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# Effect of Soil Mixtures on Early Growth Performance of *Grevillea robusta* and *Cupressus lusitanica* Seedlings in the Highlands of Kenya

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Authors JOO, AAO, PMA, SKI Study conception, research design, data collection and manuscript drafting, author JOO data analysis. All authors read and approved the final manuscript.*

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## ABSTRACT

Seedling production nurseries have been receiving much attention because of increasing demand for seedlings. In sub-Saharan Africa studies have showed over 50% of smallholder seedlings planted were sourced in tree nurseries. This has caused a rise in need to improve quality of seedlings especially focused on production level. The focus on most studies on early growth performance of selected key species important either for commercial plantation or agroforestry has been varied on length of the study periods and measurement parameters, with the focus never being to compare the farmer practices with the industry. This study main objective is to determine the effect of growing media on early growth performance of *Grevillea robusta* and *Cupressus lusitanica* seedlings in the highlands of Kenya. These species from literature have shown abundance in terms of demand and availability in smallholder tree nurseries and received complaints on varied performance. The parameters under observation were height, branch numbers, leaf numbers and survival of the seedlings of these species over a six-month period. There were 13 treatments which included various soil mixtures as follows: Agricultural soil (A), Forest soil (FS), Farmyard Manure (FYM), and Sand (S) and their combinations. The study

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employed a Completely Randomized Design with total of 390 seedlings per species. The performance showed that the soil mixture with the combined mean cumulative highest survival was FS 78±3.2% and combined mean lowest cumulative survival was A+S+FYM (37±4.2%). *Cupressus lusitanica* performed better in survival (70±1.2%), height (171±8.1mm), branch numbers (25±1.1), and leaf numbers (119±12.1), when compared to *Grevillea robusta* survival (38±1.6%), height (57±4.0mm), branch numbers (2±0.2), and leaf numbers (13±1.1%) in the nursery. Different soil mixtures had performed differently for each of the parameters in the study with key observation was FS+FYM+S was the best performing for *C. lusitanica* height, branching, leaf numbers and survival. The study also observed FS was best performing for the survival of *G. robusta* in the nursery. This study demonstrates that seedlings in the nursery for these two species require different soil mixtures to ensure survival and high growth performance.

*Keywords: Cupressus lusitanica; Grevillea robusta; soil mixtures; early growth performance; farmyard manure; forest soil; smallholder tree nurseries.*

## 1. INTRODUCTION

Previously global expansion of tree plantation had been predominantly linked to large scale plantations, currently there is a shift to smallholder plantations [1,2]. Seedling production nurseries have been receiving much attention because of increasing demand for seedlings, studies showed over 50% of smallholder seedlings planted were sourced in tree nurseries [2,3]. Smallholder tree farmers have been observed in many studies to face challenges in availability of quality planting materials that affect the quality of the subsequent trees established [1,4-6]. Studies have showed large scale commercial nurseries as having an edge over many smallholder nurseries in terms of seedlings performance mainly due to good quality seed and practices [3,7]. These practices such as the selection of growing media affects the seedlings performance, and studies have shown that several materials can be used for growing media preparation; however, the final choice depends on the ability of the media to sustain plant growth [8-10]. In these also lies the concern of whether the smallholder farmers understand the effects of their growing media on the seedling growth performance [11-14].

There has been many studies in growing media and suitability on plant growth at nursery levels, the focus has been varied study periods and varied measurement parameters with studies doing this from an ideal point where the farmer practices are not key [15-21].There needs studies that evaluate the seedling performance in nurseries based on both ideal and farmer practices so as to be able to substantially guide the farmer practices.

The progress of smallholder tree plantations have been recognized in other studies as requiring considerable tailored assistance schemes and capacity building on even use of their resources [1,7,22-24]. Studies have shown an urgent need for disaggregated data on the different types of smallholder schemes to enable analysis of their benefits and costs against stated aspirations for smallholders [2,23]. In terms of nursery practice growing media is of major concern as this is where most variation in seedling performance occurs [25,26]. The variations observed in studies on nursery practices in growing media comes from the different interpretation of soil and its amendments, with many studies suggesting their own combinations [25,27,28]. This has led to a gap in looking at the actual smallholder tree nursery farmer practice and comparing with ideal that can be adaptable to the farmers [11,12]. The implications of the growing media on the performance of commercial tree species is an important factor as it forms the basis for how farmers make adjustments to their tree nursery practices [8,9,29,30].

Observations from other studies in Kenya that focus on growing medium did not include Grevillea nor Cypress tree species early growth performance whose smallholder farmers preference was observed to be high for these species [11,31,32]. Further, did not focus on early growth and also the studies did not focus on smallholder tree nurseries also the growing media variation were not specific on sources of some of the media [33-35].

This present study sought to analyze the early growth performance of *Grevillea robusta* and *Cupressus lusitanica* seedlings in different soil mixtures. The specific objectives were i) to determine the effect of varying soil mixtures on heights, ii) to determine the effects varying soil mixtures on branching and leaf numbers and iii) to determine the survival of the seedlings on different soil mixtures. This would be useful to demonstrate the opportunities for practice change and develop a standard of practice for smallholder tree farmers selection and mixing of growing media.

## 2. MATERIALS AND METHODS

Seedlings were germinated in sand germinations beds and transplanted to the potting tubes with prefilled growing media in an open nursery to mimic smallholder farmers' tree nursery practices. Daily environmental temperature, humidity and precipitation was collected for the duration of the study, 6 months (Fig. 1) though seedlings in the nursery were watered daily.

### 2.1 Experimental Design

The study employed Completely Randomized Design (CRD) replicated 3 times in the Open nursery containing *G. robusta* (390) and *C. lusitanica* (390) (Tables 1a and 1b). The experiment took 6 months in the nursery [36].

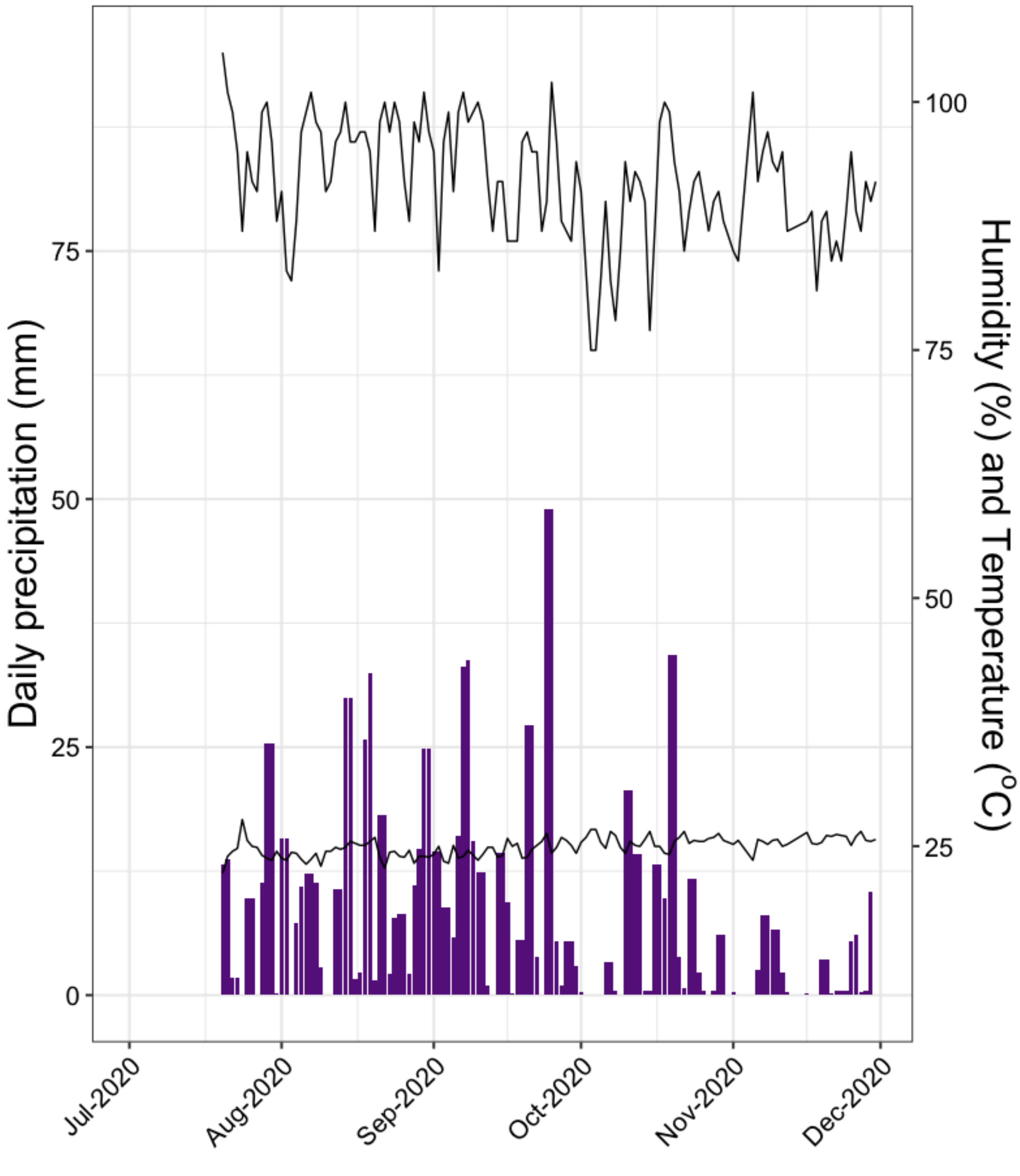



**Fig. 1. The total daily precipitation as bars (axis on left) and mean daily humidity-top (%) and mean daily temperature (°C) -bottom as lines (axis on right)**

**Table 1a. Experimental design showing the treatments soil mixture (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand) combinations for the experiment**

| Treatment | N |
|---|---|
| A | 30 |
| A+FS | 30 |
| A+FYM | 30 |
| A+S | 30 |
| A+S+FYM | 30 |
| A+S+FS | 30 |
| A+FS+FYM | 30 |
| A+FYM+FS+S | 30 |
| FS | 30 |
| FS+S | 30 |
| FS+FYM | 30 |
| FS+FYM+S | 30 |
| FYM+S | 30 |
| Total number of seedlings per species | 390 |

**Table 1b. Experimental layout for *Cupressus lusitanica* and *Grevillea robusta* soil mixture treatments trial, Completely Randomized Design with 13 treatments replicated 3 times in the open nursery. Each treatment consisted of 30 seedlings divided into 3 replicates of 10 plants each. Each species had 39 experimental units randomly distributed as follows**

| ***Cupressus lusitanica*** | | | ***Grevillea robusta*** | | |
|---|---|---|---|---|---|
| **Experimental units (Rows)** | **Treatment (soil mixture)** | **Replicate** | **Experimental units (Rows)** | **Treatment (soil mixture)** | **Replicate** |
| 1 | FS | 3 | 1 | FYM+S | 2 |
| 2 | A+FS+FYM | 2 | 2 | A+FS | 1 |
| 3 | A +FYM | 2 | 3 | A+FS+FYM | 1 |
| 4 | FYM+S | 1 | 4 | FS+S | 3 |
| 5 | FYM+S | 3 | 5 | FS+FYM | 1 |
| 6 | A+FS+FYM | 1 | 6 | A+S+FS | 1 |
| 7 | A+S+FYM | 2 | 7 | A+S+FYM | 2 |
| 8 | A+ FS | 3 | 8 | A+FYM+FS+S | 3 |
| 9 | A+ FS | 1 | 9 | FS | 1 |
| 10 | FS+S | 2 | 10 | A+S+FYM | 1 |
| 11 | A | 1 | 11 | FS+FYM | 2 |
| 12 | A +FYM | 1 | 12 | A+S+FS | 3 |
| 13 | A | 3 | 13 | A+S+FYM | 3 |
| 14 | A+FS+FYM | 3 | 14 | A+FS | 2 |
| 15 | A+ FS | 2 | 15 | FYM+S | 1 |
| 16 | A | 2 | 16 | A | 3 |
| 17 | FS+FYM+S | 2 | 17 | FS+FYM+S | 2 |
| 18 | FS | 1 | 18 | A+S | 1 |
| 19 | FS+S | 1 | 19 | A+FYM | 3 |
| 20 | A+FYM+FS+S | 1 | 20 | FS+S | 1 |
| 21 | A+S+FS | 3 | 21 | A | 2 |
| 22 | FS+FYM+S | 3 | 22 | A+S | 3 |
| 23 | A+FYM+FS+S | 3 | 23 | FS | 3 |
| 24 | FS+FYM | 3 | 24 | A+FYM | 1 |
| 25 | FS+FYM | 2 | 25 | FS+S | 2 |
| 26 | A +FYM | 3 | 26 | A+FS | 3 |
| 27 | A+FYM+FS+S | 2 | 27 | FS+FYM+S | 3 |
| 28 | A+S+FS | 1 | 28 | FS | 2 |
| 29 | A+S | 1 | 29 | A+S | 2 |
| 30 | FS+S | 3 | 30 | A | 1 |

| *Cupressus lusitanica* | | | *Grevillea robusta* | | |
|---|---|---|---|---|---|
| **Experimental units (Rows)** | **Treatment (soil mixture)** | **Replicate** | **Experimental units (Rows)** | **Treatment (soil mixture)** | **Replicate** |
| 31 | A+S+FS | 2 | 31 | A+FYM | 2 |
| 32 | FS+FYM | 3 | 32 | FYM+S | 3 |
| 33 | A+S+FYM | 1 | 33 | A+FS+FYM | 3 |
| 34 | FS+FYM | 2 | 34 | FS+FYM+S | 1 |
| 35 | FS+FYM | 1 | 35 | A+FS+FYM | 2 |
| 36 | FS+FYM+S | 1 | 36 | A+FYM+FS+S | 1 |
| 37 | A+S+FYM | 3 | 37 | FS+FYM | 3 |
| 38 | FYM+S | 2 | 38 | A+FYM+FS+S | 2 |
| 39 | FS | 2 | 39 | A+S+FS | 2 |

**Table 2a and b: a) Initial nutrient content of the soil mixtures (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand). b) Mixing ratios and mean weight in the potting tubes for each treatment**

| Nutrient content | Sand | FYM | A | FS |
|---|---|---|---|---|
| Nitrogen % | 1.17 | 1.86 | 0.93 | 1.05 |
| Phosphorus % | 0.27 | 0.25 | 0.21 | 0.15 |
| Potassium % | 1.32 | 1.29 | 0.96 | 0.89 |
| Calcium % | 2.17 | 1.62 | 2.02 | 1.42 |
| Magnesium % | 0.55 | 0.4 | 0.56 | 0.25 |
| Iron mg/kg | 1325 | 807 | 1285 | 1085 |
| Copper mg/kg | 13.3 | 8.33 | 15 | 15 |
| Manganese mg/kg | 63.3 | 41.7 | 40 | 25 |
| Zinc mg/kg | 33.3 | 21.7 | 13.3 | 16.7 |

| Treatment | Mixing ratio | Mean Weight (g) | Variance (g) |
|---|---|---|---|
| A | 1 | 467.2 | 17.29 |
| A+FS | 1:1 | 454.5 | 16.44 |
| A+FS+FYM | 3:3:1 | 437.9 | 8.67 |
| A+FYM | 3:1 | 442.8 | 14.33 |
| A+FYM+FS+S | 3:1:3:1 | 466.9 | 19.62 |
| A+FYM+S | 3:1:1 | 489.1 | 8.13 |
| A+S | 3:1 | 523.4 | 15.05 |
| A+S+FS | 3:3:1 | 484.8 | 11.30 |
| FS | 1 | 429.6 | 7.39 |
| FS+FYM | 3:1 | 414.7 | 21.63 |
| FS+FYM+S | 3:1:1 | 484.7 | 15.99 |
| FYM+S | 1:1 | 477.4 | 18.19 |
| S | 1 | 657.8 | 13.46 |

Initial growing media were analysed for Nitrogen %, Phosphorus %, Potassium %, Calcium %, Magnesium %, Iron mg/kg, Copper mg/kg, Manganese mg/kg and Zinc mg/kg (Table 2a) [37]. The size of the potting tubes was diameter of 7cm, height of 15cm and weight of empty tube was 2.0g, these resulted in volume of tubes being 577.5 $cm^3$. The growing media was mixed manually using a spade according to the determined mixing ratio as shown in Table 2b and filled in the labeled potting tubed. These materials were Sand (S)-river sand was sourced from River Kipchorian in Kipkelion of Kericho County around Londiani Town, aggregate size ranged from 5mm-10mm in diameter. Forest Soil (FS)- was collected from Masaita Forest Londiani, the soil was collected by digging topsoil (30cm) under *Dombea torrida* tree species. Other associated tree species in the site include *Polyscias kikuyensis*, *Albizzia gummifera*, *Prunus africana*, *Cordia abyssinica* and *Podocarpus falcatus*. The soil type for the site is humic nitisols. Agriculture soil (A)- Agriculture soil was obtained from a farm next to Masaita Forest near Kericho District Forest Offices. Soil was collected by digging the topsoil up to a depth of 30cm. Crops grown on the farm include maize, beans and potatoes. Trees on the farm include *Acacia* *lahai*, *Cupressus lusitanica* and *Grevillea robusta*. The type of soil is humic nitisols. Farmyard Manure (FYM)- Manure was obtained from a farm next to Masaita Forest. The type of FYM is cattle manure which hand been left to decompose for 6 months.

Origin of seedlings for *Grevillea robusta,* the seeds were collected from farms around Njoro town in Nakuru county in March 2021. Seed collection was from 30 trees that were seeding at the time. The age of the trees ranged from 10 to15 years. A total of 200g of seeds were collected (there are 70,000 seeds/kg). Seeds were sown at the beginning of June 2021. Seeds were sown in a seedbed by placing them on sand and covering with a thin layer of sand equal to double the thickness of the seed. Germination started after 14 days and continued up to day 30. Pricking out was done in July 2021.

Origin of seedlings for *Cupressus lusitanica,* seeds were collected in April 2021 from a 14-year-old seed orchard. Cones were collected from 20 tree that were seeding well within the orchard. About 1.5kg of seeds were obtained after extraction. Seed sowing was done at the beginning of June 2021. Seed were sown in a seedbed containing river sand as growing media by placing them on the sand and covering with a thin layer of sand. Germination stated on Day 15. Pricking out was done in July 2021.

After mixing the growing media, weights were recorded per each treatment combination based on the mixing ratios and means provided (Table 2b). Monthly measurements were taken from 3 plants per row: Plant number. 3, 5 & 8. The study used systematic sampling to measure same plants for consistent results: Survival was recorded monthly for 6 months, Root Collar Diameter collected monthly, Heights collected monthly, branching Number collected monthly and Leaf number also counted monthly.

## 2.2 Data Analysis

The data was tabulated by species and treatments and analysed in RStudio Version 1.2.5042, where means were derived for each of the parameter measured to derive rate of height, branch number and leaf number changes for the six months of the study. Further Means were used to compare the parameters for month six of growth using one way ANOVA and TukeyHSD to show difference at $p<0.05$.

# 3. RESULTS AND DISCUSSION

The weather changes during the six-month study period showed conducive growth conditions for *G. robusta* and *C. lusitanica* seedlings. The timing was also relevant as the farmers have been observed to also raise these species in the same period in preparation of planting from the beginning of the subsequent years [4,38-40]. The humidity ranged from 60% to 99%, Temperature ranged from 23ºC to 27ºC, and precipitation occurred in over 90% of the days, it rained throughout the study (Fig. 1) which was also indicative of the highlands of Kenya during this period.

The soil mixtures were analyzed and showed the nutrient content in the soil mixtures derived for use in the experiment (Table 2). Soil mixtures vary and in this study the soil mixtures used was wide enough representing various farmer combinations and able to demonstrate useful treatments for dissemination [6,7,41]. Studies have shown various growth ranges of *C. lusitanica* in the nursery on using different ideal soil mixtures. The ranges in growth from the previous studies have been from a mean of 16cm over 1 month to 38cm after three months [15,20]. The current study shows the height changes every month for six months for this species and thus able to show the performance in different soil media, the highest increase in height was from soil mixture *C. lusitanica* FS+FYM 182mm, *G. robusta* A+FYM 72mm (Table 3). There was no significant difference in height increase for *C. lusitanica* in the nursery between month 5 and 6, though all previous months were significantly different ($p<0.05$) (Fig. 2a), the tallest seedlings were observed from soil mixture FS+FYM (Fig. 2c). The soil mixture for *G. robusta* that showed the highest rate of increase in height was A+FYM (89±1.7 mm) (Table 3 and Fig. 2b), though the tallest seedlings were observed from soil mixture treatment of A+FYM+ FS+S at month six (Fig. 2d).

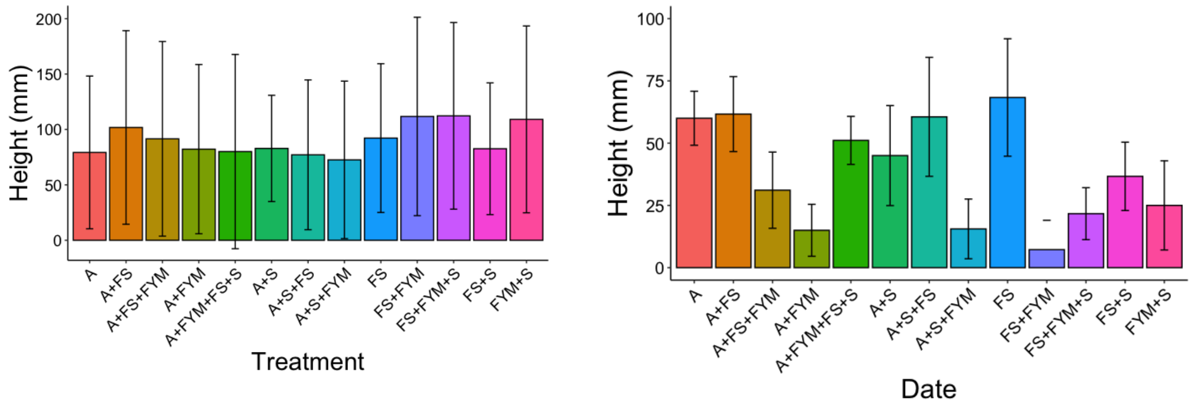
Other studies such as by Lindqvist and Ong [42]; Madadi et al. [43]; Lindqvist, [42] observed that farmers with tree nurseries preferred to assess seedlings with other morphological traits such as Size accounting for over 50% of the preference and the rest including, Colour, Growth rate, Stem form, Sturdiness, Root collar diameter, Leaf form and General health being less than 50% preferred. This showed similarity with farmer interests in the current study hence the factors of leaf numbers and branch numbers were also preferred for the seedlings in this study (Fig. 3). This study observed that for *C. lusitanica* the rate of branch numbers increase was high for the soil treatment FS+FYM+S (16±1.6) (Table 2 and Fig. 3a). Leaf numbers for *C. lusitanica* showed a high change in soil mixture A+FS+FYM and that FYM+S had the most leaves after six months (Table 2 and Fig. 3b). The rate of branch increase for *G. robusta* was low for FS+FYM and FYM+S which had very little change in six months (Table 2 and Fig. 3c). Leaf numbers showed a similar pattern FS+S having the most leaves at the end of six months (Table 2 and Fig. 3d).

**Table 3. Initial and final after six-months height, number of branches and number of leaves for the seedlings of *Cupressus lusitanica* and *Grevillea robusta* in the nursery for the treatments of soil mixtures (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand) (± Standard error)**

| | | ***Cupressus lusitanica*** | | | |
|---|---|---|---|---|---|
| **Treatment** | **Initial height (mm)** | **Final height (mm)** | **Final branch number** | **Initial Leaf numbers** | **Final leaf number** |
| A | 13±0.9 | 158±21.6 | 25±3.4 | 20±1.2 | 113±15.9 |
| A+FS | 18±4.7 | 180±35.3 | 22±4.6 | 22±1.0 | 99±19.5 |
| A+FS+FYM | 26±2.1 | 188±30.1 | 25±2.7 | 23±0.8 | 111±9.5 |
| A+FYM | 24±2.4 | 155±30.9 | 24±4.9 | 20±1.1 | 99±19.3 |
| A+FYM+FS+S | 21±1.7 | 141±43.9 | 19±5.9 | 19±1.9 | 83±22.7 |
| A+S | 27±4.8 | 144±10.3 | 25±4.6 | 17±3.1 | 115±8.6 |
| A+S+FS | 25±1.4 | 136±27.3 | 23±4.8 | 22±0.9 | 101±19.4 |
| A+S+FYM | 27±3.3 | 129±31.5 | 21±4.5 | 21±1.7 | 87±17.9 |
| FS | 25±1.5 | 160±23.2 | 23±3.3 | 22±1.1 | 114±16.1 |
| FS+FYM | 26±2.1 | 208±25.5 | 29±1.5 | 22±1.4 | 118±13.1 |
| FS+FYM+S | 23±1.5 | 225±11.1 | 32±1.8 | 22±1.1 | 138±4.7 |
| FS+S | 24±1.7 | 149±16.5 | 29±1.5 | 21±1.6 | 118±6.5 |
| FYM+S | 23±1.0 | 204±27.1 | 22±3.4 | 20±1.1 | 255±145.8 |
| | | ***Grevillea robusta*** | | | |
| **Treatment** | **Initial height (mm)** | **Final height (mm)** | **Final branch number** | **Initial Leaf numbers** | **Final leaf number** |
| A | 22±1.1 | 67±12.3 | 2±0.6 | 4±0.5 | 15±3.1 |
| A+FS | 30±3.6 | 49±11.2 | 2±0.4 | 5±0.5 | 8±2.7 |
| A+FS+FYM | 20±3.8 | 43±14.1 | 1±0.3 | 4±0.7 | 8±2.5 |
| A+FYM | 18±4.8 | 90±2.5 | 3±0.5 | 3±0.7 | 19±1.5 |
| A+FYM+FS+S | 24±3.0 | 74±11.1 | 2±0.7 | 4±0.3 | 18±3.7 |
| A+S | 20±4.2 | 64±12.2 | 2±0.7 | 3±0.8 | 15±3.0 |
| A+S+FS | 23±2.9 | 69±5.6 | 2±0.2 | 4±0.8 | 15±2.8 |
| A+S+FYM | 8±4.0 | 54±2.6 | 1±0.1 | 1±0.4 | 12±0.7 |
| FS | 25±2.3 | 57±8.9 | 2±0.4 | 4±0.4 | 13±2.6 |
| FS+FYM | 15±4.4 | 0±0.00 | 0±0.00 | 3±0.8 | 0±0.00 |
| FS+FYM+S | 14±4.5 | 45±18.3 | 1±0.5 | 3±0.9 | 10±4.5 |
| FS+S | 18±2.8 | 86±3.5 | 3±0.8 | 4±0.6 | 22±3.6 |
| FYM+S | 18±3.9 | 13±13.0 | 0±0.3 | 3±0.9 | 5±4.8 |

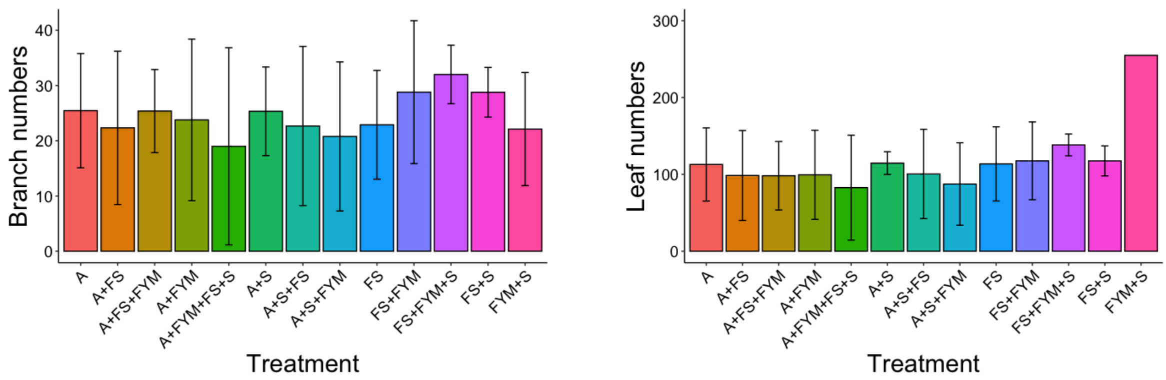
**Table 4. Six-month combined mean survival percentage for the treatments of soil mixtures (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand) after six-month period in the nursery (± Standard error)**

| Treatment | Survival (%) |
|---|---|
| A | 61±1.7 |
| A+FS | 62±2.3 |
| A+FS+FYM | 47±3.3 |
| A+FYM | 41±5.0 |
| A+FYM+FS+S | 51±2.6 |
| A+S | 52±4.3 |
| A+S+FS | 62±3.4 |
| A+S+FYM | 37±4.2 |
| FS | 78±3.2 |
| FS+FYM | 53±5.6 |
| FS+FYM+S | 54±5.8 |
| FS+S | 63±5.0 |
| FYM+S | 44±4.3 |

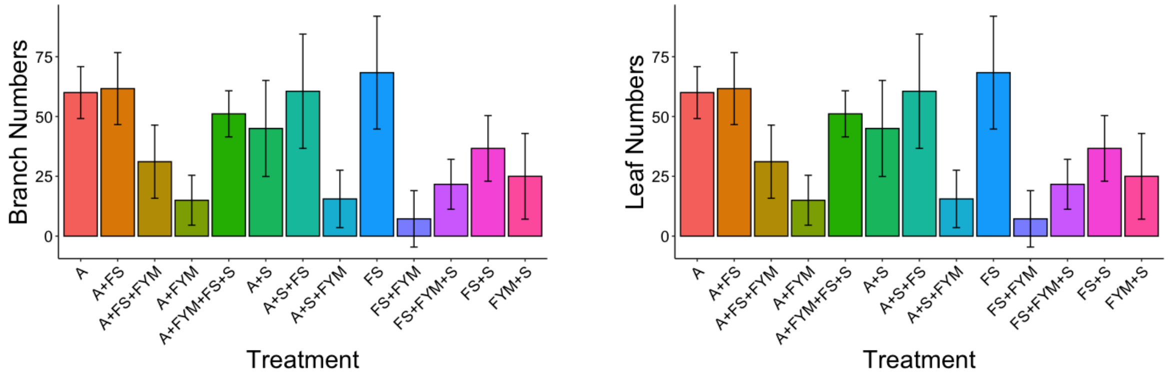



**(a)** **(b)**

**Fig. 2. Mean final heights at month six for the seedlings of *Cupressus lusitanica* (a) and *Grevillea robusta* (b) for the various treatments of soil mixtures (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand)**

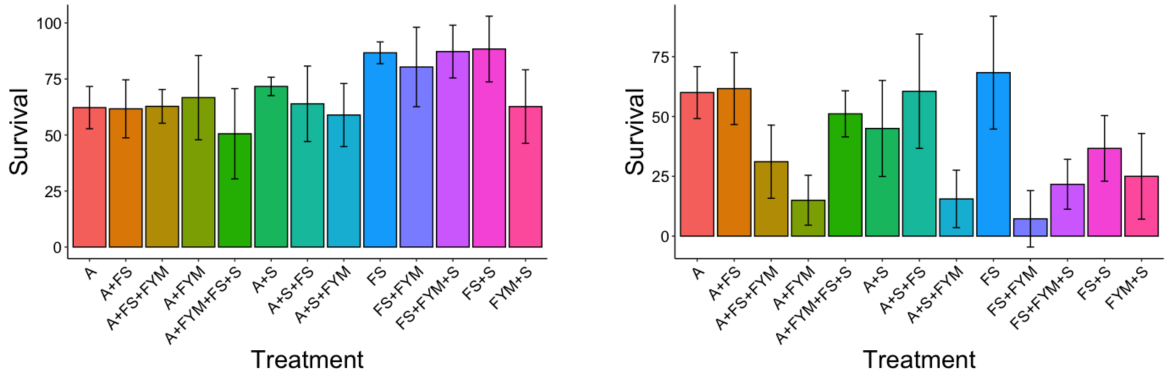



**(a)** **(b)**




**(c)** **(d)**

**Fig. 3. *Cupressus lusitanica* mean final branch numbers count (a) and mean final leaf number counts (b), *Grevillea robusta* mean final branch numbers count (c) and mean final leaf number counts (d). Treatments for the soil mixtures (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand)**




**(a)** **(b)**

**Fig. 4. Mean percentage survival for six-month period for each treatment of soil mixture (A=Agricultural soil, FS =Forest soil, FYM = Farmyard Manure, S = Sand) for *Cupressus lusitanica* (a) and *Grevillea robusta* (b)**

*Cupressus lusitanica* had generally high survival with highest being observed form Forest soil with sand mixture at 91±2.2% (Fig. 4a and Table 4). Studies such as by Gebrekidan, 2020 focused on survival rate only and observed that for Grevillea survival was 57% though in field condition planted in watershed area with high rainfall but unspecified soil medium [44]. The current study observed similar range though higher with the highest survival coming from Forest Soil at 67±4.7% at six months monitoring period ($p<0.05$) (Fig. 4b and Table 4). *Grevillea robusta* in FS+FYM had dismal performance with lowest survival only two plants survived, thus too few to draw conclusions (Fig. 4b). The survival by treatments which were different soil mixtures would be useful in farmer information to demonstrate the opportunities for practice change and identify how the current practice boards for smallholder tree farmers. When the two species were compared *C. lusitanica* had highest survival in nursery at 70±1.2% against *G. robusta* 38±1.6% (Table 4). This shows that nursery practices can be improved to increase the survival of *G. robusta* seedlings.

## 4. CONCLUSION AND RECOMMENDATION

The study observed that the performance of *Cupressus lusitanica* was varied from the performance of *Grevillea robusta*. A combination of Forest soil, Farmyard Manure and Sand (FS+FYM+S) was observed to have the best growth parameters on height, Branch numbers, leaf numbers and survival for *C. lusitanica*. *Grevillea robusta* showed different soil mixtures preforming well for different parameters, Agricultural soil combined with Farmyard Manure (A+FYM) was suitable for height and branching, with low survival (10%) while Forest soil (FS) had highest survival (63%) and for high leaf numbers Forest soil combined with sand (FS+S) performed well with survival at 30%. This showed that different soil mixtures should be used for raising each species in the nursery. The farmers who are located far away from the forest could do a combination of A+FYM as it would have high levels of NPK than only FS. However, the agricultural soil (A) should be sourced from the well managed farms which are not exhausted through continuous cropping and subsequent nutrient mining. This study therefore recommends Forest soil (FS) be used in raising *G. robusta* in the nursery as it will have high survival thereby minimizing loss for the smallholder farmers, while for *C. lusitanica* this study recommends forest soil combined with Farmyard manure and sand (FS+FYM+S) as the suitable mixture to ensure high survival and good growth parameters for the species in the nursery.

## AVAILABILITY OF DATA AND MATERIAL

The data used for this manuscript is available upon request from the author

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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