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PERSPECTIVES OF THE APPLICATION OF BIOPHYSICAL METHODS IN SUSTAINABLE AGRICULTURE

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Summary. Sustainable agriculture has different meanings for different people. For some of them it means continuing present farming methods, for others it demands new efforts in research, development and implementation on ecological integrity. Summarizing all meanings of sustainable agriculture, it is a management system for renewable natural resource for food production, income and livelihood for present and future generations, maintaining and improving economic productivity and the ecosystem.

Sustainable agriculture is a function of many factors including a concept of stewardship. For effective implementation and operationalization of sustainable agriculture in each country it is necessary to be institutionalized and given long-term financial support.

In the last 50 years the progress of chemical technology provoked a scientific and production revolution in agriculture. Many agricultural chemicals are used for fertilizing crops, controlling pests and helping to develop a highly successful farm system, ensuring an abundant and wholesome food supply. But in some cases there is an impact on the environment and on public health. On the other hand, the long-term use of chemicals in food production which caused a decrease in plant resistance and soil bioenergy structure, resulted in a decrease in plant resistance, plant yield and soil yielding capacity.

The goal of the sustainable agriculture is to utilize fertilizers, chemicals, manure efficiency through the use of soil testing, innovative crop management techniques, integrated pest management, use of natural growing regulators and biostimulators and control of water and air pollution.

Today, for production of one unit of product from agriculture is spent ten times more energy than at the beginning of the last century, hence many ag-

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ricultural experts look for possibilities to increase more efficiency and effective plant usage of energy.

Hence biophysics methods are useful for plants able to vegetate at a higher energy level. It is based on the fact that physics methods increase the energy account by internal transformation of energy, independent of their origin, into electrical and increasing the electro potential of the membrane. Biophysical stimulation on the seed and plants, through increasing the energy balance and intensification of the exchange of materials and activation of the growth and yield processes.

Biophysics methods applicable in agriculture

The past century was an age of advanced chemical application in agriculture as well in other and different areas of modern living, and negative effects on food products and on the environment are commonly known. Therefore, many scientists believe that this century will be the age of biophysical method application. The influence of physical factors on biological organisms affects the dielectric characteristics of biomembranes. The capability for polarization and therefore the capability to cross from lower to higher electrical level, under the different physical, chemical or mechanical influences are basic characteristics of dielectrics. In fact, the influence of physical factors on live organisms, is based on the increment of the energy balance through transformation of the energy, independent of it's origin, into electrical and effecting into increasing of the electro potential of biomembranes. The simulative influence of physical factors is reduced on increasing of the energy balance of live organisms and intensification of exchanges of materials and activation of the processes of growing and developing.

Injushin in 1990 wrote that the survival of the modern science must undergon a "cosmic" evaluation on all processes on our planet. It is necessary to discover the interrelations between forces and materials, connecting and elaborating astrophysics and astrochemical phenomena together with biophysical and biochemical processes of the forces of cosmobiology.

From the present and accessible literature sources, it is possible to select various research results of the application of different biophysical methods on plant production.

Thus:

1. Radiation of live organisms with ultraviolet (UV-rays), gamma rays, ultrasound, ionized radiation a.t.s.;
2. Radiation with laser light;
3. Dialectical separation and stimulation of seed;

4. Resonance impulse electromagnetic stimulation of seed and plants;
5. Magnetic stimulation;
6. Electromagnetic stimulation;
7. Application of effect of “gold crossing” of electromagnetic fields and Principe of “Keops Pyramid”;
8. Weed control with high electro frequency.

Even though at the present time many questions about the mechanisms still remain unanswered, it is a fact that this problem is extremely complex, and needs interdisciplinary research. Pollution of the environment, risk assessment and the slow pace of technical and technological development without using ionizing radiation is very hard to solve. But biological systems are extremely sensitive to radiation and research on those applications is a very responsible task.

In these investigations, beside the explanation of plant reactions, the basic goal is to ensure repetition of the positive effects on plants.

Injushin at.al., 1981; Vasilevski, 1987; Vasilevski, Gajdadziev, 1988; Vasilevski, Stankovich, 1990; Vasilevski at.al., 1994 used laser light as a biostimulator. During their investigations they showed effects on the growth and development of plants, as a result of byoenergetical structure “excitement” which causes “cell pumping” with additional energy and increases the bioenergetic level in organisms.

Based of the results from the investigations of the electromagnetic fields (Dohorov, 1984), the author points to the method of biostimulation of the plants as perspective one.

Marinkovic at al. (2000) noted that some results using magnetic stimulation on cereal seed, in Canada, increased the yield for 20%.

Application of the variable electromagnetic field according to results of Marinkovic at al. (2002), shows a 94% increase of the root mass of sugar beet, leaf surface up to 52%, yield to 12,88 t/ha and the percentage of sugar was increased for 0,70%. In similar trials performed with corn a higher root mass (55%), vegetative mass (57%) and yield (18,70%) was achieved.

Variable electromagnetic fields with different frequency in a macro trial with potato showed a yield increase up to 144,8%. (Marinkovic at al., 2002).

The yield of pepper was increased by 64,9% with resonant impulse electromagnetic stimulation in the trials of Takac at. al. 2002.

Crnobarac at al. (2002) showed an increase in yield of soybean from 5 to 25%, with a higher quantity of oil and protein and at sunflower from 13,2 to 17,3%.

Govedarica and Milosevic (2002), achieved results with electromagnetic stimulation of soil. They concluded that total microbial abundance in soil was increased and decreased abundance of fungi, ureolithic microorganisms, denitrifying organisms and urease activity. The yield of cultivars in trials (sugar beet, corn) was increased.

Some crop producers stored the seed in pyramid shaped warehouses and concluded that seed germination is maintained for a long time and plants grew better and displayed higher resistant characteristics.

Vasilevski (2002), researching germination of wheat under pyramids, made from different materials, concluded that root length is higher from 63,7 up to 144,6% and primary stem from 65.6 to 194.3%.

It is a fact that nature cleans and renews itself, but pollution levels today are so high that renewal is made all but impossible and it takes many years to recover naturally. On the other hand it is impossible to totally halt further pollution. Thus by ordinary methods of agricultural production and protection of the environment, clean nature is nothing but a dream for this generation. From this point of view mankind ought to look for new methods for cleaning nature and producing more and more food for all habitants on the planet.

Today in scientific circles for the future of producing safety food, ending of the destructive processes and protecting the environment we must develop additional bioenergetical sources and biostimulators, which will help to plants and animals grown-up on the higher energy level.

Possibilities of the application new methods in agriculture

Many results from scientific researches on seed or plant radiation with UV-rays and gamma rays, ultrasound and ionized radiation show distinct effects on growth and development of plants, but there are problems with defined methods of treatment and replicating results.

The treatment on living organisms by laser light showed repeatable positive effects. From results achieved in other countries as well as our own was twenty years investigation the agronomic practice can be encouraged for wide application. This depends on the media for treatment, cultivars, varieties or animals, but in every case they suggest application is whorthwhile.

In agriculture, forestry, food technologies He-Ne lasers are used, which emit red light with a wavelength of 630–650 nm. With these lasers it is possible to treat seed, seedlings, plants and fields. It is possible to treat irrigation water also.

Dielectric separation and stimulation of seed it can be done with separately equipment (dielectric separators) by special inductors, which made magnetic fields, by electricity.

The method of the effect of “golden crossing” on electromagnetic fields on the principle of Keops Pyramid give opportunities for stimulation of seed and seedlings. The treated materials were different, and that’s why the results were different, but every time positive.

Effects in agriculture with biophysics methods

In agriculture especially in crop production what is it possible to achieve?

- Increased seed germination from 20 to 35%
- Decreased seed rates up to 30%
- Increased root mass up 24%
- Increased vegetative mass from 10 to 45%
- Increased yield from 10 to 50%
- Increased resistance to outside influence (drought, frost a.s.r.)
- Increased resistance to pests and diseases
- Better qualitative characteristics of products (protein, sugar, vitamins and another useful metabolites)
- Decreasing mineral fertilizers from 10 to 15%
- Decreasing application of pesticides
- Accelerated maturing
- Safer products with higher quality
- Decreasing of underground and surface water pollution
- Low price of application
- Repeated positive effects at any soil and climate conditions and on different cultivars
- Decreasing of producer price of products
- Increasing the income at producers

It is very significant to mention that biophysical methods for stimulation don't change the direction of the physiological processes, which are controlled by genetic systems. Hence the optimal doses for seed and plants at application don't provoke genetic effects.

Effects of new methods applicated in agriculture in protection of environment

According to the opinion of some scientists, every generation experiences a crisis or two. Unfortunately our generation has three of them, energy, atomic and the worse one, ecological crisis. If we don't find an answer we are headed towards an apocalyptical destruction of the whole world.

From that point of view protection of the environment knows no limits, economical, political, age or sex. Taking care of the environment ought be divided and harmonized for all of us, because everyone feels the consequences.

With the biological stimulation of the seed and plants, through biophysical methods the survival capabilities of the plants as well as the resistance to climatic influences are increased. Based on the fact that the yield is increased, and the usage of different agromeasurments in the production is decreased and the negative influence on the environment is brought to the lowest levels.

Some effects that are achieved in environmental protection are noted in the following section:

- With reduced cultivation, soil protection is increased;
- Lowered usage of pesticides leads to lower soil and water pollution;
- With reduced cultivation and lowered usage of pesticides the usage of agricultural mechanization is decreased, which results in lower exhaust fumes pollution;
- With the higher survival capability and adjustability of the plants, the possibility of wider spreading of plants, long term planting and the decrease of deteriorating processes of the soil, is enabled.
- The percentage of the natural gas produced from the farms' rubbish is higher also;
- Usage of the laser light application on the seeds and plants directly leads to less usage of pesticides and mineral fertilizers;
- With the usage of the laser light a rehabilitation of pure water, as well as of the polluted water is enabled;
- Acceleration of the plant growth, the production of seedlings as well as growth of trees in the forests is also achieved, which enables full implementation of this technique in the forestry.

Conclusion

The methods shown in this paper don't conclude the list of possible implementation in the agricultural production and the environment protection in the future, but surely will initiate some serious thinking of their implementation and realizing of their positive effects.

The usage of these methods in the agricultural production will enable intense and more qualitative production, as well as the protection of the environment.

Surely wider acceptance of these methods is not to be expected, but one thing is crystal clear, that the acceded results are indisputable and they are paving the road for their wider implementation in the agricultural production.

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