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Evaluation of different sunflower (*Helianthus annuus* L.) genotypes for sodium chloride induced salinity

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Several sunflower genotypes including hybrids, varieties, R-lines, CMS-lines and inbreds were initially screened in the laboratory to select saline tolerant lines. Initially sodium chloride (NaCl) concentrations were standardized and later seven different concentrations (0, 50, 100, 150, 200, 250 and 300 mM NaCl) were considered for the screening. Physiological observation *viz*., germination per cent, total seedling length (cm), per cent reduction in seedling growth over control and seedling vigour index were recorded. Later all the entries were classified as susceptible, moderately tolerant and tolerant lines. CMS-lines performed well even at higher osmotic concentrations. Many of the inbreds and R-lines were susceptible at 100 and 150mM NaCl concentrations. This screening technique can be followed for the initial screening of more number of sunflower genotypes in the laboratory before evaluating them in the field.

Key words : Osmotic potential, Sodium chloride concentration, Sunflower

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INTRODUCTION

Salinity in soil or water is one of the major stresses and, especially in arid and semi-arid regions, can severely limit crop production (Ashraf and Harris, 2004). High salt concentration in the soil solution is bound to create high osmotic pressure in the root zone and reduce availability of water and nutrients to plants. Such conditions are known to affect plant physiological activities which determine the crop yield (Hebbara *et al*., 2003). The deleterious effects of salinity on plant growth are associated with low osmotic potential of soil solution (water stress), nutritional imbalance, specific ion effect (salt stress), or a combination of these factors. Nearly 20 per cent of the world's cultivated area and nearly half of the world's irrigated lands are affected by salinity1. Processes such as seed germination, seedling growth and vigour, vegetative growth, flowering and fruit set are adversely affected by high salt concentration, ultimately causing diminished economic yield and also quality of produce (Zhu, 2001).

Sunflower (*Helianthus annuus* L.) is moderately tolerant to salinity and yield is unaffected by salinities up to 4.8 dS^{-1} m in the saturation soil extract and declines by approximately 5 per cent per unit increase in salinity thereafter (Francois, 1996).

As the evaluation of large number of entries to salinity under field conditions is difficult, an experiment was conducted in the laboratory using Petriplates for initial screening of sunflower entries for salinity with respect to germination per cent, root length, shoot length and total seedling vigour.

RESEARCH METHODOLOGY

The screening was conducted in the laboratory using Petriplates. For standardization, the seeds of two sunflower hybrids (KBSH-44 and KBSH-53, sunflower hybrids released from UAS, Bangalore)) were exposed to different sodium chloride (NaCl) concentrations *viz.*, 50, 75, 100, 125, 150, 175, 200, 250, 300, 350, 400mM NaCl along with control (water). Five ml of respective saline solution was taken in each Petriplate. Counting of germinated seeds was done daily for 6 days in each treatment. The observations indicated that the seeds of KBSH-53 were germinated up to 250 mM NaCl and

KBSH-44 seeds were germinated up to 200 mM. For further screening of all the sunflower entries the treatments were finalized as control (T_1), 50 mM (T_2), 100mM (T_3), 150 mM (T_4), 200 mM (T_5), 250 mM (T_6) and 300 mM NaCl (T_7). Ten seeds were germinated in each petriplate with different treatments in three replications. Solutions were replaced everyday. Daily per cent germination was recorded for NaCl treatments and genotypes. On 6th day after sowing, root length (cm) and shoot length (cm) were recorded. Seedling vigour index was calculated by multiplying germination per cent with total seedling length.

All entries were further classified as susceptible, moderately tolerant and tolerant based on the per cent reduction in seedling growth over control.

Susceptible:

The entries with more reduction in seedling growth over control at 50mM and 100mM NaCl (>70% reduction).

Moderately tolerant:

The entries with less reduction in seedling growth over control at 150mM NaCl (<80% reduction).

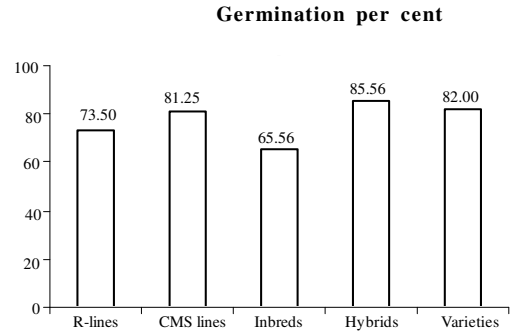
Tolerant:

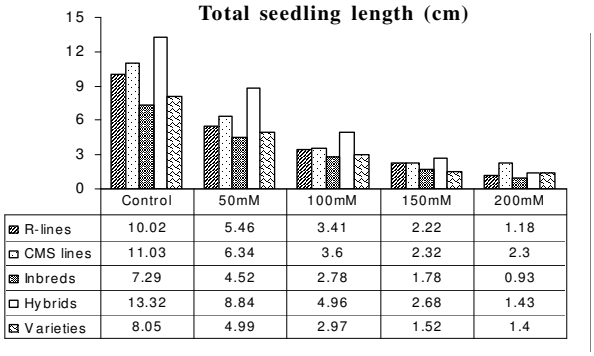
The entries with less reduction in seedling growth over control at 200mM NaCl (<80% reduction)

RESEARCH FINDINGS AND ANALYSIS

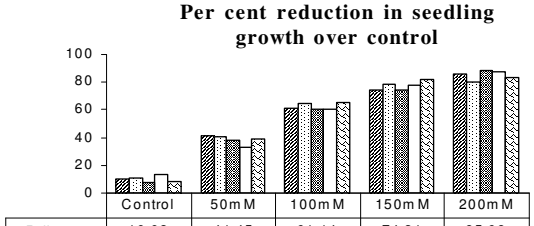
Germination per cent, total seedling length (cm), per cent reduction in seedling growth over control and seedling vigour index of all R-lines, CMS-lines and inbreds are presented in the Fig. 1. Most of the entries tested responded up to 100mM NaCl. Some entries germinated even at 200 mM NaCl but with more reduction in seedling growth compared to control seeds. Based on the mean values for all the measured parameters, hybrids showed more germination percentage (85.56%), more total seedling length and seedling vigour index compared to R-lines and inbreds. All the entries showed more reduction in seedling growth at 200mM NaCl. CMS lines showed less per cent reduction in seedling growth at high osmotic pressure (200mM NaCl) when compared to other entries. Seedling vigour index was more in hybrids even at high NaCl concentration, whereas it was less in R-lines.

Further all the entries were classified as susceptible, moderately tolerant and tolerant lines based on their per cent survivability at different NaCl concentrations (Table 1). According to the classification 8 R-lines, 13 CMS lines and 2 inbreds were completely susceptible to salinity and 9 R-lines, 7 CMS lines and 6 inbreds were moderately tolerant. Two R-

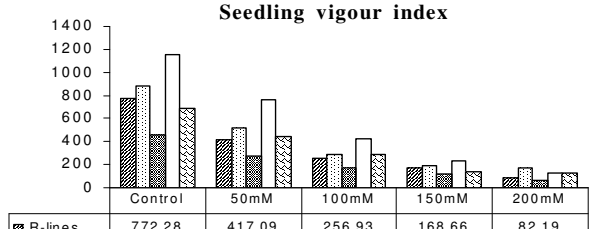




	Control	50mM	100mM	150mM	200mM
R-lines	10.02	5.46	3.41	2.22	1.18
CMS lines	11.03	6.34	3.6	2.32	2.3
Inbreds	7.29	4.52	2.78	1.78	0.93
Hybrids	13.32	8.84	4.96	2.68	1.43
Varieties	8.05	4.99	2.97	1.52	1.4



	Control	50mM	100mM	150mM	200mM
R-lines	10.02	41.45	61.14	74.31	85.68
CMS lines	11.09	40.25	64.45	78.28	80.3
Inbreds	7.29	38.12	60.44	74.26	88.84
Hybrids	13.32	32.81	60.61	77.94	87.26
Varieties	8.05	39.23	65.49	81.96	83.1



	Control	50mM	100mM	150mM	200mM
R-lines	772.28	417.09	256.93	168.66	82.19
CMS lines	885.45	519.74	290.02	188	168.8
Inbreds	450.84	275.2	171.88	113.6	59.41
Hybrids	1152.19	763.08	420.7	229.94	123.85
Varieties	687.08	449.7	283.08	141.4	128.9

Fig. 1: Germination per cent, total seedling length, per cent reduction in seedling growth over control and seedling vigour index in R-lines, CMS lines, inbreds, hybrids and varieties at different NaCl concentrations

Table 1: Classification of sunflower genotypes based on their tolerance level to salinity

Genotypes	Susceptible	Moderately tolerant	Tolerant
R-lines	RHA-6D-1, P-107-RP2, R-348, LTRR-83-273, NDR-4, W-Sel-1-3-2, R-45, RCR-6D-P	R-298, R-278, RHA-17, P-93-R, LTRR-341, R-273, RCR-114, R-64-NB, R-630	R-298, RHA-17
CMS-lines	CMS-89-B, NDCMS-103A, CMS-248A, CMS-207A, CMS-851A, CMS-11B, CoSF-1A, CMS-400B, CMS-302A, CMS-47B, CMS-597A, CMS-135A, CMS-10B	CMS-103A, CMS-10A, CMS-343A, CMS-302B, ARM-246A, CMS-1B, CMS-852B	CMS-336A, CMS-135A, CMS-89A, IMS-400A, CMS-10B, ARM-246A
Inbreds	IB-29, IB-39,	S5-474-4-1, S5-474-1-4, S5-429-4-3, IB-46, HOCL-6, PSN-569	IB-46, HOCL-6
Hybrids	KBSH-41, NDSH-1	DRSF-108, RSFH-130, RSFH-1	KBSH-1, DRSF-108
Varieties	PSFH-118	CoSFV-5, TAS-82, PKVSF-9	PKVSF-9

lines, 6 CMS lines and 2 inbreds were considered as promising entries for salinity. However, the experiment with these entries has to be confirmed further.

The physiological traits used in this experiment help for initial screening of huge number of sunflower genotypes in the laboratory. From this experiment the selected genotypes can further be used to check their performance either by pot culture experiment or in the field condition.

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