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AGRICULTURAL MAGNETIC TREATERS FOR SEEDS AND WATER

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A b s t r a c t. Magnetic devices of various constructions and productivity for treatment of water, seeds and soil have been developed, produced and tested in the Hydrophysics Laboratory and in the Department of Magnetobiology of the Agrophysical Institute. Pre-germination magnitophore seeds treatment is intended for improving sowing characteristics of seeds. The method consists in the effect of the low-frequency magnetic field created by the steady systems of ferrite-barium plates.

Magnitogramm of the magnetic fields of the given structure is recorded on the surface of the plates with help of a special inductor. To realize the method in agriculture a portable magnitophore chute has been designed. The seeds intended for treatment are poured into the bunker.

Under the effect of their own weight they spill through the proportioning device in the magnitophore chamber. Magnitophore seeds treatment improves the growth vigour, accelerates plant development, especially on the early stages, increases the crops. This method is simple, cheap, ecologically harmless and it can be recommended for applying in the technologies of vegetable crop growing.

To treat the irrigation water some devices on permanent magnets have been developed. Their capacity ranges from 10 to 1000 cm^3/hour. Magnetic treatment of water systems or more correctly magnetohydrodynamic activation of natural water is used to change (operate) physical and chemical properties of the irrigation water, particularly to shift of the carbon dioxide equilibrium alkalinity of water.

K e y w o r d s: magnetic treater, irrigation water, saline soil, seeds treatment

INTRODUCTION

The study of the affect of low frequncy magnetic fields on biological objects presents a great scietific and practical interest and may be considered as a new rapidly developing branch of biophysics, namely magnetobiophysics [13].

The Department of Magnetobiology was organized in 1980 attached of Hydrophysics Laboratory of Agricultural Research Institute. The main tasks of the Departement are studying the influence of electromagnetic fields (EMF) of natural and artificial character, as a factor of environment, on plant objects; electromagnetic ecology; a search for reagentless methods for intensification of agricultural production.

The basis for the elaborated theoretical problems connected with the mechanisms of action of EMF on water systems and biological objects is the idea of a living system as of a nonequilibrium open system in which electric current and bulk electric charges are continuously functioning, mass- and electrotransfer is realized.

PRE-GERMINATION MAGNITOPHORE SEEDS TREATMENT

A method for pre-germination seed treatment was suggested as a result of investigations concerning the effect of magnetic fields on agricultural crops. The method consists in the affect of the low-frequency magnetic field created by the steady systems of polygradient alternate magnetic fields on moving seeds [6].

Pre-germination magnetic treatment of seeds allow secure earlier maturity, better

development of plants and increase the output of ealier production by 10-15 %.

Devices intended for this purpose are: the Polymag treater (Fig. 1) for small farms and greenhouses, and the Polymodul for treatment of large batches of seeds and potato tubers. The recommended period of treatment is 1-3 days before sowing. The principal characteristic feature of the designed seed treater is the special structure of magnetic field. In most known treaters seeds pass through one or several (up to 3) pairs of magnetic poles created by direct current or permanent magnets [1]. However, such treatment does not always give a positive result. To take the seed from the state of rest multipoles magnetic treatment is much more efficient. It seems that such effect is explained by inducing the impulse electric field in the seeds moving in magnetic field with changing sings. For the sake of saving electrical energy instead of A.C. We used special magnitophore magnetization of ferrite-barium plates.

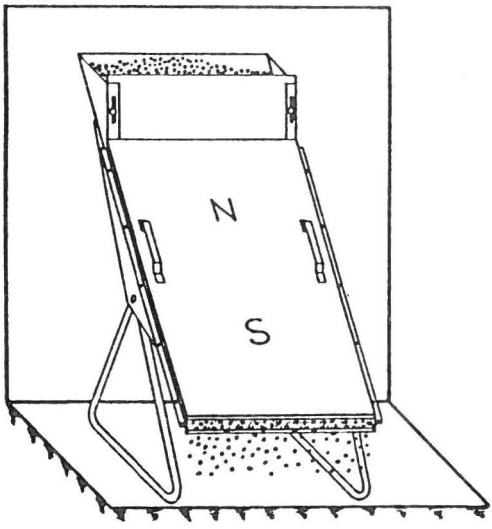

Fig. 1. The total view of magnitophore chute.

Magnetic fields of the given structure (form, induction, gradient) are recorded on the plates surfaces with the help of a special inductor. Figure 2 shows examples of different distribution of magnitophore magnetic fields. The space non-homogeneous structure of magnetic field distinguishes magnitophore from other sources of permanent magnetic fields. Peculiarity of these magnetic carriers is that vertical component of field falls rapidly with removal from the surface, and the transverse component along which the movement of seeds occurs experiences frequent changes.

To realize the method in agriculture a portable magnitophore chute has been designed

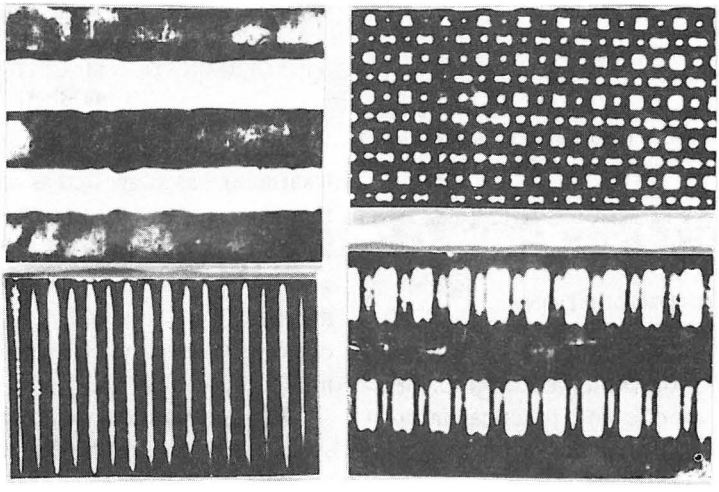

Fig. 2. Topogramme of magnetic field of magnitophore.

(Fig. 1). The seeds intended for treatment are poured into the bunker and under the effect of their own weight they spill into the magnitophore chamber, where they are treated by magnetic field created by magnitophore plates mounted on both sides into the chute body. The construction is placed in metal body which prevents the magnetic field to dissipate [12].

Magnitophore chutes 'Polymag' have been tested on some farms and show stable results as to additional vegetable yields.

Now we choose optimal parameters of magnetic field for treatment of large seed batches (grain, technical crops, potato tubers, etc.) apparatus 'Polymodul'. Pre-germination magnitophore treatment can be used for all vitable seeds of any agricultural crops which need some improvement of sowing characteristics. Magnitophore seeds treatment raises the energy of plant germination, increases plant development, especially on the early stages, increases the crops. This method is simple, cheap, ecologically pure and it can be recommended for applying in the technologies of the vegetable crop growing.

Research for the mechanism of the magnetic field effect on dry seeds has shown the 2.5 % increase of free water which may be the results of conformation changes of macromolecules of albumen and nucleus acids. The increase of total quantity of water in seeds may be associated with the increase of permeability of plant cell membrans. The investigation of the activity of some ferments playing an important role for germination of seeds has shown a valid increase with the probability 95 % of alkaline lipase activity for 1- and 2-daily shoots and acid lipase for 3-daily shoots.

MAGNETOHYDRODYNAMIC ACTIVATION OF NATURAL WATER

Magnetic treatment of water systems, or more correctly, in our opinion magnetohydrodynamic activation of natural water is used in farming to intensify washing of saline soils and irrigate crops [2,4].

The method is based on the change of physical and chemical properties of irrigation water after passing the magnetic device presenting a hydrodynamic direct-flow system of variable cross-section with non-homogeneous magnetic fields generated inside it. The essential factors being both magnetic induction in the device and the flow rate of water through it, to be more exact hydrodynamic regime water flow [3].

While the solution passes at a certain velocity through the magnetic field, MHD-convection occurring near the ions, particles and gas bubbles may give rise to some phase transformations persisting for some hours after the exposure to the magnetic field. They are the shift of carbon dioxide equilibrium of water, the pH value, changes in the gas composition, cristallization and coagulation processes. These changes can be a measure of effectiveness of MHD water treatment.

According to our theoretical and experimental estimation, the regime of operation of the magnetic device is optimized by suitable relationship between the magnetic induction and the water flow velocity. In addition, changes of physical and chemical properties of water are caused by the magnetic field only in non-equilibrium solutions which can undergo phase transformations.

In the laboratory there was developed a water treatment indication method based on the rate of crystallization of calcium carbonate by alkali added in a definite proportion to the solution containing calcium bicarbonate. The carbon dioxide equilibrium in the solution, i.e.:

$$Ca(HCO_3)_2 = CaCO_3 + CO_2 + H_2O \quad (1)$$

is very unstable and can easily shift to the right under the effect of various factors such as temperature, pressure, radiation, ultrasound, electric and magnetic field. The onset of the reaction in the MHD-activated water is detected by a decrease of the pH-value and by turbidity (Fig. 3).

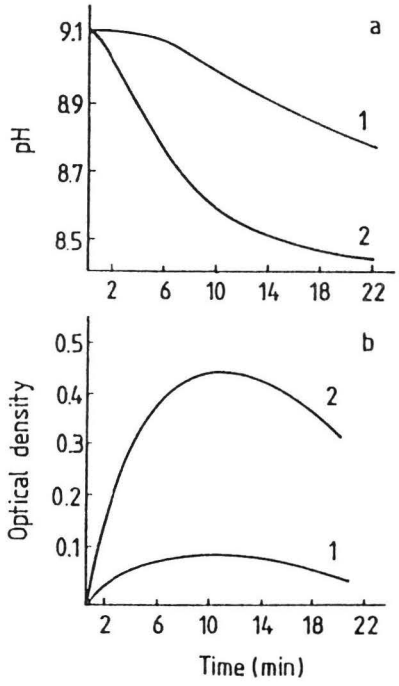

Fig. 3. Variation in time relationship of pH (a) and optical density (b) with alkalinization 1 - control; 2 - magnetoactivated solution.

The shift to the right of the carbon dioxide equilibrium (Eq. (1)) results in a higher concentration of free gaseous carbon dioxide. CO_2 acidifies the water and thus it acts similar to adding a meliorant that supplies H^+ ions intensifying the ion exchange which allows offer utilization of magnetic devices for washing carbon alkaline soils. The role of CO_2, as ecologically pure chemical meliorant, should be stressed when washing soda saline soils [5] and irrigation [9] despite the sources of CO_2-formation in water.

Studing the effect of MHD-method on various saline soil made together with scientists from Armenia, Turkmenia and Azerbaidjan make it possible to recommend application of MHD-activation for water of various miniralization with an alkaline reaction (pH>7.5), oversaturated with $CaCO_3$ and $CaSO_4$ and with an HCO_3^- bicarbonate ion content >1 mmol/l.

The method is most effective for the soils of sodium salinity or with soda impurity. The use of MHD-activated water accelerated filtration, reduced washing time by 25 % and increased salt removal by 20-40 %. The efficiency of the method depends greatly on water composition and on the type of soil salinity.

Irrigation by MHD-activated water may result in a better dissolving and a deeper penetration of fertilizers in soil, creation of washing conditions, and a better penetration of water and nutrient solution into the plant cells.

The MHD-activation of natural water attracts attention of agricultural and reclamation workers by its low cost and less labour expenses, complete safety and by no changes in conventional procedures.

To treat the irrigation water some devices on constant magnets have been developed in St. Petersburg. Their capacity ranges from 10 to 1 000^3 m/h. The principal characteristic feature of these devices is their absolute ecological safety both for attending personnel and environment. The treaters are performed on permanent magnets; there is no need in energy supply. Steel casing defends environment from electromagnetic pollution.

Table 1 shows specification of magnetic devices for water treatment elaborated in Agrophysical Institute. The first number of the treater type (100, 250, 1 000, etc.) indicates the free cross-sectional area of the devices for flow in cm^3 and the second number (10) shows the length of the water path in magnetic gradient field in cm. The devices are flange-connected to pipelines or pumping station as shown in Fig 4. The capacity of these devices are tabulated below. The range of use is greenhouses and irrigation systems under pressure.

For open irrigation systems (throughs, ditches) pressureless devices of the YMO-750-20 type have been elaborated, manufactured and tested. They are disjoinable and portable, assembled of 7-10 separate blocks mounted into a canal, a ditch or an outlet

Table 1. Specification of magnetic devices for water treatment

Treater type	Diameter of supplying pipeline (mm)	Capacity (m^3/h)	The range of use
YMO- 100-10	80	36	Pressure irrigation system, greenhouses. Treaters are flange-connected to metallic pipeline
YMO- 250-10	150	90	
YMO- 1000-10	250	360	
YMO- 750-20	250-350	350	Open irrigation systems (throughs, ditches)
YMO- 40-80-H	40-80	5-20	Covered irrigation systems. Treaters are mounted outside nonmetalic pipelines

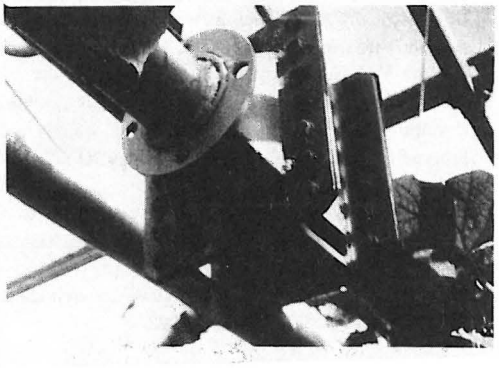

Fig. 4. Connection of magnetic device YMO-100-10 to irrigation network of greenhouse 'Undermoscow' in Moscow region.

tray (see Fig. 5). Each block being a self-contained direct-flow magnetic unit, the number of blocks varying according to the size of the ditch. The optimum operation of the device at a water velocity of 0.5-1.0 m/s.

Field test of YMO types under a variety of climatic conditions (Russia, Armenia, Turkmenia, Uzbekistan) have demonstrated their effectiveness for washing and irrigation of saline soils. Application of the above devices allow to intensify washing of saline soils, to decrease water consumption and to increase the crop yield by 15-20 %.

This method is ecologically harmless and should be recommended for applying in technology processes of agriculture.

We have to admit that the MHD-activation has not yet become a standard for land reclamation procedure. Its efficiency is studied and checked for various soils and water.

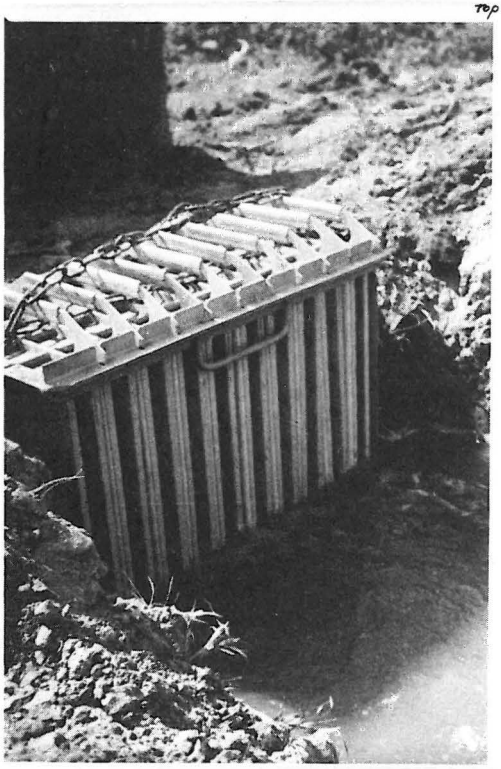

Fig. 5. Magnetic device YMO-750-20 in aryk Horezm region of Uzbekistan.

Reference should be made to studies of subject in other countries (Germany, Romania, Israel, Bulgaria), [7,8,10,11].

CONCLUSIONS

1. Application of magnetic treaters for seeds and water is one of reserves of agricultural production.

2. Pre-gemination magnitophore treatment of seeds makes it possible to improve germination of seeds, which can be clearly seen with vegetable seeds; besides it results in obtaining earlier crop output.

3. Application of magnetic treaters for water is efficient not for all types of water and soil. MHD-method is most effective in arid regions where water alkalinity is high and there is a tendency for soda salinization of soil.

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