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EFFECT OF MANNITOL CONCENTRATION ON CHILLI GENOTYPES

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ABSTRACT
Water scarcity is the most imperative factor constraining agricultural production not in India but all over the world. Present investigation was planned to study the effect of drought stress on morphophysiological characteristic of chilli. Two chilli genotypes (PSB and PJ) were grown under natural condition (all recommended irrigations are given) and drought conditions (created by the different concentration of mannitol; 100mM, 150mM, 200mM and 250mM) in screen house at the experimental area of MD University, Rohtak. A continuously decreasing pattern was observed in germination percentage, root length, shoot length, fresh weight and dry weight gradual increase in mannitol concentration; whereas a sharp reduction was observed at 90 days after sowing under 250mM mannitol concentration. Genotypes PSB was found better tolerance behaviour and growth compare to PJ under different mannitol concentration.

KEYWORDS: Drought, *Capsicum annum*, mannitol, morpho-physiology.

INTRODUCTION

Capsicum annum L. (pepper) is crop plant belongs to Solanaceae family originated in Americas have high medicinal as well as nutritional aspects (Mazourek *et al*., 2009). It is one of the vegetable with great importance due to economic value and high nutrient content like protein, carbohydrate, sugar, fibre, fat, water, sodium and vitamin. Drought stress is one of the major stress that cause agriculture losses rather than other environmental stress (Jianyong *et al.*, 2004). Drought is very common and osmotic adjustment is an effective method in the event of stomatal regulation to strengthen the synthesis of metabolism, increase intracellular infiltration of substance concentration, reduces osmotic potential, maintain the pressure and normal cell physiological function. Global warming and climate change is occurring today cause the limited water availability for crops (Budiastuti, 2010) and considered as severe threat for sustainable crop production in conditions of climate change (Anjuum *et al.*, 2011; Hammad and Ali, 2014). Growth of plant shoot, crop growth rate, number of leaf area, plant fresh and dry weight are decreased under drought stress (Abdalla, 2014). Drought stress not only influences the seed germination (Bates *et al*., 1973) but also decrease germination means (Willenborb *et al*., 2004). Irrigation is practiced in all parts of the world where rainfall does not provide enough ground moisture (Bhuiya *et al.*, 2003). Fernado and Chandrapala (1996) showed that the amount of rainfall received by the country has been declining gradually. In India, the states of Andhra Pradesh, Karnataka, Maharashtra, Orissa, Tamilnadu account for more than 75 percent of the area and total production of chilli while the drought stress account for decrease in yield by more than 50 per globally (Bayoumi *et al.*, 2008). Capsicum requires warm soil and grows at 21 to 29 degree Celsius. During initial growth drought stress effect the development and establishment of plant (Shao *et al.*, 2008). Drought stress causes water deflects because water uptake by root is not fullfill the demand of transpiration (Yoo *et al.*, 2010). Different transcription factor like transcription domain, oligomerization site, DNA binding site and nuclear localization signal are proteinecous in nature that help in regulation of gene expression (Banerjee, Roy choudhury, 2015). Reddy *et al.*, (2004) also reported the reduced photosynthesis and severe metabolic disturbance and plant death was associated with severe drought stress condition. Therefore, the present investigation was focussed on the effects of drought stress (100mM, 150mM, 200mM and 250mM mannitol) on morpho-physiological parameters to suggest possible adaptation measures.

MATERIALS & METHODS

Two Capsicum varieties PSB (Pusa Sadabahar) and PJ (Pusa Jwala) were grown under natural and drought stress condition created by different mannitol concentration (100, 150, 200, 250 mM) at the herbal garden of Department of Botany, Maharshi Dayanand University, Rohtak in the season of 2016-2017. Seeds were procured from Indian Agricultural Research Institute, New Delhi. Before sowing seeds were surface sterilized with the sodium hypochlorite and ten numbers of seeds were sown in each earthen pot with three replicates containing mixture of loamy and sandy soil.

Effect on seed germination and germination percentage

Germination percentage was recorded at 15 days after the sowing when radical length reached up to 1mm (Kabir *et al*, 2008) and the germination percentage was calculated by following formula:

Germination percentage= Number of germinated seeds/ Total number of seeds×100

Root and Shoot length

Length of root and shoot was recorded in cm at 30 and 90 days after sowing with the help of meter scale and reading

was taken from both control as well as drought treated plants.

Total plant fresh and dry weight

Plant were uprooted from the soil after 30 and 90 days after sowing for fresh weight (weighing immediately) and dry weight (g) (oven dry for 4-5 days at 80 ^{o}C) measurement. Fresh and dry weight of plant was recorded using electronic weighing balance model number A&D (EK 6001).

Statistical analysis

Origin 9.0 software by origin lab was used for analysing the data and plotting the graphical representation.

RESULTS & DISCUSSION

The graphical representation (Fig-1) showed a decreasing trend in germination percentage. Maximum germination of seed was found under control condition (Hoagland solution without any mannitol concentration) as compared to all mannitol concentration (Hoagland solution with 100mM, 150mM, 200mM and 250mM). Variety PSB showed maximum germination at controlled condition than PJ (97.5% and 96.0%) whereas under 250mM concentration a sharp decrease was noticed (38.4% and 23.3%). Firstly, drought effect germination then establishment (Harris et al., 2002). Nishimura et al., 2011 found germination percentage was greatly reduced under mannitol induced stress in rice genotype. Significant difference was found for root length, shoot length, plant fresh weight and dry weight in both genotypes and different mannitol concentration. Result in graphical representation (Figure 2) showed increasing in root length (cm) in both of genotypes with different application of drought and maximum root length was found in PSB at 250mM whereas, minimum root length was observed in PJ at control environment (19.0 and 4.3 cm). Shoot length (cm) was decreased under different mannitol concentration in both of genotypes (Figure 3). Genotype PSB was found maximum in shoot length whereas, PJ was found minimum at induced mannitol concentration (84.8 and 38.5 cm). Average shoot length under different drought condition ranged from 35.9 to 64.5 cm. Under water stress period cell elongation of plants can be repressed by interlude of water flow from xylem to surrounding elongating cells (Nonami, 1998). Results of this study are in collaboration with previous study of Khan *et al.* (2008); Gaikwad *et al*. (2013); Lakshmi et al (2015); Him *et al.* (2015) finds drought reduced shoot length and increase root length in *Capsicum annum*.

Induced application of mannitol showed a remarkable reduction in shoot fresh (Fig. 4) and dry (Fig. 5) weight both at 30 DAS and 90 DAS. Maximum fresh weight was found in PSB at Controlled condition whereas, minimum fresh weight was observed in PJ at 250mM concentration (24.8 and 5.7 gm). Average fresh weight under different drought condition ranged from 5.4 to 15.5 gm and average fresh weight for genotypes ranged from 14.2 to 9.5 gm whereas, maximum fresh weight observed at 250mM (22.6 gm). Average fresh weight for induced mannitol concentration ranged from 5.4 to 15.5 g and dry weight ranged from 0.76 to 5.6 g whereas, average fresh weight for genotypes ranged from 14.2 to 9.5 and dry weight from 4.6 to 2.1 for PSB and PJ. Significant difference was found for Fresh and dry weight in all genotypes induced concentration of mannitol. Our result is in line with the results of Khan et al., 2001; Zhao et al., 2006; Sharma and Ramawat, 2013 they find the drought condition reduced fresh and dry weight in different plant species. Drought stress condition get increased from 60 to 100 % field capacity in *Trachyspermum ammi L*. fresh weight and dry weight get reduced (Ajhar *et al*., 2011).

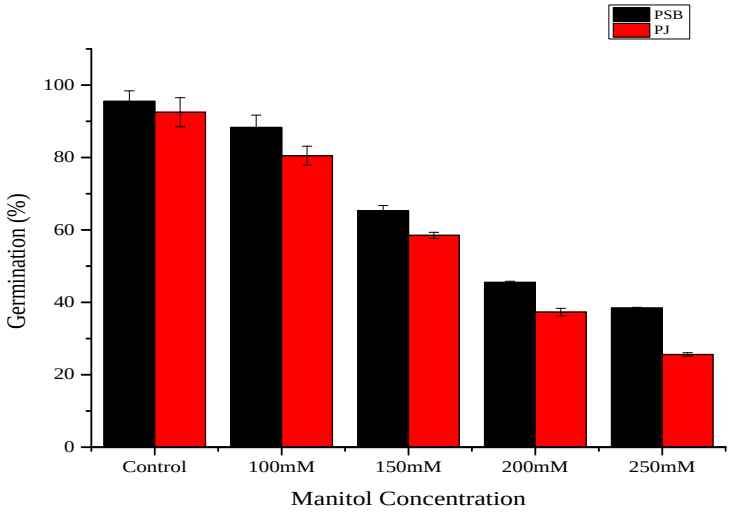

FIGURE 1: Germination percentage of *C. annum* at different concentration of mannitol

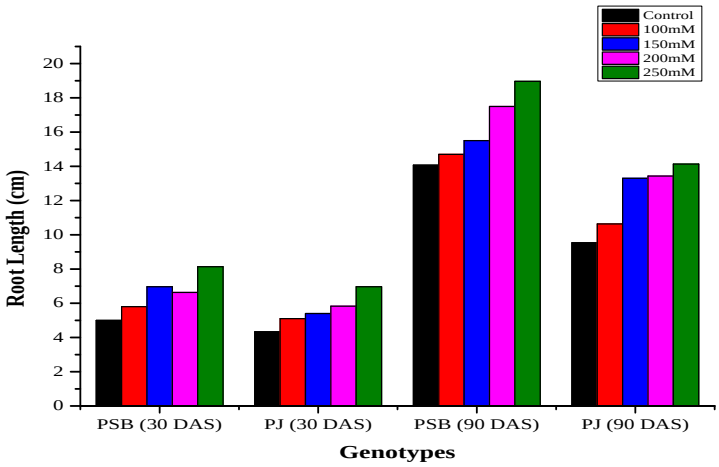

FIGURE 2: Response of chilli genotype under different mannitol concentration for root length (cm) at 30 and 90 days after sowing.

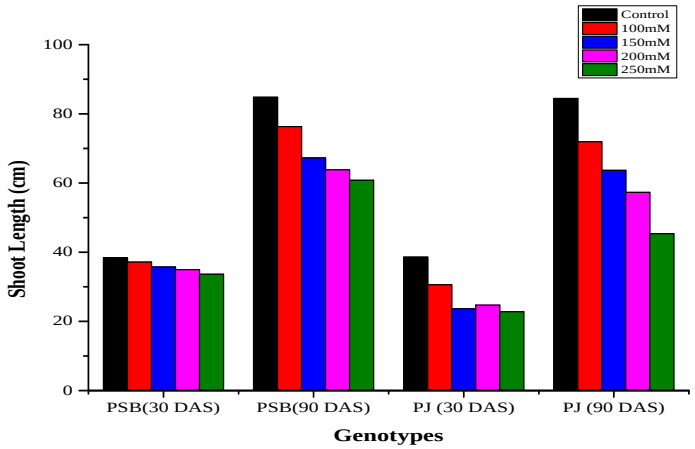

FIGURE 3. Response of chilli genotype under different mannitol concentration for shoot length (cm) at 30 and 90 days after sowing

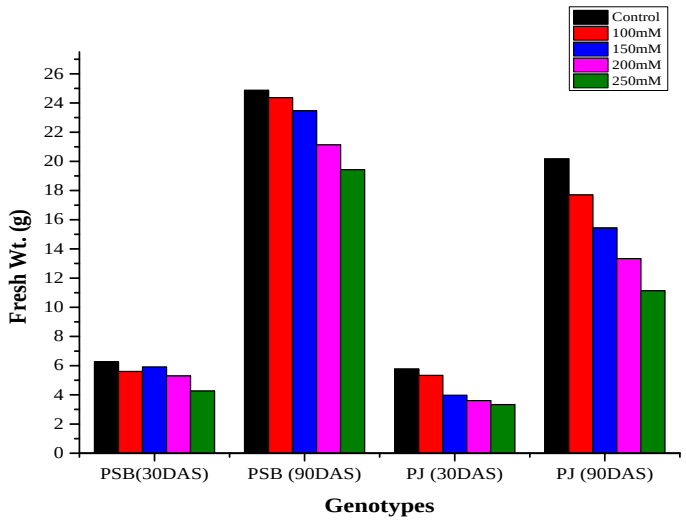

FIGURE 4. Response of chilli genotype under different mannitol concentration for plant fresh weight (g) at 30 and 90 days after sowing

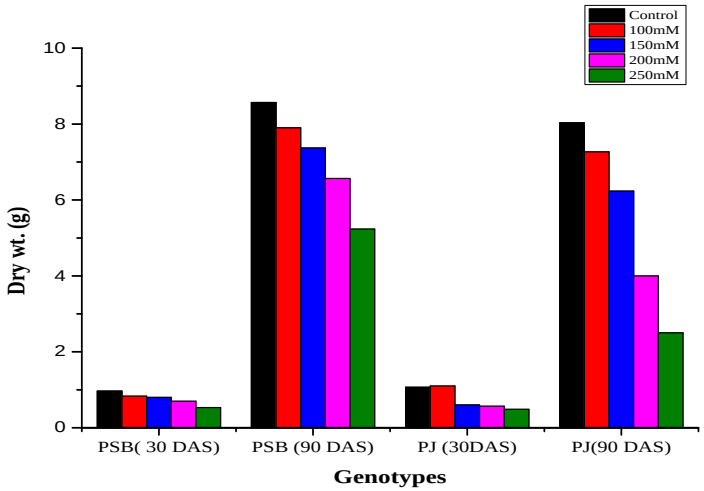

FIGURE 5: Response of chilli genotype under different mannitol concentration for plant dry weight (cm) at 30 and 90 days after sowing.

CONCLUSION

In the sum of stress drought is more pronounced stress from germination to reproductive stage. Mannitol induced drought effects the plant metabolism; that's effects showed on the morphology of plant; in present study induced concentration of mannitol reduced shoot length, fresh and dry weight of plant but a minimal increase in roots length was observed at 30 and 90 days after sowing in both chilli variety. Genotype Pusa Sadabahar (PSB) was found promising under every environment can be used for biochemical and molecular study.

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