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DIFFERENT NURSERY GROWING SYSTEMS AND GROWTH MEDIA IMPROVED GERMINATION AND SEEDLING GROWTH OF FEVER TEA (*LIPPIA JAVANICA*)

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Abstract

An experiment was set up in a Completely Randomized Design (CRD) to examine the influence of nursery growing methods and growth medium on fever, tea germination, and seedling development. Two nursery growth methods (Conventional-CON and Float tray system FTs) and six different growing medium (pine bark, peat moss, coco peat, vermiculite, sand, and cattle manure) were used. ANOVA was used to compare treatment means, and means were separated using the Least Significant Difference (LSD) at a 5 % significance level. The nursery growing method and growth material exhibited a strong interaction regarding the germination index, germination percentage, seedling height, leaf area, root length, density, and final crop stand. The float tray approach yielded the greatest germination index for peat moss and the lowest for cattle manure. In the float tray method, peat moss and coco peat had the highest germination percentages, whereas cattle manure had the lowest. Under the float tray technique, the tallest seedlings emerged in peat moss and the smallest in coco peat. Peat moss had the most leaf area in the float tray system, whereas coco peat had the least in the conventional technique. Peat moss in the float tray system had the highest root length density while coco peat in the conventional technique had the lowest. Peat moss in the float tray system had the highest final crop stand, whereas seedlings in the conventional and float tray systems had nothing. based on the findings, it is recommended that fever tea seedlings be grown on peat moss using the float tray method.

Keywords: Fever tea (*Lippia javanica*), herb, nursery, growing system, growth media, float tray, conventional system.

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1. Introduction

Fever tea (*Lippia javanica*), an upright woody shrub of the Verbenaceae family [1], has to be prevalent on savannahs, forests, sides of hills, and river banks throughout east and southern Africa [2]. The plant has been documented as an important commercial medicinal herb in southern Africa [3], with generations of people using it. The demand for medicinal and aromatic plants as sources of essential oils for the medical and cosmetics industries has recently increased [4]. Fever tea has received much attention due to its health and nutritional advantages. The plant is used to treat a variety of chronic illnesses, as well as as an infusion and food. It can also be used to treat cancer, diabetes, plasmodia, microbial infections, and viruses [5], and it also has pesticidal properties [6, 7]. Fever tea is caffeine-free and packed with minerals including copper, zinc, and iron. The plant also contains water-soluble flavonoids and phenolic compounds, both of which are high in antioxidants.

Many people in southern and eastern Africa have turned to traditional medicine to tackle the COVID-19 (SARS-CoV-2 virus) epidemic. Fever tea, which was previously used to treat flu-like diseases, is now being utilized as a home therapy to treat coronavirus [5]. Except for flu-related conditions, there is no evidence that fever tea can cure corona virus [5].

The significant surge in unlicensed harvesting of fever tea in its habitat is threatening its extinction. Commercial firms in Zimbabwe, such as Tanganda Tea (Private Limited), Zimbabwe, are currently collecting the plant in its natural environment and making fever tea leaves commercially. The rising use and consumption of fever tea are not accompanied by an in-situ or ex-situ replenishing strategy. Zimbabwe has no plans for domestication or commercial cultivation of the plant [5]. Fever tea is still wild-harvested in large quantities, raising the risk of biodiversity loss, lack of planting material, and extinction owing to excessive collection. The degree of ecological stresses, such as drought and wildfires, determines ecosystem success; clearance for agricultural production is not uncommon.

The major help to native species protection is the modification of the germination procedure for producing high-quality seedlings suitable for field settings. Temperature requirements for the germination of three Lippia species (*L. graveolens, L. javanica,* and *L. multiflora*) under incubation circumstances have been studied [8]. However, there has been relatively little recorded research to investigate the effect of growing media on fever, tea germination, and seedling growth.

The standard and float tray nursery growth techniques have been employed in the production of horticultural seedlings and *Mentha spicata* and *Mentha piperita* [4, 8].

The standard technique involves suspending polystyrene trays on benches or simple wire and irrigating the substrates regularly, whereas the floating tray system involves floating polystyrene trays on water and the container-growing system, which is used in tobacco seedling production [9–11] and for aromatic plants and herbs production [12]. Other researchers have experimented with various growth media on a variety of plants [13–16]. Organic elements include peat, compost, coconut fiber, and tree bark, as well as inorganic materials like vermiculite and perlite [17]. Growing media ranges in structure, particle size, pH, aeration, water holding capacity, and nutrient retention [18] hence, determining the best growing media for fever tea germination and seedling growth is critical. Meena et al. [19] agree that the choice of proper growth medium for seed sowing has a direct influence on germination, growth, and root system functionality.

It is consequently critical to investigate domestication and multiplication strategies in order to enhance planting material and reduce the strain on fever tea wild harvesting and extinction. As a result, the purpose of this study is to investigate the effect of various nursery growing methods and growing materials on fever, tea germination, and seedling growth.

2. Materials And Methods

2. 1. Study site description

Midlands State University is located at grid coordinates 19° 52'S and 29° 84'E. The location is in Zimbabwe's Agro-Ecological Region III, which has an annual rainfall range of 500–750 mm on average. The site's average yearly temperature range is 18–22 °C. The soils are sandy loam of the fersialitic group, with kaolinite clay minerals predominating [20].

2. 2. Experimental design and treatments

The experiment was set up in a Completely Randomized Design (CRD) and the treatments were laid out in a 2×6 factorial structure. There were two nursery growth systems: Conventional and Float tray. Growing media included coco peat, peat, moss, vermiculite, cattle manure, sand, and pine bark as a control. The treatments were replicated three times, yielding a total of 36 experimental units.

2. 3. Experimental Procedure

The seeds were collected in the wild at their peak morphological and physiological development, gently thrashed, and kept in a well-ventilated dry place until planting time. To remove excess salts (K, Na, Cl), coco peat was soaked for 24 hours and then again for 12 hours to maintain a reasonably low soluble salt content with a reasonable exchange capacity to contain and provide the components essential for seed germination and seedling growth. Several types of growing medium were placed in polystyrene seedling trays (200 cells) (**Table 1**). Each treatment consisted of 20 cells that were reproduced three times. Water was applied to the growing media to field capacity, and the surplus water was allowed to drain freely. A seed rate of one seed per cell was employed. For the float tray system, the trays were designed to float in water troughs, whereas for the standard system, the polystyrene trays were suspended on wire benches beneath the shed cloths.

Table 1

Measured the physical and chemical properties of the six growth media used in the experiment

Growing Media	Bulk density (g/cm)	Porosity	pH	Electrical conductivity ($dS \cdot m^{-1}$)
Pine bark	1.56	0.37	4.6	0.96
Coco peat	0.61	0.75	5.1	1.53
Peat moss	0.45	0.82	6.2	0.40
Vermiculite	0.90	0.64	7.0	0.75
Cattle Manure	1.30	0.48	8.6	1.10
Sand	0.90	64.0	7.6	1.23

2. 4. Measured growth media physical and chemical parameters

Bulk density.

The core ring method was used, with 18 core rings, three for each type of growth media. To avoid spillage, the core rings were filled with media and carefully elevated; excess media was removed with a sharp knife. The core ring's primary weight was determined, and the growing media samples were dried in an oven at 105 degrees Celsius for 24 hours. After 24 hours, the core rings were reweighed to determine their final weight. To calculate the bulk density, the (1) was employed [21]:

$$\text{Bulk Density} = \frac{\text{mass oven dry soil}}{\text{volume of soil}}. \qquad (1)$$

Porosity.

Porosity was calculated using the (2) by [22]:

$$\text{Porocity} = 1 - \frac{\text{bulk density}}{\text{Particle density } 2.5}. \qquad (2)$$

Media pH and EC.

The pH and EC were measured following the produre by [23] using a SANXIN pH/conductivity TESTER (MP522, Sanxin, Shanghai) and the readings were recorded.

Germination and growth parameters measured.

Seeds were considered to have germinated when the radicle had emerged to >1mm and germinated seeds were recorded on a daily basis.

Days to 50 % emergence.

The days taken by the seedlings to reach 50 % emergence were recorded. This was done by manually counting up to half the total number of fever tea seeds that have emerged in the cells.

Mean germination time.

The mean germination time (MGT) was determined using the (3) by [24]:

$$\text{Mean Germination Time} = \frac{\sum Dn}{\sum n}, \tag{3}$$

where n is the number of seeds that germinated on day D and D is the number of days counted from the beginning of germination.

Germination index.

The germination index (GI), which denotes seedling vigor, was determined following the (4) described by [25]:

$$\text{Germination Index} = \frac{\text{No. of germinating seeds}}{\text{Days of first count}} + \frac{\text{No. of germinating seeds}}{\text{Days of last count}}. \tag{4}$$

Germination percentage.

The percentages of germination were determined by dividing the total number of seeds germinated by the total number of seeds sown and then multiplied by 100, using the (5):

$$\text{Germination \%} = \frac{\text{number of seeds germinated}}{\text{number of seeds sown}}. \tag{5}$$

Seedling stem height.

A 30 cm ruler was used to measure the seedling height after 90 days. A ruler was placed on the polystyrene tray cell on the base of the plant and the height was measured from the top of the media up to the apical meristem.

Root length density.

Root length density is the total length of roots divided by the volume of soil or media, it was determined following the (6) by [26]:

$$\text{Root length density} = \frac{\text{root length}}{\text{root volume}}. \tag{6}$$

Leaf area.

Leaf area was calculated using the procedure by [27] using the (7):

$$\text{Leaf area} = 0.667 \times \text{length} \times \text{Width}. \tag{7}$$

Length and width were determined using a 30 cm ruler.

Final crop stand.

The final crop stand was calculated at the end of the expiment using the (8):

$$\text{Crop stand} = \frac{\text{Surviving seedlings}}{\text{Total sown seeds}} \times 100. \tag{8}$$

2. 5. Data analysis

A two-way analysis of variance (ANOVA) was done using GenStat 18th edition for all data collected. The means were separated using LSD at a 5 % level of significance.

3. Results

3. 1. Influence of nursery growing system and media type on the number of days to 50 % emergence of fever tea seeds

There was no interaction (P>0.05) between the nursery growth system and medium type on day to 50 % emergence of fever tea seeds. However, there were significant (P<0.05) variations in days to 50 % emergence of fever tea seeds between different growth media (**Table 2**). Fever tea seeds grown on peat moss, sand, and vermiculite took the least time to attain 50 % emergence. Fever tea seeds placed on pine bark required the most time (30.23 days) to reach 50 % emergence (**Table 2**). There were also significant changes in the number of fever tea seeds that emerged to 50 % (P<0.05) between different nursery growth methods. The FTS fever tea seeds took the shortest period to attain 50 % emergence (18.69 days). Seeds sown in the CON system need the most time (30.76) to attain 50 % emergence (**Table 2**).

3. 2. Influence of nursery growing system and media type on the mean germination time (MGT) of fever tea seeds

There was no interaction (P>0.05) between the nursery growth system and medium type the MGT of fever tea seedlings. However, there were significant changes (P<0.05) in the mean germination time of fever tea seeds across different growing media. The MGT in seeds sown in peat moss, sand, and vermiculite was the shortest (21.98 days). MGT took the longest (31.93 days) for seeds sowed in pine bark (**Table 2**). On the average germination time, there were significant variations (P<0.05) across different nursery growth methods. The FTS system had the shortest mean germination time (20.3 days), whereas the CON system had the longest (31.43 days).

Table 2

Influence of nursery growing system and media type on T50 **%** and MGT

Treatment	Germination index	
Growing Media	T50 %	MGT
Peat moss	21.05^{a}	21.98^{a}
Sand	21.57^{ab}	22.93^{ab}
Vermiculite	24.17^{ab}	25.39^{ab}
Coco peat	25.40^{b}	26.46^{b}
Manure	25.92^{b}	26.50^{b}
Pine bark	30.23^{c}	31.93^{c}
Grand mean	24.72	24.72
P-value	0.009	<0.001
$LSD_{0.05}$	4.923	4.063
CV %	16.7	13.2
Nursery System		
Float tray	18.69^{a}	20.30^{a}
Conventional	30.76^{b}	31.43^{b}
Grand mean	24.72	25.86
P-value	<0.001	<0.001
$LSD_{0.05}$	2.842	2.346
CV %	16.7	13.2

3. 3. Influence of nursery growing system and media type on the germination index (GI) of fever tea seeds

There was an interaction (*P*<0.05) between the nursery growing system and media type on the germination index of fever tea seeds. The maximum germination index (1.2) was achieved by fever tea seeds seeded in peat moss under the FTS (**Fig. 1**). The lowest GI was obtained for fever tea seeds grown in sand under the CON system and in cattle dung under both growth methods (**Fig. 1**).

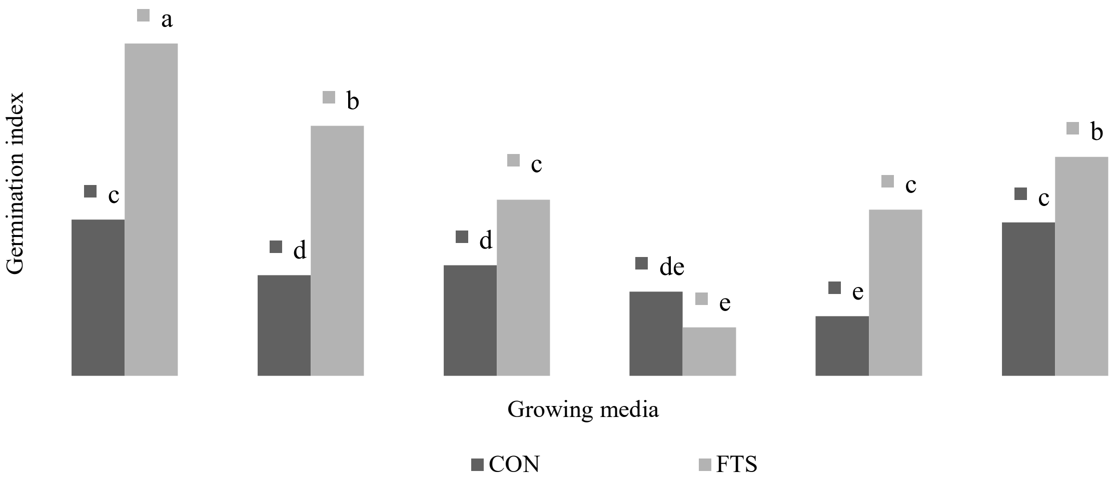

Fig. 1. Influence of nursery growing system and media type on the GI of fever tea seeds (Columns with the same letter are not significantly different (*P*>0.05))

3. 4. Influence of nursery growing system and media type on germination percentage of fever tea seeds

There was an interaction (*P*<0.05) between nursery growing system and media type on the germination percentage of fever tea seeds. The CON system's coco peat and peat moss, as well as the FTS system's peat moss, had the greatest germination percentages (**Fig. 2**). Fever tea seedlings placed in sand in the CON system and manure in the FTS system had the lowest germination rates of 25 % and 18.3 %, respectively.

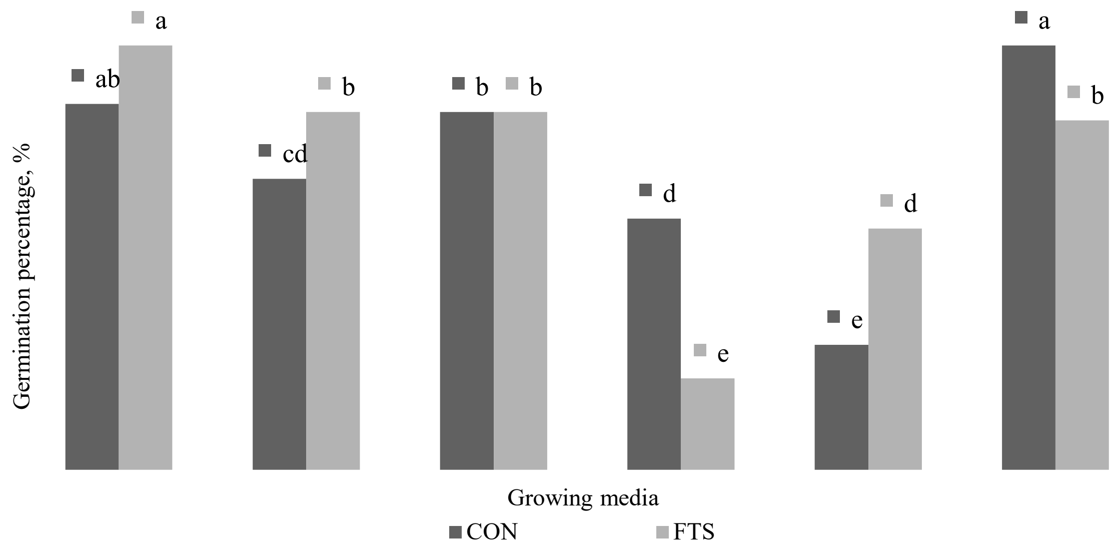

Fig. 2. Influence of nursery growing system and media type on germination percentage of fever tea seeds (Columns with the same letter are not significantly different (*P*>0.05))

3. 5. Influence of nursery growing system and media type on the seedling height of fever tea seedlings

There was an interaction ($P<0.05$) between the nursery growing system and media type on the height of fever tea seedlings. The highest seedlings (19.4 cm) were developed in peat moss under the FTS. Coco Peat produced the shortest fever tea seedlings in the nursery system. Seedlings in the FTS system's manure and sand in the CON system perished before data was gathered (**Fig. 3**).

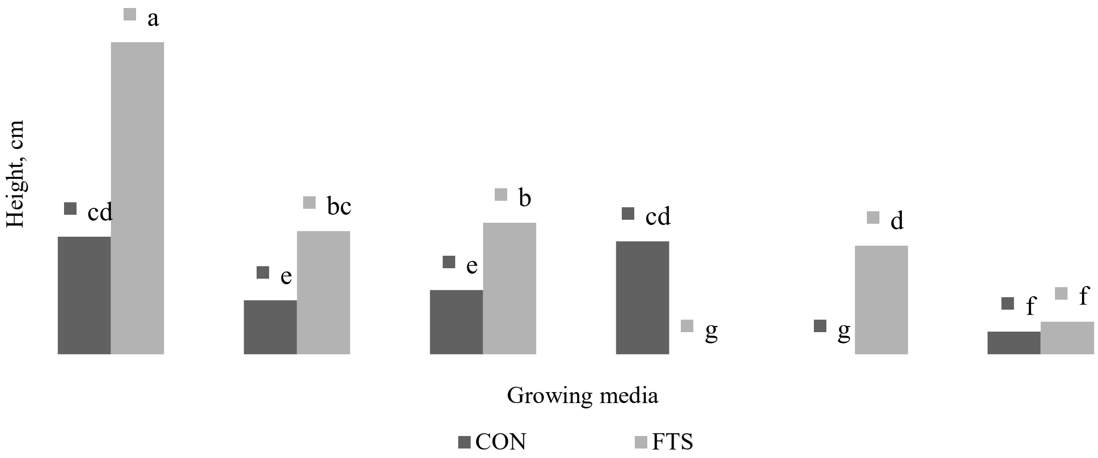

Fig. 3. Influence of nursery growing system and media on the seedling height of fever tea seedlings (Columns with the same letter are not significantly different ($P>0.05$))

3. 6. Influence of nursery growing system and media type on leaf area of fever tea seedlings

There was an interaction ($P<0.05$) between the nursery growing system and media type on the leaf area of fever tea seedlings. Seedlings established in peat moss under the FTS had the largest leaf area (11.76 cm^2). Seedlings established in coco peat in both nursery growing systems recorded the smallest leaf area (**Fig. 4**).

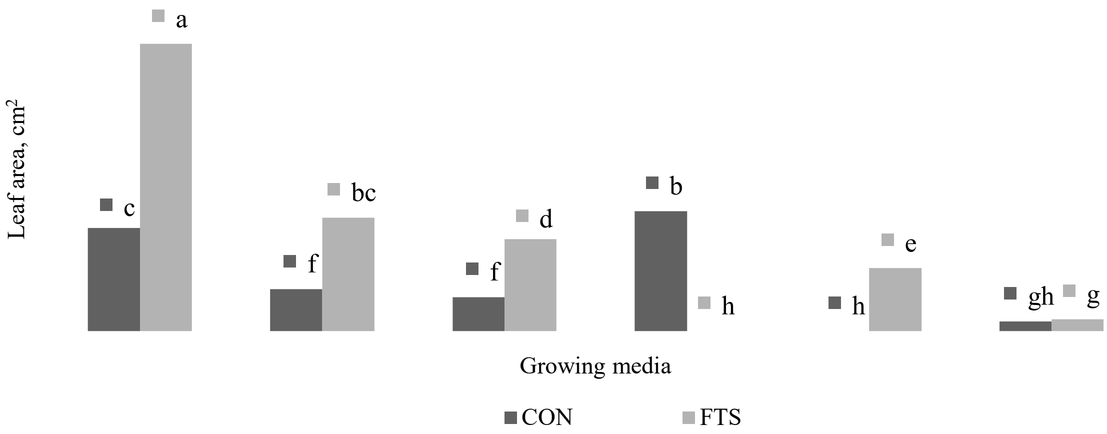

Fig. 4. Influence of nursery growing system and media type on leaf area of fever tea seedlings (Columns with the same letter are not significantly different ($P>0.05$))

3. 7. Influence of nursery growing system and media on root length density of fever tea seedlings

There was an interaction ($P<0.05$) between the nursery growing system and media on the root length density of fever tea. Fever tea seedlings cultivated in coco peat using the CON system had the lowest root density (0.23 cm/cm^3), whereas those grown in peat moss and sand using the FTS system had the highest root density (0.62 cm/cm^3 and 0.57 cm/cm^3 respectively) (**Fig. 5**).

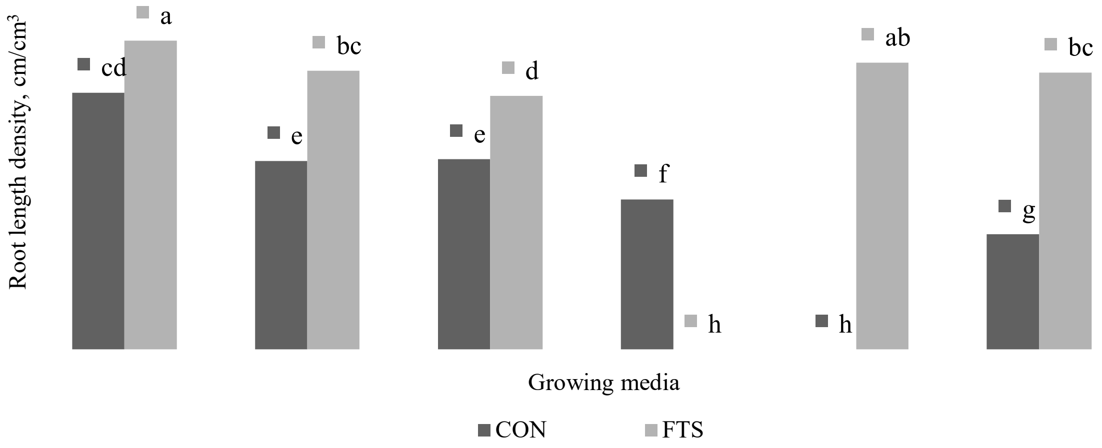

Fig. 5. Influence of nursery growing system and media type on root density, of old fever, tea seedlings (C*olumns* with the *same letter* are not significantly different (*P*>0.05))

3. 8. Influence of nursery growing system and growing media on the final crop stand of fever tea seedlings

There was an interaction (*P*<0.05) between the nursery growing system and media on the final crop stand of fever tea seedlings. In the FTS, peat moss had the greatest final crop stand (85 %). The lowest (0 %) crop stand was obtained by fever tea seedlings planted in manure using FTS and sand using the CON technique. In all nursery growth systems, three growing media (peat moss, pine bark, and vermiculite) had a final crop stand of more than 58 %, whereas manure, sand, and coco peat had less than 50 % final crop stand (**Fig. 6**).

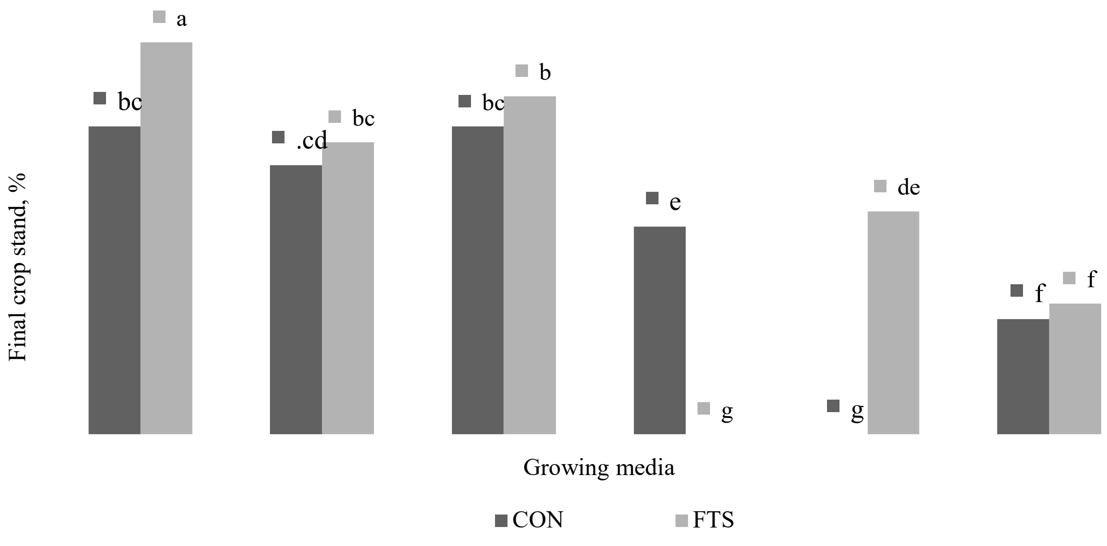

Fig. 6. Influence of nursery growing system and media on the final crop stand of fever tea seedlings (Columns with the same letter are not significantly different (*P*>0.05))

4. Discussion

4. 1. Influence of nursery growing system and media type on days to 50 % emergence and mean germination time of fever tea seeds

Fever tea seedlings produced using the float tray approach had the lowest mean germination time and the fewest number of days to 50 % emergence. This was most likely due to the continual hydration of the media in the FTS, which provided optimal water absorption by seeds compared to the conventional system, in which the media were watered on a regular basis. Fever tea seeds have a stiff seed coat, which limits the amount of water imbibition and consequently the rate of germination [28]. As a result, the FTS's continuous hydration delivered ideal moisture that helped soften the seed coat, allowing the seed to ingest water to hydrate enzymes and membranes, aiding the breakdown and translocation of the stored material. Imbibed water may also have played a part in lowering abscisic acid, which is important for seed dormancy. Water ingestion by the seed boosts the dominance of gibberellic acid, which stimulates growth. The growth media's low water content induces incomplete imbibition, which results in decreased cell turgor [29]. Water absorption decreases cell turgor, as well as cell division and elongation, eventually inhibiting radicle protrusion. These findings are consistent with those of [30], who discovered that increasing moisture levels in the growth media boosted germination speed for Savannah tea (*Lippia multiflora*).

Fever tea seeds cultivated on pine bark needed the longest time to attain 50 % emergence and the longest mean germination time when compared to those planted in peat moss, sand, and vermiculite. This is because pine bark has a higher bulk density (1.56 g/cm^3) than peat moss (0.45 g/cm^3), sand (0.90 g/cm^3), and vermiculite (0.90 g/cm^3) (**Table 1**). According to [19] an ideal growth medium should have a low bulk density to allow for optimal air and water flow through the soil. When compared to those sown on peat moss, sand, and vermiculite fever, tea seeds grown on pine bark required the most time to reach 50 % emergence and the longest mean germination time. This is due to the increased bulk density (1.56 g/cm^3) of pine bark compared to peat moss (0.45 g/cm^3), sand (0.90 g/cm^3), and vermiculite (0.90 g/cm^3) (**Table 1**). An optimum growing medium, according to [19], should have a low bulk density to allow for efficient air and water movement through the soil. Low bulk density growth media have a lower density than high bulk density growth media.

4. 2. Influence of nursery growing system and media on germination index of fever tea seeds

Fever tea seedlings cultivated in peat moss using the float tray approach had the greatest germination index of any nursery growth system or substrate tested. This is because peat moss has a high porosity (0.82) (**Table 1**). Low pore spaces in the medium prevents oxygen from being available for cell energy metabolism, causing seed germination to be delayed. The reduced germination index found in cattle dung might be attributable to anaerobic conditions in the growth environment, which cause seed degradation. The high porosity of peat moss allowed excess water to drain, allowing for optimal oxygen and moisture, findings are consistent with those of [4], who discovered that basil (*Ocimum basilicum*) and spearmint (*Mentha spicata*) seeds cultivated in a float system had a higher germination index. The results were ascribed to the continual hydration of the medium, which provided optimal moisture for the breakdown of cell membranes to initiate germination. Sand had the lowest germination index in this study's traditional setup. This is most likely because media in the conventional system were wetted on a regular basis, and because the sand has larger particle sizes with little water holding capacity, it dried up rapidly.

4. 3. Influence of nursery growing system and media type on germination percentage of fever tea seeds

The low bulk density of peat moss (0.45 g/cm^3) and coco peat (0.61 g/cm^3) may explain the high germination percentages found in the FTS and CON systems, respectively (**Table 1**). The continual hydration of peat moss in the FTS system and the moisture retention capacity of coco peat in the CON system may have given adequate moisture to soften the seed coat, enhancing the seed's imbibition ability and period. [28] revealed that the hard seed coat was to blame for the poor germination percentages in Lippia species. The difficulty of sand to hold moisture due to its high porosity (64.0) (**Table 1**) may explain its poor germination percentage in the CON system. Moisture availability is critical for seed germination. When moisture levels are low, seeds partially absorb moisture but do not germinate, instead decaying. Chaibva et al. [31] discovered a poor germination percentage of quinoa seeds on sandy soils owing to a lack of suitable moisture levels. Excess moisture generates anaerobic conditions that inhibit germination. The poor germination percentage of manure under the FTS might be related to anaerobic conditions. Alphonse et al. [30] discovered comparable results in Savannah tea germination (*Lippia multiflora*).

4. 4. Influence of nursery growing system and media type on seedling height and leaf area of fever tea

On the FTS, the highest seedlings and the most leaf area of fever tea were found in peat moss. This is due to the optimal physical and chemical qualities of peat moss as well as the nursery growth technique. The bulk density of the media determines the availability of air, water, and nutrients, whereas soil pH regulates the availability of nutrients in any growth medium [32]. Electrical conductivity, on the other hand, influences plant nutrient uptake and digestion.

Peat moss's reduced bulk density (0.45 g/cm^3) may have impacted seedling height and leaf area of fever tea seeds by supplying oxygen in the root zone to enhance root respiration, morphology, and structure, which in turn controlled vegetative growth. According to [19] an optimal growth medium should have a low bulk density (1.5 g/cm^3) for optimum flow of air and water through the soil. The findings are also consistent with those of [33] who discovered that seedlings planted in peat moss had more leaves and so grew higher than those established in coco peat. The higher water content in peat moss compared to coco peat boosted the availability of oxygen in the root zone. Plants release abscisic acid in the roots that is directed to the shoots in response to an increase in bulk density, inhibiting leaf growth and expansion. Because of its high porosity, peat moss under the FTS allowed excess water to drain, leaving enough water for growth. Regardless of fertilization Akoumianaki-Ioannidou [4] discovered that basil and spearmint cultivated in the FTS had higher plants. Furthermore, low water levels restrict water from flowing from the transpiration stream to the developing tissues, lowering cell turgor pressure and, as a result, affecting cell elongation and leaf area development [34].

When electrical conductivity levels are high, the plant development rate slows, and delicate plants may be harmed. Peat moss exhibited a low EC (0.4 dSm^{-1}) (**Table 1**), which may have aided fever and tea development. A high EC of a medium causes osmotic pressure, causing it to be saline [35]. Salinity stress is one of the most serious abiotic stress affecting adversely plant growth, various metabolic processes, and crop production [36–38]. Increased salt concentrations in the media also inhibit root moisture extraction [39]. Stomatal closure decreases transpiration, which has an impact on plant development [40, 41]. Coco peat exhibited a higher EC of 1.53 dSm^{-1} (**Table 1**) than peat moss, which might result in short seedling height and small leaf area across all nursery systems.

4. 5. Influence of nursery growing system and media on fever tea root length density

The environmental conditions that exist in the root zone have a substantial influence on root growth. Water and oxygen are required for the root development of woody plants [42]. In peat mosses with adequate aeration and moisture availability, significant root elongation was found. The substrate facilitated gaseous exchange and water flow through micro-pores in the root zone. Carbon dioxide may build to lethal amounts in a medium to poor ventilation, impeding root growth and resulting in root death [42]. The favorable physical qualities of the growing media, on the other hand, enhance root development by allowing roots to infiltrate the substrate. The increased electrical conductivity of the medium may explain the low root length density reported in coco peat (**Table 1**).

4. 6. Influence of nursery growing system and media type on the final crop stand of fever tea seedlings

The survival rate of fever tea seedlings cultivated on peat moss using FTS was high. The perfect physical and chemical qualities of peat moss, as well as the continuous hydration of the medium given by the FTS, may be credited to the outcome. Peat moss's great porosity supplies the necessary conditions for germination and gaseous exchange required by roots for respiration. Poor aeration causes oxygen to be unavailable in the root, reducing seedling survival prospects. The poor crop stand seen in sand using the standard approach might be related to the media's inability to hold water, lowering germination percentage and seedling survival. In the case of manure, the low final crop stand in the FTS might have been caused by anaerobic conditions, which could have caused seed degradation and poor germination. The anaerobic environment may have also hampered seedling development. The reduced electrical conductivity of peat moss may account for the high final crop stand (**Table 1**). When the electrical conductivity of a growth medium is high, sensitive plants may suffer from salt stress. Salinity stress limits leaf growth by sealing the stomata, lowering the rate of photosynthesis [39]. The rate of transpiration is also impacted, lowering plant survival prospects. The effect of salt stress on seedlings raised on coco peat may have lowered the ultimate crop stand across all nursery methods. There is a reduction in solute potential in a medium to high salt levels, resulting in ion toxicity to plants and plant mortality [43]. It is worth noting that under the typical system, coco peat had a high germination percentage (85 %).

5. Conclusions

Fever tea seeds can be propagated in a float tray method with peat moss as a propagation substrate for improved germination and early seedling growth. Peat moss in a float tray method enhanced mean germination time, days to 50 % emergence, germination index, root length, density, leaf area, germination percentage, and ultimate crop stand in this study. Using a propagation material with low bulk density and high porosity in a system that provides constant moisture to the seeds and roots gives ideal circumstances for fever tea germination, and early establishment. Manure and sand, although being less expensive and more frequently accessible as propagation media, did not function effectively. To improve their physical and chemical qualities, they may benefit from amendment with other media or organic materials. Using peat moss in a float tray method might be a good place to start for commercial and small-scale fever tea nurseries, conservationists, herbalists, and forestry professionals. The unique strategy will help to regenerate fever tea bushes in the wild as well as commercial production.

The limitation of the study was working with pure media substtates which is rarely the case with most nursery growers. Further research of the study would be to use amended media substrates which is commonly practiced by most farmers and nursery growers and see their effect on enhancing germination and seedling growth of the herb.

Conflict of interest

The authors declare that there is no conflict of interest in relation to this paper, as well as the published research results, including the financial aspects of conducting the research, obtaining and using its results, as well as any non-financial personal relationships.

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Data availability

Data will be made available on reasonable request.

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