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VARIATIONS STUDIES IN GROWTH PERFORMANCE OF NEEM (*AZADIRACHTA INDICA* A. JUSS) PROGENIES IN THE NURSERY

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ABSTRACT
The present work was to assess the variation in neem progenies and their adaptation to different eco climatic regions of southern parts of country. The results of the nursery experiments revealed that three progenies *viz*., NPT 20, NPT 10 and NPT 28 significantly higher collar diameter shoot length, fresh weight, dry weight and leaf area. Hence the integration of these progenies in the tree improvement programme would result in better field performance for higher seed production.

KEYWORDS: Neem, Progeny, Leaf Area, Improvement.

INTRODUCTION

Neem is an important multipurpose tree in nature, wildly distributed in Indian subcontinents; it is well recognized as the main ingredients in different industrial and pharmaceutical uses globally (Abutaba *et al.*, 2014). Neem is such a versatile resource that can be used as traditional medicine in rural area. Creating large scale plantation and as a consequence related to industry based raw material can be established in these area thus tree can contribute to rural development and economic welfare of rural people (Schmutterer, 1995; Kumar and Mishra, 2007). Neem is propagated mainly through seeds. Four to six months old seedlings are ready to plant in the field. Fruiting begins in 4-5 years. In India neem flowers from March to May and fruits mature from June to August. Seed viability generally ranges from 2-3 weeks after collection; the presence of unsaturated free fatty acids (Oleic acid, 51.3%) in neem oil could be responsible for the quick loss of viability (Chaney and Knudson, 1988). Whether neem is a genuine recalcitrant or short lived orthodox species, however is still nebulous. On the basis of low moisture content of seeds (12.5%), it has been argued that neem is not a recalcitrant species. Again since neem occurs in dry tropical forests, while most recalcitrant tropical species are found in moist tropical forests in Sudan, it was suggested that neem may have short-lived orthodox seed, after extraction of seeds are immediately sown under nursery (Willam, 1985; Devendra, 2015).

The real differences in growth attributes that can relate to the variation in the progenies or to adaptation of same genotypes to the various ecosystems where it grows. Neem plantations can be established in the right place to insure good growth rates, satisfactory production within the thought rotation and accordingly full industrial, pharmaceutical and other uses can be planned concurrently. It is well established that many tree species with a range of geographical diversity exhibit physiological, morphological, biochemical and genetic variations as an adaptation to varying environmental conditions (Knothe, 2005). Therefore the objective of this study was to examine the seedlings growth performance of progenies of *Azadirachta indica* collected from thirty four plus trees from southern parts of India.

MATERIALS AND METHODS

Neem seeds were collected from 34 identified plus trees from southern parts of Tamil Nadu and karnataka during August 2017 (Table 1). Physiologically matured green fruits were collected and extracted quality seeds. The seeds were directly sown in polybags (15 x 25 cm size) filled with mixture of red soil, sand and FYM (2:1:1). This study was conducted in the Neem Nursery, Department of Forest Biology and Tree Improvement, Forest College and Research Institute, Mettupalayam using Completely Randoomized Design with five replications.

The observations were taken 45 days after sowing (DAS) of seeds. The variation in the growth attributes like collar diameter (mm), plant height (cm), number of leaves and leaf area (cm^2) was measured using a graphical method. From each sample three leaves were randomly taken from the upper, middle and lower part of the seedling for leaf area measurement. Destructive sampling was adopted to measure the root length, shoot length, fresh weight and dry weight. Fresh weight was carried out using the displacement method as described by Mitchell (1977). Oven dry weight was determined by drying at 80 $\pm 1^{\circ}C$ for 48 hours. Analysis of variation was analyzed using SPSS statistical package 'version 2000'. Duncan Multiple Range Test (DMRT) was performed at 5% significance level in variations among progenies.

TABLE 1. Morphological characters of identified plus trees of neem

S.No.	Plus Trees	Tree morphology			
		Tree Height (m)	DBH (cm)	Canopy Height (m)	Canopy Width (m)
1.	NPT 1	7.00	62.00	5.30	5.20
2.	NPT 2	9.00	67.50	6.50	8.50
3.	NPT 3	7.50	65.00	5.00	7.00
4.	NPT 4	13.00	127.00	9.00	10.50
5.	NPT 5	14.50	175.00	11.50	13.00
6.	NPT 6	11.00	97.00	9.00	12.00
7.	NPT 7	9.50	104.00	7.50	7.00
8.	NPT 8	9.00	88.00	6.50	6.00
9.	NPT 9	8.50	70.50	6.00	8.50
10.	NPT 10	11.00	104.00	8.50	10.50
11.	NPT 11	12.00	86.50	7.30	7.00
12.	NPT 12	8.30	80.00	5.60	6.00
13.	NPT 13	12.50	115.00	8.00	14.00
14.	NPT 14	10.00	105.00	6.00	8.00
15.	NPT 15	13.00	95.00	7.00	8.00
16.	NPT 16	12.50	95.00	9.80	10.80
17.	NPT 17	9.00	74.00	6.30	7.50
18.	NPT 18	11.50	95.00	8.00	14.00
19.	NPT 19	8.00	78.50	4.00	5.50
20.	NPT 20	10.50	73.00	6.00	5.00
21.	NPT 21	8.00	68.50	4.50	5.00
22.	NPT 22	14.00	112.00	10.50	12.00
23.	NPT 23	8.00	79.50	4.50	8.00
24.	NPT 24	11.00	109.00	8.00	11.00
25.	NPT 25	13.00	94.50	10.00	12.00
26.	NPT 26	7.00	61.00	4.00	5.00
27.	NPT 27	16.00	135.00	13.00	14.50
28.	NPT 28	11.00	98.50	8.00	7.50
29.	NPT 29	9.50	122.50	6.50	5.00
30.	NPT 30	9.50	105.50	7.00	11.00
31.	NPT 31	8.00	83.00	6.00	6.50
32.	NPT 32	8.50	91.50	6.50	10.50
33.	NPT 33	5.50	69.50	3.00	7.50
34.	NPT 34	14.50	136.50	11.50	18.50

RESULTS

Analysis of variance showed very high significant ($p < 0.001$) differences among the progenies for shoot length, fresh weight and leaf area. The analysis revealed significant ($p < 0.05$) differences between the progenies in collar diameter and dry weight traits (Table 2). There were no significant differences among progenies for root length, root shoot ratio and plant fresh and dry weight.

TABLE 2. ANOVA on seedlings growth characteristics (neem) *Azadirachta indica* progenies from different location in South India

Characters	Df	SS	MSS	F value	Sig
Collar diameter (mm)	33	7.62	0.24	0.44*	0.88
Shoot length (cm)	33	533.78	17.21	4.36**	0.21
Root length (cm)	33	93.76	3.04	0.58^{ns}	0.82
Root shoot ratio	33	0.13	0.01	0.18^{ns}	0.99
Fresh weight (g)	33	247.92	7.99	7.62**	0.12
Dry weight (g)	33	56.76	1.83	1.41*	0.51
Fresh and Dry weight ratio	33	6.78	0.22	0.24^{ns}	0.97
No of leaves	33	63.51	2.05	0.63^{ns}	0.78
Leaf area (m^2)	33	276.71	13.35	10.34**	0.05

* 0.05% Significant level ** 0.01% Significant level

The growth performances of 34 progenies at 45 DAS under nursery evaluation are present in the table 3. The collar diameters of seedlings varied significantly among the progeny. NPT 20 progenies recorded the highest collar diameter (2.80 mm) and followed by NPT 10 (2.74 mm), NPT 28 (2.40 mm) and NPT 2 (2.21 mm). Two progenies viz., NPT 24 (0.85 mm) and NPT 33 (0.83 mm) are least performing compared with general mean (1.47 mm).

Shoot length was ranged from 8.00 cm (NPT 24) to 24.67 cm (NPT 20). Seven progenies *viz*., NPT 20 (24.67 cm), NPT 10 (22.67 cm), NPT 28 (21.50 cm), NPT 13 (20.50 cm), NPT 9 (18.17 cm), NPT 5 (18.00 cm) and NPT 14 (17.33 cm) were documented significantly superior among

thirty for progenies and lowest growth was documented in NPT 25 (9.00 cm) and NPT 24 (8.00 cm) at nursery conditions.

Root length of 34 progenies at 45 DAS recorded a range from NPT 32 (5.00 cm) to NPT 20 (12.50 cm). The general mean was 7.24 cm. The highest root shoot ratio was observed in NPT 1 (0.68) followed by NPT 24 (0.63) and NPT 27 (0.62).

TABLE 3: Variations in seedlings growth characteristics of *Azadirachta indica* progenies

Plus Tree	Collar diameter (mm)	Shoot length (cm)	Root length (cm)	Root shoot ratio	Fresh weight (g)	Dry weight (g)	F:D	No of leaves	Leaf area (m^2)
NPT 1	2.17*	12.50	8.50	0.68	11.37	3.98	2.86	6.12	22.50
NPT 2	2.21*	15.83	9.00	0.57	12.43*	4.23	2.94	7.58	28.45*
NPT 3	2.07*	9.51	5.47	0.57	10.31	3.38	3.05	5.83	20.40
NPT 4	1.13	11.53	6.50	0.56	8.69	3.27	2.65	8.80	18.56
NPT 5	1.24	18.00*	8.83	0.49	9.78	3.08	3.17	7.94	25.15
NPT 6	1.56	13.67	7.33	0.54	10.55	3.53	2.99	10.24	28.40*
NPT 7	1.31	13.33	6.50	0.49	9.30	3.58	2.60	6.08	19.08
NPT 8	1.44	16.00	8.17	0.51	11.26	3.22	3.50	6.39	20.15
NPT 9	1.28	18.17*	7.50	0.41	10.37	3.25	3.19	9.78	22.30
NPT 10	2.74*	22.67*	10.17	0.45	16.65*	6.67*	2.50	10.31	30.85*
NPT 11	1.46	12.33	5.50	0.45	9.79	3.36	2.92	9.03	29.00*
NPT 12	1.27	14.00	8.17	0.58	8.94	3.35	2.67	8.94	26.50
NPT 13	2.12*	20.50*	9.17	0.45	14.60*	5.90*	2.47	9.07	24.55
NPT 14	1.57	17.33*	7.00	0.40	11.17	4.47	2.50	8.56	26.95
NPT 15	1.07	10.33	6.33	0.61	6.66	2.92	2.28	7.64	19.75
NPT 16	1.15	12.17	6.17	0.51	6.41	2.64	2.43	9.41	23.50
NPT 17	1.32	15.50	8.17	0.53	10.71	3.18	3.37	5.64	18.05
NPT 18	1.06	14.67	6.33	0.43	10.37	2.71	3.83	8.71	22.50
NPT 19	1.60	16.27	7.33	0.45	13.14*	6.17*	2.13	10.06	23.00
NPT 20	2.80*	24.67*	12.50	0.51	18.34*	7.49*	2.45	11.27	32.50*
NPT 21	1.74*	14.00	7.30	0.52	11.57	5.22*	2.22	8.17	24.57
NPT 22	1.21	12.50	6.50	0.52	10.38	3.54	2.93	9.10	23.98
NPT 23	1.22	16.67	7.17	0.43	12.54*	4.75*	2.64	8.19	25.50
NPT 24	0.85	8.00	5.05	0.63	8.64	2.82	3.06	8.06	23.45
NPT 25	1.04	9.00	5.33	0.59	7.54	2.83	2.67	8.11	22.15
NPT 26	1.23	13.33	7.30	0.55	11.51	4.15	2.77	8.71	26.90
NPT 27	1.35	15.17	9.33	0.62	14.16*	4.81*	2.94	8.38	28.30*
NPT 28	2.40*	21.50*	10.50	0.49	16.66*	6.09*	2.74	10.59	31.05*
NPT 29	1.07	12.33	6.50	0.53	10.19	3.02	3.37	7.64	23.89
NPT 30	1.12	10.50	6.00	0.57	8.35	2.58	3.23	6.49	25.05
NPT 31	1.07	9.00	5.13	0.57	8.96	2.42	3.70	9.12	26.75
NPT 32	1.21	12.50	5.00	0.40	10.64	2.33	4.57	10.11	28.45*
NPT 33	0.83	8.33	5.07	0.61	8.13	2.29	3.54	9.02	29.05*
NPT 34	1.09	12.83	5.33	0.42	8.72	2.66	3.28	6.49	23.68
Mean	**1.47**	**14.25**	**7.24**	**0.52**	**10.85**	**3.82**	**2.95**	**8.40**	**24.85**
SED	**0.09**	**0.69**	**0.30**	**0.01**	**0.47**	**0.23**	**0.09**	**0.25**	**0.76**
CD (5%)	**0.17**	**1.38**	**NS**	**NS**	**0.94**	**0.47**	**NS**	**NS**	**1.52**

NPT 20 (18.34 g) recorded significantly higher plant fresh weight followed by NPT 28 (16.66 g) and NPT 10 (16.65 g). In terms of dry weight, it ranged from 2.29 g (NPT 33) to 7.49 g (NPT 20). Eight progenies *viz*., NPT 20 (7.49 g), NPT 10 (6.67 g), NPT 19 (6.17 g), NPT 28 (6.09 g), NPT 13 (5.90 g), NPT 20 (7.49 g), NPT 27 (4.81 g) and NPT 23 (4.75 g) were documented for significantly high dry weight compared with the general mean 3.82 g. NPT 32 (4.57) recorded the maximum fresh and dry weight ratio followed by NPT 31 (3.70) and NPT 18 (3.83). Number of leaves ranged from 5.83 (NPT 3) to 11.27 (NPT 20) and there was no significant difference observed among the 34 progenies. The maximum leaf area was recorded in NPT 20 (32.50 cm^2) followed by NPT 28 (31.05 cm^2), NPT 10 (30.85 cm^2) minimum in NPT 17 (18.05).

DISCUSSION

Neem is used in Ayurvedic medicine for more than 4000 years due to its medicinal properties. All plant parts such as fruits, seeds, leaves, bark and roots contain many chemical compounds. Azadirachtin and other limonoides are great potential in the fields of pest management, environment protection and medicine. Neem based products are source of eco-friendly insecticides, pesticides and agrochemicals (Brahmachari, 2004). The present investigation reveals that three progenies *viz*., NPT 20, NPT 10 and NPT 28 was performing well in term of its growth traits. NPT 24 was found to be the least for the most of the growth traits examined. It has been suggested by (Kundu *et al.*, 1998) that eco-climatic attributes play an important role in the differentiation of neem populations and thereby affect their growth during the early growth stages. Significant differences were found among 34 progenies for growth characteristics *viz*., collar diameter shoot length, fresh weight, dry weight and leaf area at nursery stage during 45 DAS of evaluation. A plethora of researchers have reported the existence of variability in

growth parameters due to different genotypes at nursery stage and these differences vary with soil and climatic conditions (Abutaba *et al.*, 2015; Kumaran, 1997; Krishnakumar *et al.*, 2018; Schmutterer, 1995). Seed morphology, shoot length, basal diameter, leaf area and shoot: root survival rate were important traits for evaluation of seed progeny and indicated a potential parental population for selection and breeding (Kundu, 2000). Similarly evaluating the relationship between leaf area, plant dry weight and photosynthetic parameters are considered as an important growth determinant characters (Kunda and Tigerstedt, 1998). The investigation to improve the quality planting material and growth performance of sandalwood (*Santalum album* L.) under nursery condition were evaluated for significantly higher growth performance in term of shoot length (43.53 cm), collar diameter (4.06 mm), total biomass (15.45 g) and quality index (1.03) at 270 DAS (Mohapatra *et al.*, 2018). A superfluity of workers reported the existence of significant differences and superiority of few species, seed sources, progenies and provenances in various tree species like *Acacia nilotica* (Padmini and Banerjee, 1986). *Eucalyptus tereticornis* (Otegbeye, 1990), *Santalum album* (Bagchi and Sindhu Veerendra, 1991), *Tecomella undulate* (Jindal *et al*., 1991), *Tectona grandis* (Parthiban, 2001) and *Khaya senegalensis* (Sondarva *et al*., 2017) which thus lend support to the current findings.

CONCLUSION

The combined analysis of variance revealed significant differences among morphological growth traits among the evaluated progenies of *Azadirachta indica*. Among the 34 progenies evaluated under nursery, three progenies viz., NPT 20, NPT 10 and NPT 28 consistently expressed superiority for growth characteristics particularly collar diameter shoot length, fresh weight, dry weight and leaf area and these three progenies are focused for tree improvement programme.

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