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INFLUENCE OF DROUGHT ON SEEDLING DEVELOPMENT IN DIFFERENT CORN GENOTYPES (Zea *mays* L.)

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Abstract: Assuming that drought affects 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 negatively affecting seed germinability and seedling growth.

Key words: seed viability, germinability, seedling length, drought, osmotic stress, salinity.

Introduction

A seed is the origin for new life for a plant, a complex biological system and, as such, the foremost and fundamental factor of successful plant production (Milošević et al., 1996). 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.

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The aim of this study was to assess the effects of drought on seed germinability of several corn hybrids under laboratory conditions. Effects of these stress factors on seedling growth (hypocotyl and radicle) were observed. Observations were made on the level of individual corn genotypes.

Effect of drought

Drought affects all stages of plant growth and development including germination (Hadas, 1976). Drought poses problems in most food-producing regions. That is why this problem has been studied by numerous researchers and in a large number of crops such as tomato (Taylor et al., 1982), rice (Singh and Singh, 1983), wheat (Kerepesi and Galiba, 2000), various grass mixtures (Emmerich and Hardegree, (1990, 1991, 1993), etc.

The problem of drought in corn has been extensively studied by Parmar and Moore, (1965), Heydecker, (1977) and Van der Venter, (1988). Numerous authors have found that drought negatively affects seed germinability in various crops as well the growth of the radicle and hypocotyl in seedlings. Polyethylene glycol (PEG) has been used in laboratory studies for simulation of drought conditions.

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).

Three tests were applied: the standard method of seed germinability testing, effect of polyethylene glycol on seedling germinability and length and the effect of high salinity in the substrate on the 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.

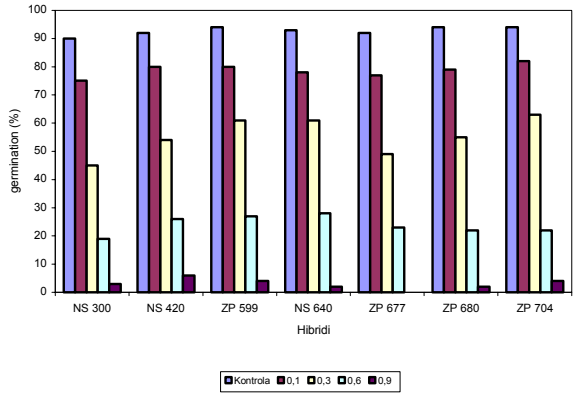
Polyethylene glycol application (osmotic stress) - Seeds were incubated on filter paper in petri dishes at 25^{o}C. Filter paper was previously treated with polyethylene glycol, with the molecular mass of 6000, differing in the osmotic potential: -0.1 MPa, -0.3 MPa, -0.6 MPa, -0.9 MPa. Filter paper treated with distilled water served as control. Germinability and seedling length were assessed 7 days after treatment. The tests were done in 4 replications, 50 seeds per replication. The obtained data were procesed by the analysis of variance for the two-factorial trial (Hadživuković, 1991). Statistical analyses were performed with the MSTAT computer program.

Results and Discussion

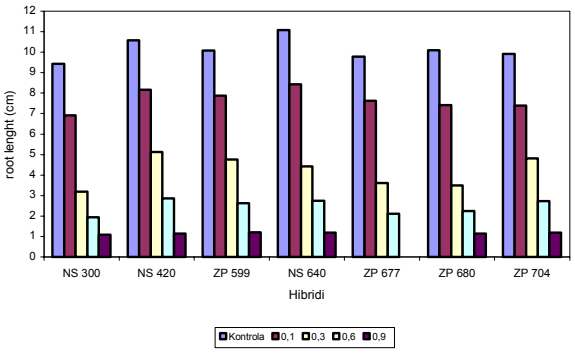
Osmotic stress - PEG application

The results of these tests showed that seed germination LSD $_{0.05}$ was 3.074; for root lenght was LSD $_{0.05}$= 0.430 and for seedling length was LSD $_{0.05}$= 0.142.

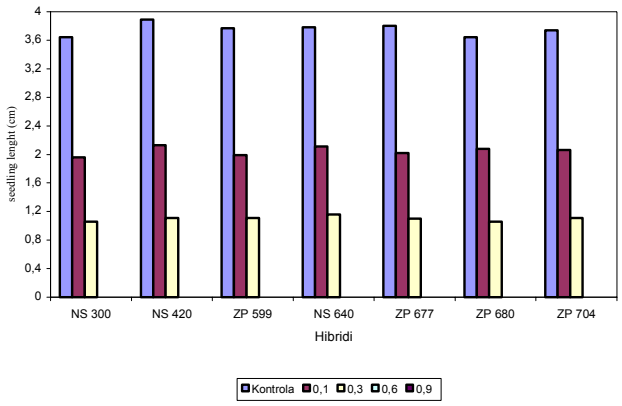
The tests showed that the hybrid NS 300 exhibited lowest germinabilities with all PEG concentrations except the highest one (Graphs 1.2 and 3). The same effects were observed for seedling length. Highest germinability values were found for the ZP hybrids, highest radicle lengths for the NS hybrids. As regards the hypocotyl, the hybrids NS 300 and ZP 680 had shortest ones with all PEG concentrations and the hybrid NS 420 had the longest one.



Graph. 1.- Influence of PEG on seed germination



Graph. 2. - Influence of PEG on root length



Graph. 3. - Influence of PEG on seedling length

A comparison of the above results indicated that the development of the aboveground seedling part was more sensitive to increased PEG concentrations than the radicle development.

The hybrid NS 300 was most sensitive to increased PEG concentrations, i.e. to the occurrence of drought at the time of planting. Conversely, the hybrids NS 420 and NS 640 exhibited the highest resistance.

Parmar and Moore, (1965), Heydecker, (1977) and Van der Venter, (1988) obtained similar results for corn. Taylor et al., (1982), Singh and Singh, (1983), Bhat and Srinivasa Rao, (1987) and Emmerich and Hardegree, (1990, 1991, 1993) obtained similar results for seed germinability in various plant species.

Negative effects of drought on the growth of the primary root and hypocotyl were reported by Parmar and Moore, (1965) and De and Kar, (1994). These authors showed that the seeds treated with a PEG solution with a low osmotic potential caused significant reductions in the lengths of radicles and hypocotyls, while a solution with a high osmotic potential completely interrupted the formation of hypocotyls.

Conclusion

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

Drought tended to reduce corn seed viability. Negative effects were also evident regarding seedling growth and development.

The osmotic potential at which seed quality parameters dropped down was 0.1 MPa.

NS 300 was most sensitive to drought.

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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UTICAJ SUŠE NA RAZVOJ KLIJANACA KOD RAZLIČITIH GENOTIPOVA KUKURUZA (*Zea mays L.*)

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R e z i m e

Seme različitih genotipova kukuruza izloženo je različitim nepovoljnim faktorima. Simulirani su uslovi suše i njen uticaj na klijavost i dužinu ponika kod pojedinih genotipova kukuruza. Seme svih biljnih vrsta je osetljivo na pojavu suše, koja može javiti u vreme setve. Suša može da utiče na smanjenje klijavosti semena kukuruza kao i na smanjenje dužine korena i dužine nadzemnog dela ponika. Ispitivanja su pokazala razliku između genotipova u otpornosti na sušu. 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 stresne uslove.

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