GERMPLASM VARIABILITY IN NEEM *(AZADIRACHTA INDICA)*

D. K. Mishra

Silviculture Division, Arid Forest Research Institute, PO Krishi Mandi, New Pali Road, Jodhpur – 342 005, India. E-mail: dkmishra@afri.res.in

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MISHRA, D. K. 2005. Germplasm variability in neem (*Azadirachta indica*). A variant neem (*Azadirachta indica*) tree, growing in the Arid Forest Research Institute (AFRI), Jodhpur, India was compared with the nearby growing normal tree and a neem tree from Thailand of the same age. The tree has now attained the height of 6 m and collar diameter of 38 cm. The tree differed morphologically, *viz.* leaf area, leaf texture, shape, venation and petiole size as well as physiologically, *viz.* photosynthesis, transpiration, stomatal conductance and resistance characters with the local neem and neem of Thailand origin.

Key words: Leaf venation – leaf area – photosynthesis – transpiration – stomatal conductance

MISHRA, D. K. 2005. Variasi plasma germa pokok mambu (*Azadirachta indica*). Pokok mambu varian yang hidup di Institut Penyelidikan Hutan Gersang, Jodhpur, India dibandingkan dengan pokok mambu biasa yang hidup berhampiran dan dengan pokok mambu dari negeri Thai. Kesemua pokok yang dikaji mempunyai usia yang sama. Pokok varian kini mencapai ketinggian 6 m dan diameter kolar 38 cm. Pokok tersebut berbeza dari segi morfologi iaitu luas daun, tekstur daun, bentuk daun, urat daun, saiz petiol dengan pokok mambu tempatan dan pokok dari negeri Thai. Pokok ini juga berbeza dari segi fisiologi iaitu fotosintesis, transpirasi, konduksi stomata dan penutupan stomata dengan pokok mambu tempatan dan pokok dari negeri Thai.

Introduction

Germplasm variability is one of the important aspects of nature. A growing stock is bound to have variations. Variability is the key for improvement in any biological system. Genotype × Environment (G × E) interactions are present in genetic entries (clones, families, provenances or species) if their relative performances differ when entries are grown in different environments. Neem (*Azadirachta indica*) is an evergreen, multipurpose tree native to the Indian subcontinent and South-east Asian countries. The species adaptation to hot and dry climates has made it one of the most commonly planted species in arid and semi-arid areas, both within its natural range and outside, in Africa, Latin America and Caribbean (Koul *et al.* 1990, Kundu *et al.* 1998).

The variability of azadirachtin content (Anonymous 1987, Surendran *et al.* 1993, Gupta & Prabhu 1997, Kaushik 2000), oil content (Surendran *et al.* 1993), fatty acid composition (Kaushik & Vir 2000) as well as seed weight, seed length, moisture content and germinability (Surendran *et al.* 1993) have been studied. Amplified fragment length polymorphism (AFLP), a DNA-based marker technique for evaluating genetic variation and phenotic relationships in *A. indica* has been advocated (Singh *et al.* 2001). Variation in net photosynthesis, stomatal

characteristics, leaf area and whole plant phytomass production of ten neem provenances have also been studied (Kundu & Tigerstedt 1998). Variations in net photosynthesis, stomatal size and density have also been reported as determinants of plant productivity (Luukkanen & Kozlowski 1972, Wang *et al.* 1995).

National and international neem trials co-ordinated under neem network of FAO are underway at the Arid Forest Research Institute (AFRI), Jodhpur. The plants of Thailand origin are growing faster than local ones. Moreover, a variant of neem was also planted in the same experimental area. The purpose of the study was to compare the morphological and physiological traits of local neem, neem from Thailand origin and variant neem. This paper deals with the morphological and physiological variability observed in *A. indica* growing in Jodhpur, India.

Materials and methods

The experimental site was Jodhpur (24° 40' N, 71° 15' E, 250 msl), India. The sapling of variant neem was brought from the Rajasthan State Forest Department in 1993. The sapling planted at AFRI grew well but did not bear flower or fruit. This neem variant was compared with the local neem and neem from Thailand, growing at the same experimental area.

Leaf area was measured by leaf area meter. Photosynthesis, transpiration and stomatal resistance were measured with a CO_2 gas analyser.

Results and discussion

The variant neem was 6.0 m high with a collar diameter of 38.0 cm (Table 1). Its branch angle was more acute (40–50°) than that of the local neem (48–55°) and that from Thailand neem (55–60°). The texture of the stem was smoother, less brownish

Table 1 Morphological and physiological parameters of local neem, Thai neem Thailand and a variant

Parameter	Local neem	Variant neem	Thailand neem
Height (m)	6.5	6.0	7.15
Collar diameter (cm)	32.6	38.0	43.2
Branch angle	48–55°	40–55°	55–60°
Peduncle angle	5–15°	10–25°	20–30°
Leaf shape	Lanceolate, acute, serrated veins, extra veins are also visible	Thin, more acute, serrated, single midrib and each serration has veins	Waxy, thick, lanceolate, less acute, most veins bifurcated at the end
Arrangement	Alternate	Somewhat opposite	Alternate
Petiole length (cm)	38.5	19.8	45.0
Stomatal conductance (mole $m^{-2} s^{-1}$)	0.0228	0.0347	0.051

Table 2 Analysis of variance for leaf area, photosynthesis, transpiration and stomatal resistance of local neem, Thai neem and a variant

Germplasm	Leaf area (cm^2)			Photosynthesis ($\mu mole\ s^{-1}\ m^{-2}$)			Transpiration ($\mu mole\ m^{-2}\ s^{-1}$)			Stomatal resistance ($m^{-2}\ s^{-1}\ mole^{-1}$)		
	Mean	F**	CD**	Mean	F**	CD**	Mean	F**	CD**	Mean	F**	CD**
Local	12.26	114.63	4.26	4.38	227.78	0.63	1.05	71.34	0.27	41.85	132.04	5.78
Thailand	20.46			7.05			1.73			22.53		
Variant	3.24			4.90			1.40			29.00		

** $p \leq 0.001$

and more fragile than the local neem. Peduncle angle, petiole size, leaf area, shape and venation were also different. The leaf was very short, serrate and thin.

Neem from Thailand origin showed minimum stomatal resistance and maximum photosynthesis, transpiration and leaf area, while local neem showed minimum photosynthesis and transpirational but maximum stomatal resistance (Table 2). Neem variant, despite having minimum leaf area, showed higher photosynthesis and transpiration compared with the local neem. When transpiration is lower, stomatal resistance will be higher, which is an indication of lower stomatal conductance (Table 1). Stomatal conductance was lower for local neem plant, followed by variant neem and neem of Thailand origin (Table 1). Attempts to relate net photosynthesis to growth have had limited success (Pereira 1994), although photosynthesis has been related to growth after net photosynthesis was scaled up on the basis of estimates of total leaf area (Wang *et al.* 1995). In the present case, neem from Thailand showed highest photosynthetic rate, leaf area and stomatal conductance compared with the local and variant neems. Net photosynthesis and stomatal conductance are often related to each other (Salisbury & Ross 1992).

Plant dry weight is often used in growth analysis (Kramer & Kozlowski 1979). In evaluating the relationship between leaf area, whole plant dry weight and photosynthetic parameters, leaf area is considered as an important growth determinant (Kundu & Tigerstedt 1998).

Analysis of variance (F-statistics) for leaf area, photosynthesis, transpiration and stomatal resistance showed that the differences were significant. Critical differences (CD) were calculated to observe the difference between individual values. Each tree differed significantly from each other for each parameter.

The genetic diversity estimated in 37 neem accessions from different eco-geographic regions of India and four from Thailand growing at AFRI through AFLP markers showed that Indian genotypes formed a broad germplasm base in comparison to that of Thailand origin (Singh *et al.* 1999). Moreover, the value of genetic similarity coefficient was also very low between Indian and exotic (Thailand) genotype. The observed significant differences in photosynthesis, transpiration, stomatal conductance and leaf area of local neem and neem of Thailand origin also verified the above findings.

Conclusions

Local neem showed least photosynthetic activity, transpiration and stomatal conductance compared with those of variant neem and neem from Thailand origin. Local followed by variant neem will be ecologically more suitable to this region.

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