

## Germination profile of babul (*Acacia Nilotica*) under different salinity conditions

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### Abstract

Babul (*Acacia nilotica*) is an important multipurpose, leguminous tree species, grown widely under agroforestry systems in India, Middle-East Asia, and Africa. It is an important source of fodder, fuel, timber, gum and medicines. The salinity tolerance ability of Babul in 15 provenances (Sagar, Jabalpur, Raipur, Nagpur, Akola, Khandwa, Ujjain, Shajapur, Bhopal, Guna, Jhansi, Bharatpur, Jaipur, Rewari, Karnal) were investigated using petri dishes and poly bags. The solutions of different compound like sodium chloride, sodium bi-carbonate, calcium chloride, magnesium sulphate and calcium sulphate was prepared with five level of salinity concentration, which have electrical conductivity of 3, 6, 9, 12 and 15 dSm<sup>-1</sup>, respectively. Among the five doses of salinity, the highest does EC 15 dSm<sup>-1</sup> was found most deleterious to the seed germination of Babul in all the provenances. Out of 15, ten provenances had more than 50% reduction in germination at EC 9.0 dSm<sup>-1</sup>. Akola, Khandawa, Guna and Jaipur provenances were least affected by the increased level of salinity under both the test i.e., petri dishes and poly bags and hence these provenances may be called as most tolerant to salinity.

### Highlights

Out of 15 provenances Akola, Khandawa, Guna and Jaipur provenances were least affected by the increased level of salinity under petri dishes and poly bags.

**Keywords:** *Acacia nilotica*, babul, provenance, salinity, tolerance

*Acacia nilotica* ssp. indica is considered to be the most common variety and most valued species for timber and fuel. It is one the most important tree species for agroforestry in Central India. It is mostly found on field bund and very important tree for social forestry, afforestation and reclamation of degraded lands in India (Simmons 1981). Keeping in view the importance of *Acacia nilotica* for agroforestry under rainfed and saline soil conditions, and the work on the visual symptoms in salinity conditions (Craig *et al.*, 1990; Bimlendra Kumari 2000), this species was

selected for present study. Further information on the critical limits of salt-tolerance of this species is scanty. Keeping these facts in view, the present investigations have been carried out to study the salinity tolerance ability in geographically diverse population of *Acacia nilotica* ssp. indica.

### Materials and Methods

The Present study was undertaken during 2008 at Tree Improvement Laboratory, National Research Centre for Agroforestry, Jhansi (U.P). Refined seeds

of *Acacia nilotica* were used as study material for this study. The seeds were collected during May-June of year 2003-05 from different districts of Haryana, M.P., U.P., Rajasthan, Chhattisgarh and Maharashtra states. The name of districts, soil conditions, and their longitude, latitude and altitude (above mean sea level) have been given in Table 1.

#### Preparation of Saline solutions

The saline solutions were prepared by using the different amount of NaCl, Na<sub>2</sub>SO<sub>4</sub>, NaHCO<sub>3</sub>, CaCl<sub>2</sub> and MgSO<sub>4</sub> to get electrical conductivity of solution as 3, 6, 9, 12 and 15 dSm<sup>-1</sup> (Table 2). For comparing the saline solution of different concentration one control (OEC solution) was also used. In this way, six level of saline solution was prepared and their real electrical conductivity and pH was observed to know the exempt concentration of solution (Table 3).

#### Application of saline solution

In present study, the seeds were scarified using a sterilized finger nail cutter to remove a minute portion of seed coat of each seed from the cotyledon end (ISTA, 1987; Dantu *et al.*, 1992). For each treatment 10 seeds per replication and a total of three replications were used in present study. Thus, a total of 30 seeds per treatment of each provenance and 180 seeds of each provenance for all the six treatments were used. For 15 provenances a total of 2700 seeds were used. The germination was tested using petri dishes in laboratory as well as poly bags in nursery. Before putting the seed in petri dishes all the scarified seeds were soaked in the solution of different EC (0 to 15) for 24 hours. In case of control the seeds were soaked in distilled water. After soaking the seed in saline

**Table 1. Geographical and soil characteristics of the provenances of *Acacia nilotica***

S.N.	Provenance	State	Latitude (N)	Longitude (E)	Altitude (m)	Soil type
1.	Sagar	M.P.	78° 43'	23° 51'	532	Clay loam, black
2.	Jabalpur	M.P.	79° 56'	23° 10'	394	Loam, Clay loam, black
3.	Raipur	Chhattishgarh	81° 37'	21° 15'	325	Clay loam, black and sandy
4.	Nagpur	Maharashtra	79° 56'	23° 10'	394	Sandy brown and Clay black
5.	Akola	Maharashtra	81° 37'	21° 15'	325	Sandy brown and Clay black
6.	Khandwa	M.P.	79° 05'	21° 09'	304	Grayish and black Clay
7.	Ujjain	M.P.	76° 58'	20° 42'	297	Black Clay loam
8.	Shajapur	M.P.	76° 22'	21° 48'	303	Sandy brown and Clay black
9.	Bhopal	M.P.	77° 24'	23° 15'	545	Clay loam, red and Black
10.	Guna	M.P.	77° 18'	24° 38'	487	Clay loam, Red sandy
11.	Jhansi	U.P.	78° 32'	25° 30'	271	Black and Red sandy
12.	Bharatpur	Rajasthan	75° 47'	27° 07'	432	Sandy loam and fine loam
13.	Jaipur	Rajasthan	77° 29'	27° 13'	175	Sandy loam and fine loam
14.	Rewari	Haryana	76° 34'	28° 53'	224	Sandy loam
15.	Karnal	Haryana	77° 02'	29° 42'	232	Clay loam

**Table 2. Composition and concentration of saline solution**

EC (dSm <sup>-1</sup> )	Compounds	Quantity (mg/lit)	Observed EC and Ph	
			EC (dSm <sup>-1</sup> )	Ph
0	-	-	0.0	7.0
3	NaCl	438.75	3.36	7.1
	NaHCO <sub>3</sub>	405.00		
	CaCl <sub>2</sub>	416.20		
	MgSO <sub>4</sub>	270.00		
	Na <sub>2</sub> SO <sub>4</sub>	213.00		
6	NaCl	877.50	5.92	7.05
	NaHCO <sub>3</sub>	810.00		
	CaCl <sub>2</sub>	832.50		
	MgSO <sub>4</sub>	540.00		
	Na <sub>2</sub> SO <sub>4</sub>	426.00		
9	NaCl	1316.00	8.87	7.2
	NaHCO <sub>3</sub>	1215.00		
	CaCl <sub>2</sub>	1249.00		
	MgSO <sub>4</sub>	810.00		
	Na <sub>2</sub> SO <sub>4</sub>	639.00		
12	NaCl	1755.00	12.33	7.2
	NaHCO <sub>3</sub>	1620.00		
	CaCl <sub>2</sub>	1655.00		
	MgSO <sub>4</sub>	1080.00		
	Na <sub>2</sub> SO <sub>4</sub>	852.00		
15	NaCl	2194.00	13.33	7.1
	NaHCO <sub>3</sub>	2025.00		
	CaCl <sub>2</sub>	2081.00		
	MgSO <sub>4</sub>	1350.00		
	Na <sub>2</sub> SO <sub>4</sub>	1065.00		

**Table 3. Observed EC and pH of the solution**

Expected EC (dSm <sup>-1</sup> )	Observed EC (dSm <sup>-1</sup> )	Observed pH
0	00.00	7.0
3	03.36	7.1
6	05.92	7.05
9	08.87	7.2
12	12.33	7.2
15	13.33	7.1

**Table 4. Effect of different concentration on germination**

Parameters	Concentration of solution (dSm-1)						LSD (0.05)
	0	3	6	9	12	15	
Germination –GP (%)	57.44	52.71	43.77	24.17	18.29	11.37	11.28
Mean Daily Germination-MDG (%)	5.32	4.45	4.98	1.64	1.29	0.57	3.14
No. of days to complete germination-GT	3.53	5.06	4.67	6.48	5.53	5.73	1.21
Peak value of germination-PV	8.87	10.20	7.38	3.58	2.33	0.90	2.32
Germination value-GV	58.95	46.04	45.11	6.72	4.04	0.92	6.89

**Table 5. Concentration of solution on germination**

Prove- nances	Concentration of solution on Germination				
	GP	MDG	GT	PV	GV
Sagar	36.11	3.69	5.00	4.61	29.24
Jabalpur	33.19	3.56	3.00	4.25	21.61
Raipur	23.06	1.07	6.33	2.21	3.64
Nagpur	31.25	3.63	5.17	4.83	21.34
Akola	43.75	4.59	4.00	7.50	48.41
Khandwa	51.64	3.65	5.50	7.83	40.43
Ujjain	39.72	2.54	6.50	8.31	25.87
Shajapur	33.75	2.16	6.50	3.91	12.55
Bhopal	31.94	3.22	4.83	5.46	23.67
Guna	48.31	5.07	4.50	8.75	55.59
Jhansi	16.50	0.96	5.83	5.17	7.17
Bharatpur	35.28	3.13	5.67	6.75	35.89
Jaipur	46.80	4.57	5.00	7.45	62.25
Rewari	25.27	2.21	5.83	3.82	11.18
Karnal	24.17	1.61	3.83	2.27	5.61
LSD (0.05)	8.40	1.20	2.21	2.05	16.68

**Table 6. Effect of different concentration on germination in poly bags**

Parameters	Concentration of solution (dSm-1)						LSD (0.05)
	0	3	6	9	12	15	
Germination-GP (%)	56.22	44.33	34.33	17.33	15.71	13.64	11.58
Mean Daily Germination-MDG (%)	1.03	0.54	0.58	0.26	0.23	0.22	0.60
No. of days to complete germination-GT	10.93	8.33	6.64	7.13	7.00	6.45	2.14
Peak value of germination-PV	1.40	0.60	0.65	0.26	0.39	0.23	0.58
Germination value-GV	1.82	0.41	0.49	0.09	0.07	0.05	0.32

solution, the seeds were placed between two layers of moist germination paper in 15 cm diameter glass petri dishes. The seeds or seedlings in petri dish were watered daily with solutions of respective EC. The germination paper was changed at two days interval to avoid fungal growth on the seeds. All the petri dishes were kept in seed germinator, maintained at temperatures between 28°C to 30°C, till the completion of germination.

Similar experiment was conducted in poly bags to test the effect of salinity on germination and growth of seedlings under field conditions. Poly bags were filled with the sandy and FYM (Farm Yard Manure) in the ratio of 1:1 and saturated with saline solutions

of different levels (same as used in case of petri dishes). Germinant were counted daily at the same time until there was no further germination for two weeks and assessed according to International Seed Testing Association rules (ISTA, 1985). A seed was counted germinated when the radicle protruded 2 mm beyond the seed coat. The different parameters of seed germination like, germination percentage (GP), mean daily germination (MDG), number of days to complete the germination or germination time (GT), peak value of germination (PV) and germination value (GV) were determined. After recording above observation the data was analysed stastical and biometrical tools.

## Results and Discussion

Average effect of salinity treatments on seed germination in petri dishes and poly bags of different provenances of *Acacia nilotica* ssp. indica is presented in Table 4 to 7. The mean germination under all the treatments was 34.67%. Maximum germination of 57.44% was recorded in control and minimum of 11.37 % in 15 EC. Mean daily germination, peak value of germination and germination were minimum in higher salinity as compared to lower salinity. The no. of days to complete germination was maximum with higher salinity than lower salinity. Among different provenances, Akola, Khandwa and Jaipur had higher

**Table 7. Effect of Concentration of solution on Germination in poly bags**

Provenances	Concentration of solution on Germination				
	GP	MDG	GT	PV	GV
Sagar	35.00	0.35	9.50	0.54	0.26
Jabalpur	35.83	0.56	7.50	0.56	0.56
Raipur	25.00	0.33	8.50	0.52	0.26
Nagpur	24.17	0.45	6.00	0.70	0.30
Akola	37.50	0.72	7.00	0.78	1.03
Khandwa	49.17	0.83	7.67	0.99	1.20
Ujjain	22.78	0.27	9.00	0.35	0.11
Shajapur	27.50	0.47	7.17	0.58	0.53
Bhopal	17.78	0.27	6.17	0.29	0.10
Guna	40.56	0.63	7.50	0.67	0.63
Jhansi	13.61	0.11	6.83	0.11	0.02
Bharatpur	25.00	0.29	8.00	0.44	0.23
Jaipur	47.50	0.78	5.83	0.99	1.40
Rewari	15.00	0.31	5.17	0.36	0.24
Karnal	25.83	0.41	4.33	0.41	0.46
LSD(0.05)	9.72	0.17	1.70	0.25	0.32



seed germination in control and with 3 EC (dSm<sup>-1</sup>) as compared higher value of salinity concentration. Similar results were also found in case of poly bags but Akola, Khandwa, Guna and Jaipur performed better than other provenances in respect of different parameters of germination test. The present findings are in conformity with findings made by Bimlendra Kumari (2000) and Bimlendra Kumari *et al.* (2006) on salinity.

### Conclusion

The present study revealed that the highest does EC 15 dSm<sup>-1</sup> was found most deleterious to the seed germination of Babul in all the provenances among the five doses of salinity. Out of 15, ten provenances had more than 50% reduction in germination at EC 9.0 dSm<sup>-1</sup>. Akola, Khandawa, Guna and Jaipur provenances were least affected by the increased level of salinity under both the test i.e., petri dishes and poly bags and hence these provenances are most tolerant to salinity.

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