Effect of different growing media on seed germination and growth of Indian lac tree (*Schleichera oleosa*) in nursery conditions

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ABSTRACT

Present study was conducted to test the effect of different growing media on *Schleichera oleosa* seeds. The experiment was carried out at the Forest Tree Laboratory, Dehradun, Uttarakhand during 2019-20. The seeds of *S oleosa* were collected from 10 healthy mature trees during the last week of July to first week of August. The seeds were extracted manually and their initial viability, moisture content and germination were tested in the laboratory. As the seeds of *S oleosa* were dormant during the collection, the seeds were kept for after-ripening at 16 per cent intact moisture content at 25°C for 60 days. Fully after-ripened seeds were sown inside the polyhouse in leveled beds prepared from six different growing media viz soil, sand, soil + sand (1:1), soil + sand + FYM (1:1:1), soil + sand + FYM (1:2:1) and soil + sand + FYM (2:1:1). The seed sowing was done at 2 to 3 cm depth in the month of March. The seed germination was recorded from 2nd week onward and the germination, seedling height and collar diameter were measured after 60 days and vigour index was calculated. The seedlings were transplanted in the polythene bags of 6" × 8" size filled with same growing media. The seedling height and collar diameter were measured two times, after 3 and 30 months of sowing. The results revealed that maximum germination (60%) and vigour index (1,533.74) were recorded in soil + sand + FYM (1:1:1) media, which were significantly higher than other growing media. After 3 months of sowing, maximum seedling height (32.94 cm) was recorded in soil + sand + FYM (1:1:1) which was significantly higher than other growing media. However, the effect of all the growing media on collar diameter was statistically non-significant. At the end of the experiment after 30 months of sowing, maximum seedling height (100.47 cm) and collar diameter (22.41 cm) were recorded in soil + sand + FYM (1:1:1) media, which was significantly higher than the only soil and only sand media.

Keywords: Germination; growing media; nursery; *Schleichera oleosa*, seedlings

INTRODUCTION

Schleichera oleosa (Kusum) belongs to monotypic genus *Schleichera*, family Sapindaceae (Troup 1921). Due to its multipurpose nature and nutritional and medicinal properties, it is being popularized among the local people, as Doon Valley is well known for its forests, wildlife values and tourism. *S oleosa* is an important tree species providing food, shelter and space for many wildlife species. The tree provides fodder to the elephants and the branches broken by these large mammals also become food for other herbivores. The tree provides shade and shelter to wild animals/birds and protects them from dry hot summers. The fruits are edible to various birds, monkeys and langoors. The fallen fruits are eaten by Cheetal, Sambhar and other herbivores. The fruits or seeds after dispersal are also eaten by insects, rodents and white ants. The green leaves of *S oleosa* are used as a nutritive fodder, which are collected by local people and Van-Gujjars. Raw fruits are pickled; seeds yield oil about 30-38 per cent and is used as an illuminator

by the villagers. The fine powder obtained by grinding of seeds is applied on the wounds of cattle to prevent flies and maggots. Wood is a source of excellent firewood and heartwood is used for making cartwheels, axels, plough rollers of sugar mills, oil press and other agricultural implements (Troup 1921). The species also has potential to generate employment through lac culture, exploiting their nutritional and medicinal properties at commercial scale (Sarkar et al 2022). The habitat degradation, over-exploitation for fuel wood/fodder, presence of over mature trees, typical germination behaviour and no fresh plantations are the main factors for dwindling its population in natural habitat. To restore degraded natural population, better use of fallen fruits to extract seed oil of high trade, utilize medicinal, nutritional and daily use values, there is an ample scope to develop effective propagation methods and suitable good cultivars through nursery management programme (Sarkar et al 2022). Thus the present study was conducted to study the effect of different growing media on seed germination and growth of *S oleosa* in nursery conditions.

MATERIAL and METHODS

Field survey: The field surveys were carried out in Doon Valley to collect the information about species distribution, different pheno-phases and maturity status of seeds during the study period.

Seed collection: Mature fruits of *S oloesa* were collected during last week of July to first week of August from natural populations distributed in Doon valley (Table 1). The fruits were collected from 10 randomly selected, healthy and mature trees located at least at a distance of 100 m from each other (Schmidt 2000) to avoid relatedness.

Table 1. Seed collection and sampling details

Characteristic	Species phenology and sampling details
Distribution	29°57' N 78°11 E
Altitude	250-500 m amsl
Number of trees sampled	10
Flowering	March-April
Fruit collection time	29 July-3 August 2018
Number of seeds/kg	1,486-1,500
Initial moisture content	26.90%
TTC viability	95%
Initial germination	12.50%

Seed processing and extraction: The fruits were collected with intact branches for 3-5 days to ripen well and then these were macerated, de-pulped and washed 2-3 times with running tap water to remove aril part completely. After extraction, seeds were surface sterilized with 1 per cent sodium hypochlorite solution for 10 minutes. The seeds were washed again with distilled water thrice to remove any traces of sodium hypochloride from the seed surface.

Moisture content determination: The moisture content of the seeds was determined through oven-dry method by placing 4 replications of 5 g seed samples at 103 ± 2°C for 17 ± 1 hours (Anon 2010). The moisture content was determined on fresh weight basis using the following formula:

$$\text{Moisture content} = \frac{\text{Fresh weight of seeds} - \text{Oven dry weight}}{\text{Fresh weight of seeds}} \times 100$$

Initial viability and germination in the laboratory: The initial seed viability was tested through rapid test of viability using triphenyl tetrazolium chloride (TTC) test (Witty 2012). One hundred seeds of *S oleosa* were scarified and dipped in 0.5 per cent TTC solution for 48 hours and the pattern of staining was analyzed. The seeds were considered viable if the embryo portion of seed was stained.

The initial germination test was carried out by placing 20 seeds per replication on moist filter paper in Petri plates at 28°C in the laboratory. A total of four replicates of 20 seeds each were used for germination test and germination was observed at completion of the experiment after 28 days as follows:

$$\text{Germination (\%)} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

Seed desiccation: Initial moisture content of freshly collected seed was 26.90 per cent. The initial weight of seed samples was recorded at given moisture content. To desiccate seed further to the lowest safest moisture content (16%) suitable for seed after ripening, the seed samples were packed in a nylon mesh and dried down to targeted moisture content by placing seeds in a desiccator with equal amount of silica gel (w/w) at room temperature. During

the process of desiccation, the seed weight was recorded at one hour interval till the desiccation was completed and seed attained the weight calculated at targeted moisture content (TMC) as per (Anon 2004) using following equation:

$$\text{Seed weight (g) at TMC} = \frac{100 - \text{Initial moisture content after processing}}{100 - \text{Targeted moisture content}} \times \text{Initial seed weight}$$

Experimental details

The experiment was carried out at Forest Tree Seed Laboratory, Forest Research Institute, Dehradun, Uttarakhand during 2018-20. The seeds of *S oloesa* were dormant during the collection. To break seed dormancy, the desiccated seeds with 16 per cent moisture content were kept at 25°C for 60 days for after-ripening purpose. The fully after-ripened seeds (50) were sown inside polyhouse in prepared leveled beds at 2-3 cm depth using six different growing media (GM) viz T_1 = Soil, T_2 = Sand, T_3 = Soil + sand (1:1), T_4 = Soil + sand + FYM (1:1:1), T_5 = Soil + sand + FYM (1:2:1) and T_6 = Soil + sand + FYM (2:1:1). The experiment was laid out in nursery in CRD with four replications of 50 seeds each.

Observations recorded

The germination in the nursery beds was recorded from second week onward as under:

$$\text{Germination (\%)} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

During the experiment, observations were made on first day count, final day count, seedling length, collar diameter and vigour index. For calculating vigour index, total seedling length (root length + shoot length) of 10 randomly selected plants was measured after 60 days and multiplied with total germination percentage (Abdul-Bakki and Anderson 1970):

$$\text{Vigour index (VI)} = \text{Total seedling length (cm)} \times \text{Germination percentage}$$

The seedlings were kept in mother beds for 3 months and then transplanted to black polythene bags of 6" × 8" size, filled with different growing media as per the treatment combination. The seedling height and collar diameter were measured twice, after 3 months of sowing and then after 30 months of sowing.

Statistical analysis: At the end of the experiment, the data collected were analyzed using IBM-SPSS 21 software.

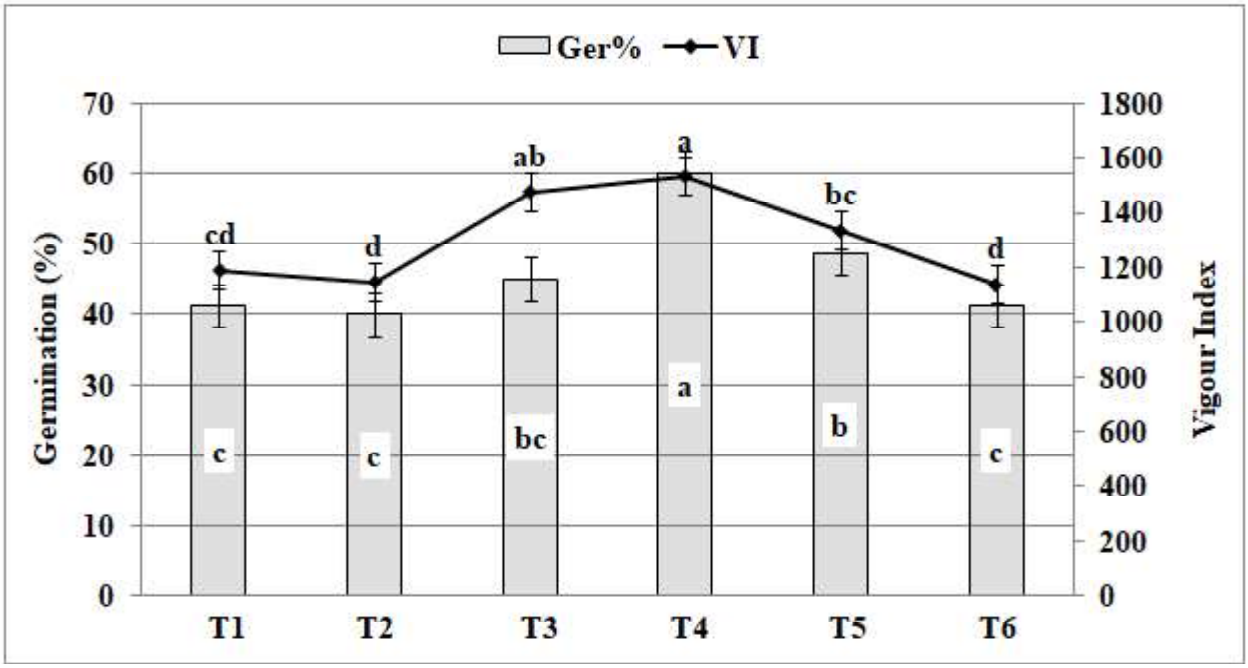
RESULTS

Species distribution and climate: During the reconnaissance survey, the population of *S oleosa* was recorded in mixed dry deciduous forest in the lower Himalaya and Himalayan valley eg Kalsi, Saiya, Barwala, Hatyari, Timli, Shakumari Devi temple, along the foot of the Saharanpur Shivaliks, Teen Pani, Motichur, Chilla range, Thano, Barkot, Dehradun, near Rishikesh toward Narendra Nagar and Neelkanth Mahadev temple and Shivpuri range up to 1,000 m altitude. It grows on dry to occasionally swampy locations (Mothichur and Teen Pani area), often rocky, gravelly or loamy and well-drained soil.

Phenology: In Doon valley, the new leaves of reddish colour initiated just before flowering in February-March. The racemes of greenish yellow flowers appeared with young leaves; small flowers occured in clusters. Flowering period remained for 30-35 days. The fruits turned from green to yellow and then yellowish brown and aril became more juicy and yellow in colour at full maturity. The fruit dispersal started in mid-July and ended till second week of August.

Effect of different growing media on seed germination in nursery conditions: The germination of *S oleosa* seeds was significantly affected by the growing media in the nursery. The maximum germination (60%) was recorded in the seeds sown in soil + sand + FYM (1:1:1) media which was significantly higher than the other growing media, while, lowest germination (40%), when only sand was used as a media. Maximum vigour index (1,533.74) was recorded in soil + sand + FYM (1:1:1) media, while lowest (1,138.68) in soil + sand + FYM (2:1:1), which were statistically at par with sand and soil media (Fig 1).

Growth parameters recorded after 3 months of sowing showed that the maximum seedling height (32.94 cm) was recorded in soil + sand + FYM (1:1:1) media, while the effect of other media was statistically at par. However, the effect of growing media on collar diameter was non-significant. The seedling height and



T_1 = Soil, T_2 = Sand, T_3 = Soil + sand (1:1), T_4 = Soil + sand + FYM (1:1:1), T_5 = Soil + sand + FYM (1:2:1), T_6 = soil + sand + FYM (2:1:1); Values with the same alphabet(s) do not differ significantly at the 5% LoS according to Duncun multiple range test (DMRT)

Fig 1. Germination percentage (primary axis), vigour index (secondary axis) with (mean ± SEM)

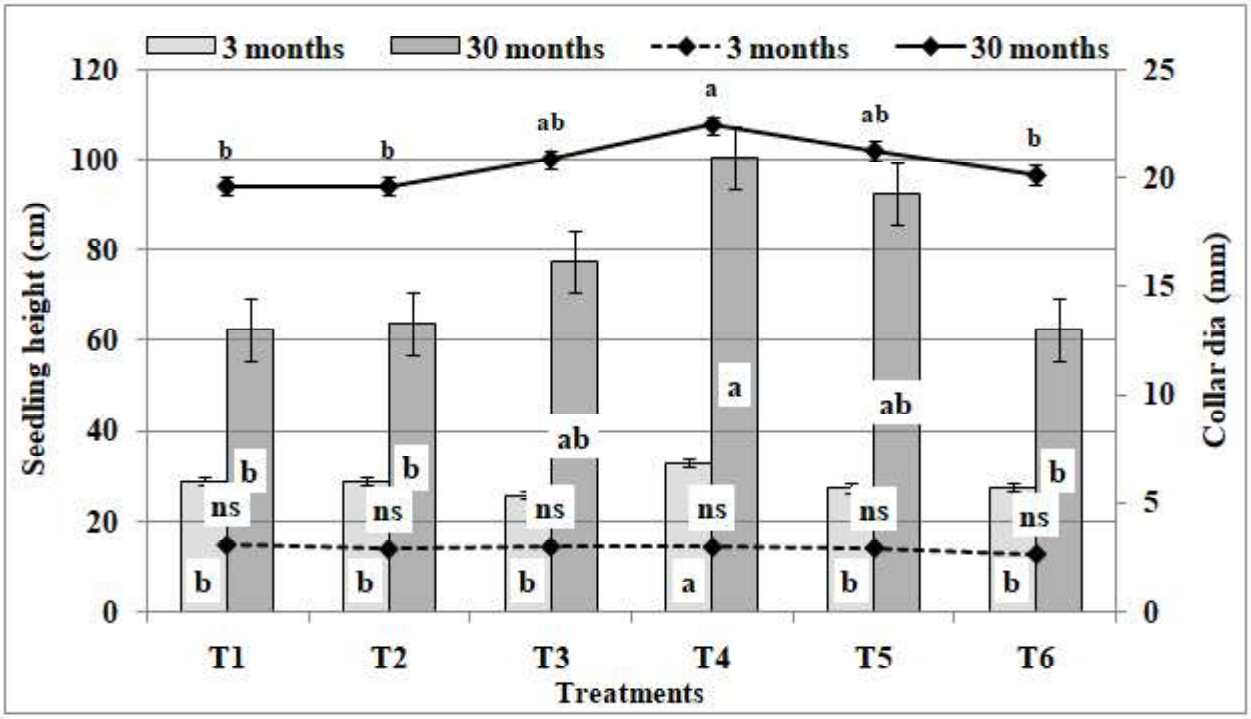


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Fig 2. Seedling height (primary axis) and collar diameter (secondary axis) of *S oleosa* in nursery conditions using different soil media

collar diameter recorded after 30 months of sowing showed that the maximum seedling height (100.47 cm) was recorded in soil + sand + FYM (1:1:1) followed by soil + sand + FYM (1:2:1) with seedling height (92.46 cm), while minimum in soil as a media, which was statistically at par with sand and soil + sand + FYM (2:1:1). Maximum collar diameter (22.41 cm) was recorded in soil + sand + FYM (1:1:1) media, which was significantly higher than sand and soil media as depicted in Fig 2.

DISCUSSION

The suitable growing media directly affects the seed germination, growth, development, rooting system and their function (Meena et al 2017). It provides adequate support to the plant and serves as a source of nutrients and water and allows the release of oxygen to the roots and gas exchange between the roots and the atmosphere outside the roots substrate (Abad et al 2002). In the present study, maximum germination and vigour index were recorded in the seeds sown in soil + sand + FYM (1:1:1) media which were significantly higher than soil only and sand only as media. This increase in germination percentage and vigour index could be attributed to the suitable combination of available air space and moisture holding capacity of growing media. The results are similar to those of Al-Imam and Al-Jubury (2009).

The suitable growing media greatly affects the quality of seedlings in the nursery (Agbo and Omaliko 2006). In addition, growth media ie soil + sand + FYM (1:1:1) might have contained adequate nutrients and the high moisture retention capacity required for germination and growth of *S oleosa* seedlings. The seedlings were significantly affected by the growing media, however, their effect on collar diameter was statistically non-significant after three months.

It was interesting to note that the effect of soil media was most pronounced and recorded as statistically significant on seedling height and collar diameter after 30 months of sowing. The results are in agreement with those of Mahmoud et al (2019), who reported that the soil + sandy soil + vermiculite (2:1:1) enhanced the growth of pistachio seedlings. Thus it is concluded that the sandy loam-textured soil having soil + sand + FYM (1:1:1) is recommended for maximum germination and growth of *S oloesa* seedlings in the nursery.

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