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Standardization of Growing Media for Raising *Pinus wallichiana* Seedlings under Root Trainer Production System in Nursery

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Abstract

The study was aimed to optimize the growing media and their proportion for the production of quality planting stock of *Pinus wallichiana* seedlings. To achieve the objective various types of growing media i.e. M_1 (peat : vermiculute, 1 : 1), M_2 (soil : sand : dal weed, 1 : 1 : 2), M_3 (soil : sand : spent mushroom ; 1 : 1 : 2), M_4 (soil : sand : forest litter ; 1 : 1 : 2) were used. Porosity analysis of growing medium was carried out before the layout of trial for better understanding of total porosity, aeration porosity and water holding porosity of growing medium. Growing media exercised significant effect on most of the parameters except dry root weight of *Pinus wallichiana* seedlings, where results were found to be non-significant. Growing medium M_4 (soil : sand : forest litter : 1 : 1 : 2) revealed best results in maximum number of parameters i.e. collar diameter (2.39 mm), fresh shoot weight (1.78 g), fresh root weight (1.51 g), total seedling fresh weight (3.30 g), dry shoot weight (0.54 g), dry root weight (0.40 g), total seedling dry weight (0.94 g), sturdiness (69.1), plug compactness (29.33 cm) and overall quality index i.e. Dickson's quality index (0.112).

Key words : Standardization, Growing media, *Pinus wallichiana*, Seedlings, Root trainer .

Production of sturdy seedlings is an prerequisite for execution of any afforestation programs, and quality seedlings can be produced by inducing morpho-physiological changes in the plants for making them competent enough to bear the shock of field planting and enhance their productivity. Growing media is the most important input for containerized seedling production and responsible for healthy and uniform seedling production. Apart from the selection of proper ingredient, it is necessary to maintain the porosity of parting mixture so that proper development of roots takes place (1). The deficiency or excess of any element in media may cause adverse effect on the growth of the seedlings. Selection of component growing media is based on the required function, cost and availability. Generally used growing medium includes compost, sugarcane bagasse, animal manure (FYM), coconut husk, pine bark, sawdust, peat moss, spent mushroom medium and rice husk in different proportion with soil and sand. Use of suitable potting mixtures, supplying adequate nutrition for healthy nursery stock and having good aggregation is important (2). Necessity of using balanced potting mixtures for obtaining good growth of nursery seedlings have been emphasised by many workers (3). Often, heavy clay soils are used as potting medium. Heavy poorly drained soil media however, cannot be used in root trainers as they inhibit aeration, drainage and root growth and may damage the container. Many commercial growing media are available in West for container growing seedlings productions which are based on the mixtures that consist of various ratios of peat moss, vermiculite, perlite and nutrients (4). An ideal growing medium has the following characteristics : light weight, homogenous, easily or locally available, fertile and having high nutrient retention capacity, moderately acidic pH, well drained and sufficiently cohesive to maintain the root ball after removal from the containers (5). A potting mixture must also have a greater water holding capacity and good aeration (6). Keeping in view the important role of growing media for producing quality seedling in nursery and increased demand of *Pinus wallichiana* as timber species and for plantation and afforestation programs, present study was aimed to optimize growing media ingredients and their

Table 1. Details of potting mixture ingredients and their proportion used for the study.

Treatment	Ingredients	Proportion
M_1	Pear : vermicullite	1 : 1
M_2	Soil : sand : dal weed	1 : 1 : 2
M_3	Soil : sand : spent mushroom	1 : 1 : 2
M_4	Soil : sand : forest litter	1 : 1 : 2

proportions for raising quality seedlings of *Pinus wallichiana* in the nursery under root trainer production system.

Methods

The investigation was carried out at the forest nursery of Faculty of Forestry, SKU AST-K, Shalimar during March 2006 to August 2007. The experimental site i.e. forest nursery at Shalimar is located between 34.08° N latitude and 74.83° E longitude at an altitude of 1,587 m above mean sea level (msl). The temperature of the region varies from a minimum of —8C in winter to a maximum of 34C in the summer.

Each ingredient of potting mixture was sun dried, pulverized and then sieved separately through a wire mesh (9 holes/cm) except peat-vermiculite.

Different ingredients namely soil, sand, dal weed, forest litter, spent mushroom, peat and vermiculite were mixed in different proportions to get best mixture for production of quality seedling stock and then resulted mixtures were filled in upto the top of the root trainer cell and gently pressed with the help of fingers (Table 1).

The aeration porosity, water holding porosity and total porosity of the growing medium was determined (7, 8) by using the formulae (Table 2).

$$\text{Aeration porosity (\%)} = \frac{\text{Aeration pore volume}}{\text{Container volume}} \times 100$$

$$\text{Total porosity (\%)} = \frac{\text{Total pore volume}}{\text{Container volume}} \times 100$$

Water holding porosity (%) = Total porosity–aeration porosity

The one month old seedlings of *Pinus wallichiana* commonly known as Kail were pricked out for planting in different sizes of root trainers i.e. 150 cc, 250 cc, 300 cc filled with growing medium. The experimental trail was laid with complete randomized design (CRD) taking three replications. The seedlings were maintained by regular watering (twice a day) and weeding. The seedlings were periodically administered with fungicide (copper oxychloride at 0.2%) and urea at 0.2%.

Table 2. Aeration porosity, water holding porosity and total porosity of the different growing media.

Growing medium	Aeration porosity (%)	Water holding porosity (%)	Total porosity (%)
M_1	28.5	55.5	84.0
M_2	8.9	45.4	54.3
M_3	8.0	48.0	56.0
M_4	13.5	58.0	71.5

Five seedlings were randomly selected from each treatment per replication and various observations were recorded. Seedling height and colar diameter were measured with graduated scale and digital caliper respectively. For taking fresh weight i.e. total seedling, shoot and root, selected seedlings were uprooted without disturbing the root system. The root plug containing potting mixture was gently washed with tap water till all the adhering particles of potting mixture were washed away from the root system. Excess of water was wiped out by placing them between the folds of blotting paper, in order to achieve the accurate estimations.

For estimation of dry weight of the seedling, the already cut root and shoot were separately dried at 60C in paper bags for about 48 h in hot air oven and dry weight of shoot, root and total seedling dry weight was recorded using pan electric balance. The seedling quality parameters viz. sturdiness (the ratio of height to diameter), root shoot ratio were calculated for each treatment. Dickson's quality index (seedling weight (g) / height : diameter) was worked out following Dickson et al. (9). Plug compactness was also determined for each treatment. Seedlings with plug were taken out of root trainers and dropped on cemented flour to check the plug compactness, a graduated scale was placed to record the length from which seedlings were dropped. The dropping of seedlings

Table 3. Effect of growing medium on seedling growth and biomass of *Pinus wallichiana* (blue pine)—18 month old.

	Growing medium	Height (cm)	Collar diameter (mm)	Fresh shoot weight (g)	Fresh root weight (g)	Total seedling (fresh weight) (g)	Dry shoot weight (g)	Dry root weight (g)	Total seedling dry weight (g)
M_1	(Peat : vermiculute, 1 : 1)	18.17	1.98	1.20	1.19	2.39	0.38	0.38	0.76
M_2	(Soil : sand : Dal weed, 1 : 1 : 2)	17.63	2.34	1.48	1.16	2.65	0.47	0.33	0.81
M_3	(Soil : sand : spent mushroom, 1 : 1 : 2)	19.45	1.89	1.51	0.86	2.37	0.52	0.34	0.87
M_4	(Soil : sand : forest litter, 1 : 1 : 2)	16.62	2.39	1.78	1.51	3.30	0.54	0.40	0.94
	CD at 5%	0.78	0.20	0.18	0.22	0.22	0.07	NS	0.10
	± SE	0.38	0.10	0.09	0.11	0.11	0.03	NS	0.05

with plug was started from 5 cm, then the height was increased till the plug was broken more than 50 per cent and this height was recorded as final reading or full breakage.

The data on growth, biomass and quality parameters of seedlings were subjected to analysis of variance using the computer software Minitab to examine the effect of treatments (root trainers) on all the parameters studied.

Results and Discussion

The results indicated that the effect of differ-ent types of growing media was significant in respect of growth and biomass parameters except dry shoot weight (Table 3). Seedling height was obser-ved to be maximum (19.45 cm) in M_3 (soil : sand : spent mushroom ; 1 : 1 : 2) followed by M_1 (peat : vermiculite ; 1 : 1) 18.17 cm and minimum (16.62 cm) with M_4 (soil : sand : forest litter ; 1 : 1 : 2). Whereas the M_4 (soil : sand : forest litter ; 1 : 1 : 2) gained maximum (2.39 mm) collar diameter followed by M_2 (soil : sand : dal weed, 1 : 1 : 2) 2.34 mm and M_3 (soil : sand : spent mushroom ; 1 : 1 : 2) depicted minimum collar diameter (1.89 mm) of seedlings.

The growing medium is the second most important feature controlling the quality of stock in nursery. It exercises a significant influence on seedling performance through its control on aeration, water holding capacity and retention and availability of nutrients. Several researchers have found large variation in seedling growth due to growing media viz. *Pinus halepensis* (10), *Grewia optiva* (11, 12), *Dalbergia sisoo* (13).

Likewise the growth differences observed in *Pinus wallichiana* seedling raised in different growing media could be the response of wide variation in physical properties of growing medium (Table 2). The growing medium M_3 (19.45 cm) and M_4 (2.39 mm) resulted in maximum height and collar diameter, respectively. Whereas, the stock raised in M_4 (16.62 cm) and M_3 (1.89 mm) depicted least performance in terms of seedling height and collar diameter, respectively.

The growing medium displayed significant influence on fresh and dry weights of *Pinus wallichiana* seedlings during the study. The seedling fresh shoot (1.78 g), fresh root (1.51 g) and total seedling fresh weight (3.30 g) were observed to be maximum in growing medium M_4 (soil : sand : forest litter ; 1 : 1 : 2) ; similarly dry shoot (0.54 g), root (0.40 g) and total seedling dry weight (0.94 g) were also observed maximum in growing medium M_4 (soil : sand : forest litter ; 1 : 1 : 2), that implies growing medium M_4 out performed other media i.e. M_1, M_2, M_3 with respect to fresh and dry weights.

Biomass accumulation in plant is a function of growth of different plant components that depends primarily on photosynthetic efficiency and carbon dioxide diffusion (14). Seedling biomass is the out-

Table 4. Effect of growing medium on seedling quality parameters of *Pinus wallichiana* seedling (blue pine)—18 month old.

Growing medium	Root/shoot (dry weight basis)	Sturdiness	Dickson's quality index	Plug compactness (breaking height in cm>50%)
M_1	0.97	91.60	0.074	13.00
M_2	0.68	75.80	0.090	24.77
M_3	0.66	108.80	0.075	28.77
M_4	0.73	69.10	0.112	29.33
CD at 5%	0.12	9.00	0.014	1.75
± SE	0.06	4.30	0.007	0.85

come of all the growth parameters and depends on physical of growing medium.

The seedling fresh and dry weights were observed to be maximum in growing medium M_4 (soil : sand : forest litter 1 : 1 : 2). The best performance of growing medium M_4 could be attributed to mycoorhizal association of forest litter and better water holding capacity (Table 2).

The growing medium also affected significantly the quality parameters (Table 4) i.e. root/shoot ratio, sturdiness, Dickson's quality index and plug compactness of *Pinus wallichiana* seedlings. Growing medium controls the quality of stock raised in nursery. It exercises a significant influence on seedling performance through its control on aeration, water holding capacity and retention and availability of nutrients. Several researchers have found large variation in seedling quality parameters due to growing media (11, 13, 15). The growing medium M_4 (soil : sand : forest litter, 1 : 1 : 2) observed maximum Dicksons quality index (0.112) and plug compactness (29.33 cm) and minimum sturdiness (69.1), which indicates better growth of seedling. The results are achieved due to good water holding capacity i.e. adequate moisture and proper porosity of respective growing medium (16). Likewise maximum root/shoot ratio (0.97) was recorded in M_1 (peat : vermiculite ; 1 : 1) whereas minimum value (0.66) was observed in M_3 (soil : sand : forest litter ; 1 : 1 : 2).

Conclusion

Thus, it is concluded that among the various types of growing medium used in the study M_4 (soil : sand : forest litter ; 1 : 1 : 2) registered best results for maximum number of parameters.

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