Laser irradiation research promises breakthroughs for plant development

Research on the role of light energy in plant growth is proceeding in a number of centers around the world. At the University of Illinois, experiments have been conducted on how to utilize the induced light sensitivity of plants for the purpose of making weeds self-destruct. Early in September the university and the National Science Foundation announced the discovery of a "laser herbicide"—a chemical to be applied to weeds, which induces them to produce light-sensitive structures overnight, which in turn destroy the plant through laser action activated by the morning sun.

An article in the Aug. 30 issue of Krasnaya Zvezda *reports on Soviet experiments with lasers in agriculture. The underlying conceptual notion is that there is a state of matter in living organisms called "bioplasma," where the accumulation of energy and the transformation of energy from one form to another takes place. Plants have a characteristic frequency of vibration which electromagnetic waves can influence. Lasers can thus reinforce the energy of the plant, producing bigger crops, etc. An introductory section states: "Under the new conditions of economic management, in which intensification and faster introduction of the achievements of scientific and technological progress in agricultural production are acquiring crucial significance, the role of science is being increased. This was discussed at the May [1982] Plenum of the Central Committee of the CPSU, which adopted a National Food Program, and at the All-Union Economic Conference on Problems of the Agro-industrial Complex, which took place this past spring in Moscow.*

"In solving the tasks posed by the Party, an important role belongs to bio-engineering. The following article reports on certain achievements in this area by the scientists of Kazakhstan."

Excerpts of the article, by Professor V. Inyushin, Doctor of Biological Sciences, follow.

The effect of the increase in biological activity under the influence of light energy in nature is remarkable. In the Pamirs [mountain range] in a high-mountain botanical garden, where the level of solar radiation is 50 times higher than at sea level, apple trees produce two harvests during the brief summer, and potatoes reach a weight of four kilograms. But would it not be possible to achieve similar results by artifical means?

Several years ago a set of agro-engineering methods were worked out on the basis of using an optical quantum generator laser. These include the pre-planting processing of seeds, laser illumination of the vegetative organs of plants (stalks, leaves and flowers) directly in the field, irradiation for the purpose of raising the resistance of plants to various diseases, and the "activation" of water by laser beams. Laser agro-engineering assumes the control of the processes of life activity taking place in the plant at all stages of development, something that predetermines the fate of the harvest.

It is well known that light impulses produce a number of stimulating effects in plants: speeding up the growth, intensity of photosynthesis (creation of complex organic substances out of inorganic matter), and intensification of various biochemical processes. As a result of work carried out under the leadership of Professor A. Shakhov, an entire field of investigation was defined: that of light-impulse irradiation of plants. The scientists arrived at the conclusion that seeds can absorb photons of concentrated sunlight, turn their energy into chemical energy, and then store it and subsequently expend it on further growth and development. Biophysicists were interested in the question of how the tissue of the seeds accumulate the light energy and whether it would be feasible to produce an energy (photon) "pumping" of the seeds?

There is now scientific proof of the possibility that there exists a special state of matter in living organisms—bioplasma. It is also the accumulator of the energy which is necessary for life activity. It is through the bioplasma that the redistribution and transformation of energy from one form into another takes place.

Each plant has its own frequency of vibration, dictated by the processes of cell division (generation) and dying. If two identical plants are placed side by side, then their frequency of vibration induces a resonance phenomenon. It is well known that resonance of sound in the mountains or in the woods produces a loud echo. Something similar takes place in the world of plants. Under conditions of biological resonance, the process of formation of new cells is speeded up in weak plants. Resonance phenomena also include the influence of electromagnetic waves on plants. Here, every plant has its own "favorite" frequency (and, correspondingly, a color as well). For instance, radishes prefer dark blue, onions red-orange, and sunflowers a near-violet. Under the influence of "its own" color, the biological activity of the plant is heightened. Thanks to this kind of selectivity, wise nature has guaranteed the variety of the world of plants on our planet.

Scientific investigations permit us to conclude that plant seeds acquire the greatest energy potential as a result of processing by a laser beam, in which the energy density per square unit of area is tens of thousands of times higher than the energy density of sunlight of a similar wave-length. Biophysicists have determined that seeds "respond" best of all to irradiation in which there is a coincidence (resonance) of the frequency of the laser and the internal vibrations. This phenomenon has been termed resonance biostimulation.

According to the program laid down by nature, life also continues in the seeds. In the course of oxidation-renewal processes during the winter, a part of the seed is "burned up," and the best grain is significantly depleted by the spring sowing. Even under favorable sowing circumstances, much grain does not have an adequate reserve of bioenergy to ensure the germination and development of the sprout. With the aid of laser irradiation, it is possible to increase this reserve.

The first laser-processed seeds were sown at the East Kazakhstan Agricultural Station and in the "Alma-Ata" state farm. Around 2.5 tons of cucumber, tomato, cabbage, onion, watermelon and carrot seeds were processed. All of the crops sprouted, blossomed and matured earlier than the control plants and produced additional yields of from 13% (cabbage) to 45% (cucumbers). The following year 120 tons of laser-processed spring barley was planted. Under conditions of severe drought, the yield was one-third greater than the control crop.

It is well known that per-hectare winter-wheat yields are around 500-600 kilograms greater than spring wheat yields, but it sometimes happens that the winter wheat is destroyed by frost. Would it not be possible to increase its resistance to frost by means of laser processing? Winter wheat grain of the "mironovskaya-808" type was subjected to photon "pumping." Soon after sprouting, before the beginning of winter, the buds of the plants already contained more sugars than the control plants. Moreover, the processed seeds put down significantly deeper roots. As a result, the yield was increased by 450 kilograms per hectare, with an increased gluten content in the grain, which determines its flour-milling and bread-making properties.

Over the course of several years, field trials in planting laser-processed spring wheat were conducted in six state farms in Northern Kazakhstan. As a result of photon "pumping" of the seeds, the growth of the plants was significantly speeded up and the length of the ears and the number of grains per ear were increased. The increase in yield was also significant. Experience in a number of farms showed that the use of pre-planting processing of the seeds by laser beams is economically advantageous: the increase in net income per ruble of expenditures ranges from 1.6 to 3.96 rubles.

One of the elements of laser agro-engineering is the illumination of the vegetative organs directly in the field. It stimulates the growth processes, especially in the leaves, where the formation of pigments is intensified, and it speeds up the maturation of fruits by several days. If the illumination takes place at the point of blossoming, then the fertilization capacity and the viability of the pollen is heightened, which leads to the formation of a greater quantity of ovaries and fruits.

In the Alma-Ata district, production experiments in illumination of corn, soybeans, and alfalfa were conducted on 300 hectares. As a result of the activation of the crops, the quantity of grains per ear was increased by 21%, and the per hectare yields for soy and alfalfa amounted to several hundred kilograms.

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The illumination of plants in greenhouses is particularly promising. A device for illumination was constructed on a mechanized freight-carrier which can move about freely in the greenhouse. Passing by the plant-beds, the laser light irradiates each plant. They develop into stocky and heavy plants with thicker stems and well-developed foliage, and they are disease-resistant. And this, it is well known, is a guarantee of a high yield.

Now, the third element of laser agro-engineering. Hard smut has long been considered one of the most vicious diseases of grain cultures. Chemical methods have been used to combat it. They are effective, but their use on a large scale may lead to undesirable consequences. Agriculture was faced with the practical task: to find another, less environmentally toxic method of combatting these diseases. And once again the laser came to their aid.