

APPLICATION OF ELECTROMAGNETIC RADIATION OF LOW FREQUENCY FOR INCREASING OF THE CROP CAPACITY OF THE AGRICULTURAL SEEDS

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The comparative analysis between various ways for increasing of the crop capacity of the agricultural seeds is carried out. Is developed and probed a method of use of electromagnetic radiation of low frequency for increase of productivity of agricultural seeds.

Keywords: Electromagnetic radiation, low frequency, agricultural, seed, increase of productivity.

Introduction

The intensive farming (amelioration, introducing elevated doses of mineral and organic fertilizers, utilization, apply remedies of protection for pests and illnesses etc.) along with increasing of the crop capacity inevitably leads to sharply increasing of power inputs during growing of agricultural production.

So, for visible short historical term the costs of processing of soil, the fertilizers, pests, transportation, storage, processing of production of an agriculture have increased in tens time, and as a corollary, the power price of a food calorie was considerably increased [1]. For this reason for the last years the large attention is given to development of methods and means of increasing the crop capacity, distinguished by small power-consuming. Such alternate way at the present stage, alongside with an improvement of the structure of areas under crop, creation of highly productive kinds, broad usage of physiological reserves of increase of a crop, that is intrusion in agronomical practice of the scientifically reasonable methods (receptions, acceptances) of control of physiological processes which are flowing past in plants, with the help of physical and chemical reactants. Use of activators and regulators of growth, scientifically reasonable application in the plant growing of a various kind of radiation of an electromagnetic spectrum are belonged to them.

Due to the fast recouperation labor and material expenses of the introduction of these methods will allow to sharply reduce general power consuming and cost price of agricultural production, that is one of major problems of the biophysical and agricultural sciences.

Review

For the last decades in the biological science significant successes were reached in research of the mechanism of physiological and metabolic processes: the main principles of the cell biopower were uncovered, the sources and forms of its power balance were investigated; the role and functions of bioelectric potentials are established and the role of an electricity in management of main physiological processes in all alive organisms was proved.

Every alive cell has outside plasmatic membrane isolating contents of the cell from environment, and intracellular of the membrane, bounding organelle of cells: a nucleus, mitochondrion, chloroplast etc.

The biomembranes are very thin structures; thickness is about 0.008 μm , consisting from two stratum of molecules. Representative features of biomembranes are constant availability of an electrical potential supported at the expense of exchange of substances. Dividing the cell on sets of separate compartments, the membranes ensure preservation of the specific physical-chemical conditions in each of them, keeping different dispersing condition of systems at the expense of electrostatic forces. On both side of membrane such environments, as an acidity, temperature, concentration of the solutes, electrical potential, as a rule, are different. Therefore, the availability of an electrical potential on the membrane is necessary conditions for an alive cell [2,3]. While

vanishing of the potential the membrane fails, organelles of the cells mix up according to the law of diffusion, and the cells perish.

The alive organisms consist considerable quantities of water, which depending on energy connection with the frame are divided on chemical, physical-chemical, physical-mechanical connected waters /4/. At the chemical connection the water is belong to the structure of substance in the hard molecular ratio, forming hydrates and crystallohydrates.

The physical-chemical binding of water happens in the hard molecular ratio, it is adsorbed connected and osmotic connected water. In the first case this moisture is conditioned by interaction of adsorbent molecules with the molecules of water. At that it is possible preservation of individuality of adsorbed water - physical adsorption, if the molecule of water returns or receives from the adsorbent surface electrons and is split on atoms, which contact with atoms of the surface everyone, -the chemical adsorption takes place. To the osmotic connected moisture (swelling moisture and the structural moisture) belongs to the moisture being in closed cells, as osmotic absorbed with complicatedly constructed micelle, captured the forming the gel. This moisture is free in the sense that the rather small energy of connection corresponds to it. The osmotic absorbed moisture diffuses into the skew field as a liquid through walls of cells due to the difference of concentration inside and outside of cells.

Physical-mechanical binding of water happens in uncertain proportions, it is the structural captured water, the moisture of micro- and macro capillaries, the moisture of wetting.

It is necessary to note, that as the quantity as the types of connected waters, contained in the seeds influences on electrical properties of membranes noticeably, and mainly, in the structure of agricultural seeds the physical-chemical connected water is prevalence. Therefore, all qualitative and quantitative characteristics of external effects, progressing through it, depend on the properties of plasmatic membrane. It transforms them to the electrical energy and transmits them into as the bioelectric potentials. The alive organism generates electric pulses in answer to external effects, it was established experimentally. At that, the electric pulses is generated the most effectively at the fixed meaning of external resonance effects. These bioelectric potentials and waves are the peculiar starting mechanism for a number of only physiological processes - photosynthesis, breathing, variation of intensity of exchange processes in cells etc.

The role of these potentials in stimulation of biochemical processes /5,6/. Or else, every alive organism is an open electrical system, knowing parameters and dynamics of which it will be possible with the help of electrical effects to control of vital activity of organisms /7/.

Now the set of the physical factors is known, in influencing of which on seeds it is observed the effect of stimulating of growth processes. And among them the especial interest is represented the processing of sowing material by electromagnetic effects: by electrical and magnetic fields with various parameters (constants and variable fields of millimetric and submillimetric ranges, magnetic-gradient fields etc.), by the investigation in an optical range with various frequencies (infra-red and laser radiation, broad spectrum of impulse solar light, ultra-violet radiation), by ionizing radiation (x-ray, gamma - radiation, accelerated electrons etc.).

The essence of stimulating effect of the physical factors is reduced to the rise of power balance of seed by means of transformation of every kinds of energy in electrical and raising of an electrical potential in the membrane complex. Under natural conditions in sprouting seeds the potential is supported at the expense of breathing energy, and each cell spends for it a solid share of own power reserve. Therefore before sowing processing seeds by the physical factors in optimum dozes ensuring the rise of an electrical potential in the membrane complex of cells, should reduce in useful increase of power balance of seeds, essential intensification of exchange of substances and activation growth processes. The before-sowing electro processing of seeds essentially increases the water-adsorbing capacity of them, the fermentative activity and intensity of breathing sprouting seeds, that, in the end, it has an positively effect on energy of germination, germination capacity, intensification of growth processes and photosynthesis of ontogenesis of plants in early stages /8,9/.

One of the main reasons of the stimulating operation before-sowing processing of seeds is that the amount of functional genes in the nucleus of cells is increased which, being included in the

metabolism of plants, accelerate forming of separate fabrics and organs and change the structural condition and functional activity of the genetic means of the cells /8,10/.

The numerous scientific - investigating works, which have shown the high efficiency before-sowing processing of seeds by electromagnetic effects were conducted in former Soviet Union, as well as in abroad in this direction /11/. Many tests were conducted also by our Kazakhstan scientists /12-16/. After processing of seeds of grain-crops in electric field, the average rise of crops was equal in 2,1 c/he, in particular, in state farm "Leninsky" of Tchkalovsky region of Kokchetav area for 1978-1981, and after the applying the rule of sowing electro stimulation of grain-crops in state farm "Konstantinovsky" of Arekbalyksky region of the given area, the rise of crops for 1997-1981 was equal within the 2,2- 2,5 c/he /13,14/.

The manufacturing check of agricultural method before-sowing electric stimulation of rice seeds conducted in farms of Alma-Aty area (state farms " Akdalinsky " and " The 50 years of October ") has given an rise of the crop from 11 to 22 % from each experimental hectare /15,16/.

The special problem was the determination of optimum terms of seeds staying after processing and adjustment of seeds sowing norm after electric stimulation. /17/. So, in a number of cases the drop of agricultural method efficiency because of excessive bodying of crops was observed. As the existing sowing norms were installed with subject to the soil-climatic conditions of the zone and the biological features of the sort, but disregarding the applications of any mode of promoting growth processes. The electric stimulation mode of seeds considerably increases their germination, productive bushiness and spring-summer survival of plants. All that conducts to essential magnification of number of plants and productive stalks per unit of area, resulting to shifting, excessive bodying of crops.

Briefly we shall stay on the degrees of effect of various types of electromagnetic radiation on cultural seeds.

Depending on the frequency of radiation the quantum of energy transmitted to cells of plant at the single act of interaction makes of in the order of 10^{13} erg/piers for the submillimetric range of frequency and can result to the modification and mutation effects. But depending on the intensity and duration of effect it is possible to achieve a positive effect of the processing /18/. But at low frequencies of a radiation (low radio-frequencies) the portion transmitted energy is less still, at least, on 10^{10} times. That basically can not result in the mutation effects (genetic modifications), as even the weakest types of connection in molecules of cell are more than the transmitted energy in billions time.

Therefore, the electromagnetic waves of low radio frequencies can change only the size of membrane's biopotential and by that to act selectively and to control only by the course velocity of physiological processes in cells.

There are some notes concerning technological solutions of existing techniques and equipment:

1. Electromagnetic radiation's of millimetric, submillimetric, and also visible range of the light (including the laser exposure) has the limited permeability in substances on the nature. That is cause of, that at the cultivating of seeds the electromagnetic radiation effect is distributed only over the first surface stratum of seeds and main mass of seeds, which being in inside of volume is not subjected to processing in essence. By that efficiency of the agricultural method sharply decreases.
2. Electronic installations (for example - AEK-30 with the productivity in 30 t/h, and also the installations on creation of high magnetic gradient or electrical field are rather bulky on the technical construction and technical complicated in management. In essence, in the farms, where they should be exploited are not the experts on their service. The seed material should pass through the volume, where there is a necessary electromagnetic field on technology. Besides the high voltage and the large currents which is necessary for normal activity of these installations require additional quarantines on the safety engineering.
3. The installation on creation of electromagnetic radiation of low frequency /19/ (prototype of technology, offered to us,) in essence is low productive - for one time allows to treat in some tens kg of the seed material.

Thus, the analysis of the existing domestic techniques and installations of electro processing of seeds before sowing shows on their technological imperfections and small productivity.

Experimental procedure and result

In the present work the effect of effect of the resonance low-frequency electromagnetic radiation of weak intensity on the electrical condition of intercellular and intracellular membranes, and also on the properties of connected waters in cells of seeds for the purpose of acceleration of the biological processes of substance exchange flowing past in cells during development of a germ. The such weak resonance power effect has allowed to the germ to run in all nutritious substances in full volume which were in seeds and by that to generate the more healthy plant with powerful root system and developed top, than the germination plants in usual conditions.

The preliminary laboratory tests have shown, that under effect of an electromagnetic field created by the prototype of generator /20/, the seeds of the barley and wheat rise for 1.5-2 days earlier, than the controlled seeds. And the volume of the rooted system of plants, germinated from treated seeds, was ~ in the 1,5 times more, than the controlled plants. The treated seeds of the spring barley "the sort "Nutons- 940" and the wheat "the sort besostaya-1" planted on the experimental plots was shown the following preliminary outcomes: the amount productive escape exceeded the controlled in the 20-30 %, ripened for one week earlier, than the controlled crops, in total the treated crops have given on the average in the 25 % more crop, than the raw.

Let's mark, the ecological cleanness, the small material - and power-consumption and high efficiency of the offered agricultural method on increasing of productivity of agricultural seeds.

That is - the slight sizes (the means weighs about 15 kg together with a system of radiation) and the minimum consumption of energy (no more than 150 watts of consumed energy at the work in a nominal mode) and the practically unlimited productivity of created installation (600 tons of a sowing material in an hour). It is possible to conduct the processing of all sowing of the average farm for one light day at the correct organization of the work. And the main costs of time are connected, mainly with moving of seeds from one storehouse to other. In difference, for example, from the laser installation, which, at least, considerably concedes on productivity, and also requires the special technologies of preliminary preparation of seeds before processing - the seeds is decomposed in one stratum.

For clarification of main characteristics of the laboratory model it is necessary to conduct full-scale test of the gear, which includes in itself the study of frequency influence, form and magnitude of an electromagnetic field for the acceleration of biological processes in seeds during their germination. It is necessary to investigate the influence of the external factors (temperature, humidity, agro technical conditions, sort and quality of seeds etc.) on the degree of electromagnetic waves effect on the treated seeds. Besides, it is necessary to determine the optimum keeping terms of the treated material before crop, for reaching the maximum electric stimulation effect. In the work /17/ was shown: if to plant the seeds after processing at once, in the humid medium the seed loses acquired charge and the stimulating effect disappears. On the other hand, the optimum keeping term of the Hutons-970 sort of barley was observed within the limits of 10-14 days, and with increasing of the keeping duration it was marked sharply decrease of the activity of growth processes.

Conclusion

On the basis of the outcomes of the complex research it is supposed to develop and to create an experimental sample of the gear on processing of seeds before crop and to conduct its field test with the purpose of preparation of the full technical documentation for the issue of an industrial gear - generator of electromagnetic waves.

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