year research on the variability of economically important characters under the influence of low-frequency electromagnetic waves showed that the variability of the varieties and line plants taken as the object of research in terms of fiber yield is higher in the variety plants compared to the line plants in both irrigation conditions, and this is the case according to the fiber index. repeated. Also, the difference in the indicators of the weight of cotton in one boll became significant in the varieties and lines of plants, and in the plants developed under normal and water shortage conditions, mainly Namangan-77 (difference-0.43 g.), Farovon (difference-0.59 g.) and Bukhara -102 (difference-1.31 g.) varieties occurred under normal conditions, while under water shortage conditions Farovon (difference-0.45 g.), Bukhara-8 (difference-0.42 g.), Bukhara-102 (difference -0.45 g.), S-6524 (difference-0.38 g.) and Sultan (difference-0.45 g.) varieties, the difference between the experimental and control variant plants between the lines of the genetic collection under standard conditions L -492 (difference-0.51 g.), L-620 (difference-0.70 g.) and Mutant-3 (difference-0.48 g.) (difference-0.35 g.), L-620 (difference-0.35 g.), L-452 (difference-0.52 g.), and Mutant-3 lines (difference-0.26 g.) occurred between In the plants of the remaining varieties and lines taken as the object of research, a partial superiority of the control compared to the plants of the experimental variant was felt, on the basis of which the differences in the indicators of the research results were formed, including the changes depending on the genotypic state and the cells of the generative organs of the plants.

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MONOGRAPHY

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