Opinion

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2023.52.008211

Humanity Violates the Objective Laws of Nature Leading to an Ecological Catastrophe

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ARTICLE INFO

Received: July 25, 2023

Published: August 11, 2023

Citation: Chikov V I. Humanity Violates the Objective Laws of Nature Leading to an Ecological Catastrophe. Biomed J Sci & Tech Res 52(2)-2023. BJSTR. MS.ID.008211.

Opinion

In the course of evolutionary development, representatives of Homo Sapience are increasingly accumulating knowledge about the world around them. At some stage of this process, individuals even have a feeling of "the lord of nature". And he begins to alter everything around to suit his ideas. Some private actions that do not reach a catastrophic scale pass unnoticed. But in some cases, for example, in pursuit of a high crop of plants, people began to use mineral fertilizers more and more. In the middle of the twentieth century, such a slogan was even in vogue: "If you want to get a big harvest, return the minerals taken by plants to the soil." In Holland, the doses of mineral fertilizers applied over the year have already reached 1.5-2.0 tons per hectare. At the same time, the existing soil microflora was disturbed. As a result, over the past hundred years, our (Russian) two-meter chernozems have lost half of their organic matter [1]. And by the way, these chernozems were formed without mineral fertilizers. However, plants use no more than 10% of these fertilizers. The rest is washed out with rains into streams, rivers, seas and oceans. Nitrates, getting into the water of the seas, are absorbed by algae. They become more protein. They're getting tastier.

They are eaten by unicellular bacteria that absorb oxygen in water. As they say, "water blooms". Oxygen, therefore, dissolves little in water, and a further decrease in its concentration leads to the death of marine animals. News like this appears on the Internet: "A herd of 150 dead whales has been found, etc. But in the absence of oxygen, the corpses of animals do not decompose. They are used by anaerobic bacteria. They find oxygen atoms in the organic molecules of the corpse and tear them off for use in their breathing. It is clear that by removing oxygen atoms from an organic molecule (no matter which one: proteins, fats, or carbohydrates), carbon and hydrogen, i.e. hydrocarbons, i.e. oil, remain in it. And the rest of the minerals (from the bones and shells of mollusks) give limestones. For example, Russia has a large oil field in the center of Eurasia (in Tatarstan). And the whole of Tatarstan itself lies on a large limestone slab. This means that there really was a sea here. Consequently, the very existence of an oil field is 100% proof of the death of the previous civilization [2]. And the use of fertilizers after some time will lead to an environmental catastrophe.

To understand all these processes using mineral fertilizers, it is necessary to study how plants carry out symbiosis with soil microorganisms. How microbes bind air nitrogen with oxygen and give plants nitrate nitrogen ready for assimilation. Of course, in addition to nitrogen from minerals, the plant also needs nitrogen with potassium. And they are present in the soil, but are not available for absorption by plants. Microbes can do that, too. They will make these substances available to the plant. It is only necessary to provide the microbes themselves with energy. That is, it is necessary to give them more photosynthetic products formed in the leaves of plants. And then the microbes will multiply in greater numbers and strengthen their metabolism. And some of these metabolites will be absorbed by plants. Since the transport of photosynthesis products is carried out mainly in the form of sucrose. From carbohydrates, the plant can

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synthesize only polysaccharides (mainly cellulose). And from cellulose, root vessels are formed, through which transport processes take place between the roots and leaves. 50 years ago, one Kazan entomologist (Konstantin Ignatievich Popov) was the first to outline the way to solving these problems [3].

He noticed that plants that were damaged by insects then grow back faster. He reported on this in 1959 at the Kiev Conference [4] and decided to prepare a doctoral dissertation on this topic. But the authorities said that such work would discourage rural workers and banned such a research topic. However, it has interested many biologists. But, despite all the obstacles, it was possible to complete this task only after 50 years in Kazan. When solving such issues, it is important to choose the right object for research, since the relationship between donors of photosynthesis products (leaves) and their consumers (acceptors) - ears, fruits, shoot growth points, etc.) in case of violation of their use can vary greatly. With the right choice of all these conditions, you can get large and convincing differences between the studied options. This is how the work in our laboratory has been conducted for many years. Cotton [5] and wheat [6] were chosen as the first objects of research. In cotton, up to 80 boxes are formed on the plant (each weighing 4-5g). And if you remove all the boxes, then the leaves will simply have nowhere to put the resulting photosynthesis products. It should be noted that it was during these years that the reverse process of photosynthesis, photorespiration, was discovered. And, as it turned out, such a photo-oxidative process is actively involved in the regulation of photosynthesis and the entire metabolism of the plant leaf.

But to measure photorespiration, special equipment is needed, with which there was a problem at that time. But, since the Department of Biochemistry of Kazan University had an infrared spectrometer X-21, a gas analyzer was assembled on its basis, which measured photorespiration [7]. All this made it possible already in the 70s of the twentieth century to show ([8] Chikov, 1987) a great connection between photorespiration and glycolate metabolism with the regulation of photosynthesis and crop formation. In one of the experiments on wheat, by releasing some of the photosynthesis products (removing only the top three spikelets out of 18 the whole ear after earing), which were eventually transported to the roots, they received a 30% increase in the mass of grains from the plant. And most importantly, this effect depended on the varietal characteristics of wheat. This made it possible to find the genetic features of such regulation in the future. By this time, it was discovered that in the extracellular space of the leaf (apoplast) on the cell surface there is an enzyme (invertase) that hydrolyzes the transport product of photosynthesis sucrose, preventing its export from the sheet. Experiments with labeled carbon 14CO2 on plants with genetically modified invertase (with its suppressed activity, [9] Chikov et al. 2015), allowed us to directly prove the mechanism of regulation of photosynthesis at the leaf level, and then at the level of the whole plant.

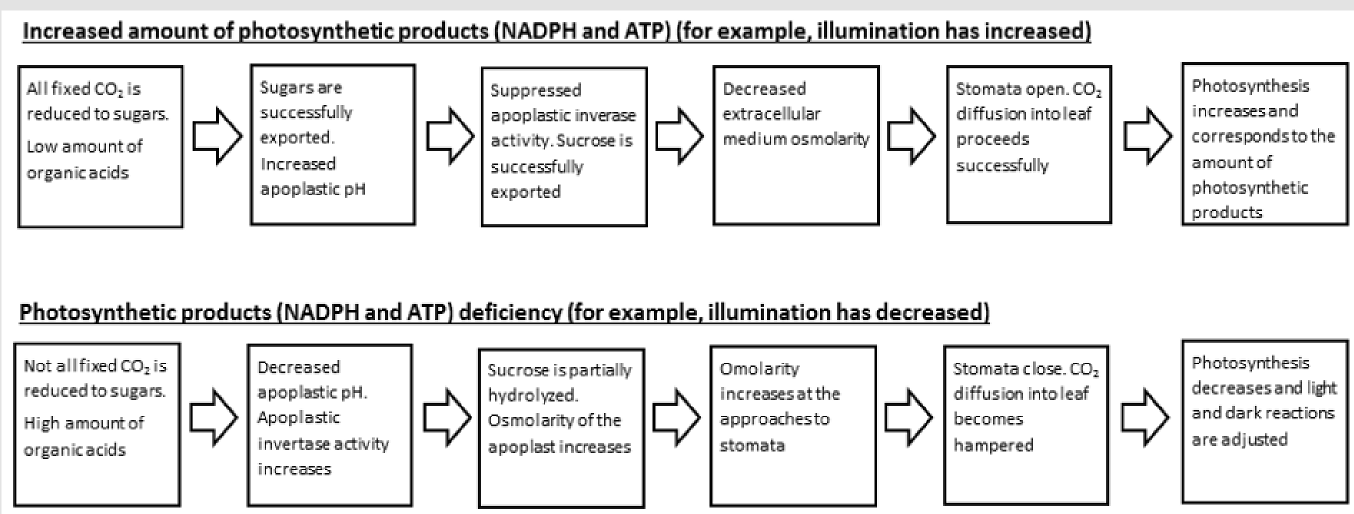

Figure 1: The involvement of the apoplastic invertase in the regulation of photosynthesis under changes in the ratio of CO_2 assimilation and the flux of light energy.

Thus, there is a regulatory system in the leaf [[8-10] Chikov et al., 2015; 2016], combining photochemical processes in chloroplasts, cell photosynthetic carbon metabolism, apoplastic invertase and stomata, which reacts to changes in light intensity, nitrogen (nitrate) nutrition level, activity of growth processes in sink organs and optimizes the entire photosynthetic function of the plant. The key trigger mechanism in all cases (Figure 1) is probably the use of products of photochemical reactions in chloroplasts (primarily NADP·H). When

 DOI: 10.26717/BJSTR.2023.52.008211

nitrate concentration increases in the leaf, the competition of nitrite for electrons of the chloroplasts electron transport chain increases. As a result, CO2 assimilation reacts to a decrease in the amount of reducing agent formed and, consequently, all subsequent changes occur as described above. Under inhibition of assimilate export from the leaf (for example, as a result of a decrease in the number or activity of sink organs), it will be difficult to load sucrose into an overfull phloem. There will be an increase in its concentration in the apoplast, which will cause vacuolization of the phloem companion cells (as it is observed at an increase in the concentration of nitrates or NO [11], activation of the invertase by its substrate, increased sucrose hydrolysis and subsequent stomatal closure.

The resulting large quantities of hexoses will return to mesophyll cells and interfere with the metabolism of triose phosphates, leaving the chloroplasts, which will lead to activation of the Mehler reaction and appearance of glycolate of the transketolase origin. The carbon of glycolate metabolism products cannot return to the Calvin-Benson cycle and will replenish the pool of acids with subsequent effects on the invertase activity and the stomatal guard cells. In addition, the accumulation of hexoses in the cytoplasm and the non-return of inorganic phosphate to chloroplasts will enhance the synthesis of starch in chloroplasts [12-30]. All this will increase photorespiration, which will protect the chloroplast photosynthetic apparatus from photo-destruction. Under inhibition of assimilate export from the leaf (for example, as a result of a decrease in the number or activity of sink organs), it will be difficult to load sucrose into an overfull phloem. There will be an increase in its concentration in the apoplast, which will cause vacuolization of the phloem companion cells (as it is observed at an increase in the concentration of nitrates or NO, activation of the invertase by its substrate, increased sucrose hydrolysis and subsequent stomatal closure [31-40].

Having proved the molecular mechanism of photosynthesis regulation, we began to look for ways to influence leaf invertase in order to control the export function of the leaf, and hence the production process of plants. As it turned out, the key enzyme regulating the export function of the leaf invertase is active only in an acidic environment. This acidity usually increased with the activation of nitrate metabolism and synthesis of amino acids. Complex compounds of biogenic metals copper and zinc with ammonia (ammoniacates) were found, which adsorbed on the outer surface of the mesophyll cells of the leaf and supported the alkaline reaction of an aqueous solution of apoplast. As a result, invertase was suppressed, and the export function of the leaf increased. Photosynthesis increased accordingly [41-51]. We tried to change the activity of invertase through nitrogen exchange of the leaf (primarily by changing the amount of nitrates. It turned out that it was enough to sow seeds not in the soil with fertilizers, but in the groove of washed sand, as the mass of roots in barley seedlings increased twice, and if you also spray the leaves of plants with ammonia, then even three times. It is important that these drugs acted this way at very low concentrations (10-5M). This suggests that it is not a matter of changing the pH of the aqueous medium of the apoplast, but that the ions of divalent metals (Cu, Zn), binding their charges to different (rather distant) sections of the invertase protein molecule, deform it.

As a result, the enzyme partially loses its activity. As soon as we proved all this, I applied for a patent for these compounds. The patent specialists who helped me with this convinced me to submit documents to the European Patent Office. A month later, I received a letter with a proposal to issue a European patent for 16,000 euros. I've never had that kind of money. 20 years have passed since that. Recently I received a letter that my patent has expired. So you can use this data for everyone. However, there is no reaction. Nobody needs anything. Maybe there is an action of special services under the carpet here. But humanity spends half of all its energy resources on the production of fertilizers. And all the merchants tell me that if there is such a business (selling fertilizers), then no one will leave it. And what about saving energy??? Throwing money away??? The data obtained in our laboratory make it possible not only to obtain a high yield without fertilizers and at the same time increase soil fertility, but also the drought resistance of plants, since by increasing the roots, the plant can keep up with the water going deep into the soil.

And for this it is necessary to increase the symbiosis of plants with soil microorganisms. But to do this, it is necessary to involve microbiologists in this problem, who will select the best forms of microbes for this. We have already done how to provide microbes with photosynthetic products. Agronomists will allocate funds for such studies (a very small share (5%) of the termination of the purchase of fertilizers. Our articles show this. Agronomists can check these experiments (repeat and make sure). In two weeks, the roots will increase by 1.5-2.0 times. This means that it is possible to increase the fertility of poor soils without fertilizers.

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ISSN: 2574-1241

DOI: 10.26717/BJSTR.2023.52.008211

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