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EFFECT OF CONTAINER TYPE AND GROWING MEDIA ON GERMINATION AND SEEDLING GROWTH PARAMETERS AT NURSERY STAGE IN ALLEPO PINE IN KASHMIR VALLEY, INDIA

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ABSTRACT

The present investigation on Allepo pine indicated that container type exert significant influence on germination and seedling growth parameters. Root trainer 300 cc (C_3) raised seedlings exhibited maximum plant per cent (70.00), plant height (16.27 cm), collar diameter (1.90 mm), root dry weight (0.21 g), shoot dry weight (0.42 g), shoot root ratio (2.34) and total fresh biomass (1.37 g) per seedling variation in seedling growth parameters in different containers can be attributed to the size and type of the containers. The minimum values in all these parameters were observed in seedlings raised in polytubling of size 150 cc (C_4). Besides other seedling growth parameters, the poly bag of different size raised seedlings have shown slightly lower values for plant height, collar diameter and total biomass. Among growing media, forest soil: sand: FYM: dalweed (1:2:3:3) resulted in significantly highest plant per cent (67.97), plant height (15.03 cm), collar diameter (1.93 mm), dry root weight (0.22 g), dry shoot weight (0.44 g), shoot root ratio (2.47) and total fresh biomass (1.42 g) in the seedlings under nursery condition. The study also reveal that growing medium exert significant influence on germination and seedling growth parameters in Allepo pine. The data in Table 01 to 03 indicated significantly high germination (67.97%) and seedling growth parameters like plant height (15.03 cm), collar diameter (1.93 mm), dry root weight (0.22 g), dry shoot weight (0.44 g), shoot root ratio (2.47), and total fresh biomass (1.42 g) when seedlings were raised in growing medium of soil: sand: FYM: dalweed in the ratio of 1:2:3:3 (M_3). The better growth of seedlings raised in potting mixture M_3 may be attributed to the fact that more nitrogen from the FYM as a component of potting mixture having the better decomposition rate leading to the narrower C:N ratio.

Figure : 01 References : 21 Tables: 03

KEY WORDS : Allepo pine, Container types, Germination, Growing media, Growth parameters.

Introduction

In recent years interest to produce quality seedlings by using improved and modern nursery technique has increased. The new techniques mainly aim at producing sturdy seedlings by inducing morpho-physiological changes in the plants and prepare them to bear the shock on field planting. The system lends itself to establishment of plantations in arid and degraded sites. Although polythene bags are widely used for raising coniferous seedlings, increasing importance is being accorded to the use of root trainers because of their wide acceptance in India due to its numerous advantages[5]. Study was therefore undertaken to evaluate the effect of various type of containers on growth and development of Allepo pine seedlings to recommended best container type for large scale production of quality stock in the species. This might be attributed to the development of root coiling and distortion which leads to stunted growth of seedlings[8]. On the other hand the root trainer raised seedlings produces fibrous root system which enables to absorb water and nutrients from the soil more efficiently, ultimately leading to better growth and survival[2]. Root trainer seedlings of *Acacia nilotica* registered the maximum survival when compared to other containers of poly bag[8]. In general, the present findings are in consonance with others[12] growth and biomass parameters of lodge pole pine, white spruce and Douglas fir seedlings increased in large containers or in the improved and widely spaced cells. Similar findings have been reported by others[6] who obtained significantly higher seedling growth parameters in *Pinus roxburghii* raised in perforated poly bags. Similar with *Acacia catechu, Albizia lebbeck, Azadirachta indica* and *Pinus roxburghii* reported maximum plant height, collar diameter and other seedling

TABLE- 1 : Effect of spacing, nitrogen fertilizer and their interaction on total fresh biomass (g) of *Pinus halepensis* during the year 2009 and 2010 (Average)

Fertilizer / Spacing	Total fresh biomass (g)								
	F_0	F_1	F_2	F_3	F_4	F_5	F_6	F_7	Mean
B_1	1.78	1.88	2.05	2.03	2.32	2.52	2.21	2.12	**2.11**
B_2	1.97	2.07	2.12	2.18	2.42	2.72	2.25	2.17	**2.23**
B_3	1.99	2.13	2.16	2.20	2.72	3.08	2.50	2.43	**2.40**
B_4	2.10	2.16	2.26	2.35	3.06	3.18	2.69	2.44	**2.53**
Mean	1.96	2.06	2.15	2.19	2.63	2.87	2.41	2.29	

CD (P d" 0.05) B = 0.006 F = 0.009 B x F = 0.018

800 seedlings/m^2 (2.5 x 5 cm)	F_0 :	Control	F_4 :	N_{50} + 1.0 t FYM ha^{-1}
400 seedlings/m^2 (5 x 5 cm)	F_1 :	50 kg N ha^{-1}	F_5 :	N_{50} + 1.5 t FYM ha^{-1}
200 seedlings/m^2 (5 x 10 cm)	F_2 :	100 kg N ha^{-1}	F_6 :	N_{100} + 1.0 t FYM ha^{-1}
100 seedlings/m^2 (10 x 10 cm)	F_3 :	150 kg N ha^{-1}	F_7 :	N_{100} + 1.5 t FYM ha^{-1}

growth parameters when improved bottom hole poly bag production system on MAI (Mounted Angle Iron Bed) was used for nursery production[7].

Materials and Methods

1. Location

The experimental site *i.e.* Forest Nursery at Shalimar is located between 34.08^{O}N latitude and 74.83^{O}E longitude at an altitude of about 1587 m above mean sea level whereas the average altitude of Kashmir valley (valley zone) ranges between 1500 to 2300 m above m.s.l. The experimental site was roughly 14 km south east to the Srinagar city and the soil of the nursery was well drained, silty loam type.

2. Climate

The climate in general is temperate type. Winter was severe extending from December to March. The region faces a wide temperature range from a minimum of -8^{O}C in winter to a maximum of 33^{O}C in the summer. Winter frost was common and medium to heavy snow fall was also witnessed. The area receives an annual precipitation of 676-1193 mm. Data pertaining to the weather parameters during the study period are presented in Fig.1.

3. Container type and potting mixture

Six container types and seven potting mixture in different combinations (v/v) were tried. The seeds were sown in the container with different potting mixture in the month of February during 2009 and 2010. The dalweed consisted of decomposed plants of *Ceratophyllum*, *Potamogeton* and *Myriophyllum* sp. Decomposed farm yard manure (FYM), sand and forest soil were sieved with ordinary nursery meshes to remove undecomposed twigs, leaves, stones and other foreign matter. All the materials were collected locally. This experiment consisted of 42 treatments with three replications each and was laid out in completely randomized design. To raise Allepo pine on large scale in forest and non-forest areas, quality seedling is the pre-requisite. Besides, good quality seeds, suitable growing medium is also necessary for the production of high quality seedlings. The growing medium in which seedlings are raised has an important bearing on the quality of nursery stock. It exercise a significant effect on seedling growth through its influence on soil aeration, water holding capacity and availability of nutrients. Many researchers have found that the production of high quality of seedlings for large scale plantation programmes needs a readily available and suitable growing medium besides other suitable conditions. In *Pinus caribaea* variation in seedling growth is due to variation in soil medium, in *Pinus roxburghii*[3,13] and in *Cedrus deodara*[18].

Container type

C_1 : Root trainer of size 150 cc

C_2 : Root trainer of size 250 cc

TABLE - 2 : Effect of container type, growing media and their interaction on plant height of *Pinus halepensis* during the year 2009 and 2010 (Average)

Media / Container	Plant height (cm)							
	M_1	M_2	M_3	M_4	M_5	M_6	M_7	Mean
C_1	14.10	13.96	14.66	11.83	13.43	12.60	11.41	**13.14**
C_2	15.73	15.13	16.03	14.68	15.05	14.83	13.20	**14.95**
C_3	16.93	16.75	**17.51**	16.00	16.60	16.30	13.83	**16.27**
C_4	12.88	12.85	13.15	11.50	12.35	12.08	**11.08**	**12.27**
C_5	13.21	12.61	13.46	11.33	12.55	12.26	10.91	**12.33**
C_6	14.91	14.78	15.36	12.45	14.50	13.86	12.40	**14.04**
Mean	**14.63**	**14.35**	**15.03**	**12.96**	**14.08**	**13.65**	**12.14**	

CD (P d" 0.05) M = 0.179 C = 0.182 M x C = 0.484

C_1 : Root trainer of size 150 cc

C_2 : Root trainer of size 250 cc

C_3 : Root trainer of size 300 cc

C_4 : Perforated polythene tubling of size 150 cc

C_5 : Perforated polythene tubling of size 250 cc

C_6 : Perforated polythene tubling of size 300 cc

M_1 : Soil: Sand: FYM: Dalweed 1:2:3:2

M_2 : Soil: Sand: FYM: Dalweed 1:1:3:2

M_3 : Soil: Sand: FYM: Dalweed 1:2:3:3

M_4 : Soil: Sand: FYM: Dalweed 1:1:1:1

M_5 : Soil: Sand: FYM 1:1:3

M_6 : Soil: Sand: FYM 1:2:2

M_7 : Soil only

C_3 : Root trainer of size 300 cc

C_4 : Perforated polythene tubling of size 150 cc

C_5 : Perforated polythene bags of size 250 cc

C_6 : Perforated polythene bags of size 300 cc

Potting mixture

M1: Forest Soil : Sand : FYM : Dalweed (1 : 2 : 3 : 2)

M2: Forest Soil : Sand : FYM : Dalweed (1 : 1 : 3 : 2)

M3: Forest Soil : Sand : FYM : Dalweed (1 : 2 : 3 : 3)

M4: Forest Soil : Sand : FYM : Dalweed (1 : 1 : 1 : 1)

M5: Forest Soil : Sand : FYM (1 : 1 : 3)

M6: Forest Soil : Sand : FYM (1 : 2 : 2)

M7: Forest soil only

4. Seedling growth studies in nursery

Five randomly selected seedlings from each replication were carefully uprooted without snapping the roots in the first week of December during the year 2009 and 2010 after nine months of sowing to measure the following characteristics:

Seedling height

Seedling height was recorded in centimeters from ground level to the apex of stem.

Collar diameter

Collar diameter of the seedlings was measured in millimeters using electronic vernier caliper.

Root and shoot weight

The seedlings were washed with water. Excess of water was wiped out by placing it between the folds of filter paper. Then the seedlings were cut at collar with a secateur and root and shoot fresh weight was taken separately. Root and shoot dry weight was taken after drying to constant weight in an oven at 70^{O}C.

Shoot: root ratio

It was worked out on dry weight basis by dividing the weight of dry shoot by the weight of dry root of each plant separately.

Total biomass of seedlings

It was expressed in grams as the sum of fresh

TABLE-03:Effect of container type, growing media and their interaction on shoot root ratio of *Pinus halepensis* during the year 2009 and 2010 (Average)

Media / Container	Shoot root ratio							
	M_1	M_2	M_3	M_4	M_5	M_6	M_7	Mean
C_1	2.42	2.31	2.45	2.13	2.25	2.20	1.97	**2.24**
C_2	2.44	2.34	2.53	2.19	2.26	2.24	2.11	**2.30**
C_3	2.44	2.36	**2.62**	2.24	2.27	2.26	2.19	**2.34**
C_4	2.38	2.24	2.36	1.98	2.07	1.99	**1.80**	**2.13**
C_5	2.41	2.28	2.38	2.03	2.20	2.03	1.91	**2.18**
C_6	2.44	2.34	2.48	2.14	2.25	2.20	2.05	**2.27**
Mean	2.42	2.31	2.47	2.12	2.20	2.15	2.01	

CD (P d" 0.05) M = 0.03 C = 0.05 M x C= 0.09

C_1 : Root trainer of size 150 cc

C_2 : Root trainer of size 250 cc

C_3 : Root trainer of size 300 cc

C_4 : Perforated polythene tubling of size 150 cc

C_5 : Perforated polythene tubling of size 250 cc

C_6 : Perforated polythene tubling of size 300 cc

M_1 : Soil: Sand: FYM: Dalweed 1:2:3:2

M_2 : Soil: Sand: FYM: Dalweed 1:1:3:2

M_3 : Soil: Sand: FYM: Dalweed 1:2:3:3

M_4 : Soil: Sand: FYM: Dalweed 1:1:1:1

M_5 : Soil: Sand: FYM 1:1:3

M_6 : Soil: Sand: FYM 1:2:2

M_7 : Soil only

root weight and fresh shoot weight.

Plant percent

The number of seedlings that have survived at the end of growing season and expressed in percentage.

Results and Discussion

The six types of containers *viz*. 150 cc root trainer (C_1), 250 cc root trainer (C_2), 300 cc root trainer (C_3), 150 cc perforated polythene tubling (C_4), 250 cc perforated polythene tubling (C_5), 300 cc perforated polythene tubling (C_6), seven growing media viz. M_1 - forest soil (Fs): sand: FYM: dalweed (1:2:3:2), M_2 - Fs: sand: FYM: dalweed (1:1:3:2), M_3 - Fs: sand: FYM: dalweed (1:2:3:3), M_4 - Fs: sand: FYM: dalweed (1:1:1:1), M_5 - Fs: sand: FYM (1:1: 3) and M_6 - Fs: sand: FYM (1:2: 2) were assessed to find out suitable combination for optimum growth and development of Allepo pine seedlings. The experiment was laid out in a completely randomized block design (factorial) under nursery condition during 2009 and 2010.

The 300 cc root trainer (C_3) registered significantly maximum plant percent (70.00), plant height (16.27 cm), collar diameter (1.90 cm), root dry weight (0.21 g), shoot dry weight (0.42 g), shoot root ratio (2.34) and total fresh biomass (1.37 g) in the seedlings. The minimum values in all these growth parameters were recorded in seedling raised in poly tublings of size 150 cc (C_4).Among growing media, forest soil: sand: FYM: dalweed (1:2:3:3) resulted in significantly highest plant per cent (67.97), plant height (15.03 cm), collar diameter (1.93 mm), dry root weight (0.22 g), dry shoot weight (0.44 g), shoot root ratio (2.47) and total fresh biomass (1.42 g) in the seedlings under nursery condition. The seedlings raised in forest soil only performed poorly in the nursery.

The interaction of container type and growing media exhibited significant effect on germination and seedling growth parameters. The seedlings raised in root trainer 300 cc filled with forest soil: sand: FYM: dalweed in the ratio 1:2:3:3 (C_3M_3) resulted in significantly maximum plant per cent (76.39), plant height (17.51 cm), collar diameter (2.10 mm), dry root weight (0.28 g), dry shoot

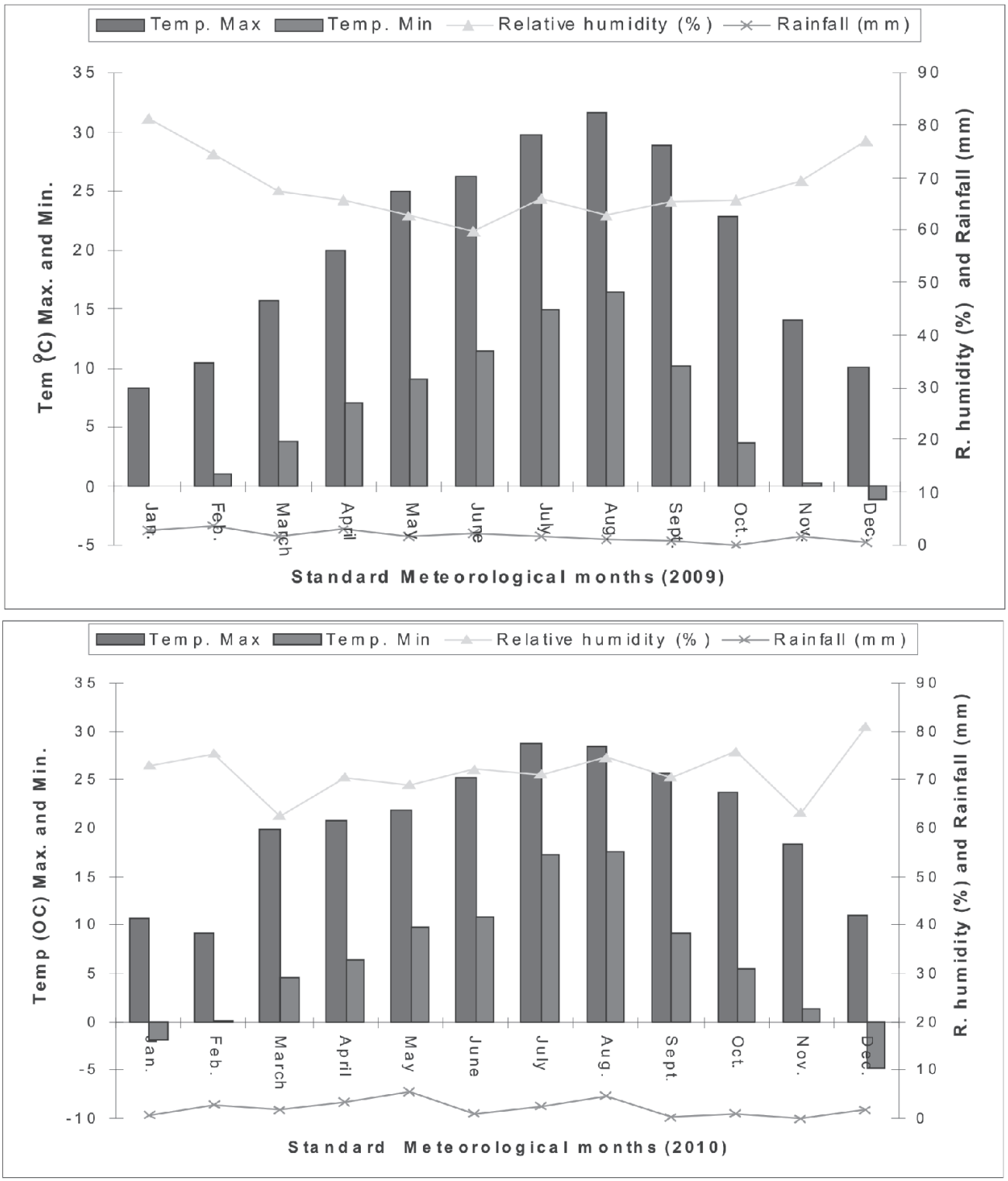

Fig. 1 : Mean monthly meteorological data during growth period of 2009 and 2010.

weight (0.49 g), shoot root ratio (2.62) and total fresh biomass (1.64 g) in the seedlings. The minimum values in all these growth attributes were found at C_4M_7 treatment combination.

These results are also in harmony with the earlier findings[9] which found *Acacia nilotica* seedlings in 300 cc. Hiko pots performed the best in nursery as well as in the field in terms of seedling quality parameters. Another study also showed better establishment of teak plantation by using root trainer raised plants due to their multiple top root system and showed that root trainer raised teak plants were sturdier, healthier and were putting up better collar girth in comparison to stump origin plants.

On the other hand the fibrous root system

produced might be due to the presence of ridges meant for guiding the roots to the drainage hole and ultimately leads to the development of lateral/ adventitious root system thereby morphologically desirable, vigorous balanced root system is developed. Therefore, the higher container volume and presence of ridges and drainage hole in 300 cc root trainer recorded higher seedling growth and survival in the nursery. The findings get support from the work of many other research workers in *Picea glauca*[4], and in *Cedrus deodara*[18,19].The study reveal that growing medium exert significant influence on germination and seedling growth parameters in Allepo pine. The data in Tables 01 to 03 indicated significantly high germination (67.97%) and seedling growth parameters like plant height (15.03 cm), collar diameter (1.93 mm), dry root weight (0.22 g), dry shoot weight (0.44 g), shoot root ratio (2.47), and total fresh biomass (1.42 g) when seedlings were raised in growing medium of soil: sand: FYM: dalweed in the ratio of 1:2:3:3 (M_3). The better growth of seedlings raised in potting mixture M_3 may be attributed to the fact that more nitrogen from the FYM as a component of potting mixture having the better decomposition rate leading to the narrower C:N ratio. These results are in harmony with the previous findings for *Pinus roxburghii*[3], for *Quercus leucotrichophora*[16]. in *Pinus roxburghii*[6], in *Cedrus deodara*[18] and for *Pinus wallichiana*[15]. The poor growth in the nursery were observed in seedlings raised in potting mixture of forest soil only (M_7). This could be due to wider C: N ratio resulting in immobilization process and hence leading to less availability of nutrients which caused poor growth of seedlings.

The interaction between container type and potting mixture were significant for all the seedling growth parameters (Tables 01 to 03) under nursery conditions. The maximum plant height (17.51 cm), collar diameter (2.10 mm), dry root weight (0.28 g), dry shoot weight (0.49 g), shoot root ratio (2.62), total fresh biomass (1.64 g) per seedling and plant percent (76.39) was recorded in root trainer 300 cc with potting mixture of soil: sand: FYM: dalweed in the ratio 1:2:3:3 (C_3M_3) which was closely followed by the seedlings raised in root trainer 300 cc with potting mixture of soil: sand: FYM: dalweed in the ratio of 1:1:3:2 (C_3M_2). The poor growth of seedlings in the nursery was observed in seedlings raised in poly tubling of size 150 cc with potting mixture of forest soil only (C_4M_7). The reason for the varied seedling growth has already been quoted separately while discussing the individual effect of container type and potting mixture on seedling growth parameters. However, this may be attributed to variation in container size/type and nature of potting mixture as has also been observed earlier in *Anthocephalus cadamba*[21], in *Acer* spp[20]., in *Acacia nilotica*[1] and in *Acacia tortilis*[11]. The results are in harmony with earlier in *Acacia catechu* and *Dalbergia sissoo*[17], in *Pinus roxburghii* and in *Cedrus deodara*[18].

Conclusion

Among the different containerized raised seedlings, the root trainer (300 cc) raised seedlings produced maximum plant percent and healthy nursery stock as compared to the seedlings raised in 150 cc perforated poly tubling and root trainer of size 150 cc. Potting mixture of soil: sand: FYM: dalweed in the ratio of 1:2:3:3 (M_3) and 1:2:3:2 (M_1) performed equally well in terms of seedling growth and biomass. However, the best response was observed in M_3 potting mixture. These results are in harmony with the earlier findings for *Acacia albida*[1]. FYM in the ratio of 1:1:1 gave best results of *Mallotus phillipensis* seedlings in nursery stage. The results were also similar with the earlier findings for soil: sand: FYM in the ratio 1:1:2 best for production of quality planting stock of teak in terms of superior growth and biomass[14].

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