PROVOCATIVE RAIN. WHEAT. RAPESEED

Can losses be avoided?

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Below we will talk about the already traditional situation, when grain is sown in dry soil at the end of summer, and there is no precipitation. All agrarians hope for the sky, for the mercy of God! And at last it rains but just a little, some 10-12 mm, it's a provocative rain. After it seeds start growing, the shoots looking like awls, and then again a prolonged drought… In a week or two, the shoots dry out and the damage is severe.

As a rule, in such cases the world's leading companies emphasize the development of powerful roots as guarantees against drought and offer products which help to enlarge them, for example, silicon oxide, calcium compounds, etc.

In our opinion, there is no scientific basis for this, as well as practical achievements in combating natural disasters.

In the south of Ukraine the problem of drought appeared much earlier than in Central Ukraine. That is why about 12 years ago we began studying such situations on the famous Oleshki sands which resulted in creating a fundamentally new technology of retention under the most unfavorable conditions of prolonged soil and atmospheric drought.

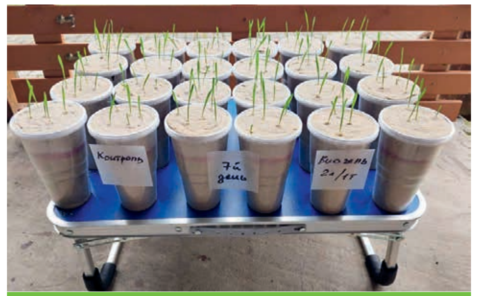
Photo 1. Germinating plants on the 7th day after sowing

Photo 2. Dug up plants with sticky sand (7th day)

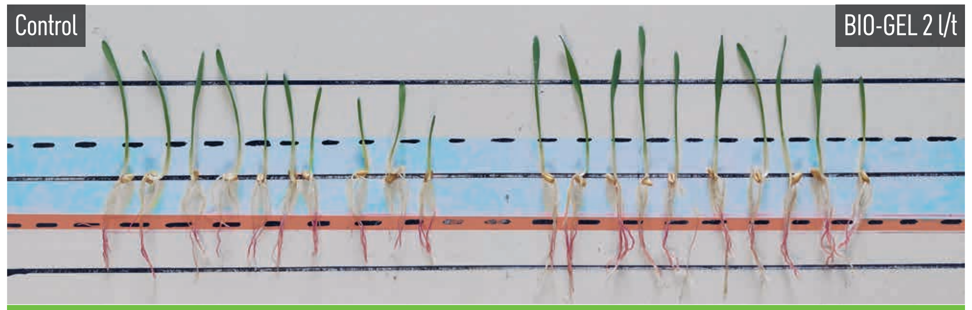

Photo 3. Plants washed away from the sand (7th day)

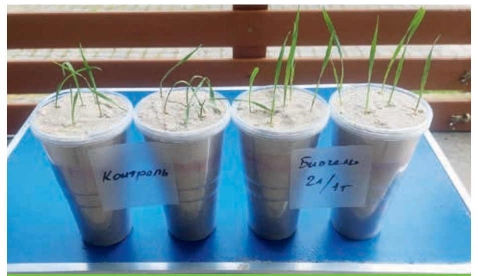
Photo 4. Plants condition on the 11th day of the experiment

Photo 5. Dug up plants on the 11th day of the experiment: a - control, b - BIO-GEL


Photo 6. Dry sand falling from the roots

And as will be proven later, the idea here lies not only in developing a long branched root and its ability to reach soil , but also in the reserves around it. We will speak about the symbiosis of a plant and microorganisms around the roots of this plant, in the so-called rhizosphere. These microorganisms feed on root secretions, or exudates. Of course, it requires a great part of the grain energy, and the stronger the drought, the more exudates are consumed.

The price of this struggle for survival is so high!

It should be added that the concentration of exudates in the form of complex sugars, vitamins, enzymes, proteins, etc is insignificant: just 1-3% of the total secretion. The rest is the transferred by the root while it is growing to the lower dry soil layers, thus creating a kind of "container" with exudates and liquid sticking to the root.

Let's emphasize that the following will be about the first 10-12 days of plant development. As is well known, during this period plant development continues only due to the energy of the seed. That is, seed quality, soil chemical composition, photosynthesis and other factors are not so important. What is important is the ability of the soil to retain after little precipitation. That is why we chose river sand (1 mm fraction) as the most unfavorable for retaining . The upper layer of the similar sand (4-5cm) was hydrated by 100% of its -retaining capacity, which makes about 15% of the sand weight. Then goes dry sand not affected by rain.

In fact, the river sand was washed and dried to zero humidity, and plastic containers (cups) were used for experiments, which are very convenient for digging up plants without damaging the roots. A 500 ml cup contains about 960 g of sand, 60 ml of drinking water practically ensuring the 100% moistening of the upper layer (40 mm). The seeds were sown to the depth of 2 sm. 5 seeds were sown into each container, which practically corresponds to very dense crops, especially for rapeseed. However, taking into account the fact that we are talking about only the initial phases of plant growth, such thickening is fully justified. During the experiment the soil moistening took place only once. The relative humidity did not exceed 60%, which simulated atmospheric drought. As a result every day about 5 ml of evaporated from each container. Accordingly, due to capillary effects, the in the container rose up, which significantly reduced its concentration near the roots. At the same time the plant root grew deep into the soil.

The experiment purpose consisted in the following:

- creation of the most deeply located root system under these unfavorable conditions for the plant;
- creating a maximum reserve of in the root itself and in the rhizobial cover around it;
- lengthening plants lifetime before their death because of loss;
- finding a possible mechanism influencing these processes due to new biological products and agronomic measures.

As the air temperature indoor varied within +18-20*C, which corresponds to the real conditions of agricultural production in Ukraine in the second half of August - the first half of September, the plant's survival period varied from 8 to 12 days. During this period the supply in the containers decreased to almost zero level, which fully corresponds to absolute soil dryness. In the course of the research, seven experiments were carried out on the Arnova wheat variety and four experiments on the Architect rapeseed hybrid.

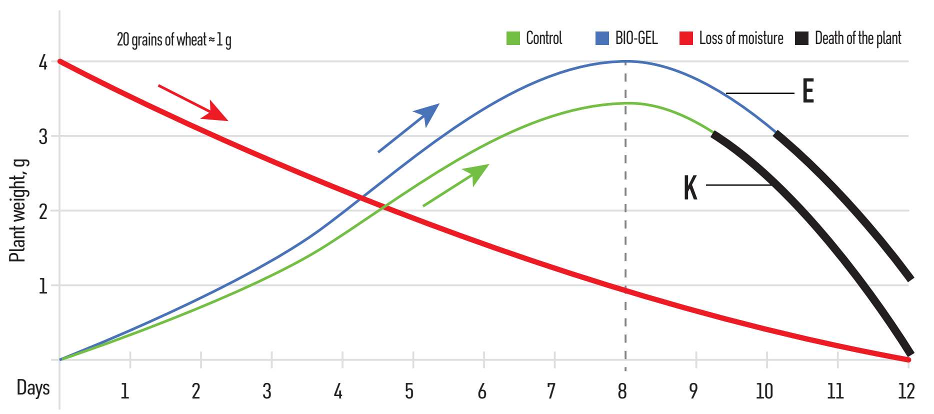

Fig. 1. Conditional graph of loss from the soil due to evaporation from the surface and accumulation of in the plant itself over a 12-day period.

The seeds were sown in the 100% moistened sand (control). In the experiment with wheat BIO-GEL innovative product (better known to consumers as LEANUM™ and STERK BIOgel™) was used. For winter rapeseed BIO-GEL dry concentrate (under Vitamin O7™) was used. These products are organic and created as anti-stress products for arid conditions. Great numbers of so-called signaling molecules (SM), bacteria hardened by high temperature (probiotic) and their effective nutrition (prebiotic) which make part of the named products, help plants to survive in drought or at any rate delay their death caused by loss for several days. The importance of these additional days in practice is difficult to overestimate.

Below (*fig. 1*) is a conditional graph of loss from the soil due to evaporation from the surface and accumulation of in the plant itself over a 12-day period.

As you can see, over a 12-day period of the experiment the amount in the soil is reduced practically to zero. Instead, the seed germinates and the plants accumulate for approximately 6-8 days. Their roots reach the maximum depth and their weight increases 3.2 times in the control (K) and 4 times where BIO-GEL (E) was used. After that the plants' growth stops and the survival depends only on the accumulated .

In photo 1 you can see the germinating plants on the 7th day after sowing.

In photo 2 you can see the dug up plants with sand sticking to them. A strip of sand approximately 40 mm high, which was initially wetted at 100% (blue color), is delimited by red water-soluble paint. Below is a 7mm strip of sand with water-soluble red paint. Below this strip the sand was not moistened. During the 7 days of the experiment the loss of amounted to 35 ml, that is, 25 ml of remained in each container.

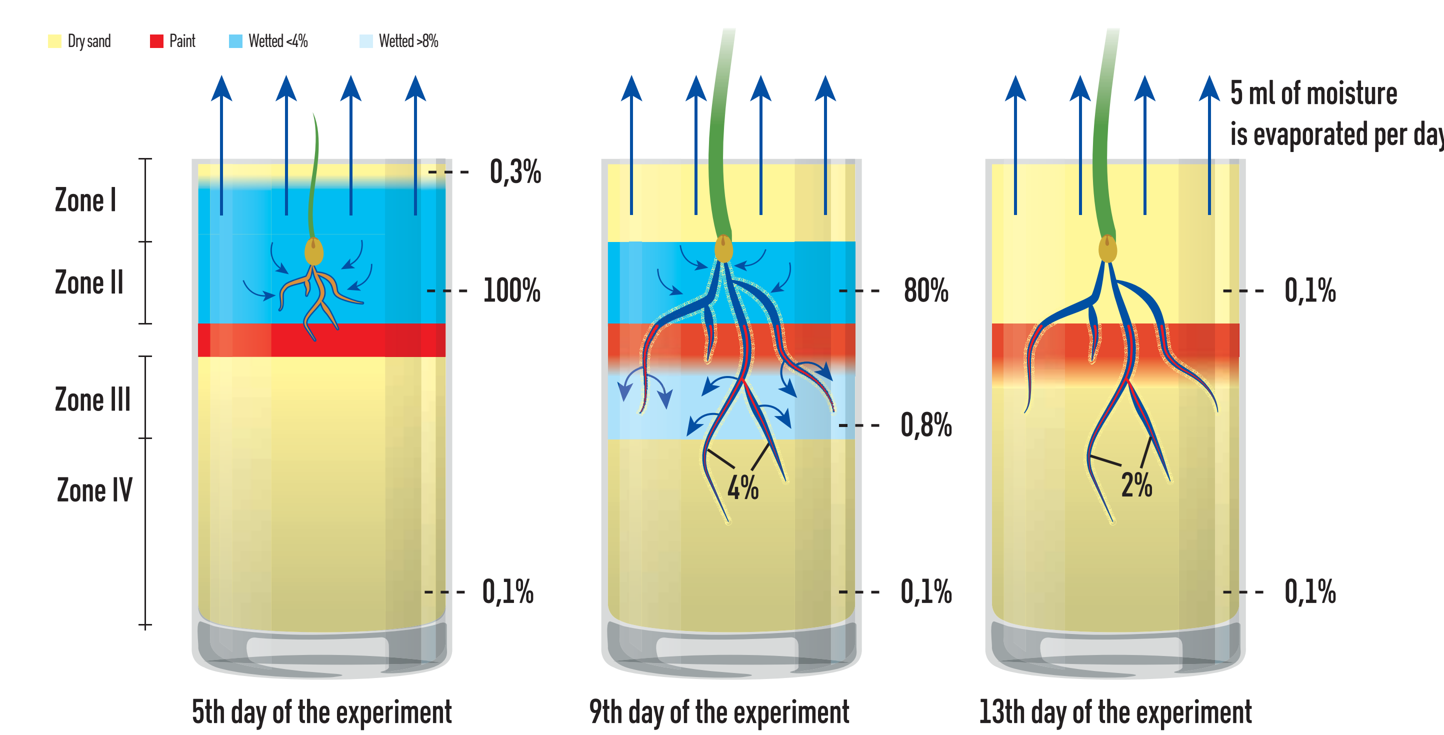

Fig. 2. Cross-section of the container along its central axis, showing the transfer of by the root from the upper layers of the soil to the lower non-moistened ones.

Photo 7. Rapeseed plants on the 5th day

Photo 8. Dug up rapeseed plants on the 8th day of the experiment

Thus, the upper part of the container (**zone I**) has a little water (about 0.3%) which is insufficient for plant growth. The loss of caused by evaporation is critical.

Zone II is the zone of active initial root growth when the amounted to 80-100%. On the 10th day loss reached a critical level — 1.8% when the root growth stops.

Zone III is the zone with little, about 0.8%. The root does not grow, the whole plant acts as a accumulator.

Zone IV is the zone with no in which the roots of the plant have sprouted. That is, in absolutely dry soil! And this is quite new! At the same time, in the very roots is 3.16% in the control and a bit higher (4.09%) where BIO-GEL was applied.

According to the traditional views of agrarian science, the wilting point of plants in sand occurs when the amount of in it is 2.5-2%. Then the plant dies. But as you can see in *photos 2, 3* and *fig. 2*, it remains alive and grows deep in dry sand! And, which is very important, it happens not only due to the accumulated in the plant but due to the around the root in the rhizobial cover where the mucus of exudates retains and the soil stuck to it preserves it, like an ancient Greek amphora. In totally dry sand!

And, which is of great importance, 15% more efficient with BIO-GEL applied!

The same effect can be observed in Kalahari, the world's hottest desert where it rains only one month a year and yellow frogs there can survive when covered with dry clay which helps them to retain precious . Usually, such discoveries are surprising and show the way to overcoming the consequences of the now inevitable drought.

Photo 4 shows plant state on the 11th day of the experiment. In the control (on the left) plants started withering due to loss of turgor. The plants with BIO-GEL applied look better, no withering is observed. The dug up plants testify to the fact that a plant loses its functional properties in totally dry sand (0.1% of) if the rhizobial cover around roots contains less than 1.5% of (control). If the level is 2% or more, the plant can survive rather long, till the next rain (BIO-GEL).

This is evidenced by *photos 5a* (control) and *5b* (BIO-GEL), the plants dug up on the 11th day.

On the 13th day the plants treated with BIO-GEL started withering. Practically all control plants had died by that time. As you can see in *photo 6*, the dry sand surrounding the roots contains 0.2% of , while the roots retain 3.5-4%!

Similar results have been obtained with rapeseed which is more vulnerable to drought.

Photo 9. Death of plants in the control on the 9th day of the experiment

Photo 7 shows rapeseed plants on the 5th day.

Photo 8 shows rapeseed plants on the 8th day of the experiment. The amount of accumulated with BIO-GEL is practically twice as big. Death of plants in the control on the 9th day is shown in *photo 9*. Plants with BIO-GEL (Vitamin O7) remained alive 2 days longer.

Thus it has been experimentally proved that using the BIO-GEL organic fertilizer as wheat seed inoculant prolongs plant survival in drought conditions after "provocative" rain by 3 days: from 10 to 13 days, that is, approximately 30% longer. As far as rapeseed is concerned, it makes 2 days, from the 7th to the 9th. It has also been proven that the germination of roots in completely dry soil is not nonsense and sensation, as many researchers and practitioners believe, but an absolutely realistic way of adapting plants to climate changes, primarily to soil and atmospheric drought.