**Mineral nutrition of crops in the system of the natural cycle of matter**

Optimization of mineral nutrition is an essential and multifunctional processing technology of agricultural crops cultivation that demands profound knowledge of the laws of nature. This process can’t be narrowed down to the application of established dosage of mineral salts on conventional yield. That is a basic approach that doesn’t consider or understand the processes which undergo in the soil and in the plant itself.

Sometimes, they try to explain the reduction of humus content in the soil, which is a headline indicator of fertility, by insufficient application of mineral fertilizers. In our opinion, this statement doesn’t have any supporting rationale. But, occasionally, specialists of senior positions with sonorous titles represent it as the only one correct. By having 25-years experience in the organization of mineral nutrition for agricultural crops, we are certain that there is no connection between a rise in fertility that is calculated through humus content in the soil and designated dosage of mineral fertilizer. More correctly, there is a connection but it has an inverse orientation.

Application of fertilizers in designated or excessive dosage leads to an increase in salt solution content, to augmentation of acidity level, to decrease of soil biota activity and as a result to soil’s agrophysical properties loss. Locally appearing osmotic phenomena near mineral granule negatively affect the development of a plant’s root system, especially in the early stage of growth. So under these circumstances, the improvement of soil fertility is out of the question.

Along with that, the usage of mineral fertilizers according to proven methods already became a necessity because of its positive effect on yield.

In our opinion, the dynamic growth of yield shouldn’t distract attention from the evident processes of another kind. The problem here is that, in order to give an objective evaluation, the current processes should be examined in more details and compared within equitable time intervals because humification processes in the soil first happen for more than million years ago and our participation started only a few years earlier. In comparison with times when current ecosystem was developing, now there are evident negative consequences of our agricultural activity, so we shouldn’t use exceptionally saline fertilizers.

Stability of soil adsorption complex, which usually handles the negative pressure and responds with the growth of yield, can be explained by soil’s high buffer capacity, ability to absorb, distribute and detain mineral salts solutions as well as prolong their action due to the presence of organic compounds. Sandy soil with low buffer capacity has no mechanism of prolongation that’s why mineral compounds transport with irrigating waters to soil layers that lower than root habitable layer zone. This order of things causes troubles and requires a reorganization of mineral nutrition.

The aim of the farmer is to be a competent participant of natural organo-mineral element’s circulation and to ensure its constant development by obeying its laws. Each incautious intervention in the chain, initially with good intentions- to solve a problem and to “help” nature, will weaken the chain of element’s circulation and energy exchange.

ОАО “Buyskiy Himicheskiy zavod” as a producer of fertilizer abandoned the approach of applying mineral salts directly in the soil. Now the main ingredient of the granule is an organic component, the peat of advanced degree of decomposition, which is enriched with mineral salts and now has a function of prolongation. This technological approach of combining organic matter and mineral salts allows to transfer nitrogen in less active form and to make phosphorus, potassium, magnesium, sulfur, and carbon more assimilable and available for plants and soil microflora. The mechanism of prolongation makes possible reduction of the concentration of soil solution, optimization and full absorption of mineral nutrients.

With time, as a manufacturing technology develops, we managed to increase the content of humic compounds in our organo-mineral fertilizers by adding potassium humate that we produce with potassium alkali in the process of hydrodynamic cavitation. This was the first step towards features improvement of OMU after its usage for 20 years.

The most important manufacturing method in plant cultivation is well-organized crop rotation which is aimed to provide a biochemical diversity of the agriculturally used area. The more cultures are there in the crop rotation and more they differ in the date of sowing, growth pattern, genetic traits and life cycle, the more important crop rotation for the process of weed, pests and disease control. It is complicated enough to organize necessary crop rotation and sometimes, due to some circumstances, agriculturists are forced to breed monocultures that lead to negative consequences. We tried to solve this problem by using organo-mineral granules. As the effect of crop rotation is ensured by root secretions and biologically active ingredients of the precursor, our specialist started to incorporate plant’s extracts and cavitated mass of precursor in our product.

This method of allelochemical’s extraction succeeded by their inclusion in the fertilizer allows organizing pseudo crop rotation. Obviously, it doesn’t solve all problems which occur after cultivation of monocultures, but it helps to normalize the overall situation. Luckily, the number of plants that potentially can be used for extraction and included in the process of crop rotation is more than 200. The importance here is in the idea of incorporation of precursor’s biomass in the organo-mineral fertilizer. Good results were achieved in the Amur Region where we delivered OMU with extracts of wheat, chamomile and some more crops and herbs.

In our opinion, the biggest omission of current agrotechnologies is negligence of microbiota and mesofauna which are the main creators of this fertility and soil stratum. We won’t go into details of this important theme in our article, it already covered enough by other scientists. Assimilation of nutrients, sanitary conditions, symbiotic processes, soil structure and its agrophysical properties all depend on the activity of soil beneficial microbial flora.

If the agricolist applies only mineral salts that suppress microbes, he harms the soil and that’s why we decided to use organo-mineral granule as a carrier for a group of different bacteria: Bacillus subtilis, Bacillus mucilaginosus, Bacillus mesentericus, Bacillus megaterium, azotobacter chroococcum. Spores are attached to the granule’s surface and when in the humid and warm soil they activate.

Application of bacteria on OMU let us achieve great results, especially in the mobilization of low assimilable phosphates, and help to solve the problem related to the mineral nutrition of crops.

As we studied the experience of European nations in the subject of mineral nutrition of crops and executed a number of orders for Italy, we met with a strong and unexpected request to add a meat-and-bone meal tankage in the product.

Under the law of Italy, every fertilizer must contain not less than 3 % of organic nitrogen which you can find in horns and bones of livestock. Organic nitrogen that presents in the peat makes only a half of a needed percentage. Besides nitrogen, tankage also consists of calcium, potassium, phosphorus, magnesium, sulfur, microelements, protein and amino acids, so it is full of essential and available for plants and soil biota elements which are a part of a matter circulation and that are already been in soil, plant, animal and ready to continue the cycle. When we took a close look at this cycle and got a sense that nature lives according to its own rules, we started to add a meat-and-bone meal tankage in order to give our organo-mineral fertilizers new unique qualities. This is why insertion of a meat-and-bone meal tankage in the organo-mineral fertilizer is the essential part of this technology. The tankage composes 5-10 % of our product and we are planning to use this recyclable material in the number of thousands of tons per year.

Proteins and amino acids in OMU are the great nutrition for soil microbiota and primitives, which became more active after getting it and as a result we got a double yield of potato in comparison with control. The fact that the first half of the summer of 2017 was rainy and cold also predetermined a big rise in yield. In consequence of the high activity of earthworms during application of OMU, the soil crust was pierced by burrows that provide high soil aeration and drainage of excessive moist. At nighttime, there were so much of earthworms that they literally covered the whole surface of the test section. Besides all of what already been said, mineral composition of meat-and-bone meal tankage also predetermined good results of this experiment.

Thematic researches, the praxis of many years in Russia and comprehensive study of international experience have shown that the more we try to add mineral salts in the soil the more we need organic compounds in order not to harm the ecosystem.

As experience has shown maximum permitted concentration of mineral part in organo-mineral granules is 30 %, the maximum effect is obtained when the percentage of mineral compounds is 15-25%. In this ratio, the assimilation of nutrients is prolonged and close to 100% because there are no intermedia between granule and root system that can have an effect on the loss of nutrients. Micronet of root hairs twines round granules. What are the losses in this case? – Elements are fully absorbed by plants.

Mineral nutrition of plants is based on the natural cycle of matter and the nutrition acts as an agrochemical and agrobiological method of its development and maintenance so as a conclusion of the first part of the report I want to emphasize that we shall not ease out one-celled out of their live environment. They do a great job for us, they start the food chain, present in every link of the chain and finish it in order to restart. Every human should have enough knowledge to find a way to solve this problem otherwise people will become primitives before its due time.