

Studies on Source Variation in *Azadirachta indica* A. Juss.

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Azadirachta indica belongs to the family Meliaceae and is indigenous to India. It is a medium sized evergreen tree with irregular rounded crown and well suited for afforestation in dry situation and a common avenue tree. It is a valuable source of medicinal substances. Almost all parts of the tree are used for medicine. Seed yields deep yellowish oil used as an antiseptic and for preparing toothpaste and in soap making. It is also tolerant to sulfur-di-oxide. It acts as an indicator of dust and smoke pollutants. It releases more oxygen and act as air purifier. The value of this species is quite high with respect to environmental preservation as well as in Ayurveda and other medicinal field [1]. Therefore, there is an urgent need to investigate available genetic resources and select the superior seed sources for adaptability, disease resistance and better productivity.

The seeds of *A. indica* were collected from fourteen seed sources in southern and western part of Haryana in the month of July 2001 under the National Oilseed and Vegetable Oil Development (NOVOD) Board funded project. This board is a nodal organization for exploiting existing potential and augmenting the future potential of Tree Borne Oilseed (TBOs) in India. Ten representative trees of different size were measured for different morphological characters and the same number of trees were selected for seed collection [2]. Mostly trees are situated along roadsides. There is no problem to collect the seed from the homestead owners as well as Farmer's field. The crown development is dominant and stem is mainly straight. The trees were healthy and unbrowsed at the time of seed collection. Seed length and seed

width was measured for each source. For determination of seed weight, eight random samples of 100 seed were measured to nearest two decimal points and expressed as the 1000-seed weight. Seeds were germinated in a temperature-controlled cabinet maintained at 30°C, on top of a moist blotting paper using four replications of 100 seeds each. Seeds were considered germinated when the radicle had emerged about 1cm through the coat. On 21st day of the experiment, seedlings were measured for root and shoot length. The root and shoot length was recorded separately using a scale as per the procedure prescribed by International Seed Testing Association [3]. The germination percentage values were transformed into arc sine value prior to statistical analysis and the mean value of the experiment were compared using Duncan's Multiple Range Tests [4].

The geographical range of these sources was 27°42' to 29°90' N latitude and 76°08' to 77°23'E longitude. The altitude varied from 166 to 212m above sea level. Significant variations were observed on morphological features of the tree, seed, germination and seedlings characteristics of *A. indica*. The tree girth varied from 83.97cm (Bhiwani) to 178.55cm (Rewari). Tree height varied from 10.55m (Sirsa) to 15.65m (Rohtak). The maximum tree crown (150.21m²) was recorded in Sirsa and minimum (79.70m²) in Hissar population. Seed length, width, thickness and weight also varied widely among sources. Seed length varied from 12.08mm (Jhajjar) to 14.44mm (Hodal). Seed width varied from 5.95mm (Sohna) to 7.80mm (Hodal). The highest seed weight (160.73g/1000 seeds) was recorded in Hodal and the least

(130.10g/1000seed) in Jhajjar population (Table 1). Seed lot (AI-4) showed the highest germination percentage (95.70%) while, seed lot (AI-11) has the least germination percentage (80.60%). Seed lots (AI-2, AI-4, AI-6 and AI-12) showed maximum and same bar of significance. However, seed lots (AI-4 and AI-6) also showed the highest value of vigour (2303 and 2306) respectively. It also revealed from the results that seed lots (AI-4 and AI-6) have the little difference in vigour index and has the same bar of significance also, meanwhile, seed lot (AI-6) showed the highest dry matter production (96mg/seedling) followed by seed lot (AI-12). While, seed lot (AI-5) showed the minimum value of dry matter production. The maximum length of root also recorded in seed lot (AI-6) (Table 2). Seed lots (AI-6 and AI-8) have least number of abnormal seedlings, while seed lot (AI-10) has the maximum number of abnormal seedlings. Seed lot (AI-6) has only one decayed seedling. Damaged and deformed

seedlings had not been recorded. Thus seed lot (AI-6) showed the highest number of normal seedlings during the course of study.

Geographic variation also influences seed size as the relation between drier site with higher seed weight and wetter site with low seed weight has been emphasized [5]. Seed size and weight are the important characters for improving seedling production and reducing nursery costs through selection of quality seed apart from selecting and delineating sources [6]. Improvement in germination through seed size manipulation has also been reported [7]. However, magnitude of improvement in germination through seed size manipulation depends upon the amount of genetic variability and heritability of the traits [8].

Seed size may vary due to both internal (hereditary) and external (environmental) conditions operating at the time of seed

Table 1. Description of seed sources of *Azadirachta indica*

Seed source no.	Seed source name	Lat. (°N)	Long. (°E)	Alt. (m)	Girth (cm)•	Height (cm)•	Crown area (m ²)•	Seed length (mm)•	Seed width (mm)•	Seed weight (g)•
01/AI/BHI/HR	Bhiwani	28.48	76.08	176	83.97	10.88	96.89	12.99	6.50	145.70
02/AI/FAR/HR	Faridabad	28.26	77.11	209	123.20	14.50	107.21	13.86	7.54	155.95
03/AI/FAT/HR	Fatehabad	28.41	76.46	198	130.22	12.25	87.85	13.33	6.39	147.85
04/AI/GUR/HR	Gurgaon	28.27	77.04	204	152.55	10.73	127.25	14.29	7.59	158.62
05/AI/HIS/HR	Hissar	29.10	77.23	186	102.87	12.80	79.70	13.53	7.30	146.84
06/AI/HOD/HR	Hodal	27.42	76.52	183	171.50	11.90	99.67	14.44	7.80	160.73
07/AI/JHA/HR	Jhajjar	28.37	76.36	207	103.40	11.25	108.35	12.08	6.93	130.10
08/AI/MAH/HR	Mahendragarh	28.14	76.09	198	177.84	11.68	126.20	13.60	7.44	148.17
09/AI/NAR/HR	Narnaul	28.03	76.14	166	157.21	13.40	107.38	12.54	6.42	143.92
10/AI/PAL/HR	Palwal	28.09	77.20	203	122.50	11.58	106.49	13.05	6.99	137.54
11/AI/REW/HR	Rewari	28.12	76.40	184	178.55	14.50	141.18	12.23	6.71	138.22
12/AI/ROH/HR	Rohtak	29.90	76.60	178	158.00	15.65	132.60	13.62	7.49	153.65
13/AI/SIR/HR	Sirsa	29.31	76.26	198	160.81	10.55	150.21	13.10	6.29	143.92
14/AI/SOH/HR	Sohna	28.29	77.14	212	138.30	13.50	127.80	12.85	5.95	141.77

•Mean value of the character

Table 2. Germination per cent and seedling characteristics of *Azadirachta indica*

Seed lot no.	Germination (%)	Days taken for seedling emergence	Root length (cm)	Shoot length (cm)	Dry matter production (mg/seedling)	Vigour Index
AI-1	90.80(72.38) ^b	8.00 ^b	8.5 ^{ab}	12.36 ^a	79 ^c	1894 ^c
AI-2	94.50(77.36) ^a	7.20 ^a	8.9 ^a	15.10 ^a	92 ^a	2069 ^a
AI-3	87.0(69.80) ^c	9.00 ^b	7.9 ^c	14.20 ^b	82 ^b	1922 ^b
AI-4	95.70(81.78) ^a	7.70 ^a	9.3 ^a	14.77 ^b	94 ^a	2303 ^a
AI-5	92.00(76.89) ^b	8.00 ^b	8.6 ^{ab}	13.25 ^b	77 ^c	2010 ^b
AI-6	93.00(79.69) ^a	7.00 ^a	9.6 ^a	15.20 ^a	96 ^a	2306 ^a
AI-7	89.20(68.73) ^c	9.00 ^b	8.5 ^b	14.00 ^b	87 ^{ab}	2007 ^b
AI-8	90.00(74.88) ^b	7.30 ^a	9.3 ^a	13.20 ^b	90 ^a	2025 ^a
AI-9	87.60(69.39) ^c	8.70 ^b	7.6 ^c	14.69 ^b	87 ^{ab}	1952 ^b
AI-10	83.70(62.14) ^c	8.20 ^b	9.3 ^a	13.80 ^b	82 ^b	1933 ^b
AI-11	80.60(61.84) ^d	8.80 ^b	8.3 ^b	13.32 ^b	79 ^c	1742 ^c
AI-12	94.00(77.13) ^a	7.00 ^a	8.3 ^b	13.50 ^b	91 ^a	2049 ^a
AI-13	85.30(65.88) ^c	9.30 ^c	7.9 ^c	12.87 ^c	78 ^c	1771 ^c
AI-14	92.80(75.91) ^b	8.10 ^b	8.3 ^b	12.22 ^c	82 ^b	1904 ^b

(Figures in parentheses represent Arc sine transformation; means followed by same letter in column are not significantly different at 0.05 level by DMRT)

development [9]. Seed source variation in seed and seedling traits have been studied in several tree species under controlled conditions and the phenotypic values have been assumed to be closer to genotypic values on the basis of environmental deviation being negligible. But environmental factors also play a role in changing the component of the seed size as the species grow in a wide range of ecological conditions and, hence population can be expected to experience markedly selective pressure on seed characteristics [10].

Seed of different localities were collected from trees of approximately the same age. Therefore, the variation observed in the seed and seedling in controlled laboratory conditions may be attributed to environmental as well as edaphic factors. Similar observations in relation to habitat have also been

reported in *Acacia nilotica* [11], *Dalbergia sissoo* [12], *Acacia catechu* [13] and *Eucalyptus dunnii* [14]. On the basis of vigour index, dry matter production, root length and seedling evaluation the seed lot (AI-6, Hodal) showed the best performance in controlled conditions. High vigour seed selection should therefore produce more uniform, vigorous stand of plant with ultimately higher yield.

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