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PERFORMANCE OF SORGHUM [*SORGHUM BICOLOR* (L.) MOENCH] UNDER SALT STRESS

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SUMMARY

Present investigation was carried out to evaluate the effect of salt stress on physiological maturity of sorghum genotypes. Tolerance of different genotypes depends on the ability to avoid harmful salt accumulation. It is moderately salt tolerant crop, more than maize and less than barley. Hence, its salt tolerance potential can be exploited for reclamation of saline soils. In order to select best suited dual purpose sorghum genotypes, twenty (SPH 1798, SPH 1858 (SS), SPH 1892, SPH 1893, SPH 1895, SPH 2324, SPH 2458, SPV 2462, SPV 2524, SPV 2525, SPV 2526, SPV 2527, SPV 2530, SPV 2531, CSV 19 SS (C), CSH 24 SS (C), HJ-541, HJ-513, SSG 59-3, HC-308) sorghum genotypes were sown in controlled conditions. Salt levels (8, 10 dS m-1) were maintained by saturating the pots with desired levels of salinity and control pots with canal water. Plant height, no. of leaves, total biomass, total dry weight and grain yield were observed at physiological maturity. Some of the genotypes *viz.* SPH 2324, SPV 2462, SPV 2525, SPV 2526, SPV 2530 and HJ 513 were not able to survive at higher salinity level (10 dS m-1) and couldn't yield significantly. The genotype SPH 2324 even did not survive at 8 dS m-1 of salt stress. Decreasing trend was noticed in plant height, no. of leaves, total biomass, total dry weight and grain yield with increment of salt stress over control. The sorghum genotypes i.e. SPH 1798, SPH 1858 (SS), SPH 1892, SPH 1893, SPH 1895, SPH 2458, SPV 2524, SPV 2527, SPV 2531, CSV 19 SS (C), CSH 24 SS (C), HJ-541, SSG 59-3, HC-308 were found healthier up to physiological maturity at 10 dS m-1 of salt level. Their superior performance was estimated mainly due to the physiological screening tools like high total fresh biomass (g) and total dry weight (g) at physiological maturity. The sorghum genotypes (SPH 1858(SS), SPV 2462, CSH 24SS(C), HJ 541) set seeds at 8 and 10 dS m-1 of salt stress and were found tolerant under salt stress.

Key words : Salt stress, sorghum, physiological maturity, seed yield

Abiotic stresses (*i.e.* salinity) drastically limiting plant growth and productivity (Ahmed *et al.* 2013). Soil salinity may occur due to non-availability of good quality of water for irrigation and high evapo-transpiration or use of saline water for irrigation (Almodares *et al.* 2014). Currently, in India 6.73 million hectare land is affected by salinity and sodicity. In Haryana alone, it is 0.50 million ha area under salinity and still expanding. Now a day, irrigated land in arid and semi-arid regions of the world is degraded by salinity and become incongruous for crop production (Qadir *et al.,* 2014). One of the most effective approaches for salt tolerance is the development of tolerant genotypes. Salt over indulgences in the soil causes physiological drought by reducing the ability of plant to absorb water. This may badly affect the plant growth and development through osmotic disturbance or specific ion effects (Wang *et al*., 2008). All the physiological/biochemical processes gets altered, eminent reactive oxygen species (ROS) and eventually lead to distressed metabolic processes that finally reduces the economic yield of staple food crops (Khan *et al.*, 2014, 2015). But plants adapt different mechanisms to cope up with salt stress.

Sorghum (*Sorghum bicolor*) is one of the leading cereal/fodder crop grown in both rabi and kharif season. It is commonly known as jowari, mainly grown for animal feed, grain and ethanol production (Satpal *et al.* 2015). India contributes 9.45% of the world's sorghum production with 5.82 million ha area and 5.39 million tonnes of total production (Gite *et al.*, 2015). In Haryana, sorghum covers 72,000 ha area with average grain yield of 550 Kg/ha, annual grain production of 40 thousand tonnes (Anonymous, 2016) and 76.7 % area covered under irrigation (Agriculture

Statistics at a Glance, 2015). Because of the paucity in feed and fodder, there is a need to attain the desired levels of production (Rana *et al*. 2013). It is fast growing, wholesome, palatable fodder during lean period and utilizes as silage and hay besides fresh fodder. Urban areas are increasing due to population blast and cultivation area becomes decreasing. So, to triumph over the demand of food fibre and animal feed, we have to use the saline soil. Sorghum is a moderately salt tolerant crop hence there is a need to select the salt tolerant genotypes. Keeping view in mind, present investigation was carried out to screen salt tolerant genotypes for food, fodder and seed production.

MATERIALS AND METHODS

Twenty sorghum genotypes (SPH 1798, SPH 1858 (SS), SPH 1892, SPH 1893, SPH 1895, SPH 2324, SPH 2458, SPV 2462, SPV 2524, SPV 2525, SPV 2526, SPV 2527, SPV 2530, SPV 2531, CSV 19 SS (C), CSH 24 SS (C), HJ-541, HJ-513, SSG 59-3, HC-308) were tested at three salt levels (control, 8 and 10 dS m^{-1}) in factorial Complete Randomized Design (CRD). The experiment was conducted in the screen house of Department of Botany and Plant Physiology, CCS Haryana Agricultural University, Hisar. Salinity levels (8 and 10 dS m^{-1}) were maintained by adding saline water according to its saturation percentage and control pots with canal water. Pots were filled with 12 kg of dune sand (*Typic torrispaments*). Plants were raised with standard recommended agronomic practices. Pots were monitored on daily basis and data was recorded for plant height, no. of leaves/plant, total biomass/plant, total dry weight/plant, grain yield at physiological maturity of the crop. For biomass, only the above ground plant parts were taken into account. Data obtained was analysed using the online OPSTAT software and treatment means were compared at 0.05 % level of significance (Sheoran *et. al.*, 1998).

RESULTS AND DISCUSSIONS

The results of the present analysis revealed that the effect of salt stress was noteworthy for all the parameters studied in sorghum genotypes. To resist Effect of salt stress on plant height (A), no. of leaves (B), was presented in Fig. 1. Whereas Fig. 2. showed the total biomass/plant (A), total dry weight/plant (B) and grain yield (C) of sorghum genotypes at different salt levels. Plant height is positively correlated with the biomass and grain yield. Out of 20 genotypes, only

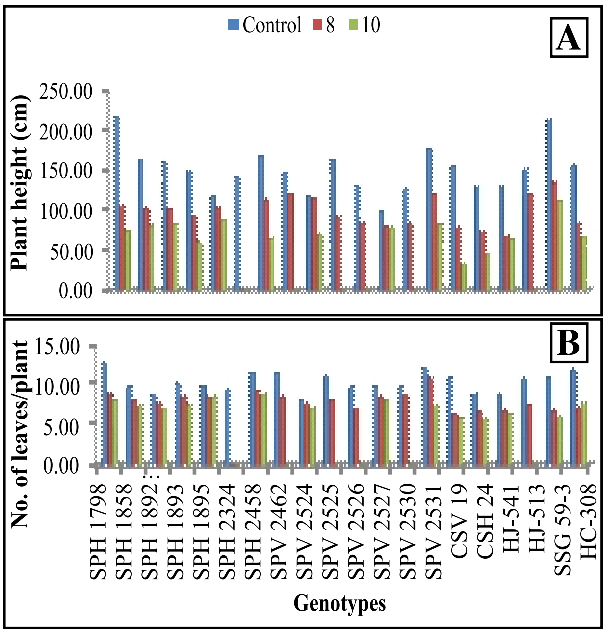


Fig. 1. Effect of salt stress (dS/m) on plant height (A) and no. of leaves (B) of sorghum genotypes at physiological maturity.

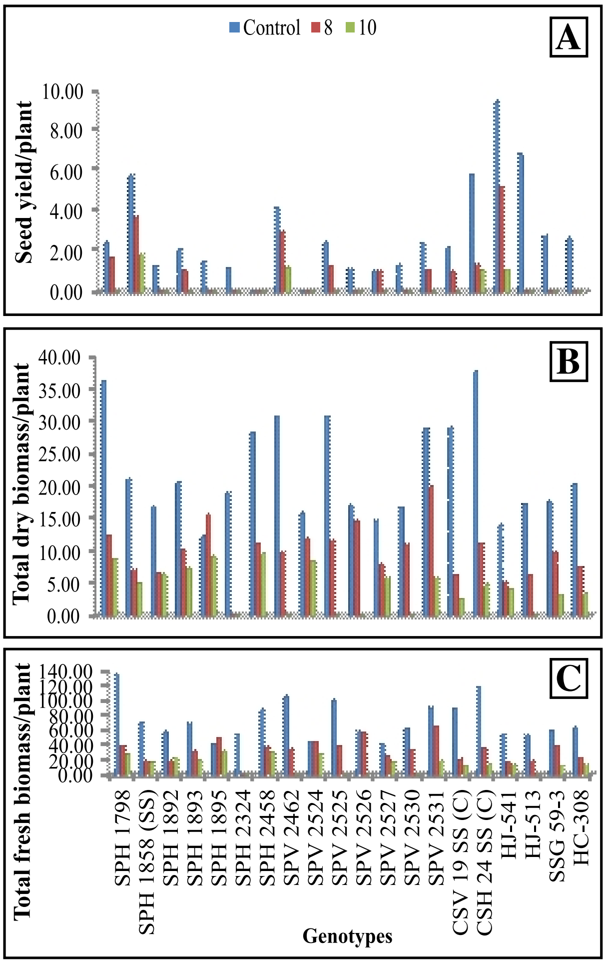


Fig. 2. Effect of salt stress (dS/m) on total biomass/plant (A), total dry weight/plant (B) and Grain yield (C) of sorghum genotypes at physiological maturity

one is exception (SPH 2324) that did not survive even at 8 dS m^{-1} of salt stress whereas, rest of the genotypes survived well. Source sink relationship was found better in four genotypes i.e. SPH 1858 (SS), SPV 2462, CSH 24 SS(C) and HJ 541.

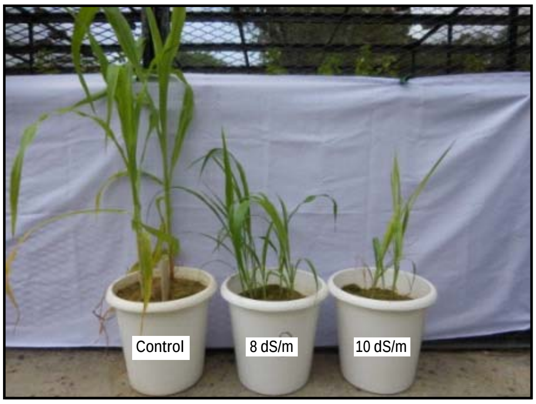
Plant height and no. of leaves per plant displayed a considerable reduction in response to different levels of salt stress. Similar results have been shown by Karlidag *et al*. (2009) and Devi *et al*. (2018). Plant height and the no. of leaves reduced with the increasing levels of salt stress, to the tune of zero at 10 dS m^{-1} of salt stress and lesser at 8 dS m^{-1} of salt stress. Reduction in values was ranged from 7.22 to 3.76 for no. of leaves. HJ-541 gave best yield with 10 numbers of leaves followed by SPV 2459, SPV 2462 and SPH 1798. The best performance with high number of leaves is due to more availability of source that is finally being converted to yield, also with better translocation efficiency.

Total biomass plant^{-1} (g) declined from 71.95 to 14.24 and total dry weight plant^{-1} from 22.16 to 4.21 with increasing salt stress. Our results are also in accord with the Asfaw (2011) and Devi *et al.* (2018) in sorghum. Highest biomass plant^{-1} was found in genotype SPH 1895 (32.0) followed by SPH 2458 (30.6), SPH 2524 (27.9), SPH 1798 (27.4) respectively at 10 dS m^{-1} of salt stress. All genotype except SPH 2324 performed relatively better at 8 dS m^{-1} of salt stress. Toxicity occurs with the imposition of salt stress due to uptake of Na^+ from the soil which leads to change in osmotic potential of the soil and finally cause the reduction in plant height. Jennette *et al.* (2002) and Devi *et al.* (2018) reported the same results in *Phaseolus* species and sorghum genotypes, respectively. Due to accumulation of salts, water potential becomes more negative (-ve) which results in retarded shoot growth, adversely affecting the water status, physiological mechanism and finally yield. Salt stress also affects plant growth and development because of high concentration of salts in the soil solution that interferes balanced absorption of essential nutritional ions by plants (Dadar *et al.* 2014).

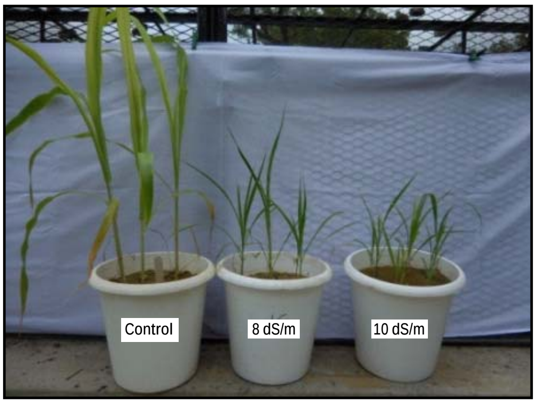
CONCLUSIONS

Based on the results, it can be concluded that at 10 dS m^{-1} of salt stress, only four sorghum genotypes *i.e.* SPH 1895, SPH 2458, SPH 2524 and SPH 1798 performed better and could set seeds. Their better performance was due to higher total biomass, total dry

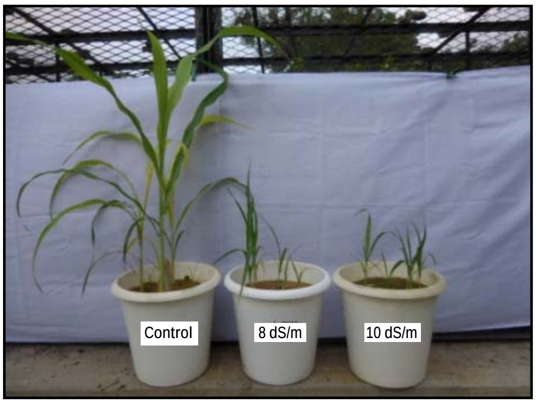
SPH 1858 (SS)



SPV 2462



SPH 24SS (C)



HJ-541

weight and seed yield at physiological maturity. All the genotype except SPH 2324 performed better at 8 dS m^{-1} of salt stress but only ten genotypes could set the seeds *i.e.* SPH 1798, SPH 1858 (SS), SPH 1893, SPV 2462, SPV 2525, SPV 2527, SPV 2531, CSV 19 SS (C), CSH 24 SS (C) and HJ 541.

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