Performance Evaluation and Correlation Coefficient studies in Dek Tree

ABSTRACT

Twenty five plus trees of *dek were* selected from agro-climatic regions of Haryana, Punjab and Uttrakhand. The plus trees were selected on the basis of the different characters of economic importance viz. straightness, clear bole height, self-pruning ability, acute branch angle etc. Among all the plus trees the maximum tree height was observed in MC21 (17.9 m) whereas, the minimum in MC3 (6.5 m). The girth at breast height (gbh) of the selected plus trees varied from 60.9 to 180.8 cm and clear bole height was recorded highest from MC-21 closely followed by MC-13. The correlation among morphological traits of selected plus trees exhibited that clear bole height had positive and highly significant association with the tree height (r = 0.941) closely followed by crown spread (N-S direction) (r = 0.910). At the age of six months, progeny from MC-18 showed maximum shoot length (98.59 cm) followed by MC-16 and MC- 17 progenies. However, the highest root length was observed in the progenies from MC12 (20.84 cm) closely followed by MC-22 (20.46 cm) and MC13 (20.06 cm) progenies. The highest collar diameter was observed in progeny MC17 (13.73 mm) and lowest in MC5 (4.89 mm). The significant variation in growth attributes of progenies of selected plus tees at juvenile stage may be exploited for subsequent breeding programme and establishment of seed orchard for production of quality planting material of this versatile tree species.

Keywords: Dek, plus trees, progenies, morphological characters, variability

1. INTRODUCTION

Low productivity (0.7 m^3/ha/year) of India's forests followed by increasing population and industries have created huge gap in demand and supply of wood and wood products (Parthiban *et al.,* 2021). Currently tree improvement programs are the most required need of hour to meet the growing domestic as well as global demands of wood and wood based products which are estimated to reach to 13.2 million tonnes till 2022 in India (Palsaniya *et al.,* 2009). Any breeding programme for the improvement of timber quality relies on the identification of the best parents. These will form the genetic base from which all subsequent improvements in form and vigour will be obtained. Such trees are usually found in forest conditions and may exhibit superior traits relative to neighbouring individuals of the same species (Clark and Wilson, 2005). Selected trees are commonly referred to as superior phenotypes or plus trees. These selected trees are referred to as the superior phenotypes of plus trees. Therefore, the plus tree selection is the first step for any tree improvement programme (Hooda *et al.,* 2009; Kaushik *et al.,* 2011 and Kumar, 2012). *Melia composita* commonly known as Dek, Burma Dek, White cedar , belonging to family Meliaceae a deciduous fast growing tree species, is native to Indian sub-continent but now is

found growing in many different regions of the world (Murugesan *et al.*, 2013 and Johar *et al.*, 2016). Breeding behavior showed that the species is predominantly self pollinated (Johar *et. al.*, 2018). It has a wide range of adaptability and can be easily propagated in areas with an average rainfall of 350-2000 mm up to an altitude 1800 msl with an average temperature range of 23-27 ^{o}C. *Melia composita* can be easily cultivated on a variety of soils, however, deep fertile sandy loam soils supports the best growth for this versatile species (Orwa *et al.*, 2009). Being a fast growing short rotation tree species and can be exploited for bio-energy applications especially for biomass gasification to generate producer gas and use in Lime Kiln to replace fuel oil and also for other wood product applications (Chinnaraj *et al.*, 2011). *Melia composita* is valued for its high-quality termite and fungus resistant timber (Swaminathan *et al.*, 2012). The multipurpose industrial wood is suitable for the manufacturing of packing cases, cigar boxes, ceiling planks, building and construction material, agricultural implements, pencils, match boxes, splints, musical instruments, tea boxes, ply board and fuel wood (Calorific value, 5.043 - 5,176 cal.) and also due its decorative appearances, which makes it suitable for furniture making (Mandang and Artistien, 2003). Every part of this versatile tree species is being used as traditional herbal medicines, such as anthelmintics, treatment of leprosy, eczema, asthma, malaria, fevers and venereal disease (Govindachari, 1992), as well as cholelithiasis, acariasis and pain (Kokwaro, 1976). Fruitsused in folk medicine as an anti-helmintic, astringent and in the treatment of colic (Kiritkar and Basu, 1999). It is well known as a rich and valuable source of bioactive limonoids (Awang *et al.*, 2007) which are highly oxygenated and modified terpenoids having insecticidal, antibacterial, antifungal, anti-malarial, anticancer, antiviral and pharmaceutical properties (Endo *et al.*, 2002; Koul *et al.*, 2004). This versatile tree has also emerged as one of the most appropriate tree species for various agroforestry systems but the productivity of this species in terms of biomass production is low. Planting of genetically poor quality of seedlings is one of the major reasons for the low productivity. Exploration, collection and conservation of germplasm of this species, identification of fast growing trees, breeding strategies for high biomass production in short life span are still in fancy stage in this valuable tree species. Therefore, in present study an attempt has been made to carry out the progeny testing of superior plus trees to boost the breeding activities of *Melia composita*.

2. MATERIALS AND METHODS

Based on intensive survey, 25 morphological superior trees were selected based on comparison tree method (Clark and Wilson, 2005) and sufficient amount of good quality ripened fruits was collected from different agro-climatic regions of Haryana, Punjab and Uttrakhand during January-March, 2019. The selection of the superior plus trees from a large population was made on the basis of the phenotypic assessment of desirable characters of economic interest such as tree height, clear bole height, girth at breast height etc. The sufficient amount of good quality physiologically ripened fruits was collected from

individual selected tree. The collected fruits were depulped and seeds were properly washed with tap water and were further air dried at room temperature for 2-3 days and subsequently kept in cotton cloth bags and were stored at room temperature. The study related to progenies of selected plus trees was conducted in the nursery of Forestry Department, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana (India) at 29° 10' N latitude and 75° 43' E longitude at an elevation of 215 m above mean sea level. The site is situated in the semi-arid region of North-Western India. The climate is subtropical-monsoonic with an average annual rainfall of 350-400 mm, 70-80 per cent of which occurs during July to September. The summer months are very hot with maximum temperature ranging from 40 to 45°C in May and June whereas, December and January are the coldest months. The progenies of individual selected tree were raised in nursery by sowing of seeds (after soaking in normal water for 72 hrs) in poly bags (22.5 x 12.5 cm in size) filled with 1:2:1 proportion of FYM, dune sand. For each progeny 60 poly bags (20 poly bags/replication) arranged randomly and one seeds per poly bag were sown in the month of July, 2019 following Complete Randomized Block Design with four replications and thereafter customary care was undertaken. Observations on germination (%), seedlings shoot length (cm), root length (cm), collar diameter (mm) and plant biomass (g) were recorded. To record the growth traits of each progeny in nursery at 180 DAS (days after sowing), three plants/replication were taken. The data were analyzed as per the model suggested by Panse and Sukhatme (1989).

3. RESULTS AND DISCUSSION

A wide range of phenotypic variability for the total height was observed. The morphological data of the selected plus trees is depicted in Table-1. The height of the selected plus trees varied from 6.5 (MC3) to 17.9 m (MC21) with an average height of 11.1 m. The maximum clear bole height was recorded from MC-21 plus tree closely followed by MC-13. The girth at breast height (gbh) of the selected plus trees varied from 60.9 to 180.8 cm. Therefore, the selected plus trees in present study had a fairly good clear bole length, gbh and straightness which is one of the desirable character for the good economic returns and marketability of timber. Earlier, Chauhan *et al.* (2012) and Meena *et al.* (2014;2016) also reported that the straightness, total height , girth at breast height and the clear bole height of the tree coupled with the lower values of crown spread are desirable for an ideal tree species for agroforestry plantation. In accordance with the findings of Mingfei *et al.* (2017) it is certainly the case that many factors contribute to the relative amounts of variation observed among populations of the same species, particularly when populations have been separated for long period of time. The observed variations suggest that different factors affect morphological traits, at least in the different agro-climatic regions and land use types such as environmental and climatic factors. The nature and magnitude of variation and correlation studies in a

selected parent population is one of the prerequisite in any genetic improvement program20.Correlation study is necessary to obtain the response of various traits to the characters interesting for selection (Falconer, 1989). The correlation studies of morphological characters of plus trees in present investigation (Table 2) showed that the clear bole height had positive and highly significant association with the tree height (r = 0.941) closely followed by crown spread (N-S direction) (r = 0.910). Likewise, Johar *et al.* (2016) also reported highly significant and positive correlation (r = 0.522) among the different progenies of *Melia composita* for different morphological characters viz. height, clear bole height, GBH etc . Fruit length (18.94 mm), fruit thickness (16.02 mm) and test weight (1365.81g) were recorded significantly higher in plus tree MC-15 whereas the minimum fruit length (11.38 mm), fruit thickness (8.22 mm) and test weight (1125.56 g) were recorded in MC5 (Table 3) indicating a wide range of genetic variation in the selected sexual planting material. Any breeding programme for the improvement of timber quality relies on the identification of the best parents. These will form the genetic base from which all subsequent improvements in form and vigour will be obtained. Such trees are usually found in forest conditions and may exhibit superior traits relative to neighbouring individuals of the same species. Selected trees are commonly referred to as superior phenotypes or plus trees. Once selected, seed is collected for progeny testing to ascertain if the desired traits of the plus-tree have been inherited by the offspring (Clark and Wilson, 2005).

The germination studies are important tool to assess the variation present in the species as well as selecting the promising genotype that can be helpful to boost the efforts of mass afforestation programmes. In the present investigation, significant variation in germination was observed among selected candidate plus trees of *M. composita*. Since, the experiment was conducted in nursery by providing the same environment, the probable reason for the variation in seed germination and its attributes may be the arousal of parental genetic effect in the offspring (Rix *et al*., 2012). In angiosperms, the primary control of germination and dormancy is known to govern through maternal tissue immediately surrounding the embryo (Mayer and Poljakoff-Mayber 1982), maternally derived seed coat and additional genetic contribution to the endosperm (Donohue, 2009). Variability in seed germination may also be attributed owing to other maternal provisioning during seed development like hormones, proteins and nutrients. Significant variation in terms of seed germination attributes have been documented in other woody perennials also. Chavan and Anand (2013) reported significant variation in half-sib progenies of *Azaditrachta indica*. Similarly, significant variation in germination was found in *Tecomella undulata* by Kant and Kumari (2016), in *Faidherbia albida* by Fredrick *et al.*, (2015), in *Pongamia pinnata* by Gupta *et al.*, (2016). Genetic variability in tree species is a gift to mankind, as it forms the basis for selection and further improvement of species. The information on the genetic structure and diversity relationship of a candidate plus tree provides a basis for planning future efficient utilization of

genetic resources to realize the potentiality for maximizing growth and yield. Significant differences were found between progeny with respect to all growth characters in nursery under study at the 5% level of significance (Table 3). The progenies from MC-18 exhibited maximum shoot length (98.59 cm) followed by the progenies from MC-16 and MC- 17 plus trees, respectively. However, the maximum root length was observed in the progenies from MC12 (20.84 cm) closely followed by the progenies from MC-22 (20.46 cm) and MC13 (20.06 cm). The highest collar diameter was observed in progeny MC17 (13.73 mm) followed by MC19 and MC18 and lowest in MC5 (4.89 mm) at the age of six months. Meena *et al.,* (2014) also reported similar findings in *Melia azaderach* . The results of present study clearly indicate that considerable differences exist among the progenies of selected plus tress for growth attributes in *Melia composita* and appreciable improvement in growth parameters can be achieved by collecting seeds from selected plus trees and may be exploited further for tree improvement programme.

4. CONCLUSION

Plus tree selection among even-aged stands is a basic tool for tree improvement. With the intensification of forest farming, tree improvement programmes have become an integral part of the forest management. As a result of which, the seed stands or seed production areas have been recommended for immediate gain in this regard. The plus trees selected through minimum selection standards method, therefore form the base for any breeding programme. A careful selection of plus trees is necessary through which efforts should be made for the maximum use of genetic variations. Such trees can be used either for progeny testing, vegetative multiplication or directly as seed sources. In the present investigation, 25 plus trees of *Melia composita* were selected from different agroclimatic regions Haryana, Punjab and Uttrakhand on the basis of comparison tree method. The significant variation in growth attributes of progenies of selected plus tees at juvenile/nursery stage may be exploited for subsequent breeding programme and establishment of seed orchard for production of quality planting material of this versatile tree species.

COMPETING INTERESTS

Authors have declared that no competing interest exist.

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Table: 1 Morphological characters of selected plus trees of *Melia composita*

Accession No.	Latitude & Longitude	Tree height (m)	Clear bole height (m)	GBH (cm)	Clear bole height: Total height ratio	Height : GBH ratio	Crown	
							N-S	E-W
MC1	29.5050° N & 75.3070° E	8.2	3.9	60.9	0.48	0.13	4.8	4.7
MC2	29.5050° N & 75.3070° E	8.6	4.2	68.4	0.49	0.13	5.2	4.8
MC3	29.5460° N & 75.9318° E	6.5	3.0	65.3	0.46	0.10	4.5	4.4
MC4	29.5460° N & 75.9318° E	6.7	3.2	70.4	0.48	0.10	4.8	4.8
MC5	30.0343° N & 76.8079° E	8.8	4.6	90.4	0.52	0.10	5.3	4.9
MC6	30.5271° N & 75.5684° E	8.5	3.7	75.7	0.44	0.11	5.1	4.7
MC7	30.3819° N & 75.5468° E	11.2	4.5	88.4	0.40	0.13	5.4	4.9
MC8	30.7614° N & 75.6499° E	9.9	4.5	85.6	0.45	0.12	5.4	5.2
MC9	30.8028° N & 75.6310° E	12.5	4.7	90.1	0.38	0.14	5.9	5.7
MC10	30.9010° N & 75.8071° E	10.9	4.9	85.4	0.45	0.13	4.8	4.6
MC11	30.9010° N & 75.8071° E	8.6	4.2	71.5	0.49	0.12	5.2	5.1
MC12	30.9010° N & 75.8071° E	9.5	4.4	76.8	0.46	0.12	4.7	4.9
MC13	30.3518° N & 78.0095° E	17.2	8.4	175.7	0.49	0.10	8.2	7.1
MC14	30.71769 ^{o}N& 77.8674 ^{o}E	10.5	4.5	126.1	0.43	0.08	4.9	4.8
MC15	30.3340° N & 77.9602° E	10.7	5.0	137.6	0.47	0.08	4.8	4.6
MC16	30.3450° N & 78.0894° E	13.5	6.5	144.7	0.48	0.09	7.4	7.2
MC17	30.2497° N & 77.9810° E	14.7	6.9	145.8	0.47	0.10	7.5	7.1
MC18	30.2662° N & 78.1062° E	10.6	4.2	110.5	0.40	0.10	5.2	5.0
MC19	30.2662° N & 78.1062° E	11.5	5.1	99.8	0.44	0.12	6.3	6.0
MC20	30.3898° N & 78.1058° E	10.6	4.8	92.8	0.45	0.11	4.8	4.6
MC21	30.3579° N & 78.1066° E	17.9	8.6	180.8	0.48	0.10	8.3	7.4
MC22	30.3579° N & 78.1066° E	11.9	5.4	165.2	0.45	0.07	6.7	6.4
MC23	30.3579° N & 78.1066° E	15.6	7.4	160.7	0.47	0.10	7.9	7.5
MC24	30.3220° N & 78.0866° E	11.8	3.7	99.9	0.31	0.12	6.4	6.1
MC25	30.3220° N & 78.0866° E	12.9	5.8	132.5	0.45	0.10	6.8	6.7
Range		6.5-17.9	3.0-8.6	60.9-180.8	0.31 - 0.52	0.07 - 0.14	4.5-8.3	4.4-7.5
Mean		11.1	5.0	108.0	0.45	0.11	5.8	5.5

Table: 2 Correlation coefficient among different traits of plus tees of *Melia composita*

	Tree height	Clear bole height	GBH	Clear bole height: Total height ratio	Height : GBH ratio	Crown Spread (N-S)	Crown Spread (E-W)
Tree height		0.941**	0.876**	-0.037^{NS}	-0.212^{NS}	0.910**	0.876**
Clear bole height			0.875**	0.300^{NS}	-0.302^{NS}	0.890**	0.849**
GBH				0.107^{NS}	-0.643**	0.835**	0.815**
Clear bole height: Total height ratio					-0.267^{NS}	0.068^{NS}	0.045^{NS}
Height : GBH ratio						-0.268^{NS}	-0.287^{NS}
Crown Spread (N-S)							0.982**
Crown Spread (E-W)							

**** Significant at 5 per cent**

Table: 3 Fruit characters of selected plus tree of *Melia composita* from different locations

Accession No.	Fruit length (mm)	Fruit thickness (mm)	Test weight (g)
MC1	11.91	8.65	1145.82
MC2	14.79	10.35	1186.72
MC3	12.99	9.22	1156.92
MC4	14.45	10.22	1180.52
MC5	11.38	8.22	1125.56
MC6	12.65	8.72	1149.77
MC7	13.87	9.28	1160.87
MC8	14.98	10.39	1192.85
MC9	11.50	8.44	1130.85
MC10	15.64	10.63	1210.7
MC11	15.27	10.45	1205.87
MC12	15.97	10.94	1224.55
MC13	18.06	14.43	1295.75
MC14	16.79	13.92	1267.87
MC15	18.94	16.02	1365.81
MC16	17.22	14.28	1287.65
MC17	15.88	10.89	1218.68
MC18	16.51	13.93	1255.73
MC19	16.84	14.15	1275.95
MC20	16.39	12.48	1245.72
MC21	15.65	10.74	1212.71
MC22	14.14	10.15	1175.83
MC23	12.81	8.95	1151.91
MC24	16.39	13.87	1248.78
MC25	15.97	10.98	1225.91
Range	11.38-18.94	8.22-16.02	1125.56-1365.81
Mean	15.07	11.21	1211.97
CD at 5 %	1.14	0.86	91.45

Table: 4 Mean performance of the progenies of *Melia composita* for emergence and seedling characters

Accession code	Germination (%)	Shoot length (cm)	Root length (cm)	Root : Shoot ratio	Collar diameter (mm)	Plant biomass (g)
MC1	6.00	32.77	12.07	0.37	5.34	1.96
MC2	6.67	31.89	10.90	0.34	5.58	1.97
MC3	25.33	48.49	16.78	0.35	7.10	2.06
MC4	6.33	28.33	12.20	0.43	5.22	1.99
MC5	7.00	30.04	11.68	0.39	4.89	2.04
MC6	19.33	44.97	18.43	0.41	7.90	2.06
MC7	26.00	47.39	19.28	0.41	6.85	2.22
MC8	24.00	49.35	19.10	0.39	7.41	2.37
MC9	7.00	27.35	12.00	0.44	6.17	1.96
MC10	16.33	73.69	16.47	0.22	7.33	3.00
MC11	21.33	64.07	17.64	0.28	8.52	2.48
MC12	29.33	64.73	20.84	0.32	7.03	2.69
MC13	26.33	60.33	20.06	0.33	7.81	2.48
MC14	30.67	70.63	17.98	0.25	9.74	2.65
MC15	31.67	82.46	20.39	0.25	11.65	3.25
MC16	22.00	87.60	17.52	0.20	9.85	3.35
MC17	19.00	85.87	18.22	0.21	13.73	3.24
MC18	23.00	98.39	16.87	0.17	11.75	3.46
MC19	17.67	70.84	18.32	0.26	11.82	2.88
MC20	28.00	67.01	17.63	0.26	10.97	2.53
MC21	26.00	76.86	19.77	0.26	11.65	3.08
MC22	27.33	84.12	20.46	0.24	9.60	3.27
MC23	28.67	79.33	18.45	0.23	9.02	3.07
MC24	30.33	69.87	18.93	0.27	10.84	2.79
MC25	29.67	82.43	19.82	0.24	10.90	3.15
Mean	21.4	62.35	17.27	0.30	8.75	2.64
CD (p=0.5)	2.94	6.93	1.66	0.02	1.37	0.39