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Variation in Seed Germination and Seedling Growth of *Acacia nilotica* ssp. *indica* Provenances

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Abstract Variation in gemination of scarified and non-scarified seeds, effect of seed coat dormancy on germination and seedling growth of 21 provenances of Babul (*Acacia nilotica* ssp. *indica*), collected from 11^0 to 31^0N latitude and 19 to 650 m altitude throughout India were studied. There were significant differences among the provenances for germination in non-scarified (16-92%) and scarified seeds (68-100%). Better seedling growth was observed for scarified seeds. The variation were random and did not show relationship with the latitude of the origin seed source.

Key words Babul (*Acacia nilotica* ssp. *indica*), Germplasm, Germination, Dormancy, Seedling

Seed germination is an important determinant for the population of a species (Mehta & Sen 1991). Germination energy and germination capacity are criteria for early selection of fast growing provenances (Khalil 1986) and further the selection of provenances with great dormancy may play an important role in afforestation of wastelands. Therefore, variation in seed germination capacity and seedling growth of *Acacia nilotica* ssp. *indica* within 21 provenances collected from its natural range of distribution in India has been studied and results are reported in this paper.

Materials and Methods

Seeds of *Acacia nilotica* ssp. *indica* were collected from 21 provenances representing the entire natural range, from latitude 11°N to 331°23′N, and altitude from 19 m to 650 m in India (Table 1). For each provenance mature pods from 10 to 16 trees were collected during March-April 1988 from southern India and during May-June 1988 from northern India. Pods were sun dried, and seeds were separated through manual threshing. Each provenance consisted of 2 to 5 kg seed to provide potentially useful genetic variation.

Tests on germination of unscarified and scarified seeds were carried out in the laboratory seeds were surface sterilized with 0.1% $HgCl_2$ and rinsed with distilled water. Seeds were manually scarified following the standard procedures (Magini 1962). For this purpose, 1 mm^2 of seed coat was scarified at the cotyledon end. Three replicate dishes (9 cm diameter) having Whatman filter paper No. 1 of both unscarified and scarified seeds, each containing 25 (total 75 seeds) seeds of a provenance were kept in the incubator at 25 ±2°C. The filter papers were replaced at two days interval to avoid fungal growth on the seeds, at each interval 5 mL distilled water was added to moistened the filter paper. Germination percentage was observed weekly untill 28th day. A seed was considered germinated when the radicle protruded 1 mm beyond the seed coat. Shoot and root length, their dry weight were recorded for total 15 seedlings for each provenances after 28th day. First leaf emergence period was also recorded.

ANOVA was calculated to find out significant differences among provenance (Panse & Sukhatme 1978).

Results and Discussion

For unscarified seeds tested in the incubator, maximum germination was observed in seeds from Jalandhar (92%) followed by those from Patna and Satna (90%), and lesser germination was observed in those from Coimbatore, Medinipur and Ahmadbad (Fig. 1). Seed Germination vigour differed significantly among provenances. Satna, Varanasi and Patna provenances completed 50% seed germination after 7 days, Jalandhar and Behrampur after 14 days, while Hisar and Jaipur after 21 days. Interestingly, the remaining provenance did

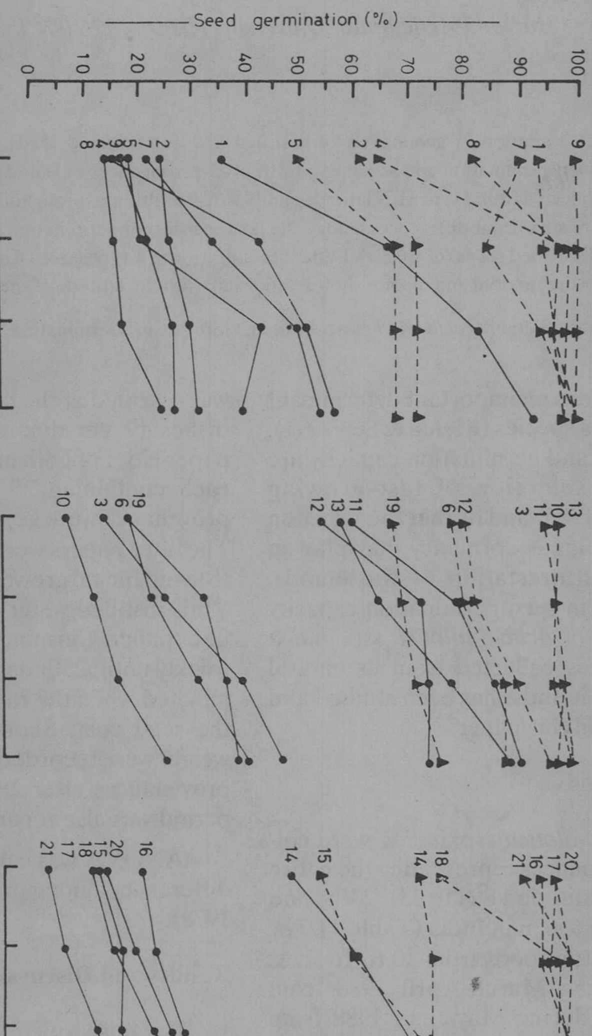

Fig 1 Germination percentage and vigour of non-scarified and scarified seeds of *Acacia nilotica* spp. *indica* in the incubator.

not show germination up to 50% even after 28 days (Fig. 1). Secarified seeds showed quicker and significantly ($P<0.05$) greater seed germination in comparison to unscraified seeds. Seed germination percentage in them was above 60% and 100% in most of the provenances (Fig. 1).

No specific trend could be observed for seed gremination percentage among provenances with respect to latitude.

Greatest seedling growth of unscarified seeds after 28 days of sowing in the incubator occurred in Aurangabad (shoot length 8.5 cm) while it was the least in Chandigarh (shoot length 5.2 cm). Root length values also varied significantly ($P<0.05$) among provenances. It ranged from 1.6 cm in Chandigrah to 6.9 cm in Roorkee provenances (Table 1)

Positive significant correlation was observed between root and shoot lengths ($r=0.434, P<0.05$). The scarified seed showed significantly greater ($P<0.05$) seedling growth. In scarified seeds, the greatest seedling growth was observed in Dharwad (10.2 cm) and least in Chandigarh (5.3 cm). The root length varied from 3.0 cm in Gurgaon to 10 cm in Roorkee provenance (Table 1). Positive significant correlation was observed between root and shoot lengths ($r = 0.448, P<0.05$).

The period of first leaf emergence varied significantly among provenances. It was 10 to 12 days in Dharwad, Stana, Roorkee, Anantapur, Patna and Aurangabad provenances, while 14 to 16 days in remaining provenances. The period of emergence of first leaf was significantly ($P<0.05$) longer in unscarified seeds as compared to scarified seeds. In both unscarified and scarified seeds, the seedling

Table 1 *Seedling growth, dry weight and period of first leaf emergence of different provenances of Acacia nilotica spp. indica in unscarified (A) and scarified (B) seeds (n=15)*

Provenance	Shoot length (cm)		Root length (cm)		Dry weight (mg plant^{-1})		Leaf emergence (day)	
	A	B	A	B	A	B	A	B
Jalandhar	6.7±1.10	6.9±0.54	4.0±0.34	4.7±0.56	69.0±3.52	74.0±3.31	0	13
Chandigarh	5.1±0.98	5.3±0.88	1.6±0.15	3.3±0.33	60.0±2.90	63.0±2.71	0	14
Roorkee	7.3±0.49	9.0±0.98	6.9±0.51	10.0±1.20	68.0±2.10	110.0±3.00	10	10
Hisar	7.3±0.40	7.7±0.92	4.4±0.42	5.1±0.78	86.0±4.20	88.0±4.22	16	13
Gurgan	5.6±0.98	6.9±0.40	2.5±0.17	3.0±0.31	65.0±3.11	76.0±3.00	0	16
Jodhpur	7.1±0.90	8.1±0.25	4.6±0.70	6.3±0.81	77.0±2.31	96.0±2.85	15	13
Jaipur	6.1±0.42	7.8±0.52	4.1±0.52	5.1±0.61	70.0±2.17	91.0±2.35	15	12
Ahmedabad	6.9±0.27	8.3±0.65	4.7±0.37	5.8±0.51	74.0±3.81	98.0±4.13	15	12
Banaskantha	6.1±0.42	7.8±0.52	4.1±0.60	5.1±0.42	70.0±3.56	91.0±3.81	15	13
Bhopal	7.1±0.15	7.8±0.72	5.9±0.44	7.0±0.90	82.0±3.00	89.0±3.15	16	12
Satna	7.8±0.28	9.0±0.49	5.9±0.80	6.3±0.85	95.0±2.75	113.0±3.10	10	10
Varanasi	8.3±0.28	9.0±0.84	5.3±0.51	6.1±0.66	101.0±2.56	107.0±2.60	12	11
Patna	8.1±0.20	8.7±0.55	3.8±0.35	4.6±0.46	98.0±2.00	109.0±2.13	12	10
Behrampur	6.9±0.49	8.9±0.27	3.7±0.40	5.1±0.60	90.0±2.23	95.0±2.95	14	12
Medinipur	7.3±0.85	8.1±0.46	2.1±0.19	3.2±0.26	78.0±3.15	93.0±2.51	15	12
Akola	8.0±0.17	8.7±0.96	3.0±0.21	5.5±0.68	100.0±3.40	106.0±3.91	13	12
Aurangabad	8.5±0.48	9.3±0.72	4.8±0.57	6.0±0.79	110.0±2.96	116.0±3.00	11	10
Hyderabad	6.7±0.78	7.6±1.10	3.9±0.30	5.0±0.34	73.0±3.50	87.0±4.21	16	12
Anantapur	7.5±0.45	8.9±0.41	4.2±0.52	5.6±0.62	78.0±2.11	96.0±2.76	12	12
Dharwad	7.5±0.33	10.2±0.35	5.0±0.42	6.2±0.87	87.0±2.81	119.0±3.67	10	10
Coimbatore	5.6±1.20	7.5±0.36	3.4±0.39	3.9±0.40	63.0±3.63	85.0±2.58	0	13
CD at 5% Level	1.56	2.25	2.20	2.81	8.50	6.30	–	–

dry weights after 28 days in the incubator also varied widely (Table 1).

Seeds of *Acacia nilotica* ssp. *indica* collected from 21 provenances showed large and random variation in germination and juvenile growth, and had no significant correlation with the latitude of the origin seed source. Mathur *et al.* (1984) also reported variation (14 to 61%) in seed germination among provenances collected from a restricted area in India. In *Acacia mangium* duration and rate of seed germination also varied among provenances (Salazar 1989).

Large random variations among provenances were due to the parent tree genotypes. While we try to relate the genetic diversity in *A. nilotica* with its reproductive biology, very little is known on this aspect of *Acacia* group (Ross 1979, Arroyo 1981). However, the study by Tybirk (1989) on pollination and seed production of *A. nilotica* in Kenya, reports that this species is bee pollinated. Out crossing is also confirmed due to the fact that full hermaphrodite floweres are at the top of the inflorescence, the most suitable position for pollination. High variability in *A. nilotica* as observed in the present study is also explained in terms of greater number of seeds produced per year.

Dormancy of seeds also cause variation in seed germination and seedling growth. Dormancy was mainly caused by impermeability of hard seed coat as in most of the provenances seeds after scarification showed 100% germination. Earlier Harper (1977) and Doran & Gunn (1986) also reported hard seed coat dormancy in *Acacia* spp. Another study in *A. raddina* and *A. tortilis* (Mahmoud *et al.* 1984) also found seed coat dormancy effects on germination behaviour.

The environmental conditions experienced by the parent plant during the seed development influence the dormancy in seeds (Fenner 1985). The differences in dormancy behaviour can usually be interpreted as an adaptation for staggering or delaying germination until the onset of favourable season, hence this character may be useful for the selection of provenance for wasteland development particularly in situations where seed broadcasting method is followed for afforestation.

The variability in *A. nilotica* ssp. *indica* as observed in the present study is of great significance in breeding work. This may be helpful in selection of fast growing provenances.

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