INFLUENCE OF PHOSPHORUS-CONTAINING FERTILIZERS ON BARLEY IN EARLY STAGES OF ONTOGENESIS

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Abstract. *Phosphorus plays an important role in the synthetic and metabolic processes in plants. Peculiarities of agricultural production and the global cycle of this element actualize research aimed at improving the efficiency of phosphorus-containing fertilizers uptake by crops. Pre-sowing treatment of barley seeds with monopotassium phosphate (5 kg/t) leads to increasing of plants water holding capacity and their ability to continue synthetic activity in short-term drought conditions. However, negative consequence of such treatment consists in reduction of seeds germination.*

Key words: *barley, phosphorus, oncogenes, crop, fertilizer.*

As one of the main macronutrients phosphorus is contained in the plant in an amount of 0,2% of dry matter. It is a component of nucleic acid molecules, phospholipids, macroergic compounds. It is involved in key enzymatic reactions, synthetic and metabolic processes and determines energy level of plants [1, 2].

Compared to other biophilic elements, the global phosphorus cycle is the least closed. Due to the lack of geochemical flow that would return a significant proportion of the element to land, weathering and erosion of rocks is the only natural way for entering the element to the global cycle. The ecological significance of this process lies in the constant mineral degradation of land and in-creased eutrophication of flowing and still waters and the hydrosphere as a whole [5, 6]. Despite the high content of total phosphorus in the soil, plants often suffer from its deficiency, because most of present element compounds are in a form inaccessible for uptake by plants. Therefore, in crop production, the use of phosphorus-containing fertilizers is a necessary technological measure. However, in the year of application, the plants absorb about 20% of the phosphorus applied with fertilizers, while the rest is converted into an immobilized inaccessible to plants form through adsorption, precipitation or conversion into organic compounds. Improving the efficiency of assimilation of phosphorus-

containing fertilizers by plants is an urgent task for breeding, genetic and technological programs [2, 3, 4, 7, 8].

Existing approaches of increasing the efficiency of phosphorus digestion by crops from applied fertilizers are separated in two main strategies:

1) cultivation of varieties with higher efficiency of nutrients assimilation;

2) introduction of effective methods of crop management (selection of optimal doses, terms and methods of application) [4].

Coating the seeds with nutrients simultaneously with fungicide treatment is advisable to provide plants with nutrients in an accessible form in early stages of ontogenesis. One of the limiting factors for coating seeds with fertilizers is increasing of working solution osmotic pressure, which reduces its sowing quality.

The aim of experiment was to establish the influence of comparably high concentration of monopotassium phosphate (recommended dose 0.5 kg/t) in composition with SDHI fungicide for pre-sowing treatment of barley grain on plant resistance to short-term drought in early stages of ontogenesis in laboratory conditions.

Seeds of bread barley *Triticum aestivum cv*. Zymoiarka were used. This sort was selected because Mediterranean barley varieties are more sensitive to osmotic pressure of working solutions compared to bread barley. For seeds treatment was used a tank mixture of fungicide Vibrance (sedaxan, 500 g/l) and phosphorus-containing fertilizer monopotassium phosphate (MPP) in the following variants:

1 (Control) – Vibrance, 2 l/t;

2 – Vibrance, 2 l/t + MPP, 1 kg/t;

3 – Vibrance, 2 l/t + MPP, 5 kg/t;

4 – Vibrance, 2 l/t + MPP, 10 kg/t.

Increasing concentration of MPP in the working solution for seeds coating causes decrease its germination. Significant difference comparable with control was found in variants 3 and 4. It reached values 8.7 and 10.7 %, respectively (table 1). Variability of germination energy index was not notable.

Table 1 - The effect of pre-sowing treatment on sowing quality of seeds and length of barley seedlings above-ground part (BBCH 13)

Variant	Germination energy, %	Germination, %	Length, cm
1	42,0±4,3 ab	92,7±2,1 a	25,2±1,85 a
2	46,7±5,5 a	91,3±2,6 a	30,2±0,8 b

3	30,7±4,5 b	84,0±3,6 b	28±0,71 ab
4	36,7±5,7 ab	82,0±2,4 b	27,6±2,25 ab
Sd	5,1	4,8	1,55
$LSD_{0,05}$	14,1	7,7	4,3

Note. Letters serve for comparisons of samples (Tukey test, P < 0.05). The same letters indicate variants without statistically significant differences.

In three-leaf phase (BBCH 13), plant height was determined. Seeds treatment by variant 2 scheme leads to more intensive development of aboveground part of plants compared with control (table 1). In addition, it was noted that in variants 2 and 3 plants were more uniform in height. The variance of their sample was 3.2 and 2.5 cm2, respectively, while in the control – 17.2, and in variant 4 – 25.3.

Influence of short-term drought on seedlings was determined in phase of 2-3 leaves. Under condition of soil moisture decreasing to 3.9±0.06%, the difference in state of plants was visually noticeable. Plants in variant 3 were the most hydrated and retained turgor, while in other variants they lost moisture more intense. To determine the ratio of water and dry matter, the aboveground part of plants that were exposed to short-term drought and kept in normal irrigation regime was weighed before and after drying at a temperature of 105 ° C to constant weight (table 2).

Under continuous watering conditions, the initial weight of plants in variants 3 and 4 significantly exceeds the control values, which shows an increase in the energy status of plants and the intensity of their development. The difference in the masses of aboveground part of barley plants under conditions of continuous watering and drought in variants 1,2 and 4 is about 40 % of total mass. This is due to both transpiration loss of water and faster plant development with sufficient soil moisture. In variant 3, this difference is 15%. It indicates activation of water retention mechanism in plants during drought.

Table 2 – The content of water and dry matter in the aboveground part of barley plants with sufficient soil moisture and short-term drought

Varia	Initial weight, g		Dry matter, g		Water mass, g		Dry matter ent, %		Water content,	
	I	II	I	II	I	II	I	II	I	II
1	0,118 a	0,196 a	0,018 a	0,021 a	0,100 a	0,175	15,00 a	11,39 a	85,00 a	88,61 a

2	0,118 a	0,188 a	0,019	0,019 a	0,099 a	0,169	16,28 a	10,04 a	83,72 a	89,96 a
3	0,211	0,248	0,022	0,026	0,189	0,221	10,73	10,90 a	89,27	89,10 a
4	0,143 a	0,255	0,021	0,029	0,118 a	0,226	15,16 a	11,38 a	84,84 a	88,62 a
Sd	0,011	0,017	0,001	0,002	0,011	0,017	1,158	1,165	1,158	1,165
$LSD_{0,01}$	0,051	0,080	0,006	0,009	0,051	0,079	5,325	5,358	5,325	5,358
$LSD_{0,05}$	0,031	0,048	0,004	0,006	0,031	0,047	3,218	3,218	3,218	3,238

Note. I – short-term drought, II – continuous watering. Letters serve for comparisons of samples (Tukey test, *P < 0.05, **P <0.01). The same letters indicate variants without statistically significant differences.

Thus, pre-sowing treatment of barley seeds with a composition of Vibrance (2 l/t) and MPP (5 kg/t) stimulates the moisture-retaining capacity of plants in the early stages of ontogenesis. At the biochemical level, this phenomenon may indicate increased hydrophilicity and viscosity of protoplasmic colloids, slightly higher osmotic pressure and bound water content in tissues. Preservation of turgor and synthetic activity of these plants qualitatively distinguishes them from other variants. With this treatment barley seedlings are more homogeneous in height of the aboveground part. Whereas the growing conditions were the same, this may indicate reducing the impact of internal factors of plants on their growth.

However, after such treatment seed germination is reduced by 9 % compared to control. This significantly negative phenomenon testifies the need for additional research aimed at finding ways for sufficient phosphorus supplement for crops on their early growth maintaining efficiency of element assimilation by plants and avoiding harmful effects of concentrated working solutions.

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