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Screening of Pearl Millet Genotypes Suitable for Drought Tolerance at Early Seedling Stage

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ABSTRACT

Background: Pearl millet [*Pennisetum glaucum* (L.) Br.] is the most widely grown staple food of majority of poor and small land holders in Asia and Africa. It is also consumed as feed and fodder for livestock. It is the sixth most important cereal crop in the world next to maize, rice wheat, barley and sorghum. The temperature is one of the key climatic factors and has profound effect on the growth and development of the pearl millet. It can only be managed through developing hybrid varieties which can tolerate high temperature during germination and early seedling stages.The present study aimed to identify drought tolerant genotypes of pearl millet at seedling stage.

Methods: This experiment was carried out at Mandor during *kharif* 2018 with five selected pearl millet advanced hybrids MH 2192, MH 2224, MH 2228, MH 2354 and MH 2359 along with three checks RHB 177, MPMH 17 and 86M86 which were tested under polyethylene glycol (PEG) (5% and 10%) induced osmotic stress. Various physiological parameters were recorded 15 days after sowing and statistical analysis made using Windostat software.

Result: The results revealed that shoot length, seedling dry weight, relative water content, membrane stability index and chlorophyll content decreased significantly with PEG induced water stress in all the hybrids while root length and catalase activity increased significantly under water stress. Among 5 hybrids, two hybrids *viz*. MH 2359 and MH 2354 performed better and found to be superior under PEG induced water stress. Thus, various drought tolerance indices may further be studied for these two hybrids and can be used in development of drought tolerant genotypes which may prove helpful for crop improvement programs of pearl millet.

Key words: Drought tolerance, PEG, Pearl millet, Physiological parametres, RWC.

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a nutritious and staple cereal of the hottest, driest areas of the tropics and subtropics which receive rainfall from 150-700 mm. It is world's sixth and India's fourth important cereal crop. It is grown on about 27 million hectares worldwide and is a daily food for more than 90 million people. Among the various abiotic stresses; drought is a regular occurrence in these regions which is a major constraint for its production. In India, water deficit limits the crop production in about 67% of the net sown area. Water stress due to drought is one of the most significant abiotic factors that limit the seed germination, seeding growth, plants growth and yield (Van and Zeng, 2006). Pearl millet [*Pennisetum glaucum* (L.) R. Br.] has made a notable place in arid and semiarid areas because of its potential for high dry matter production at water deficit and high temperature. Though the infinite storage of soil moisture resulted from monsoon rain supports the plant growth favorably at the early stages of growth, the plant suffers from water stress at the reproductive stage when the residual soil moisture depletes (Lopez *et al.,* 2003). Polyethylene glycol widely used to induce water stress in plants is a non-ionic water-soluble polymer which is not expected to penetrate into cells (Djibril *et al*., 2005). Selection for drought tolerance at early stage of seedlings is most frequently practiced using poly ethylene glycol (PEG 6000) in the medium (Rauf *et al*., 2006, Jincya *et al*., 2019). Earlier reports on identification of the drought tolerant pearl millet genotypes using different concentrations of PEG 6000 have showed significant differences for different seedling traits. The seedling traits when pooled together could discriminate between drought tolerant and susceptible genotypes (Noorka and Khaliq, 2007). Therefore, to expand pearl millet cultivation and to sustain pearl millet yield under drought prone areas the present investigation was carried out to evaluate physiological mechanism of drought tolerance in early seedling stages against drought stress.

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MATERIALS AND METHODS

The pearl millet advanced hybrids MH 2192, MH 2224, MH 2228, MH 2354 and MH 2359 along with three checks RHB 177, MPMH 17 and 86M86 were used for study at Mandor during *kharif* 2018. Thirty seeds of each advance hybrids were grown thrice in plastic pots filled with the soil mixture favourable for optimum growth. The water stress condition was created by polyethylene glycol (PEG 6000 5% and 10%). The various physiological parameters were studied at 15 days after sowing. All the growth and physiological parameters likes seedling length, seedling dry weight, root shoot ratio, seedling vigour index, relative water content (RWC), Membrane stability index, pigment content (chlorophyll) (Arnon, 1949), catalase measurements (Ali *et al.* 2005) in control and PEG treated plants were recorded. The data analysis was done for factorial randomized block design using factor (a) for hybrids and factor (b) for PEG concentration.

RESULTS AND DISCUSSION

The results of present study revealed that shoot length (Fig 1), seedling dry weight, relative water content, membrane stability index and chlorophyll content decreased significantly with PEG induced water stress in all the hybrids while root length (Fig 2) and catalase activity increased significantly under water stress. The genotypic difference was also found to be significant among them including root-shoot ratio. The advanced hybrids MH 2228 and MH 2359 performed better having high shoot length, seedling dry weight, SVI and high root shoot ratio. Similarly, Kundur *et al*. (2016) screened the rice varieties Tellahamsa and N22 for tolerance to drought and found that in Tellahamsa, the shoot and root biomass decreased, whereas in N22 there was a significant increase in root biomass. Shoot and root RWC of N22 was higher than TH under stress. The better performance of genotypes MH 2228 and MH 2359 in the present experiment may be due to high RWC, MSI, chlorophyll and CAT (Fig 3) under drought stress. Similar results of higher contents of chlorophyll were also recorded by Emmanuel *et al*. (2020) in maize genotypes EC-3161 and RJ-2020 as compared to DTSYN11 under the 8th day of stress. RWC showed a decline in BPCH-6 (72.54%) and in RJ-2020 (72.65%) and proline was significantly increased up to 10 and 13-fold, respectively. Polyethylene glycol (PEG) molecules are inert, non-ionic, virtually impermeable chains and have been used frequently to induce water stress in crop plant. One of the important speculations is that a positive correlation between drought tolerance of the genotypes in the field and in laboratory experiments was noted (Kosturkova *et al.,* 2014). Similar

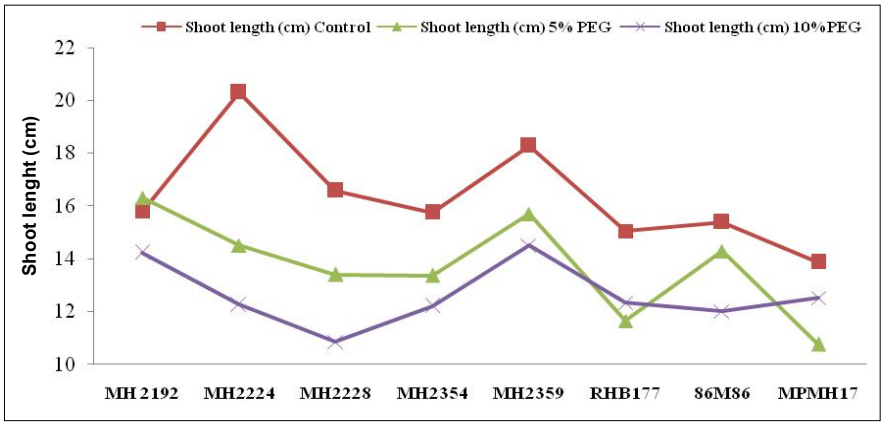

Fig 1: Shoot lenght (cm) of different pearl millet advanced hybirds influenced by PEG induced water stress.

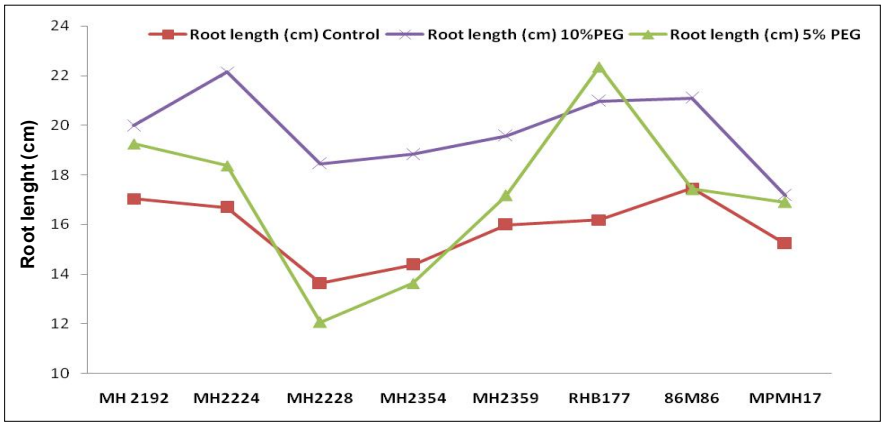

Fig 2: Root length (cm) of different pearl millet advanced hybirds influenced by PEG induced water stress.

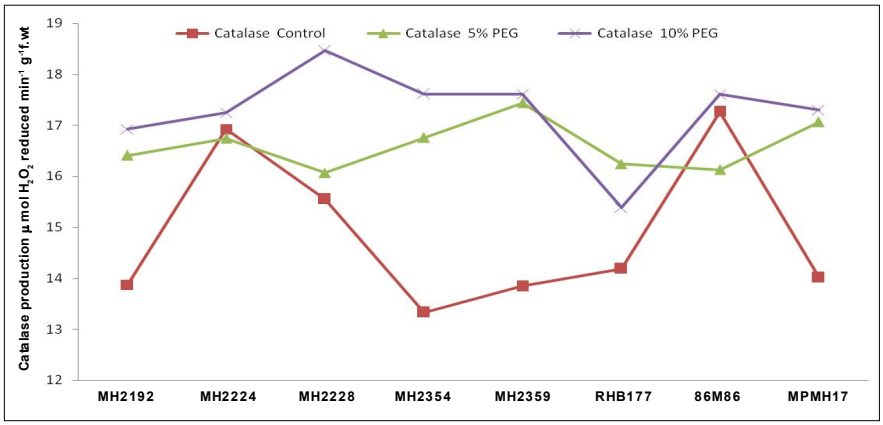

Fig 3: Catalase production µ mol H_2O_2 reduced min^{-1} g^{-1}f.wt. in millet advanced hybirds influenced by PEG induced water stress.

results like reduction in germination rate with the increase PEG were noted in chick pea. Strong negative correlation coefficient was noted between root length and PEG concentration with more than -0.81 correlation coefficient values. Roots were reported to be the primarily effected plant part under drought conditions than any other parts (Ghafoor, 2013).

CONCLUSION

Water stress due to drought is the most significant abiotic factor limiting plant growth and development. Growth of plants in arid and semi-arid land is dependent upon plants susceptibility to drought stress and also related to the ability of seeds to achieve optimum germination under these unfavorable conditions. Therefore, it is necessary to identify hybrids tolerant to drought at the primary growth stage. The advanced hybrids MH 2228 and MH 2359 found tolerant to water stress during the present study can be useful for the development for drought tolerant hybrid and varieties in future.

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Conflict of interest

Author has no conflict of interest of any type.

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