Modeling drought in laboratory conditions

Doing experiments on plant survival in drought conditions, one should be able

to properly model the drought because its various types can differ significantly. For example, early spring or autumn drought in the sowing period, when the farmer has one thing in mind: to sow or not, that is, to wait for rain like manna from heaven? All deadlines are long gone! Nerves can't stand it! At last the decision is made: take a chance and start sowing!

The job is done and the seeds inoculated with fine biological products stay motionless in the soil just as the non-inoculated ones.

And then a little rain comes, about 6-7 mm, and again no moisture. This is one of the possible situations.

This is exactly what happened in October of this year at the research plots of UkrNDIOZ in the village of Antonivka, Kherson region, where the grain lay in dry soil for 25 days before the first poor rainfall. Finally, the first shoots have appeared! Fig. 1 shows in the first row the control plants treated according to the farm technology, i.e. without using signaling molecules and biological products.

The second row shows the plants cultivated according to the farm technology but seed inoculation was enhanced by adding biological pro- prebiotic with temperature- hardened bacteria. Finally, the last two rows demonstrate the plants grown according to the farm technology but on sowing seeds the soil surface was sprayed with the biological product containing signaling molecules which effected the sown seeds positively through the soil surface. Currently, this tillage method, called the "Osipenko method" (named after the author) is in the process of patenting. Fig. 1 shows a great distinction between this method and the first two. In our opinion, it is the signal molecules obtained by a special HTD-technology® that have prepared young plants for survival even with poor rainfall. And this can be achieved only due to long roots.

FSecond one - demonstrates modeling another type of drought with a limited amount of rainfall (about 20 mm). To model this type of drought, high-temperature calcined sand before sowing wheat seeds was moistened to a depth of 8-10 cm. The seeds were placed in 7-liter containers with sand to a depth of 4 cm, i.e. in the soil layer sufficiently moist for germination.

In this experiment, various biological products for seed inoculation were tested (their names are not mentioned here). Plants dug out 8 days later differ significantly (see Fig. 3). It is obvious that in experiments 3 and 4, the energy of the seed went to the plant top, thus slowing down the development of the root

▲ **Photo 1.**
1 – control; **2 –** with pro-prebiotic inoculation (2 l/t); **3, 4 –** soil surface treated with proprebiotic (2 l/ha) after sowing the seeds

▲ **Photo 2**

▲ Photo 3

system. In experiment 5, LEANUM-X, a complex biological product was used. As you see, the plants have longer roots. In all experiments, there was observed a direct relationship between the amount of exudates and the size of the root system, i.e. the chances of surviving a drought.

In our opinion, the unique ability to expand the root deeper, closer to the soil

moisture reserves, is demonstrated by fig. 4 in which the young roots in experiment 5 go down into the completely dry sand due to root secretions, i.e. exudates. The contrasting boundary between moist and dry soil is clearly visible. It is logical to assume that the young roots should have stopped when they reach the surface of dry sand, but they pierced it by a few centimeters, forming bacterial covers around the roots with a supply of moisture, nutrients and symbiotic microorganisms. We think that this unique property of plants to colonize a completely dry soil by forming a rhizobial cover with natural microbiota should be studied most carefully!

These experiments show different reactions of plants to a particular type of drought, which must be taken into account when conducting experiments. In any case, the logic of the experiments on the exudate excretion by roots opens up a promising outlook for struggling with drought and mastering it!

It should be noted that the amount of exudates released also depends on the

condition of the soil: if the soil is poor in microbiota the plant secretes more, if the soil is rich, for example, where the NO-TILL method is used, the plant secretes less.

On the one hand, it seems that 20% of the seed weight is just wasted but it should be emphasized that these 20% remain in the soil after harvest, which enriches the soil with microbiota, i.e. raises its fertility which will definitely increase subsequent harvests.

▲ Photo 4

CONCLUSION

1. As a reaction to drought, the plant produces more root secretions - exudates. Their amount is in the range of 15-25% of the seed initial weight which accordingly reduces the natural potential of the plant and ultimately its yield.

2. The biological products of the pro-prebiotic class help plants to adapt more quickly to drought and maintain yields, especially if these biological products contain products of bacterial metabolism, including signaling molecules.

We emphasize that keeping in mind the limited energy of the grain, which a young plant uses for its development for the first 10-12 days, we must understand that treating grain with inoculants with signaling molecules to prepare it for arid conditions, we should foresee two possible scenarios: the expected drought has really occurred or it has not. In the second case, significant rainfall may occur, which is never possible to predict.

When sowing grain in arid conditions in spring or autumn, it is quite logical to inoculate it with products containing signaling molecules - carriers of information about unfavorable arid conditions. Accordingly, in response to this information, the plant begins to secrete an increased amount of root exudates. That is, the limited energy of the grain is spent on useful excretions into the soil. Accordingly, energy of growth, mainly of the root, decreases by the same amount.

A new generation of pro- prebiotics with temperature-hardened natural bacteria containing their metabolites, including signaling bacteria, will help plants reduce energy consumption.