

Effect of Different Salts on Seed Germination of *Haloxylon recurvum* (Moq.) Bunge ex Boiss., A Halophyte of Indian Arid Zone

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Abstract : The seeds of *Haloxylon recurvum* were subjected to germination in different salts. The results revealed that highest percentage of germination from fresh and old seeds were in NaCl and CaCl₂, respectively. The percentage of germination decreased linearly with increase in salt concentration. The vigour index and speed of germination from fresh and old seeds were highest in CaCl₂ and MgSO₄, respectively. The highest germination value and T Σ ₄ from fresh and old seeds were in NaCl and MgSO₄, respectively. The fresh seeds exhibited higher values of percentage of germination, vigour index, speed of germination, germination value and T Σ ₄ as compared to old seeds. The fresh seeds showed rapid and progressive seed germination. The seeds of *H. recurvum* lost their viability with the storage.

Key words : Seed germination, salts, inland saline, *Haloxylon recurvum*.

Salt affected soils are a common feature of arid and semi-arid landscapes. Like other hot deserts of the world, a considerable part of the Rajasthan State is also comprised of salt affected lands (Sen and Rajpurohit, 1978, 1982; Sen, 1990).

Seed germination is an important and critical development phase in the life cycle of plants, especially in saline environment, where seed germination ordinarily occurs during the period of high precipitation, when soil salinity is low (Chapman, 1974; McMohan and Ungar, 1978; Ungar, 1978; Sharma and Sen, 1991). In general, plants growing under saline conditions are subjected to three types of stresses : (1) water stress caused by an osmoticum, (2) ion toxicity caused by excess amount of ions, particularly Na⁺ and Cl⁻, and (3) ion imbalance. These factors slow down the water uptake by the germinating seeds, cause a decrease in the turgor pressure of embryo cells and eventually inhibition in germination resulting from the decrease in

water potential (Waisel, 1972). *H. recurvum* has economic importance and is used as "Saaji". In natural conditions, population of plant is very less and survival rate of seedlings is very low. An attempt has been made here to determine the effect of different concentrations of salts on seed germination of *Haloxylon recurvum* (Moq.) Bunge ex Boiss, a halophyte of Indian arid zone.

Materials and Methods

For the present study, the seeds were collected from Jodhpur. Twenty seeds were placed in each petridish containing filter paper moistened with aqueous solutions of 3.9, 7.8, 15.6 and 31.25 mM NaCl, CaCl₂ and MgSO₄. The control set received only distilled water. There were three replicates. Electrical conductivity of each of the test solution was determined by conductivity meter (Table 1). The whole experiment was performed in continuous light (1000 lux) at 29±3°C, which gave better response. Daily observations were taken upto seven days. The following parameters were recorded: percentage of ger-

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Table 1. Electrical conductance ($dS\ m^{-1}$) of different mM concentrations of salts

Salts	3.9 mM	7.8 mM	15.6 mM	31.25 mM
NaCl	1.094 \pm 0.023	1.965 \pm 0.042	3.528 \pm 0.101	6.048 \pm 0.175
CaCl ₂	1.468 \pm 0.129	2.582 \pm 0.055	4.459 \pm 0.031	7.008 \pm 0.067
MgSO ₄	1.393 \pm 0.030	2.366 \pm 0.051	3.733 \pm 0.080	5.597 \pm 0.161

mination (at the end of experiment), VI (vigour index), SP (speed of germination), GV (Germination value), $T\sum 4$ (Timson's index after 4th day). Timson's index is defined as mean daily percentage of germination on a specific day. Timson (1965) proposed an index of germination based on the progressive total of daily cumulative germination to observe rapid seed germination and germination ability also choosing the correct time to end germination. Germination value (GV) was worked out as proposed by Czabator (1962) as an expression of speed and totality of germination, and their interaction, where as, speed of germination or germination rate was calculated as described by Maguire (1962) for evaluation of seedling vigour. Seedling vigour was calculated as described by Abdul-Baki and Anderson (1973). Both fresh and one-year-old seeds were used to find out the effect of storage on seed germination.

Results and discussion

Percentage of germination

Among the different salts, the fresh seeds showed highest germination in NaCl, followed by CaCl₂ and lowest in MgSO₄; where as, old seeds showed highest germination in CaCl₂, followed by MgSO₄ and lowest in NaCl. Under all salts, percentage germination of seeds decreased linearly with increase in salt concentration. The fresh seeds showed higher germination as compared to one-year-old seeds in all salts.

Vigour index

The observations revealed that highest value of vigour index by fresh and old seeds

was recorded in CaCl₂, followed by NaCl and MgSO₄. The values of VI decreased linearly with increase in salt concentrations. The fresh seeds exhibited higher values as compared to one-year-old seeds.

Speed of germination

The fresh seeds showed highest speed of germination in MgSO₄ followed by CaCl₂ and NaCl; where as, old seeds exhibited highest value in CaCl₂, followed by MgSO₄ and NaCl. The speed of germination generally decreased with increase in concentration of salt. The fresh seeds exhibited higher values as compared to old seeds in all salts.

Germination value

Among different salts, the fresh seeds exhibited highest germination value under NaCl, followed by CaCl₂ and MgSO₄; where as, old seeds showed highest in MgSO₄, followed by CaCl₂ and NaCl. The germination value did not show any definite trend. However, fresh seeds exhibited higher values as compared to old seeds in all salts.

Timson's index after 4th day

Among the different salts, the fresh seeds exhibited higher values in NaCl and CaCl₂ as compared to MgSO₄; where as, old seeds exhibited highest value from MgSO₄, followed by CaCl₂ and lowest in NaCl. The fresh seeds exhibited higher values as compared to old seeds.

A very fast germination has already been reported in this species by Sharma and Sen (1991), where they reported that it takes place within 20 to 28 minutes when seeds were

Table 2. Effect of different concentrations of salts (mM) on per cent germination after 7 days of fresh (F) and one-year-old (O) seeds of *H. recurvum* collected from Jodhpur

GP	Control		3.9 mM		7.8 mM		15.6 mM		31.25 mM	
	F	O	F	O	F	O	F	O	F	O
NaCl										
%G	85.0 (7.0)	70.0 (17.3)	95.5 (7.0)	66.6 (15.2)	80.0 (14.1)	65.5 (5.5)	70.0 (14.1)	56.6 (12.9)	65.0 (12.2)	36.6 (5.7)
VI	182.3 (15.5)	149.9 (20.0)	217.9 (21.5)	129.4 (10.3)	153.8 (14.0)	96.3 (7.2)	122.9 (13.5)	82.0 (5.5)	104.1 (0.4)	51.1 (2.5)
SP	23.9 (0.7)	14.4 (0.1)	25.8 (0.1)	13.2 (0.4)	21.9 (1.0)	11.9 (1.2)	24.5 (0.9)	7.5 (0.3)	19.3 (0.4)	7.3 (0.5)
GV	195.0 (18.5)	118.0 (6.4)	565.6 (72.8)	102.1 (7.6)	170.0 (7.6)	57.9 (8.1)	148.1 (12.7)	36.4 (2.4)	121.0 (8.7)	27.8 (2.8)
TΣ ₄	60.0 (28.2)	13.3 (3.2)	75.0 (21.2)	6.6 (2.7)	50.0 (28.2)	16.6 (5.2)	55.0 (7.7)	16.7 (5.7)	50.0 (24.4)	16.7 (1.5)
CaCl₂										
%G	90.0 (14.1)	66.7 (15.2)	90.0 (14.4)	80.0 (17.3)	80.0 (14.1)	73.3 (15.2)	65.0 (5.3)	60.0 (20.0)	60.0 (14.1)	60.0 (10.0)
VI	246.3 (17.2)	182.5 (22.0)	248.4 (28.5)	159.0 (13.5)	161.9 (18.5)	130.1 (12.5)	123.6 (16.2)	92.6 (6.0)	106.9 (12.5)	83.8 (3.2)
SP	32.6 (0.0)	42.2 (1.4)	38.9 (1.7)	33.2 (1.0)	24.9 (1.0)	24.1 (1.3)	20.0 (0.1)	19.3 (0.6)	20.0 (0.3)	16.0 (0.6)
GV	324.8 (18.5)	116.2 (14.1)	242.7 (26.6)	175.6 (15.9)	133.2 (9.1)	127.7 (38.1)	179.9 (25.5)	109.6 (9.2)	135.0 (35.4)	101.4 (9.3)
TΣ ₄	65.0 (7.0)	3.3 (11.5)	75.0 (7.0)	26.6 (5.7)	30.0 (0.0)	23.3 (12.0)	45.0 (15.3)	10.0 (10.0)	60.0 (14.1)	16.7 (5.2)
MgSO₄										
%G	85.0 (7.0)	73.3 (28.8)	80.0 (17.1)	70.0 (4.2)	65.0 (20.3)	63.3 (5.1)	65.0 (4.4)	60.0 (10.0)	55.0 (7.0)	40.0 (16.4)
VI	205.7 (19.5)	148.1 (20.0)	187.8 (16.2)	134.4 (21.5)	123.6 (12.5)	136.3 (15.2)	115.7 (10.2)	116.0 (12.8)	93.5 (0.2)	60.5 (3.5)
SP	43.5 (0.3)	22.4 (0.6)	22.4 (0.2)	21.0 (0.1)	23.3 (0.4)	18.2 (0.9)	19.1 (0.8)	14.5 (0.4)	18.3 (0.7)	11.1 (0.6)
GV	274.8 (65.6)	181.8 (10.8)	203.8 (21.6)	201.3 (26.7)	163.8 (22.6)	139.0 (10.7)	135.9 (6.6)	105.5 (3.1)	75.3 (7.3)	54.7 (4.1)
TΣ ₄	60.0 (0.0)	30.0 (10.0)	65.0 (9.4)	16.6 (5.2)	25.0 (2.0)	33.3 (15.5)	50.0 (6.5)	13.3 (7.0)	45.0 (12.2)	13.3 (5.2)

GP (Index) = Germination parameter.

%G = Percentage of germination.

VI = Vigour index.

SD is given in the parenthesis.

GR or SP = Germination rate or speed of germination.

GV = Germination value (Czabator's).

TΣ₄ = Timson's index after 4th day.

allowed to germinate in petridishes moistened with distilled water. Seed germination studies on some halophytes of arid region were done by Mohammed and Sen (1990), and they observed that seed germination is controlled both by osmotic and ionic factors. The results revealed here that the percentage of germina-

tion decreased with increase in concentration of salts. Among the different salts, the highest percentage of germination was observed in NaCl. One thing is very peculiar that fresh seeds showed higher percentage of germination, vigour index, speed of germination, germination value and TΣ₄, as compared to

one-year-old seeds, as they showed lower viability. It is possible that the seeds of *H. recurvum* lost their viability with the storage. The higher concentrations of salts retard germination because of the osmotic effects. This may be of significance under natural conditions also because seeds that did not germinate under extreme salinity stress may have evolved a mechanism to germinate rapidly when the salt stress is relieved. The reduction in germination was directly related to increased levels of salinity.

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