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SALT TOLERANCE OF CORN GENOTYPES (*Zea mays L.*) DURING GERMINATION AND LATER GROWTH

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Abstract: Since corn is grown in climatically diverse regions and under different production conditions, assuming that high salinity in the substrate affect corn seed performance, such conditions were simulated in this study in order to examine their effects on seedling geminability and length in several corn genotypes.

The study showed that the tested seeds tolerated the stress conditions up to a certain point. The studied genotypes differed in level of resistance to the stress conditions. Salt concentrations were determined, which were capable of affecting negatively seed germinability and seedling growth.

Key words: corn seed, germinability, root length, seedling length, salinity.

I n t r o d u c t i o n

Since corn is grown in climatically diverse regions and under different production conditions, corn seed is inevitably subject to various stress conditions. These stress conditions affect seed germinability, resulting in poor crop emergence, reduction of plant stand below the optimum, increased presence of weeds and, ultimately, reduced yield and quality of commercial corn. Stress conditions may be due to soil humidity shortage or excess during planting, relatively low air temperature, acid or alkaline soil reaction, shortage of macro- or micronutrients, etc. Seeds of various corn hybrids react differently to such stress conditions.

The aim of this study was to assess the effects of increased salt concentration on seed germinability of several corn hybrids under laboratory

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conditions. Effects of these stress factors on seedling growth (hypocotyl and radicle) were observed. Observations were made on the level of individual corn genotypes.

Increased salinity

Seed resistance to increased salinity during germination is essential for plant survival in the field, conseqvently for its further development and high yield performance.

Seed resistance in corn has been studied by Kaddah and Gowail (1964), Maranon et al., (1989), Grieve and Francois, (1992), etc. The problem of drought has been studied in other crops too: soybean (Abel and McKenzie, 1964), red clover (West and Taylor, 1981), alfalfa and red clover (Rogers et al., 1994, 1995), barley (Bliss et al., 1986), wheat (Hamson and Simpson, 1990). These studies confirmed that increased salinity tends to reduce seed germinability. In contrast, Scialabba et al., (1999) concluded that seed sensitivity to NaCl differs among crops and that it depends on genotype and seed quality.

Bliss et al., (1986), Smith and Dobrenz, (1987) and Rogers et al., (1995) maintained that reduced seed viability and therefore reduced germinability are brought about by the negative osmotic potential of salt, i.e. by toxic effects of Na and Cl ions.

Material and Method

Experiments were conducted in National Laboratory for Seed Testing in Novi Sad. They included corn hybrids from different maturity groups (NS 300, NS 420, ZP 599, NS 640, ZP 680 and ZP 704).

Two tests were applied: standard method of seed germinability testing and effect of high salinity in the substrate on germinability and length of corn seedlings.

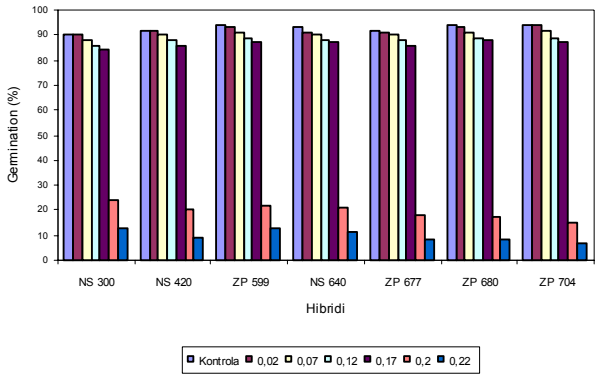
The tests were conducted in accordance with *Handbook of Vigour Test Methods (ISTA, 1995)*, which provides details of these tests.

NaCl application (salinity) - Seeds were wrapped in filter paper previously treated with the following molar concentrations of NaCl: 0.02, 0.07, 0.12, 0.17, 0.20 and 0.22, and placed in a germination chamber (temperature 25^0C, relative air humidity 95%). Distilled water was used as control. The osmotic potential of the solution was -0.1 MPa. Germination was assessed after 7 days. The tests were done in 4 replications, 50 seeds per replication.

The obtained data were processed by the analysis of variance for the two-factorial trial. Statistical analyses were performed with the MSTAT computer program.

Results and Discussion

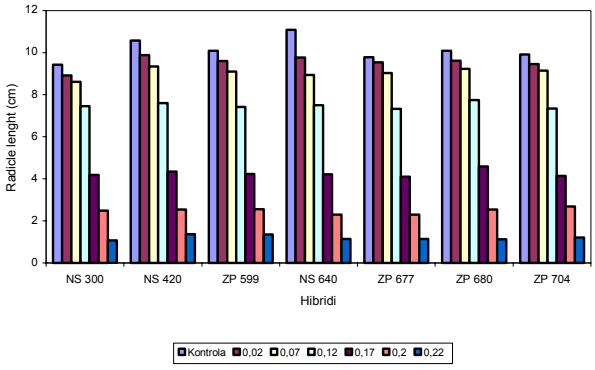
The hybrid NS 300 had lowest germinability values with the low NaCl concentrations and the highest germinability value with the highest NaCl concentration (Graph. 1). Conversely, the hybrid ZP 704 had highest germinability values with the low NaCl concentrations and low germinability values with the high NaCl concentrations.



LSD $_{0.05}$ **2.143**

Graph. 1. - Influence of NaCl on seed germination

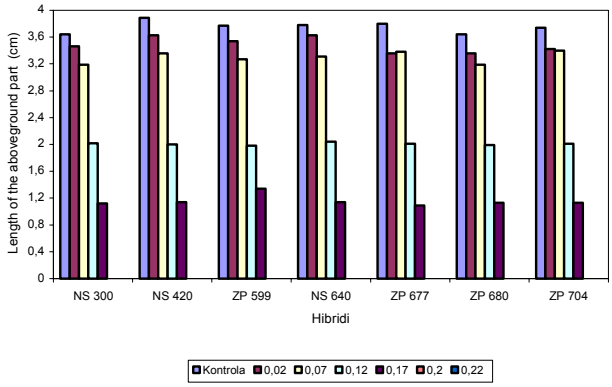
Regarding radicle length, the hybrids NS 300 and ZP 677 were most sensitive to the increased NaCl concentration, while the hybrids NS 420 and ZP 704 were the least sensitive (Graph. 2).



LSD $_{0.05}$ **0.273**

Graph. 2. - Influence of NaCl on root length

The length of the aboveground part in the tested hybrids varied with the different NaCl concentrations (Graph. 3). The hybrids NS 300 and ZP 680 were most sensitive to the low NaCl concentrations, while NS 420 and NS 640 were most tolerant. Regarding the increased NaCl concentrations in the substrate, the hybrids ZP 599 and ZP 677 exhibited significant sensitivity, and the hybrids NS 640 and ZP 704 exhibited highest tolerance.



LSD $_{0.05}$ **0.123**

Graph. 3. - Influence of NaCl on seedling length

Similar to the reaction to drought, the aboveground part was more sensitive than the radicle to the increase of NaCl concentration in the substrate.

The obtained results indicated that the increased concentration of NaCl negatively affected the germinability and development of corn seedlings. Similar results were obtained by Hamson and Simpson, (1990) for wheat, Bliss et al., (1986) for barley, Abel and McKenzie, (1964) for soybean, etc. Kaddah and Gowail, (1964) found that salt had a higher impact on seedling growth than on field germinability. These authors claimed that the weight of corn seed does not affect its tolerance to NaCl. Conversely, Maranon, et al., (1989) and Grieve and Francois, (1992) maintained that large corn seeds have a higher vigor, and therefore a higher resistance to increased NaCl concentrations than small seeds.

Conclusion

The study involving NaCl application indicated that corn seed is sensitive to abiotic stresses occurring under natural conditions.

Increase in NaCl content in the substrate was inversely proportional to germinability rate and seedling length. The differences occurring with low NaCl concentrations, were smaller than those occurring with high concentrations. A significant drop in germinability occurred with the concentration of 0.20 moles NaCl.

The other parameters reacted differently to NaCl level. Negative effects on the length of seedling root and aboveground part were already evident with low NaCl concentrations, in all hybrids under study.

NS 300 was most sensitive to drought and NaCl content in the substrate. ZP 599 and ZP 680 were less sensitive than the previous hybrid. NS 420, NS 640 and ZP 704 were most resistant to drought. It was characteristic of the hybrid ZP 677 that it exhibited average values for almost all traits under study.

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TOLERANTNOST KUKURUZA (*ZEA MAYS L.*) NA PRISUSTVO NACL TOKOM KLIJANJA I NICANJA

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R e z i m e

S obzirom na širok areal rasprostranjenja i na različite uslove proizvodnje, seme kukuruza izloženo je različitim stresnim uslovima koji vladaju u pojedinim rejonima. Seme različitih genotipova kukuruza izloženo je različitim nepovoljnim faktorima. Simulirani su uslovi povećanog sadržaja soli u supstratu kao i njihov uticaj na klijavost i dužinu klijanca kod pojedinih genotipova kukuruza. Seme svih biljnih vrsta je osetljivo na nepovoljne uslove koji se mogu javiti u prirodi.

Povećan sadržaj soli može da utiče na smanjenje klijavosti semena kukuruza kao i na smanjenje dužine korena i dužine ponika. Ispitivanja su pokazala razliku između genotipova u otpornosti na stresne uslove. Takođe ispitivanjem su utvrđene koncentracije koje mogu imati negativan uticaj kako na klijavost semena tako i na porast klice.

Istraživanje je pokazalo da ispitivano seme može podneti određene nepovoljne uslove.

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