STUDY THE RESPONSE OF SUNFLOWER GENOTYPES TO PEG-MEDIATED WATER STRESS.

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ABSTRACT

Response of five sunflower genotypes with different origin to drought stress at germination and seedling stage was investigated using polyethylene glycol (PEG 6000) as drought simulator under laboratory conditions. Normal treatment and two levels of osmotic stress were monitored. Germination percentage, root length, shoot length, root to shoot length ratio, and depression were determined for the studied genotypes, represented by three replications to evaluate the response of sunflower variety, cultivated hybrid, two interspecific hybrids and an accession of *H. argophyllus* under normal and simulated drought stress treatments. Plant height for all studied hybrids decreased with increasing water stress. Studied interspecific hybrids showed similar responses at osmotic potentials of both -0.6 MPa (10% PEG) and -1.62 MPa (20%PEG). They performed better and were classified as drought tolerant. The cultivated sunflower hybrid Divna showed medium tolerance and variety Favorit – sensitive one. The variation among studied genotypes was found to be a reliable indicator to screen the drought tolerant ones at primary growth stage.

INTRODUCTION

Among abiotic stress factors, drought is a largest factor that restricts the plants growth and production in natural environments. Drought may be the result of greater transpiration and reduction of water supply through roots. Sunflower is tolerant to the short period of drought stress due to its deep-rooted nature. Environmental extremes decrease the growth of sunflower plants and leads to the lower seed production and yield. The narrow genetic base of cultivated breeding lines and hybrids have limited the scope of studies connected to identification of possible sources of drought tolerance. Saucă *et al.* (2014) reported that some wild sunflower species especially *Helianthus argophyllus* L. have been defined as drought-tolerant, and the introgression of traits from them was expected to increase drought tolerance in cultivated breeding lines.

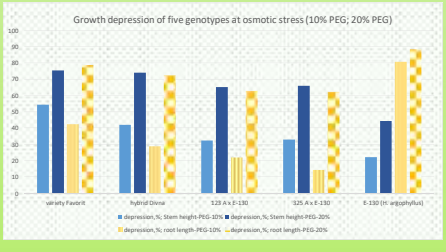
MATERIALS AND METHODS

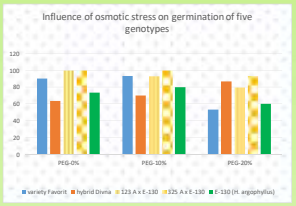
In the investigation were included 5 genotypes – accession E-130 from wild *H. argophyllus*, two interspecific hybrids 123A x E-130 and 325A x E-130, conventional sunflower hybrid Divna and sunflower large-seeded variety Favorit. The experiment was carried out at germination and seedling stages of plants under laboratory conditions (25±3°C) and artificial illumination 1500 lx 16 hours/day.

Polyethylene glycol with a molecular weight of 6000 (PEG-6000) was used as a drought stimulator and two water stress levels of zero (control), -0.6MPa, -1.62 MPa was developed by dissolving 10 and 20 g of PEG in 100 ml distilled water. Ten seeds were surface sterilized with 10% sodium hypochlorite solution for five minutes and then washed three times with distilled water. The study was laid out in three repetitions for each experimental unit. Germination percentage, root length, plant height, root to stem length ratio, and depression were determined for the studied genotypes. Ten ml of designated treatment solution was applied daily in each Petri plate after washing out the previous solution. Number of seeds germinated was counted daily and data were recorded for 8 days. A seed was considered germinated when both plumule and radicle had emerged to 3 mm.

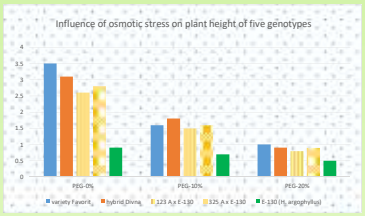
RESULTS AND DISCUSSION

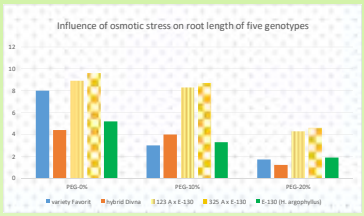
The percentage of depression of stem height at 10% PEG was lower than the same was at 20% PEG for all studied genotypes. The highest value was calculated for variety Favorit and the lowest for accession E-130 (*H. argophyllus*). The percentages of depression of root length at 10% PEG and 20% PEG were the highest for the wild accession and lower for the interspecific hybrids, which seeds germinated with the same rate at 10% PEG and 20% PEG.



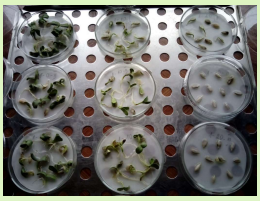


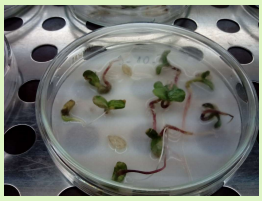
Results of this experiment showed that osmotic pressure and genotype exerted significant effects on percentage of germination. When submitted to different level of osmotic pressure, the interspecific hybrids performed better than other tested genotypes. Significant difference in germination of variety Favorit was observed at 20% PEG compare to 10% PEG. The interspecific hybrids slightly decreased their germination at 20% PEG.

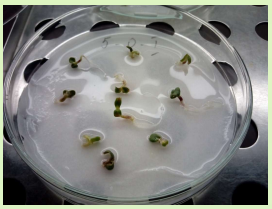


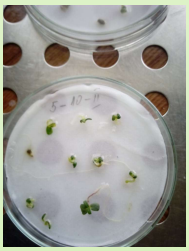


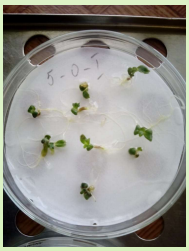
The plant height decreased with the increase in PEG concentrations and was minimum at the lowest osmotic potential (-1.62 MPa). The lower effect of osmotic stress on root length was established for all studied genotypes except the variety Favorit at 10% PEG. Root length decreased significantly for all of them at 20% PEG especially for the variety Favorit and hybrid Divna. Under 20% PEG osmotic stress on plant height, the variety and the three hybrids demonstrated the similar influence in contrast with the influence on root length, where the interspecific hybrids formed significantly longer roots.

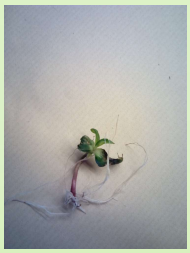


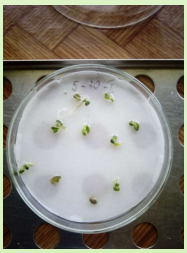












CONCLUSION

Polyethylene glycol (PEG) causes osmotic stress and could be used as a drought simulator. These results were similar to those reported by Midaoui *et al.* (2001), Ahmad *et al.* (2009), Sauca *et al.* (2014), Vasilevska-Ivanova *et al.* (2014), Hussain *et al.* (2017).

Effect of osmotic pressure was evidenced at the first day of incubation. The delay of germination and the reduction of percentage of germination under induced PEG water stress varied significantly between genotypes. These results suggested that these treatments might be used to predict tolerance or susceptibility of important genotypes with different origin subjected to moderate water stress. Several factors influence the seed such as, seed age, seed maturity, storage conditions, seed biochemical composition, genetic variability and ecological conditions. Further experiments performed with different growth stages will be required to check relations between early germination tests and dry matter production under different levels of water stress. The germination test may be useful for identifying vigorous genotypes, capable of quickly establishing adequate population under low soil moisture conditions. The genetic differences among various accessions may be correlated to seedling growth which has been studied in the present investigation. In sunflower, wide hybridization (interspecific and intergeneric) is a useful technique for development of new genotypes with desirable agronomic traits. For drought tolerance breeding, wild annual species *H. argophyllus* has been reported to be a potential source for genes for drought resistance and is therefore extensively used by sunflower breeders.