Use Of Electrochemical Activated Water During Propagation Of Biomaterials In Bio Factory

Bakhodir Khaitov, Muradjon Abdullaev, Zokir Mamadzhonov

Abstract: The introduction of advanced technologies in industry, the national and agricultural sectors, and thereby improving the economic performance of the state, is today one of the urgent problems. Pests are one of the factors that reduce crop yields. Today in the world there are more than 80 thousand pests, of which 10 thousand have very great harm to plants. Calculations show that as a result of exposure to pests in the world more than 30% of crops are lost annually. In this regard, the protection of plants from various pests is one of the urgent problems. Of great importance is the conduct of scientific research in the field of widespread use of biological methods of protecting plants from pests, as well as improving the effectiveness of the biomaterials used. The biological method is considered effective from both an economic and economic point of view. The article discusses the development of a new technology for the production of trichograms for use as a means of protection against cotton pests.

Index Terms: barley grains, butterfly moth, biological method, diaphragm eggs of a grain moth, electrochemically activated water, electrolyzer, electrode, trichogramma. pH.

1. INTRODUCTION

It is known that various insect pests are a factor in reducing the fertility of many agricultural plants in the agricultural sector. Currently, more than 80 thousand species of these pests have been found in the world, 10 thousand of which annually seriously harm the fertility of more than 30% of various plants. Given the relevance of this provision, local scientists are currently conducting research on the development of the most optimal methods of pest control, based on the production and use of new effective types of biomaterials [1,2,3,4,5,6]. In the field of cotton farming in the Republic of Uzbekistan, pest control is widely used - chemical, physical, mechanical and biological methods. These methods in their purpose, application, cost, effectiveness and environmental impact are very different from each other. Was established that the most effective methods of combating various pests of cotton is the use of biological agents - gabrobracon grown using electrochemically activated water. Currently, in cotton growing, rational methods of combating the winter and cotton scoops on cotton are widely used, using biological active materials such as bracon, trichogramma and golden-eyed. In the production of these biomaterials, water from the water supply network is mainly used.

2 METHODOLOGY

The aim of the study is the use of electrochemically activated water for breeding butterfly butterflies (citrogens) of eggs in biological factories, improving the technology for producing trichograms, as well as increasing production efficiency.

In accordance with the results obtained, our scientific research and experiments on the development of diets for growing wax moth caterpillars and production on its basis of a defect in the laboratory of the joint-stock company “Bioservice” of the Namangan region, performed in the period 2015-2018, using electrochemically activated water, more optimal options and regimes of rational production and more cost-effective methods of using bracon in pest control were identified which to a certain extent subsequently contributed to the achievement in the region's agriculture of a certain economic efficiency as a whole. This method was also successfully tested during the propagation of trichograms in the eggs of a wax moth (citrogens), multiplied by a barley grain in laboratory conditions. If natural trichogram eggs collected from the fields in the autumn period of the year are used as the parent material, then further processes of multiplying trichograms from wax butterfly eggs - sitatrogs were carried out in bio laboratory conditions [7,8,9,10,11,12]. The efficiency of obtaining "sitotrog eggs" from barley grains directly depends on the quality indicators of the grain used, in production conditions (room temperature, relative humidity, sanitary conditions, etc.), as well as on the main technological factors affecting the quality of the trichogram. The algorithm of technological processes of reproduction of eggs from wax butterfly grains consists in the following:

- the preparation of barley grains for infection by the larvae of the sitatrogue;
- process of infection of barley grains with larvae of sitatrogue;
- growing larvae and collecting eggs from sitatrog butterflies.

The essence of the technology itself is as follows Reznik S. Y., Umarova T. Y., & Voinovich, N. D [13,14,15,16,17,18].

At the first stage of preparation of the main raw material, barley is selected in an amount of 1300 kg on the production line and thoroughly washed in a sieve. Next, the drying process in the dryer and the barley are kept in an autoclave, in order to thermal (temperature) disinfect them under a pressure of 1.5 atm., for 30-40 minutes. At the second stage - the disinfected grain in the specified quantity, with 16% moisture is sent to the workshop to carry out the process of infection of the grain with eggs of a sitatrogue, why it is stacked in separate cuvettes in an amount of 10 kg each. At the same time, the thickness of the layer of grain laid in the cells should not exceed 4 cm. The optimality of the process of infection of grains can be achieved by using sitatrog eggs, which have just been laid or incubated for 7 days, at the rate of 1 g per 1 kg of grain. Eggs before the infection process, previously kept in a thermostat at a temperature of 25°C. Since the appearance of the first caterpillars, the latter are immediately laid out on the surface of the barley grains laid out in cuvettes. In accordance with the established regimes, every 5 days of the process of infection of the grains, operations are made to moisten them with water (at the rate of 300 ml) for the contents of each

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cuvette, to ensure the necessary optimal (16%) humidity. Temperature parameters -23-24°C and relative humidity 80-85% in the room are regulated and supported by special automatic control devices. After the expiration of the process of infection of grains with wax butterflies, after 15 days, the degree of infection of the main material is determined by laboratory analysis methods. To determine this indicator, the selection of infected grains from different cuvettes in the amount of 500 pcs is carried out, longitudinally cutting each with a laboratory knife, and then performing analytical and visual observation. If the rate of infection of grains on average was less than 60%, then the process is repeated anew. Studying the essence and scientific foundations of modern methods and technological conditions for the production and reproduction of the most biologically active ethmophages (gabrobracon, trichograms, etc.), our research team carried out separate “Clusters” for the development and use of various types of “Trichograms”, produced on the basis of the use of wax butterfly (sitatrog) barley grain in technological processes of reproduction, using electrochemically activated water. Our research work was carried out by the experimental laboratory of Bio service factory in the Namangan region. The process of electrochemical activation of water was carried out on an electrolyze with a diaphragm, the last of which can be made of ceramics, porous fluoroplastic or tarpaulin. In the electrolyze system, the anode should be made of acid-resistant materials, and the cathode should be made of alkali-resistant materials (nickel, titanium, stainless steel). The process of electrochemical activation of water is as follows: The diaphragm electrolyze is divided into two parts, then a direct current is passed through this device, as a result, positively charged cations begin to move towards the cathode, and negatively charged anions toward the anode. In this case, oxidative reactions occur in the cathode zone, and reduction reactions occur in the anode zone. It should be noted that water, even in small volumes, by its physicochemical properties can dissociate into hydrogen cations and hydroxyl anions. Salts, such as $CaCl_2$, NaCl, Na_2SO_4, which also dissociate into cations and anions, are also found in tap water. When the electrodes are included in the electric circuit, the cations begin to move to the negatively infected electrode, and the anions to the positively infected electrode. In this case, hydroxyl OH^- ions at the anode, transmitting their electrons, contribute to the origin of the oxidation process, and chlorine ions combining with H^+ cations form an acidic environment. Chlorine ions located on the cathode, transferring their electrons to the electrode, turn into free chlorine:

$$2Cl^- - 2e = Cl_2 \uparrow$$

As a result of this phenomenon, Ca^{2+} ions located on the (-cathode) adding anions of hydroxyl groups form an alkaline medium, and an acid medium forms in the zone (+ anode) (1-scheme).

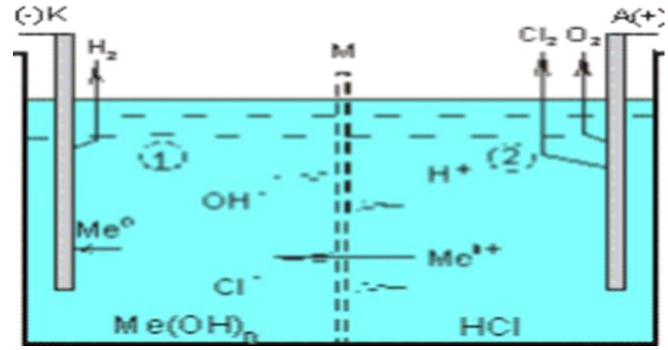

***Fig.1**. Electrolytic bath circuit for electrochemical activation of water*

As can be seen, in the presented diagram, due to the ongoing chemical reactions at the cathode, H^+ cations are formed primarily, and then, as a result of the process of reduction of dissolved oxygen to OH^- ions, alkalization of the working medium begins. The chemical composition and pH of the electrochemically activated water obtained by the above method were determined in the central laboratory of Uzvodokanal LLC in the Namangan region in accordance with hygiene requirements and quality indicators established by the state standard bodies of the Republic of Uzbekistan.

3 RESULTS AND DISCUSSION

When comparing the results of our studies, indicators of two types of solutions (plain tap water and electrochemically activated water, differences in their certain physicochemical properties were established. Analysis of plain water (control version) showed that the water hardness indicator was 5,6 mg·equiv/dm^3. According to UzGST No. 950/200, this indicator is normalized to 7-10 mg. eq / dm^3), the amount of Cl^- ions is 51.0 mg / dm^3 (according to UzGST No. 950/200, this indicator is 250 mg/dm^3), SO_4^{-2} - 162 mg/dm^3 (according to UzGST No. 950/200, this indicator is normalized to 400-500 mg/dm^3). And in other versions, these indicators of electrochemically activated water were as follows:

- in the second version (EAS) at pH = 9±0,5, the water hardness indicator was 2,5 mg·eq/dm^3, the amount of Cl^- ions was 32,8 mg/dm^3), SO_4^{-2} - 42 mg/dm^3;
- in version 3 (EAS) at pH = 10±0,5, the water hardness is 2,3 mg·eq/dm^3, the amount of Cl ions is 31,2 mg/dm^3), SO_4^{-2} - 38 mg/dm^3.

Analytical calculations of some physic-chemical indicators (EAW) are presented in the following table 1:

***Table 1**. Physic-chemical characteristics of electrochemically activated water (EAW) in an alkaline environment*

№	Options	Total hardness of water, mg·eq/dm^3	Amount of Cl^- chlorides, mg/dm^3	Amount of sulfates SO_4^{-2}, mg/dm^3
1	Control method (tap water)	5,6	51,0	162
2	Electrochemically activated water at (pH = 9 ± 0,5)	2,5	32,8	42
3	Electrochemically activated water at (pH = 10 ± 0,5)	2,3	31,2	38

In general, studies have established that the use of electrochemical activation methods of simple tap water in an alkaline medium can significantly reduce the concentration of chlorides, sulfates and the hardness index in its composition, improving its physicochemical properties. Studies on the electrochemical activation of tap water in an acidic environment showed: When comparing the results of our studies with indicators of two types of solutions (electrochemically activated water (EAW) in alkaline and acidic environments, the differences in their certain physicochemical properties were determined. The analysis of non-activated water (in the first control variant) showed that the water hardness indicator was 5,6 mg·eq/dm^3 as well as in an alkaline medium (according to UzGST No. 950/200 this indicator was normalized to 7-10 mg·eq/dm^3), and the amount of Cl^- ions is 51,0 mg/dm^3 (according to UzGST No. 950/200, this indicator is normalized to 250 mg/dm^3), SO_4^{-2} - 162 mg/dm^3 (according to UzGST No. 950/200 this indicator is normalized to 400-500 mg/dm^3). These indicators of electrochemically activated water in the remaining versions were as follows:

- in the second version of electrochemically activated water at pH=3±0,5, the water hardness index was 4,1 mg·eq/dm^3, the number of Cl^- ions was 50,2 mg/dm^3), SO_4^{-2} - 134 mg/dm^3;

- in version 3 of electrochemically activated water at pH=4±0,5, the water hardness is 3,8 mg·eq/dm^3, the amount of Cl^- ions is 48,5 mg/dm^3), SO_4^{-2} is 131 mg/dm^3.

Analytical calculations of certain physic-chemical parameters of electrochemically activated water are presented in the following table 2.

***Table 2.** Physic-chemical characteristics of electrochemically activated water in an acidic environment*

№	Options	Total hardness of water, mg·eq/dm^3	Amount of Cl^- chlorides, mg/dm^3	Amount of sulfates SO_4^{-2}, mg/dm^3
1	Control method (tap water)	5,6	51,0	162
2	Electrochemically activated water at (pH = 9 ± 0,5)	4,1	50,2	134
3	Electrochemically activated water at (pH = 10 ± 0,5)	3,8	48,5	131

Judging by the results obtained and comparisons of the indicators of electrochemical activation of tap water in alkaline and acidic environments, it was revealed that the hardness index of the studied water in the acidic medium was high, and the content of chlorides and sulfates was also significant. When performing our experiments on the infection of barley grains with sitatrog larvae and the creation of recommended norms of process humidity indicators, only electrochemically activated water with (pH=9,5-10,5) was used. These studies were carried out in three options, with three repetitions:

- in the first version of the experiment, plain tap water was used to moisten barley grains, and this option was designated as control (calibration);

- in the second embodiment, electrochemically activated water with pH=9±0,5 was used in this humidification process;

- in the third embodiment, electrochemically activated water with pH=10±0,5 was also used.

The implementation of the main experiments was started on March 1, 2017 with the process of infection of barley grains with the larvae of sitatrog. Further, in our studies (pre-cleaned, washed and with the necessary moisture), barley grains in an amount of 13 kg separately in each cuvette, a total of 104 kg, for an individual 1, 2, 3 options, 3-4 cm thick were evenly placed in every 8 mi ditches. In all 3 variants, barley grains in 24 cells were placed on racks in special rooms, where during the first 24 hours the temperature was maintained -24±1°C and relative humidity -80±5%. When measuring the moisture content of the studied grains on the Kolos-1 device, it was found that this indicator was 16-18%. On March 2, 2017, in order to infect the experimental grains in all cases, the cuvettes were evenly scattered (eggs of a wax butterfly sitatrog animated during the day at a temperature of 24±1°C, at the rate of 1 g per 1 kg of grain) using a sieve with a diameter of 2 mm. After two weeks of the start of the experiment - March 12, 2017, measurements of the average moisture content of infected barley grains were performed. According to the results of the analyzes, in connection with the higher limit decrease in humidity in the studied grains, it was necessary to carry out the process of moisturizing the latter in each variant. For this, simple tap water in the volume of 250-300 ml for every 10 kg of grain is added to the cuvettes with grain of the first variant, for experimental – 2,3 variants, not simple, but electrochemically activated water in the above proportions was used. After the barley is moistened, on the third day, heating of the grains in the cells begins. From this moment, it is necessary to produce grains from the cuvettes of each option in an amount of 500 pieces, then cut them longitudinally, to perform an analytical and calculation analysis of the degree of infection of the test product. According to the results obtained, it was found that in the first control variant the infection of the grains was -65%, in the second - 72% and in the third - 78%. It should be noted that the implementation of repeated processes of moistening grains of simple and electrochemically activated water showed:

- in the first control variant, the primary flight of the wax butterfly was observed on day 28 and grains were taken to the boxes on 03.31.2017;

- in the second embodiment, using electrochemically activated water on day 26 and grains were selected in the boxes on 03.29.2017;

- in the third embodiment, using electrochemically activated water on day 25 and grains were selected in the boxes on 03.28.2017.

The results of the experiments are presented in the table below (Table 3).

***Table 3**.The effect of electrochemically activated water on the quality index of infection of barley grains and on the development of wax butterfly larvae*

№	Options	The amount of grain kg	The required number of citrogens in gr	Grain infection period, day, month, year	Water consumption, ml	The degree of infection of grains,%	Dates of the primary flight of butterflies day, month, year	Dates of selection of butterflies in boxes day, month, year
1	Control option (plain tap water)	104	104	1.03.2017	15600	65	28.03.2017	31.03. 2017
2	Electrochemicals activated water (pH=9±0,5)	104	104	1.03.2017	15600	72	26.03.2017	29.03. 2017
3	Electrochemicals activated water (pH=10±0,5)	104	104	1.03.2017	15600	78	25.03.2017	28.03. 2017

When selecting butterflies and their eggs from infected barley grains, special attention should be paid to hydrometric conditions. According to the data of experiments and analyzes, it was found that in the first embodiment, 633 g were obtained from barley selected in the boxes, in the second version at (pH=9±0,5) - 655 g and the third version at (pH=10±0,5) - 686 g of sitatrog eggs. The experimental data are presented in table 4:

Table 4. *The economic efficiency of the use of electrochemically activated water during the infection of barley grains (in prices of 2018)*

№	Experiment Options	Barley grain consumption, kg	Citatro consumption, g	Time spent to infect grains, days	The number of citrogens, gr	The cost of the finished product, sum	Difference, sum
1	Reference method (plain tap water)	104	104	31	633	633000	-
2	Electrochemical activated water at (pH=9±0,5)	104	104	29	655	655000	+22000
3	Electrochemical activated water at (pH=10±0,5)	104	104	28	686	686000	+53000

Making some conclusions, it should be noted that when comparing the processes of moistening barley grains using electrochemically activated water (at pH=10±0,5 alkaline medium) with the control variant, it is possible to obtain 53 g more citatrog eggs from every 100 kg of grains. If about 120 tons of barley will be processed in the bio factory laboratory system per year, then the production of citrogly eggs can average more than 64 kg, the production efficiency will increase by 8-10% and, accordingly, the profitability of scientific research will improve.

4 CONCLUSION

In general, it was found that: the activity of electrochemically activated water in a production environment is not pain for two days; further, the pH of the water is capable of neutralizing; Anolyte part with acidic medium of electrochemically activated water is an effective means for sanitary treatment of laboratory premises; The optimum period of use of electrochemically activated water with an alkaline medium (catalyzes) in the production and reproduction of eggs of the wax butterfly sitotrog is more than 12-14 days; the most effective is the use of electrochemically activated water, which is used in the process of reproduction of Sitatrog eggs from infected barley grains at a temperature of 24±1°C and in conditions of relative humidity of 80±5% of laboratory premises, and also for moistening 10 kg of grain in a volume of 250-300 ml (EAW) is accepted as the most optimal option, which will ensure the preservation of barley moisture in the range of 16-18%.

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