

# Effects of electrophysical processing on the development of vine root roots

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**Abstract.** The article discusses the possibilities of electrophysical methods to increase the efficiency of grape seedling cultivation and increase root development in seedlings by 95-97% when exposed to the electric field strength of 16.64 V / m and exposure for 12.24 hours. The possibility is explained in practical and theoretical terms. However, experimental data and various electrotechnologies aimed at increasing the efficiency of root formation and development by 15-20% in grape cuttings treated for 12 and 24 hours at 16 and 64 V / m of electric field strength are presented.

## 1 Introduction

The yield of future vineyards and the quality of the harvest often depend on the seedlings' quality. Although many biological and agro-technical measures are being taken to increase the productivity of various fruit trees and grape seedlings, some farms have low seedling yields, which hinders the establishment of grape plantations.

The current state of science is to direct these factors in the right direction by controlling them through the electrophysical effects of various stimuli, including different forms of electromagnetic field energy (electric field, electric current, magnetic field, electric discharge, electromagnetic waves, pulsed electromagnetic field), indicates the possibility of redirection.

The process of root formation in grape seedlings is a complex biological process that depends on internal and external factors. [2]

Various experiments and theoretical knowledge on the study of different effects of electromagnetic field energy on grape cuttings and seedlings and their use in the cultivation of grape seedlings were analyzed using internet materials, literature, and patent data.

## 2 Methods

The practical application of this energy-saving approach to the processing of materials belonging to the plant kingdom requires an in-depth study of the process of exposure of electromagnetic fields to materials, which in turn is one of the most pressing issues in solving energy-saving problems in agricultural production.

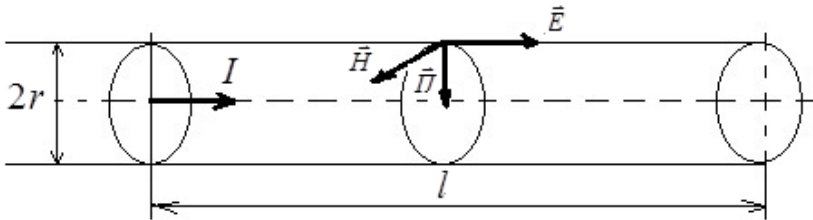
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In general, the motion of the electromagnetic field energy is represented by the Poining vector

$$\vec{\Pi} = [\vec{E} \cdot \vec{H}] \quad (1)$$

The point vector represents the direction of motion of the energy again, propagating electromagnetic waves directed perpendicular to the electric field strength and magnetic field strength vectors.



**Fig. 1.** The motion of energy in an alternating current conductor

In a unit of time, an electromagnetic wave directed (connected) to a material (body) of volume V of any finite surface F is partially absorbed by the body (technological environment), partially reflected, and partially transmitted. The energy A falling on an elementary surface (dA) can be expressed as follows.

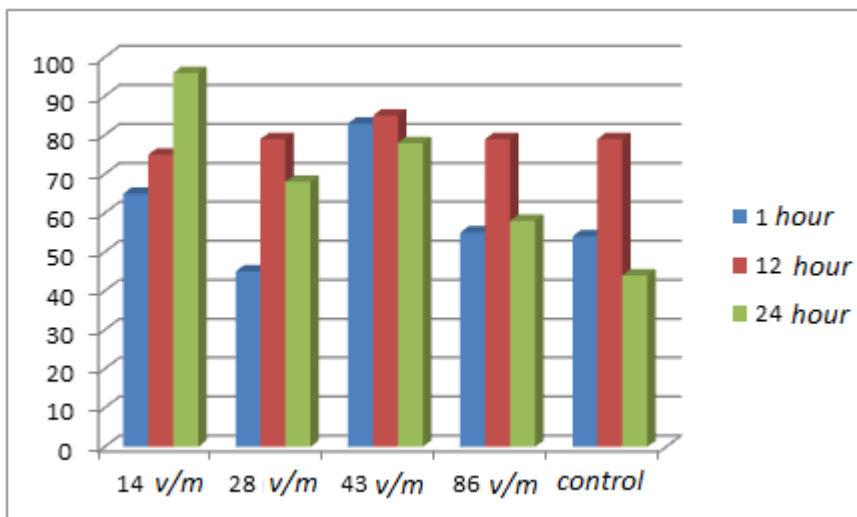
$$\bar{S} = -\oint_A \bar{\Pi} d\bar{A} = -\oint_A [\bar{E} \bar{H}] d\bar{A} \quad (2)$$

The process of rooting of fruit trees and vines, the use of electromagnetic field energy for technological purposes in agronomics of agricultural crops, processing and storage of finished products have been proven to achieve new results. [1]

### 3 Results and Discussion

Researches of domestic and foreign scientists, including V.I.Michurina, A.M. Basov, I.I.Gunara, V.V.Pilyuginoy, P.P.Radchevsky, A.G.Kudryakov, B.R. Lazarinko, and I.F.Borodin found that electrophysical methods of exposure to biological objects, including materials belonging to the plant world, in some cases give not only quantitative but also qualitatively positive results, which other methods can achieve.

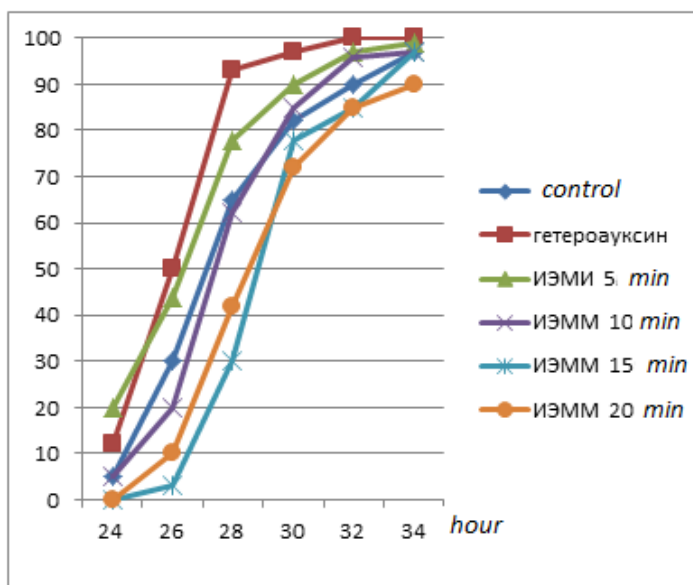
A.G.Kudryakov found that the process of rooting grape seedlings by processing grape seedlings using electricity can achieve good results when exposed to an electric field of 14 V / m and 24 hours. [3]



**Fig. 2.** The degree of root formation in grape cuttings depends on the electric field strength and processing time

The use of 50 Gts industrial frequency alternating current in electrophysical rooting methods in grape cuttings is recommended, and its transmission to the seedlings through the liquid was found to give high results. [3]

P.P.Radchevsky conducted two experiments in the spring. One control and one 0.01% heteroaxin solution were placed in the experiment, and four variants of one- and two-eyed grape cuttings were treated in a pulsed electromagnetic field. He found that when exposed to a pulsed electromagnetic field for 5-10 minutes, the rooting processes in grape cuttings are accelerated. Good results can be achieved through the effective use of these technologies [4].



**Fig. 3.** Dynamics of root formation rate in two-eyed cuttings of grapes processed in a pulsed electromagnetic field.

It should be noted that the process of root formation in grape cuttings treated in a pulsed electromagnetic field was 97.5-100. It was observed that the process of root formation in grape cuttings treated in a pulsed electromagnetic field for 5 minutes (IEMM-5 minutes) was accelerated by 7.5-15% compared to the control. [4]

Experiments and theoretical knowledge conducted by the analyzed scientists show that the rooting of fruit trees and vine seedlings may depend on a certain amount of harman active eyes.

Therefore, the inversion of electromagnetic fields into different forms of energy into biological and other energy types requires an in-depth study of the technical performance characteristics. Hence, the electromagnetic field is a form of matter that is interconnected as an energy supplier and is represented by a unit of electric and magnetic fields that form each other. [1]

The propagation of the electromagnetic field and its absorption by the environment are accompanied by the motion of the energy of the electromagnetic field, which is a unit of electric and magnetic fields. The electromagnetic field can exist (manifest) in various forms: electric field, electric current, magnetic field, electric discharge, electromagnetic waves, pulsed electromagnetic field, etc. Due to the fact that all types of electromagnetic energy are transformed into thermal, mechanical, chemical, biological, and other types of energy as a result of movement and conduction in the material environment, they can maximize their impact in solving problems of increasing energy efficiency in agricultural production. It is important to achieve efficiency.

A new methodological approach to solving the problem is to increase energy use efficiency by managing the flow of energy following the physical properties (conductive, semiconductor, insulator) and conditions (solid, liquid, gaseous) of the technological environment during the technological process. [2]

Technological efficiency is calculated only at the expense of energy absorbed by the material (technological environment).

The amount of energy absorbed by the technological environment depends on the electromagnetic field current indicators and the oscillation frequency ( $f$ ), and the physical properties of the technological environment  $\mu$ ,  $\epsilon$ ,  $r$ . Therefore, the amount of energy absorbed by solid, liquid, gaseous, electrically conductive, dielectric, semiconductor objects (technological environment) placed in the flow of an electromagnetic field with the same parameters will be different and give different technological effects. [1]

This means that by using the various electrophysical effects of electromagnetic field energy, the rooting process in seedlings made from grape cuttings can be significantly enhanced. [2]

A small experiment was conducted, taking into account the theoretical knowledge studied. The experiment was performed in a common heated room. Two-eyed cuttings cut from my black currant variety were made from 20 cm in length. A total of 170 grape cuttings were used in the experiment. The number of grape cuttings processed using electricity was left for 160 and 10 for control. The experiment used an industrial frequency (50 Gts) alternating current with a voltage of 4,8,16,36 V and a processing time of 6,12,24,36 hours.



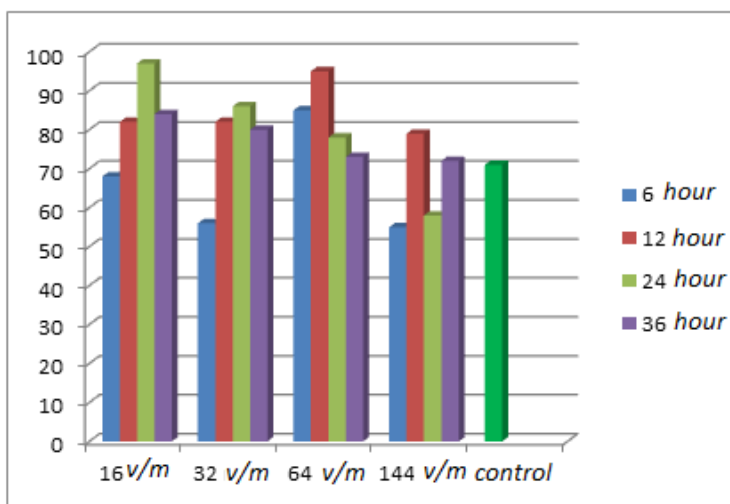
**Fig. 4.** The process of processing grape cuttings using electricity

The processed grape cuttings were stored separately in a container filled with water for 12 hours and planted in disposable containers.

The electric field strength was 16,32,64,144 V / m.

$$\begin{aligned} \varepsilon_1 &= \frac{U}{l} = \frac{4}{0,25} = 16B/m & \varepsilon_2 &= \frac{U}{l} = \frac{8}{0,25} = 32B/m & \varepsilon_3 &= \frac{U}{l} = \frac{16}{0,25} = 64B/m \\ \varepsilon_4 &= \frac{U}{l} = \frac{36}{0,25} = 144B/m \end{aligned}$$

All the grape cuttings were made from a single grape tree. The electrodes in the electrotechnical processing device were made of stainless steel; the distance between them was 25 cm. 3.8-liter plastic containers were used for processing.



**Fig. 5.** Dependence of root development level on electric field strength and processing time in grape cuttings of black currant variety

Root rooting processes by grape cuttings using electric current accounted for 95-97% of the root development process in cuttings at 16.64 V / m electric field strength and 12.24 h exposure.

Compared to the control, at 16 and 64 V / m electric field strength, root formation processes in grape cuttings treated for 12 and 24 hours were accelerated by 15-24%.

As a result of small experiments and analyzes, it was found that grape seedlings are not affected by the active state when exposed to electricity, and plant tissues have active conductivity only at low levels of electric field strength [3].

Electrophysical treatment of grape seedlings significantly increases the process of root formation in grape cuttings, which can contribute to higher yields from seedlings grown using electrotechnological methods.

Despite the great prospects for using electrotechnological methods to control the vital processes of plant organisms belonging to the plant world, the application of these methods in the cultivation of seedlings from grape cuttings remains unexplored. The substantiation of technologies (electrophysical factors and energy parameters) for the cultivation of well-developed one- and two-year-old grape seedlings using electrotechnological methods without any damage to the body, variety, and roots is currently one of the most pressing issues for agriculture.

## 4 Conclusion

Such conclusions were reached by studying the research results conducted by researchers in Uzbekistan and abroad, the results of the analysis, and various experiments.

1. Studies and various experimental tests have shown that the treatment of grape seedlings using electrophysical effects significantly accelerates the process of root formation in grape cuttings and can allow high yields from seedlings grown using these methods.
2. It is recommended to use an alternating current of 50 Gts industrial frequency in the implementation of root formation processes in grape cuttings using electrotechnological methods. It was found that one of the most effective technologies is its liquid delivery to grape cuttings.
3. The process of root formation in grape cuttings with an electric field strength of 16.64 V / m and exposure for 12.24 hours by electrotechnical processing of grape cuttings was 95-97%.
4. Compared to the control, it was observed that the process of root formation in grape cuttings treated by electrotechnological methods was accelerated by 15-24%.
5. Studies have shown that electrophysical treatment before planting agricultural products, i.e., grape cuttings, belonging to the plant world from different forms of electromagnetic field energy, can show positive results.
6. To study the effect of electromagnetic field energy on electrically conductive dielectric and insulating materials in liquid, solid and gaseous state, especially biological products, which can be used to increase the energy efficiency of agro-technical processes of agricultural production (fruit trees and grapes, apples, pomegranates) can be concluded that.

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