Cotton drip irrigation using magnetic technology

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Abstract. The article presents the results of scientific research on the use of magnetic technologies for water magnetization and their use in agriculture. On the beneficial effects of magnetic water on the rate of plant growth, the construction of the root system, and the potential for strong plants in the future. The research results proved that soaking seeds and watering with magnetized water lead to an increase in crop yields with a simultaneous decrease in the specific water consumption for irrigation by 1.5-2.0 times. The article also shows the results of field studies conducted at the site where the drip method of irrigation of cotton has been introduced using water for irrigation that has passed through a magnetic device. The magnetic apparatus used to magnetize the water in the experimental area is described, along with its design and working principal. Field research was done on meadow - serozem soils in the Kuyichirchik area of the Tashkent region to examine the impact of magnetic water on the growth, development, and increase in yield of cotton while conserving irrigation water. The outcomes show a favorable impact on the growth, development, and increase in cotton output. At the same time, water savings amounted to 10-20 percentage compared to irrigation with ordinary water.

1 Introduction

The main task in growing crops is to provide them with water, especially in regions with an arid climate. Water is the most essential factor involved in all physiological processes.

Magnetization of water is carried out using magnetic technologies of various designs. Specialized magnetic devices for agriculture come in two types: for magnetic water treatment and seed crops. They differ in throughput (m^3/h) and resistance to aggressive environments. The designer of magnetic devices and systems is Professor Yu. P. Tkachenko, under his leadership more than 300 topics were studied, including agriculture, food biotechnology, medicine, ecology [1].

On certain crops, the magnetic field has a beneficial impact on features such seed germination, seedling growth, agronomic attributes, and seed yield [2]. Watering plants with magnetized water allows its molecules to easily bind into complexes and better retain themselves in tissues under stress. In plants, a link is established between soil moisture and internal tissue hydration. Plants start to wilt when there is not enough water in the soil,

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which is followed by a range of physiological issues. In withering plants, the temperature of the leaves rises, the process of photosynthesis is weakened, the use of nutrients worsens, and growth processes are delayed. Even a short-term wilting does not pass without a trace for the plant. When wilting, the slowdown in plant growth can continue for quite a long time, this process is not immediately restored, even after the resumption of normal water supply. Many studies have been conducted the use of magnetic technologies for the magnetization of water and the use of this water for irrigation of vegetable crops, potatoes, tomatoes, spring wheat, barley, millet, sunflower and cotton. The most efficient application of magnetization is to increase the vigor of germination of seeds from crops like onions that have a dense shell. Better embryo penetration is achieved by structured water, which also stimulates cell division in the embryonic root. This eventually results in the emergence of amiable and uniform seedlings. For crops grown in arid areas, it is vital that seed germination happens sooner by 1-2 days [3].

The use of magnetic technologies in growing of crops is absolutely harmless for both humans and plants, and can increase most of the indicators from seed germination to yield volume and nutrient content of any cultivated crop. At the same time, in the application of water-saving irrigation technologies, in addition to magnetic irrigation, it is also important to take into account the water demand of crops, the conditions of cultivated soil and seepage water [4-7].

2 Materials and methods

Back in 1983-1984, in the regions of Saratov, Volgograd, Astrakhan, Krasnodar, and Stavropol, experiments on the utilization of magnetic devices for irrigation of agricultural crops with magnetic water were conducted. In the Volzh Scientific Research Institute in 1971, research was carried out on the use of magnetic water for irrigation. Spring wheat mass seedlings appeared three days sooner than usual when it was irrigated with magnetic water, and other stages of development of plants also advanced more quickly. The increase in yield during water magnetization in magnetic devices amounted to 26.5 percentage with a simultaneous decrease in the specific water consumption by half. The experiment involved several designs of devices (based on permanent magnets of the AMOV-3 type (designers Yakovlev N.P., Kolobenkov K.I) [8-9].

The results of the research show that the magnetization of water in magnetic devices of various designs, during irrigation, leads to an acceleration of seed germination, growth and development of crops, and an increase in yield is up to 26 percentage with a decrease in the specific consumption of irrigation water. The utilization of a magnetic equipment does not necessitate any upkeep, further education, or ongoing energy bills [10].

Based on the above, conducting these studies was considered to be of great importance. As a result, it was mentioned that it is possible to improve the water supply of regions with water shortage. It is also worth noting that the scientists made the mistake of using the water from the collector in the economical use of irrigation water and achieved good results. That is, when watering, add 50 percent collector water to clean water.

A water management system has also been created through the use of computer programs for crop irrigation. By contrasting the outcomes of the field research with the software's created parameters, the exact transition values were determined, in addition, a number of scientists, including S.Isaev and others, by using water-saving technology in watering plants at a time when water is scarce have conducted scientific research and achieved high results.

3 Results and Discussion

We conducted field tests on irrigation with magnetic water in 2020–2022, with the goal of making irrigation resources more wisely and carefully used, enhancing the ameliorative state of irrigated areas, and learning how magnetic water affects on growing, creation, and production of cotton. The experimental plot (Figure 1), which spans 24 hectares, is situated in meadow-serozem soil conditions on property owned by the TST "Agro Cluster" in the Kuyichirchik district of the Tashkent region.

The Institute for Scientific Research of Agriculture's methodology and B.A. Dospekhov's technique were both followed when conducting the experiments. The weight method was used to measure soil moisture, cylindrically to measure bulk density, mathematically to calculate total duty cycle, and geometrically to measure water permeability. By obtaining samples from the soil section, the mechanical composition of the soil was ascertained at the outset of the study. The Kachynski scale was used to calculate the percentage of each fraction's content. A magnetic device of the MPV MWS Dy 15 design was utilized to magnetize river water (Table 1). Nine water magnetization systems created by Tekhnomag - Kazan LLC were placed at the test location (Figure 2).

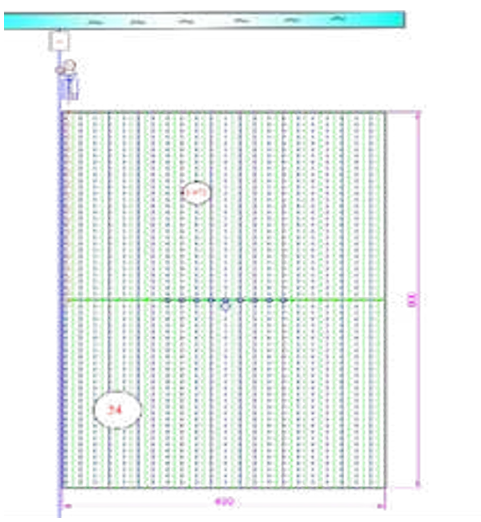

Fig. 1. Plan of the experimental site.

Table 1. The magnetic device's primary technical specifications.

Composition	Dy 15. G1 / 2 inch
Efficiency, Cubic Meter/Hour	0.15 - min
Operative pressure	1.0 - normal
Maximum force	1.7 - max
Temperature of the water	10 kg f / sm^2
The connection principle	12 kg f / sm^2
Placing	0 - 100 ^{0}C
Utilized and	Internal threaded
connecting materials	vertical or horizontal
Magnet housing	Brass, bronze
Type of magnets	Stainless steel
Conservation of magnetic energy	high energy magnets

Fig. 2. Gadget for treating water with magnets "MPV MWS Dy 15", general view (left), interior design (right).

Before vegetation irrigation was established on the experimental plot, the local temperature, the mechanical composition of the soil, the location of seepage waters and its mineralization, and the economic situation were all examined. Soil sections of the full profile were laid on the site. A morphological description of the soil-ground layer (up to 1.5 meters) can be found in Table 2.

Table 2. An explanation of the soil layer's location by section.

Layers, sm	**Morphological description**
0 - 30	Gray and dry, with medium sand present, root remnants, coarse-grained structure, and soil discoloration in the upper 0–5 cm of the soil profile.
30 - 60	The soil is a light gray hue, has a medium moisture content, is porous, medium sandy, and granular, has root remnants, and transitions to compacted layers have been seen.
60 - 100	The soil layer is light gray, has a low moisture content, is heavily compacted, has a heavy, granular mechanical structure, is inhabited by earthworms, and is moving downhill.
100 - 150	The soil has a light gray appearance, is compacted, low in moisture, and is made of clay. Its structure is unclear and there is a slight transition between layers.

The soil's surface has the impression of a gently sloping plain that periodically undulates. With an average slope of 0.0005 to 0.003, the slope normally slopes from the south to the west. The mechanical composition of the soil in the experimental plot was established prior to the start of the scientific study project (Table 3).

Table 3. Figuring out the soil's average composition in the experimental plot.

Layers,	**Composition in percentages of soil fractions with millimeter-sized particles**								**Determining the mechanical composition of soil in accordance with Kachinsky**
sm	**1-0.25**	**0.25-0.1**	**0.1-0.05**	**0.05-0.01**	**0.01-0.005**	**0.005 -0.001**	**<0.001**	**<0.01**	
0-30	1.93	1.88	17.32	33.72	8.52	14.92	15.38	38.82	An average mechanical composition
30-60	0.76	0.87	16.21	42.36	6.94	17.82	15.08	39.84	An average mechanical composition massive mechanical content
60-100	0.37	0.98	7.06	44.98	12.62	22.96	9.18	44.76	Heavy mechanical content
100-150	1.37	1.71	5.17	45.26	11.32	18.20	15.95	45.47	Heavy mechanical content

The volume weight of the soil in the experimental plot was measured at a depth of up to 1.0 m in each field at the start and end of the season. Figure 3 presents the showing results. Here are 0-30, 30-60 and 60-100 sm layer thicknesses in the graph.

The water permeability of the soil was tested at the start and end of the season using a cylindrical instrument. Utilizing multipurpose instruments, it was shown that cotton cultivation dropped by 0.0040 centimeters per minute when the soil water permeability was examined (Figure 4).

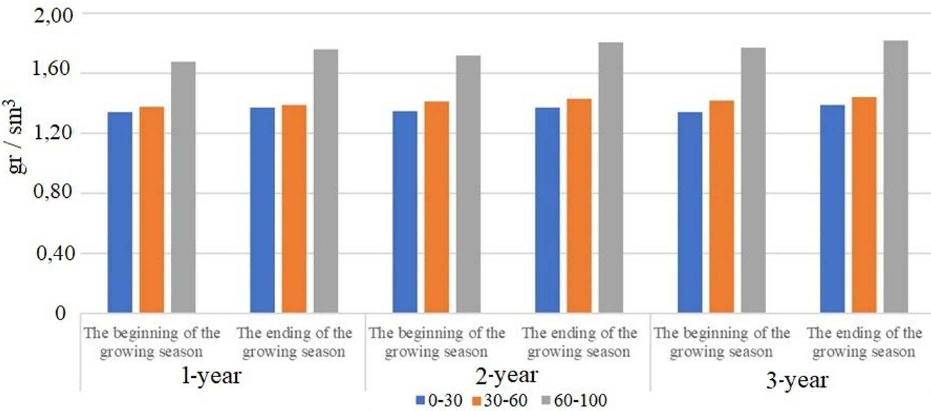

Fig. 3. Variation of volumetric weight of experimental field soil.

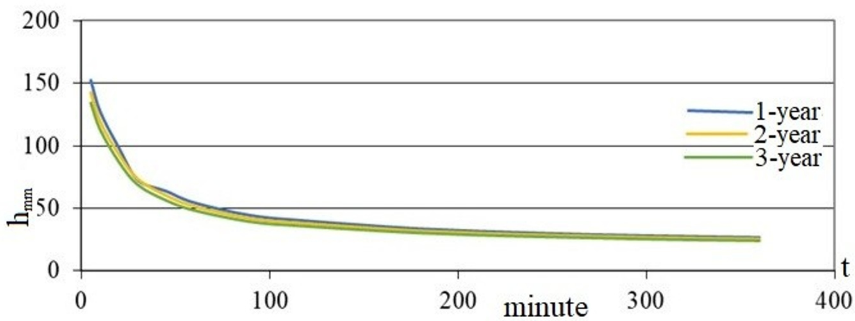

Fig. 4. Water permeability of the experimental plot with respect to time.

During the growing season, the moisture in the reference soil layer was monitored, and the precise moisture content was calculated both before and after watering.

Fig. 5. Device placement example.

The following formula was used to calculate the irrigation rate (1):

$$m_{net} = 100 \times h \times a \times S \times (W_{mfmc} - W_{mmmc}), \quad m^3 / ha \tag{1}$$

Where: h is the calculated soil layer's depth in meters; an is the volumetric amount of soil in tons per cubic meter;

WMFMC is the maximum field moisture capacity, expressed as a percentage of the dry soil mass;

W_{MMMC} is the minimum molecular moisture capacity, expressed as a percentage of the dry soil mass;

$W_{MFMC} = Z \times W_{MMMC}$;

The pre-irrigation soil moisture coefficient is Z, and it ranges from 0.6 to 0.8. In the experimental region, the drip water outlets' average flow rate during the study period was 1.26 liter/hour. At the same time, the distance between irrigation pipelines (pipelines are laid through the furrow, row spacing is 90 sm) is 180 sm and that between droppers is 50 sm. Only 8 irrigations at a rate of 130 to 160 m^3 / ha were performed on the drip irrigation experiment site. When using magnetic water, the irrigation norm was 1245 m^3/ha; when using regular water, it was 1500 m^3 / ha.

4 Conclusion

The findings of the study show that the magnetization of water with the help of magnetic devices with various designs during irrigation leads to an acceleration of seed germination, growth and development of crops, an increase in yield up to 25-30 percentage and a decrease in the specific consumption of irrigation water. Utilizing magnetic tools and technologies doesn't call for any upkeep, specialized training, or ongoing energy expenses. The employment of magnetic technology in agricultural production can raise the majority of indicators, from seed germination to yield and nutrient content of any crop planted, and is completely safe for both people and plants. Agriculture research has now expanded into other fields thanks to magnetic technology (MT). The key benefits of this technology include safety, compatibility, simplicity, environmental friendliness, cheap running costs, and the absence of any known negative consequences. One advantage of MT in agriculture is improvements in irrigation water flow, quality and quantity, yield, prevention of scale in water, and water savings.

The outcomes of field tests using drip irrigation of cotton on typical meadow - serozem soils show that magnetic water has a beneficial impact on the growth, development, and increase in cotton yields. They also show that this method has a high ameliorative efficiency, saving irrigation water by 16-25 and more percentage.

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