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EFFECTS OF VARIOUS SALT CONCENTRATIONS ON GERMINATION OF SEEDS AND MORPHOMETRIC PARAMETERS OF DIPLOID WHEAT SEEDLINGS

Tolerance to environmental stress factors is an important trait for providing normal vital functions of plant organisms. The investigations revealed several mechanisms by which plants respond to salinity conditions: some mechanisms provide plant tolerance against damaging factors, while others provide reparation of the damage [1]. The formation of the adaptive mechanisms determines plant tolerance to adverse factors. Researches on the plant adaptive mechanisms and their use in purpose of the developing salt-tolerant wheat genotypes are of great importance. One of the methods allowing to overcome the negative effects of salinity is the use of salt-tolerant wheat varieties. Creation of such forms and their cultivation will contribute to enlargement of agricultural areas and decrease in the production loss. The aim of the research was the assessment of salt-tolerance of diploid wheat genotypes at the grain germination stage.

Materials and methods

Two wheat species *Triticum monococcum* and *Triticum dicoccum* were used as the research objects. To determine morphometric parameters (the length of roots and seedlings) of salt tolerance of wheat varieties, seeds were germinated in a NaCl solution (experimental variant) and in distilled water (control variant) using the roll method [2]. Screening for salt tolerance of wheat genotypes was conducted at 100, 150 and 200 mM concentrations of NaCl. Seeds were kept on wet filter paper, at 20–22^{0}C temperature, in the dark for 3 days and then germinated under 12h/12h (light/dark) photoperiod for 7 days. During 10 days the response of wheat seedlings to salt stress, growth dynamics of the above- and underground organs (roots and seedlings) were studied and varieties were compared according to the morphometric parameters. Germination ability for each variant of the wheat genotypes, germination energy on the 3rd and germination persentage on 7th days of the germination phase were determined [3].

Results and discussion

The studied samples of the experimental variants were found to be characterized by different germination ability. So, germination energy for *Tr. monococcum* was 85–50 % and for *Tr. dicoccum* 85–70 % under salinity. It is known that the general development of the root system is closely related to some plant parameters, which confirm their importance [4]. Therefore, it is expedient to trace dynamics of the development of roots and shoots under stress.In this point of view dynamics of the growth of roots and shoots has been studied at the initial stages of the plant ontogenesis under various salt concentrations. Growth dynamics of the root system of diploid wheat genotypes during 10 days showed that the growth rate declined with increasing salt concentrations, and this decline was different in the genotypes. The *Tr. monococcum* variety was more sensitive to the influence of salt whereas *Tr. dicoccum* was tolerant.

Dynamics of the development of diploid wheat roots grown at different salt concentrations during 10 days has been presented in figure 1 (a, b, c, d).

Figure 2 (a, b, c, d) shows the growth dynamics of diploid wheat genotypes, germinated under various salt concentration, for 10 days. As seen in the figures dynamics of the development of diploid wheat roots andseedlings at the early stages of ontogenesis showed that all wheat genotypes developed normally in the germination phase and the development rate of seedlings (Fig. 2, a, b, c, d) decreased with increasing salt concentrations, relative to the control. A sharp difference between experimental and control variants was observed on the 3rd day of the germination.

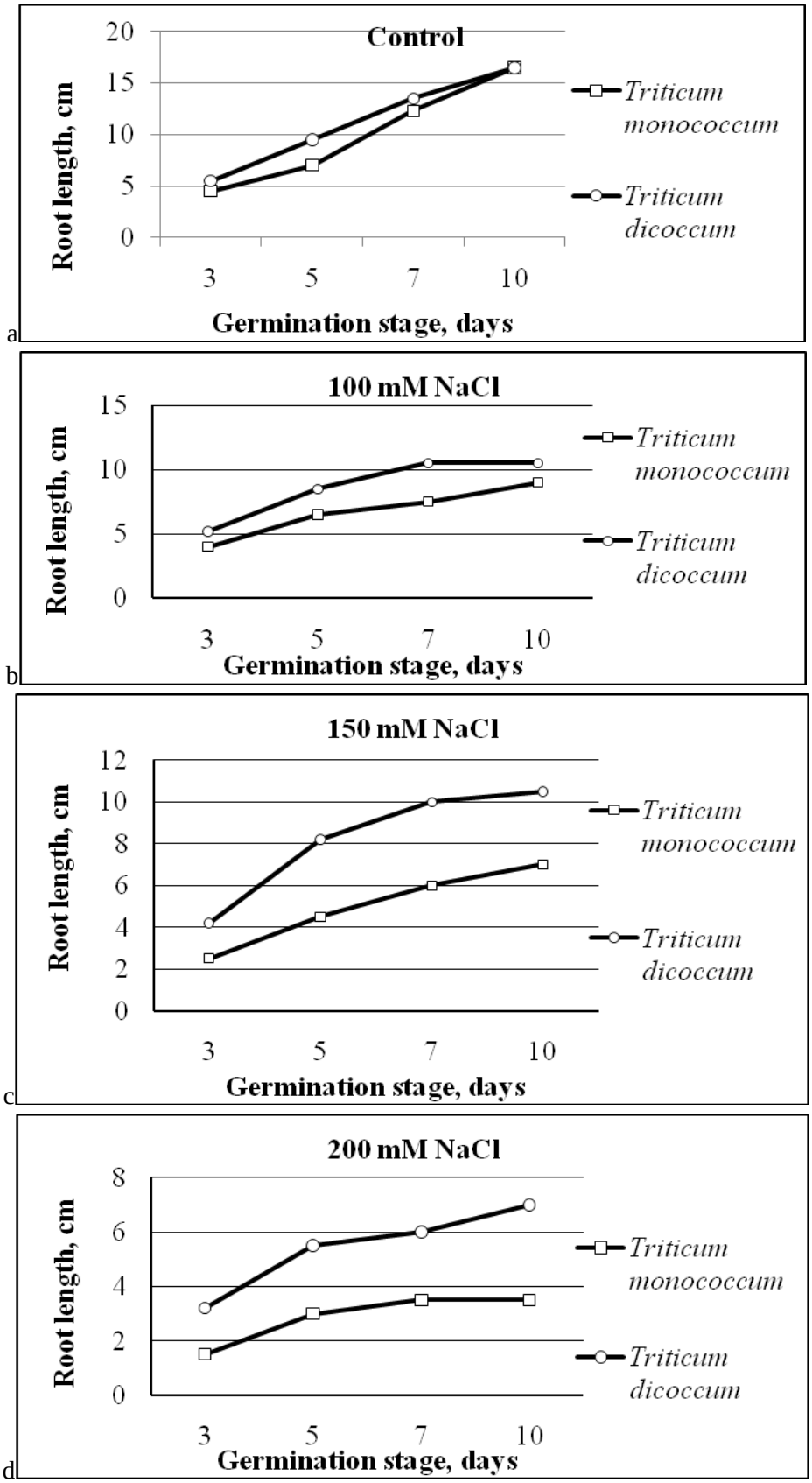
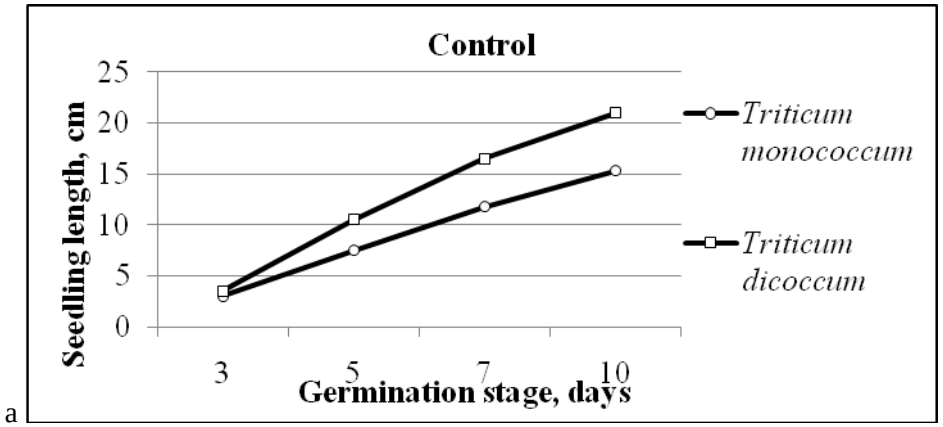
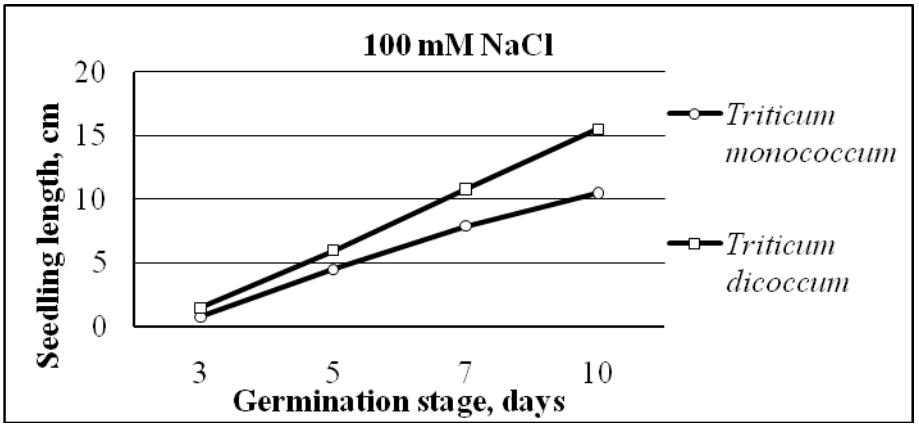


Fig. 1. (a, b, c, d). Dynamics of the growth (development) of roots of diploid wheat genotypes cultivated at different NaCl concentrations during 10 days.



a



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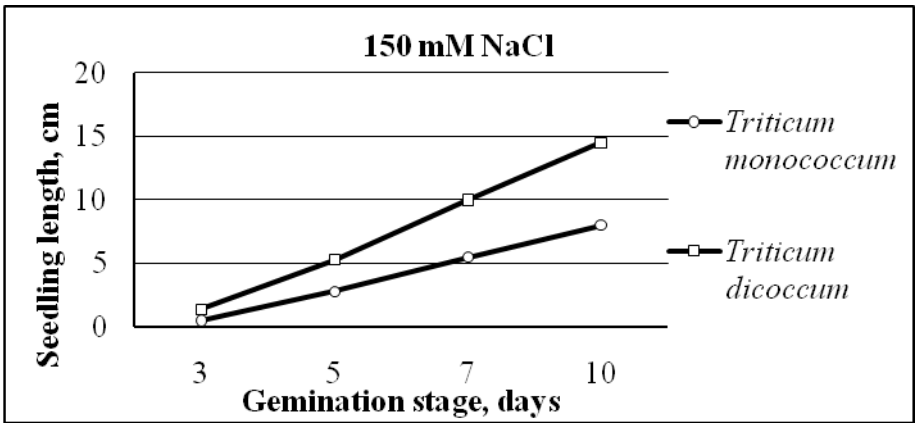
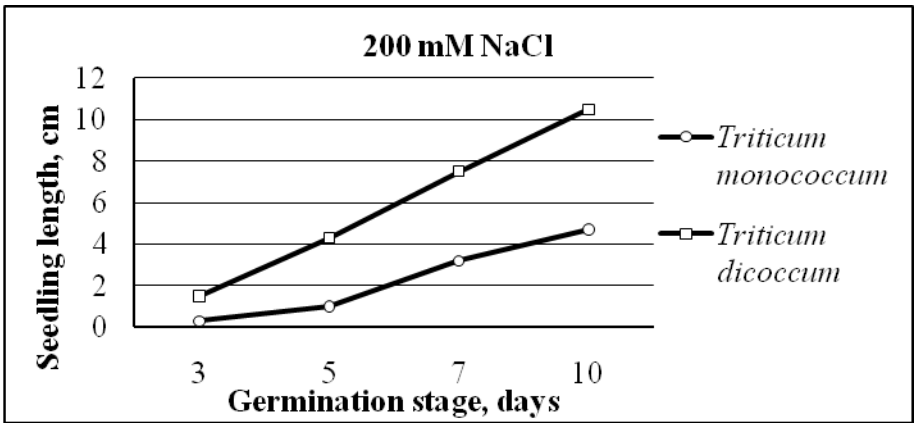


c



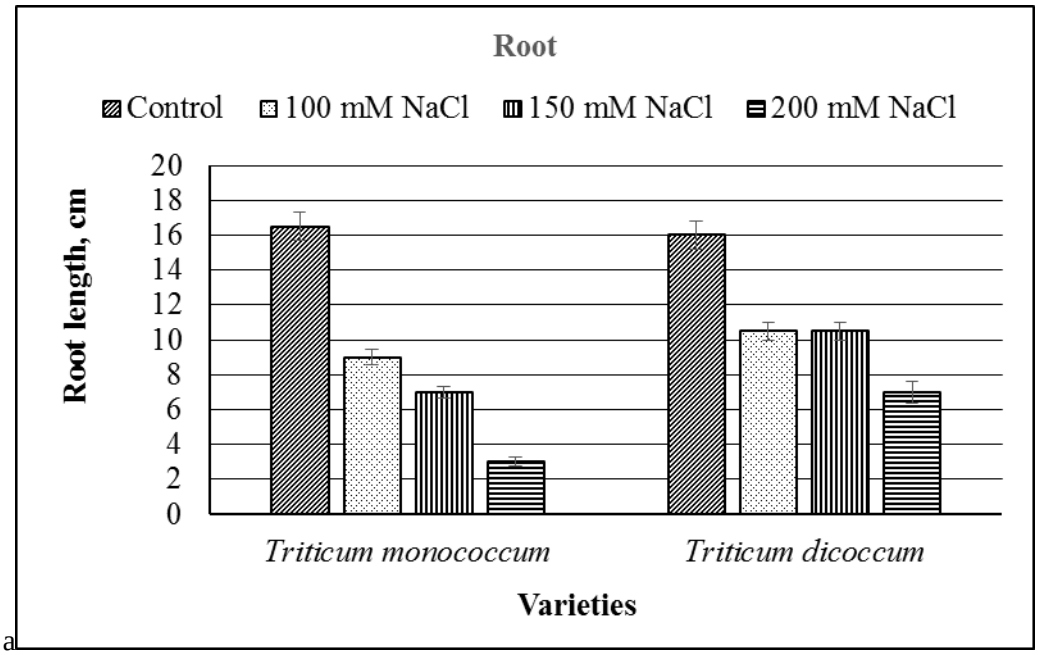
d

Fig. 2. (a, b, c, d). Dynamics of the growth (development) of seedlings of diploid wheat genotypes cultivated at different NaCl concentrations during 10 days.

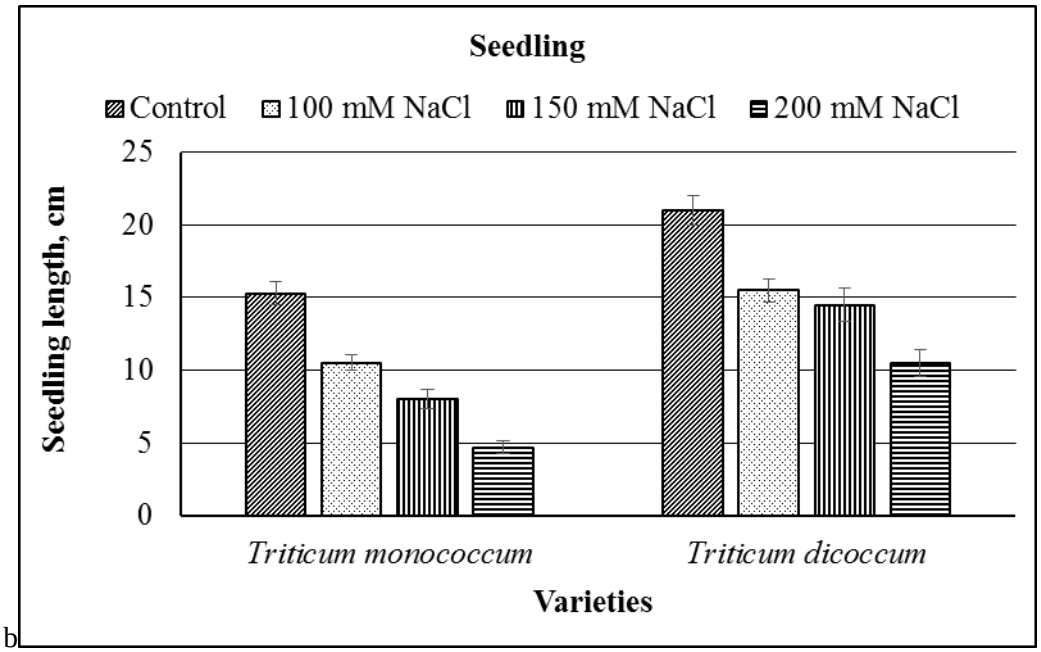
The *Tr. monococcum* variety less developed compared with *Tr. dicoccum*. However, normal development continued in the both varieties at all salt concentrations.

As seen in the figures the growth of diploid wheat genotype was normal during 10 days of the germination phase and the rate of the development of seedlings decreased with increasing salt concentration. Naturally, after the 3rd day of the germination the pronounced effect of salt was observed compared with control. The Tr.monococcum variety developed weaker than *Tr. dicoccum* one, though normal growth continued for both varieties at all concentrations of salt.

Diagrams presented in figure 3 (a, b) show parameters (root and seedling lengths) of diploid wheat varieties exposed to various concentrations of NaCl for 10 days.



a



b

Fig. 3. Average lengths of root hairs (a) and seedlings (b) of 10 day old wheat varieties exposed to various concentrations of NaCl.

Due to the general plant tolerance, alterations in the linear parameters of the growth processes express salt-tolerance of the varieties more correctly compared with the seed-germination parameters [5]. The retardation in the plant development under adverse envirionment, caused by the suppression of the cell pressure and especially cell tension, may be considered as a plant protective reaction. Tolerant forms faster adapt to stress and restore their development. The study of NaCl effects on the growth of shoots and roots showed that low salt concentrations stimulate [6, 7], and high concentrations inhibit the growing process. An increase in the accumulation of K^+ ions was observed in stems and leaves at 25 mM and 50 mM concentrations of NaCl. *Triticum aestivium* L. varieties were found to be more sensitive to high salt concentrations compared with *Triticum durum* Desf ones [8].

According to the morphometric parameters *Tr. dicoccum* appeared to be more tolerant to salinity and *Tr. monococcum* less tolerant at high salt concentrations compared with the control variants.

Conclusions

The results suggest that according to the characteristics of salt tolerance of diploid wheat varieties at the germination stage *Tr. monococcum* is a sensitive and *Tr. dicoccum*, which manifested relatively high parameters, is a tolerant variety.

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Aim. The aim of the research was the assessment of salt-tolerance of diploid wheat genotypes *Triticum monococcum* and *Triticum dicoccum* at the grain germination stage. ***Methods***. To determine morphometric parameters of salt tolerance of wheat varieties, seeds were germinated in a NaCl solution and in distilled water using the roll method. Screening for salt tolerance of wheat genotypes was conducted at 100, 150 and 200 mM concentrations of NaCl. Seeds were kept on wet filter paper, at 20–22°C temperature, in the dark for 3 days and then germinated under 12h/12h (light/dark) photoperiod for 7 days. ***Results***. Germination energy for *Tr. monococcum* was 85–50 % and for *Tr. dicoccum* 85–70 % under salinity. Growth dynamics of the root system of diploid wheat genotypes during 10 days showed that the growth rate declined with increasing salt concentrations, and this decline was different in the genotypes. ***Conclusions***. The results suggest that according to the characteristics of salt tolerance of diploid wheat varieties at the germination stage *Tr. monococcum* is a sensitive and *Tr. dicoccum*, which manifested relatively high parameters, is a tolerant variety.

Keywords: wheat genotypes, *Triticum monococcum*, *Triticum dicoccum*, salt stress, germination.