Original Research Article

PERFORMANCE OF *MELIA COMPOSITA* WILLD. SEEDLING IN ROOT TRAINERS UNDER TWO DIFFERENT GROWING CONDITIONS

ABSTRACT

The investigation was conducted to assess the performance of *Melia composita* Willd. seedling in two growing environments viz. nursery under tree shade and agro net shade house. Five different types of containers viz., root trainers of size 150 cc, 200cc, 250 cc, 300cc and poly bags (17x13cm) were used to grow seedlings in comparison to bed grown seedlings. The seedling growth parameters such as, plant height, collar diameter, root length, total fresh/dry weight and root: shoot ratio was recorded for each treatment. Interaction effect among container type, size and growing environment was significant. Plants attained maximum height, collar diameter, root length, fresh and dry biomass and dry root/shoot ratio under net house environment. Total plant biomass was maximum in bed nursery, the root: shoot ratio and sturdiness quotient were least in bed nursery, root : shoot ratio on dry weight basis and sturdiness quotient were recorded maximum 300cc root trainer.

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Keywords: *Melia composita, Open nursery, Agro-net shade house, Root trainers, Seedling/ growth/biomass*

Introduction

Melia composita Willd., a member of family Meliaceae, a large deciduous short duration tree is commonly known as Malabar Neem or Burma Dek. The tree is in high demand because of its multipurpose use such as bioenergy, paper and pulp, furniture and musical instruments, etc. (Parthiban *et al.,* 2009, Chinnaraj *et al.,* 2011). *Melia composita* also holds good potential for agro-forestry and farm forestry in Punjab and adjoining states for generating higher income (Chauhan and Ritu, 2006) and may support the farmers in overcoming the problem of decreasing income through traditional crop rotations.

Raising quality seedling requires technical skill including selecting appropriate growing medium, containers, nursery hygiene and protection. Tree seedling existence and progress are directly associated to its capacity to rapidly establish root system into the surrounding soil (Ritchie, 1984). The production of forest tree seedlings in containers aims at encouraging the plantlet to form a good root organization in the nursery and to protect these roots till the seedling is out planted. Numerous rewards to woody plant container production comprises ease of management at the nursery, consistency in plant growth, ease of shipping, consumer appeal, ability to produce more plants on less land, quicker turnover rate, stock storage and a longer seasonal market for plant material (Chauhan and Sharma 1997, Davidson *et al*, 2000). The physical characteristics of the container, such as size and space, govern seedling production per growing area. Container volume and shape also determine the type of growing medium to be used as well as the type of filling and sowing implement.

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However the polythene containers used are convenient and cheap, they have an intrinsic problem of root coiling or spiraling and also destroy environment. The introduction of root trainer technology has made a tremendous impact on forest nursery seedling production. Root trainers are specially designed cylindrical containers made of opaque material with two open ends of which lower end tapers gradually with a smaller open end, to provide favourable conditions for root development and drainage of extra water. Further, it is necessary to provide atleast partially controlled conditions for good and uniform establishment of seedlings. Agro-net shade prevents direct solar radiation to fall on the nursery plants and thus ensure their healthy growth. As *Melia composita* is gaining more importance among farmers and nursery growers, its systematic cultivation has also become more crucial. There is only sparse information available for scientific management of this species. The present study was conducted to evaluate the performance of *Melia composita* seedling in different type of growing conditions.

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Materials and Methods

The present study was carried out to evaluate the performance of suitable containers and growing environment for raising good quality seedlings and evaluation of periodic growth parameters of *Melia composita* seedlings. The experiment was conducted at experimental area of Department of

Forestry and Natural Resources, Punjab Agricultural University, Ludhiana. The seeds were sown in well prepared bed in mid of April Month. The delicate seedlings were transplanted after 45 days of sowing and closely monitored every day. The main plot treatments consisted of two growing environments (open nursery under tree shade and agro-net shade) and sub plot treatments comprised five types of containers (four types of root trainers of size 150 cc, 200cc, 250 cc, 300cc, poly bags (17x13 cm) and control in usual nursery bed). Potting mixtures used was uniform in all treatments i.e. Soil :FYM: Sand in the ratio of 2:1:1. In nursery bed, a six inch layer of the potting mixture was spread for uniformity in soil media for growth. Experiment was carried out with three replications in Factorial Randomized Block Design (RBD). The growth and biomass parameters were recorded from six randomly selected plants in each treatment at 30, 60 and 90 days after transplanting. Plant height was measured from the root collar to the tip of the shoot with the help of a scale and diameter of shoot above the root collar region was measured with the help of vernier callipers. After uprooting the seedlings, root length were measured from collar region to the tip of the longest root. Three seedlings were uprooted to measure total fresh weight and after recording fresh weight, the plantlets were oven dried at 70±2^{O}C to a constant weight and dry weight was recorded. Root: shoot ratio was calculated on dry weight basis and sturdiness coefficient (Ritchie 1984) was calculated by diving the seedling height (cm) by collar diameter (mm).Data generated was suitably analysed through CPCS software of PAU. Ludhiana.

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Result and Discussion

Plant Growth: Plant height is a selection criterion for screening vigorous plants. Performance of plants in terms of height was consistently better under agro-net shade in comparison to open nursery under tree shade. Among the containers, maximum height value was observed in nursery bed, followed by poly bag and root trainers (in decreasing order of size), Increasing trend was observed for plant height to 90 days after planting. Maximum height is recorded to be 177cm in nursery beds (Table 1). The volume of the cavity is an important characteristic of a container because, in general, larger container can help to raise bigger seedling (Kinghorn, 1974). Plant height increased as a result of active cell division and expansion, which is disrupted by limited water and nutrition availability. Higher plant height in nursery bed was due to greater nutrient uptake and water absorption by roots in nursery beds. Roots suffer root coiling and distortion when grown in polythene of variable sizes. Nursery bed has advantage in providing more space to roots for lateral expansion and uninterrupted growth of tap root, which is hindered in containers. Under open house, temperature becomes a limiting factor for nursery bed, by drying the soil giving an advantage to polybags containers in yielding greater plant height. Plant height is higher under net house conditions than open house due to high temperature stress in open but uniform light under net house. Summer injury (Jull *et al.,* 1999) and winter damage (Johnson and Havis, 1977) both have been reported in plants in open nurseries. In a study conducted on *Santalum album* L, Annapurna *et al.* (2004) and Misra *et al.* (1993) observed best plant height in plant raised in larger root trainers. In present study, plant height was less in root trainer because of small size of root trainers than polybag.

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Size of nursery raised plants can also be measured in terms of collar diameter. Greater diameter of seedling provides support to withstand physical damage. The results showed higher collar diameter under agro-net shade than open nursery under tree shade. Mean of values under both open nursery under tree shade and agro-net shade conditions were highest in nursery bed at all the phenological stages (Table 3) and least in root trainer of 150cc size. Similar results were reported by Mugloo *et al.* (2010) in *Melia azedarach* Linn. attributable to higher nutrients and moisture availability in large containers resulting in faster growth and higher collar diameter. Also, this result agrees with the view of Oni and Caspa (2002), who stated that large polythene pot had an effect on seedlings growth compared with small polythene pot in term of stem girth.

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Container grown plants are prone to root circling and subsequent poor establishment. Deeper root system is a good indicator of adsorptive root surface. Plants grown in open nursery under tree shade showed maximum root length in poly bags at all phenological stages. Under Agro-net shade conditions, more longer root length was recorded in comparison to open nursery (Table 1). Consequently, mean root length of plants was maximum in nursery bed with consistent increase as the days of observation increased. Amongst root trainers, root trainer of size 300 cc showed maximum root length at all the three transplanting dates (Table 3).

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Root length decreased as the size of container declined attributable to hindrance provided by the containers to growing root and causing root spiraling (horizontal in polybag and vertical in root trainers). Tree seedling survival and growth are directly related to the ability of the root system to promptly regenerate new roots (known as root growth potential) and grow out into the surrounding soil (Ritchie, 1984). Seedling roots grow geotropically, but if they meet any physical obstruction, they may tend to grow laterally around the side of the container causing root spiraling. Spiral roots prevent the seedling from becoming properly established in the surrounding soil, which can result in frost-heaving, toppling, or even strangulation (Burdett, 1979), that's why the polybag raised seedlings though bigger in size are not preferred due to poor after planting establishment. The unregulated root system in nursery bed is also not preferred due to uprooting damage at the time of outplanting which lead to poor survival. The growth from 60-90 days was more than 30-60 days but consistent (Table 3).

Total Fresh Biomass: In open nursery under tree shade, plants transplanted to polybags showed highest fresh weight at all phenological stages (22.46 g) after 90 days of transplanting. However under agro net shade, best results were exhibited in plants grown under nursery bed (185.85 g). Among the root trainers, root trainer of 300 cc size showed maximum fresh weight (18.59 g) and root trainer of size 150cc attained minimum magnitude of fresh weight (6.22 g). Overall, results showed higher fresh weight under Agro net shade conditions than open nursery under tree shade. Average values were highest in nursery bed treatment (101.93 g) and least in root trainer of size 150 cc. Dry weight followed the same trend at the three phenological stages. Rate of growth in their 30 day interval (60-90 days) was more in comparison to earlier phases of 30-60 days (Table 2 and 3), however, the rate of growth increased with increase in size of container. Similar results were observed by Mugloo *et al*, (2010) in *Melia azedarach* Linn. The effect of container size on plant growth in terms of fresh/dry shoot and root weight, and total seedling biomass was significant. The parameters gained maximum values in the largest container size of 300 cc. Small containers can limit seedlings growth and reduce its quality (Queiroz and Melem, 2001; Gomes *et al.*, 2003; Lima *et al.*, 2006), though may be useful in storage of stock for next season with limited growth, The container size with growing medium has a significant role in carrying capacity of potting mixture and availability of nutrients. The larger volume of container size and low growing density allows the seedling to grow vigorous and healthy compared to smaller size container. Similar results were observed for the significant influence of container size x growing media on seedling growth and biomass parameters in *Picea pungens* (Mateja and Gorzelak,

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1983), *Fagus sylvatica* (Zielinska,1988), *Lencaena* (Gupta *et al.*, 1992) and *Casuarina equisetifolia* (Rathore *et al.*, 2004),

Greater dry root/shoot ratio helps in good survival and growth on outplanting. Agro-net shade conditions yielded higher seedling dry weight at all the three phenological stages in comparison to open nursery under tree shade (Table 2 and 3). Root trainer of size 300 cc resulted in greater dry root weight/ dry shoot weight under both open and agro-net shade condition. Sturdiness quotient lower values indicate better outplanting potential. Sturdiness quotient was more in seedling raised under open environment than the controlled environment (Table 2). A non-significant difference in sturdiness quotient was observed among all the containers and both the environments.

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CONCLUSION: Agro- net shade house nursery is more suitable for production of good quality nursery stock of *Melia composita* Willd. than open nursery. Maximum root/shoot dry weight was observed in root trainer of 300cc under both the growing conditions.

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Table 1. Growth of *Melia composita* seedling after transplanting under two environments (E) in different containers (C)

Treatments	Plant height (cm)			Collar diameter (mm)			Root length (cm)		
	Open	Agro Net	Mean	Open	Agro Net	Mean	Open	Agro Net	Mean
Root trainer 150 cc	36.67	55.67	46.17	3.47	5.48	4.47	16.98	22.50	19.74
Root trainer 200 cc	39.22	59.63	49.42	3.66	5.64	4.65	19.67	24.83	22.25
Root trainer 250 cc	47.57	67.33	57.45	3.93	6.35	5.14	20.87	25.62	23.24
Root trainer 300 cc	50.90	79.25	65.08	4.11	7.24	5.67	22.40	27.55	24.97
Poly bags	82.68	122.28	102.48	5.77	9.70	7.73	33.40	34.90	34.15
Nursery bed	76.28	177.67	126.97	5.03	13.66	10.34	33.33	52.63	42.98
Mean	55.55	93.64	74.59	4.36	8.01	6.18	24.44	31.34	27.89
CD at 5%	E=4.18, C=7.24, E×C=10.24			E=0.50,C=0.87, E×C=1.22			E=2.027, C=3.510,E×C=4.965		

Table 2. Biomass of *Melia composita* seedling after transplanting under two environments (E) in different containers (C)

Treatments	Fresh weight (g)			Dry weight (g)			Root shoot ratio		
	Open	Agro Net	Mean	Open	Agro Net	Mean	Open	Agro Net	Mean
Root trainer 150 cc	4.30	8.14	6.22	1.28	3.94	2.61	0.25 (10.64)	0.30 (10.21)	0.27 (10.42)
Root trainer 200 cc	6.47	13.45	9.96	1.77	4.83	3.30	0.34 (10.96)	0.46 (10.58)	0.40 (10.77)
Root trainer 250 cc	8.38	16.39	12.38	2.25	5.77	4.01	0.36 (12.18)	0.54 (10.63)	0.45 (11.40)
Root trainer 300 cc	8.38	28.79	18.59	2.37	10.15	6.26	0.47 (12.42)	0.58 (10.99)	0.52 (11.70)
Poly bags	22.46	80.14	51.30	6.83	20.41	13.62	0.41 (14.48)	0.31 (12.63)	0.36 (13.55)
Nursery bed	18.01	185.85	101.93	5.75	62.55	34.15	0.36 (14.58)	0.34 (13.167)	0.35 (13.87)
Mean	11.33	55.46	33.39	3.38	17.94	10.66	0.36 (12.54)	0.42 (11.37)	0.39 (11.96)
CD at 5%	E=4.77,C=8.25,E×C=11.68			E=3.39,C=5.87,E×C=8.30			E=0.87, C=0.15,E×C=NS (E= NS, C= NS,E×C=NS)		

E = Environment, C = Container, E x C = Environment x Container

* Sturdiness quotient in parenthesis

Table 3. Thirty days increment (30-60 and 60- 90 days) in different growth and biomass parameters (average of two growing environments)

Treatments	Plant height(cm)		Collar diameter(mm)		Root length(cm)		Fresh weight (g)		Dry weight (g)		Root shoot ratio		Sturdiness quotient	
	30-60	60-90	30-60	60-90	30-60	60-90	30-60	60-90	30-60	60-90	30-60	60-90	30-60	60-90
Root trainer 150 cc	10.08	23.07	1.2	1.42	5.21	5.07	2.01	2.59	0.93	1.09	-0.12	-0.12	1.08	2.73
Root trainer 200 cc	13.29	21.64	1.06	1.48	4.70	6.82	3.22	4.69	0.95	1.65	-0.11	-0.04	2.57	1.55
Root trainer 250 cc	13.84	27.03	1.25	1.74	5.20	6.61	3.05	6.87	0.96	2.16	-0.1	-0.04	1.57	2.54
Root trainer 300 cc	12.11	34.29	1.45	1.96	5.98	7.14	5.29	10.57	1.06	4.08	-0.12	-0.09	0.26	3.43
Poly bags	20.79	59.32	1.68	3.36	7.62	9.28	6.05	41.23	1.34	11.13	-0.02	-0.02	1.78	3.66
Nursery bed	24.62	79.84	2.24	5.51	10.04	16.72	11.03	87.34	3.90	29.22	-0.03	-0.02	1.28	2.63
Mean	15.79	40.86	1.47	2.43	6.46	8.60	5.11	25.54	1.53	8.22	-0.08	-0.06	1.41	2.77

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