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Improvement in Seed Germination and Growth Parameters in *Murraya koenigii* (L.) Spreng Using Different Growing Media

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The experiment was conducted to determine the effect of different growing media on seed germination and growth parameters of *Murraya koenigii* (L.) Spreng under glass house conditions at Dr. YS Parmar university of Horticulture and Forestry, Nauni, Solan Himachal Pradesh during May 2022 to October 2022. The experiment consist of seven treatments (growing media) viz., S1: Soil (Control), S2: Soil + FYM (2:1), S3: Soil + Vermicompost (2:1), S4: Soil + Coco peat (2:1), S5: Soil + Sand + FYM (1:1:1), S6: Soil + Sand + Vermicompost (1:1:1) and S7: Soil + Sand + Coco peat (1:1:1) with three replications. Observations were recorded on Germination percentage (%), Initiation of germination (days), Completion of germination (days), Mean daily germination (%), Peak value, Germination value, Seedling root length (cm) and Seedling shoot length (cm). The study found that the growing media of (Soil + Sand + Vermicompost) in ratio (1:1:1) exhibited

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maximum value for seed germination and growth parameters viz., maximum germination percentage (86.00 %), early initiation of germination (10.00 days), early completion of germination (20.33 days), peak value (6.35), mean daily germination (4.26 %), germination value (27.15), seedling shoot length (17.60 cm) and seedling root length (18.90 cm). However, the minimum value for all germination and growth parameters was recorded in control.

Keywords: Murraya koenigii; growing media; germination; vermicompost.

1. INTRODUCTION

Throughout history, plants have served as medicinal remedies across the globe for millennia. Today, the World Health Organization (WHO) reports that approximately 80% of the population, particularly in developing nations continue to depend on plant-based medicines for their primary healthcare needs. India, for instance, embraces diverse medicinal systems like Ayurveda, Siddha, Unani, Amchi and local health traditions, all of which prioritize the use of plant-derived products for healing both human and animal ailments. Medicinal plants harbor a wide array of biologically active compounds that play a crucial role in treating various diseases and enhancing human well-being. Besides serving as a rich source of anti-infective agents, these plant-based remedies are cost-effective and tend to have fewer adverse side effects [1].

"*Murraya koenigii*, sometimes referred to as curry leaf or kari patta in some Indian dialects, is a member of the Rutaceae family, which has more than 150 genera and 1600 species" [2]. Over the course of centuries, this plant has been utilized in various forms and holds a prominent position in Indian Ayurvedic medicine, where it is commonly referred to as "krishnanimba."Ahluwalia et al*.,* [3]. "The plant is credited with tonic and stomachic properties. Bark and roots are used as stimulant and externally to cure eruptions and bites of poisonous animals. Green leaves are eaten raw for cure of dysentery and for checking vomiting. Leaves and roots are also used traditionally as bitter, analgesic for curing piles, inflammation, itching and are useful in leukoderma and blood disorders" (Jain et al*.,* [4]. It is also known in Ayurveda as medicine for its variety of pharmacological activities like anti-cancer, anti-oxidant, anti-inflammatory, anthelmintic, anti-diabetic and anti-microbial activity.

"Murraya koenigii is widely used for centuries and have a versatile role to play in traditional medicine. The plant is credited with tonic and stomachic properties. Bark and roots are used as stimulant and externally to cure eruptions and bites of poisonous animals. Green leaves are eaten raw for cure of dysentery and for checking vomiting. Leaves and roots are also used traditionally as bitter, analgesic for curing piles, inflammation, itching and are useful in leukoderma and blood disorders" [4].

"It is also known in Ayurveda as medicine for its variety of pharmacological activities like anti-cancer, anti-oxidant, anti-inflammatory, anthelmintic, anti-diabetic and anti-microbial activity. Phytochemical present in the leaves of *Murraya koenigii* contain proteins, carbohydrates, fiber, minerals, carotene, nicotinic acid, Vitamin C, Vitamin A, Calcium and oxalic acid. Besides these it also contains crystalline glycosides, carbazole alkaloids, koenigin, koenine, Triterpenoid alkaloids and various chemicals can be isolated from *Murraya koenigii* leaves. It was found that the anti-cancer effect may be due to high phenolic and flavonoids content and also due to free-radical scavenging ability" [5].

"Curry leaf (*Murraya koenigii*) is normally propagated by seeds. The freshly harvested seeds give maximum germination but they lose their viability very quickly in storage under open conditions" (Ranganathappa et al*.,* 2001). "The utilization of an appropriate growing medium is crucial for producing high-quality seedlings, as it directly influences the establishment and subsequent maintenance of a robust and efficient root system. A suitable growing medium not only provides adequate support for the plant's anchorage but also acts as a reservoir for essential nutrients and water. Furthermore, it facilitates the diffusion of oxygen to the roots and enables gaseous exchange between the roots and the atmosphere surrounding the root substrate" [6]. "The use of high-quality and sustainable nursery potting media has a positive impact on the production of superior-quality seeds" (Agbo and Omaliko, 2006).

The role of growing media is crucial in facilitating the germination of seeds. Serving as a substrate, it furnishes essential elements and the necessary physical foundation for the seeds. Growing under

organic conditions is particularly desirable, especially for medicinal crops, because such crops are devoid of dangerous chemical pesticide residues. The media should possess favourable attributes such as effective water retention, efficient drainage and a range of desirable physical and chemical properties [7]. Growing media encompass substances such as soil, sand, FYM along with vermicompost which comprise combinations of constituents serving to supply water, air, nutrients and mechanical stability to plants. FYM, in particular, is composed partially of cow dung, urine, bedding and straw.An ideal growing medium offers ample anchorage and support to plants, acts as a reservoir for nutrients and water, facilitates the diffusion of oxygen to the roots and enables gaseous exchange between the root system and the substrate (Abad et al*.,* 2002). “Growing media serves not only as a growth medium but also as a nutrient source for plant development. The composition of the media utilized directly impacts the quality of seedlings produced” [8]. The growing media plays a vital role in growth and development of any plant species and act as one of the growths influencing factors i.e., edaphic factor that act as precursor for initial stages of plant life. Vermicompost also known as worm castings, is a nutrient-rich organic material created by earthworms decomposing organic materials. It's a great natural fertiliser and soil supplement that promotes seed germination and seedling growth (Table 2). Nitrogen, phosphate, potassium and micronutrients are all abundant in vermicompost. It provides a natural and balanced source of nutrients that can promote the early stages of seed germination and seedling growth when utilised as a component of the growing medium. Vermicompost creates enormous surface area, providing strong absorbability and maintain nutrient for long period (Syamal et al*.,* 2021).

In spite of having lots of medicinal values and good revenue, not much work has been done on its propagation in order to produce quality planting material. Therefore, the present study was undertaken with combination of different growing with soil as a control for better germination to standardize the propagation through seeds in different potting media under glass house conditions to obtain its quality planting material for its artificial regeneration.

2. MATERIALS AND METHODS

The study was carried out in homogeneous condition in the glass house condition at Dr. Y.S. Parmar university of Horticulture and Forestry located at Nauni, Solan, H.P, India. The experimental site is at an altitude of 1270m above msl at30˚52’N latitude and 76˚11’E longitude and falls under subtropical zone.

The disease-free plants of *Murraya koenigii* were identified and marked after an initial survey from natural population of Himachal Pradesh. Ripened fruits (berries) were collected in the month of July. The berries were brought to the laboratory and the extraction of seeds was done manually by removing the mucilaginous substance by squeezing in water and then washing with water three to four times. Soil for media preparation was taken from the nursery site . The soil was sandy loam in texture. Soil, sand, well decomposed farm yard manure (FYM), vermicompost (VC) and cocopeat were mixed in proper proportions to get the requisite media (treatments) viz., soil (control), soil + FYM (2:1), Soil + Vermicompost (2:1), Soil + Coco peat (2:1) Soil + Sand + FYM (1:1:1), Soil + Sand + Vermicompost (1:1:1) and Soil + Sand + Coco peat (1:1:1).The experiment was replicated thrice and was laid in CRD design. Ten seeds per pot were sown uniformly to a depth of one cm in each treatment. The pots were watered and weeded regularly. Observations were recorded on Germination percentage (%), Initiation of germination (days), Completion of germination (days), Mean daily germination (%), Peak value, Germination value, Seedling root length (cm) and Seedling shoot length (cm). The data was analysed using the technique of variance (ANOVA) in accordance with procedure outlined by Gomez and Gomez [9]. The effect of different treatments was tested at 0.05 level of significance. Further the morphological and seed germination studies were conducted both in the field and under laboratory conditions.

3. RESULTS AND DISCUSSION

Data presented in Tables 1, 2 and 3 revealed that different growing media exhibited significant effect on initiation of germination, completion of germination, germination %, peak value, mean daily germination, seedling root and shoot length in *Murraya koenigii*.

The growing media of (Soil + Sand + Vermicompost) in ratio (1:1:1) in treatment T_6 exhibited maximum value for seed germination and growth parameters viz., maximum germination percentage (86.00 %), early initiation of germination (10.00 days), early completion of germination (20.33 days), peak value (6.35),

maximum mean daily germination (4.26 %), germination value (27.15), shoot length (17.60 cm) and seedling root length (18.90 cm). However, the minimum value for all germination and growth parameters was recorded in control (T_1).

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Table 1. Effect of different growing media on germination percentage, initiation of germination and completion of germination on *Murraya koenigii*

Treatments			Germination percentage (%)	Initiation of germination (days)	Completion of germination (days)
S_1	-	(Soil) Control	56.66(48.82)	13.33	25.00
S_2	-	Soil + FYM (2:1)	60.00(50.74)	11.67	23.00
S_3	-	Soil + Vermicompost (2:1)	66.66(54.76)	11.33	21.00
S_4	-	Soil + Coco peat (2:1)	73.33(58.98)	11.00	22.33
S_5	-	Soil + Sand + FYM (1:1:1)	76.66(61.19)	10.88	20.67
S_6	-	Soil + Sand + Vermicompost (1:1:1)	86.66(68.82)	10.00	20.33
S_7	-	Soil + Sand + Coco peat (1:1:1)	80.00(63.40)	10.67	21.71
$CD_{0.05}$			**8.62(5.77)**	**0.86**	**1.39**
SE(m)			**2.81(1.88)**	**0.28**	**0.45**
SE(d)			**1.87(2.66)**	**0.39**	**0.64**

**Values in parathesis are arc sine transformed values*

Table 2. Effect of different growing media on peak value, mean daily germination and germination value on *Murraya koenigii*

Treatments			Peak Value	Mean daily germination (%)	Germination value
S_1	-	(Soil) Control	3.09	2.27(1.80)	7.02
S_2	-	Soil + FYM (2:1)	3.67	2.61(1.90)	9.60
S_3	-	Soil + Vermicompost (2:1)	3.70	3.17(2.04)	11.77
S_4	-	Soil + Coco peat (2:1)	4.08	3.28(2.07)	13.38
S_5	-	Soil + Sand + FYM (1:1:1)	4.79	3.70(2.16)	17.72
S_6	-	Soil + Sand + Vermicompost (1:1:1)	6.35	4.26(2.29)	27.15
S_7	-	Soil + Sand + Coco peat (1:1:1)	5.45	3.87(2.20)	21.19
$CD_{0.05}$			**0.66**	**0.37(0.09)**	**3.80**
SE(m)			**0.21**	**0.12(0.03)**	**1.24**
SE(d)			**0.30**	**0.17(0.04)**	**1.75**

**Values in parathesis are square root transformed values*

Table 3. Effect of different growing media on seedling shoot length and seedling root length on *Murraya koenigii*

Treatments			Seedling shoot length(cm)	Seedling root length(cm)
S_1	-	(Soil) Control	14.22	14.55
S_2	-	Soil + FYM (2:1)	15.33	15.87
S_3	-	Soil + Vermicompost (2:1)	13.63	15.77
S_4	-	Soil + Coco peat (2:1)	17.17	16.87
S_5	-	Soil + Sand + FYM (1:1:1)	17.03	17.83
S_6	-	Soil + Sand + Vermicompost (1:1:1)	17.60	18.90
S_7	-	Soil + Sand + Coco peat (1:1:1)	17.13	18.22
$CD_{0.05}$			**0.55**	**0.32**
SE(m)			**0.41**	**0.35**
SE(d)			**0.58**	**0.50**

Fig. 1. Effect of growing media {Soil + Sand + Vermicompost (1:1:1)} on germination and seedling growth of *Murraya koenigii* (L.) Spreng in comparison with control

3.1 Germination Percentage (%)

Data presented in Table 1 revealed that different growing media exhibited significant effect on germination percentage, initiation of germination (days) and completion of germination (days) in *Murraya koenigii*. The mean value for germination percentage ranged from 56.66% to 86.66% among different treatments. The maximum value for germination percentage was observed in treatment S_6 (86.66%) followed by S_7 and S_5 and treatment S_6 and S_7 were statistically at par with each other. However, the minimum value for germination percentage (56.66 %) was recorded in S_1 i.e., control which was statistically at par with S_2. There was 52.94% increase in germination percentage in treatment S_6 over control.

3.2 Initiation of Germination (days)

Data presented in Table 1 revealed that different growing media exhibited significant effect on initiation of germination in *Murraya koenigii*. The mean value for initiation of germination ranged from 10.00 days to 13.33 days among different treatments. The early initiation of germination was observed in treatment S_6 (10.33 days) followed by S_7 (10.67) and S_5 (10.88) and treatment S_6 was statistically superior to all other treatments. However, the maximum days taken for initiation of germination (13.33 days) was recorded in S_1 i.e., control.

3.3 Completion of Germination (days)

The perusal of data presented in Table 1 revealed that different growing media exerted significant effect on completion of germination in *Murraya koenigii.* The mean value for completion of germination ranged from 20.33 days to 25.00 days among various treatments. The minimum days taken for completion of germination was recorded in treatment S_6 (20.33 days) followed by treatment S_5 and S_7 and treatment S_6 was statistically superior to all other treatments. However, the maximum days taken for completion of germination (25.00 days) was recorded in T_1 i.e., control.

3.4 Peak Value

Perusal of data presented in Table 2 revealed that different growing media had significant effect on peak value, germination value and mean daily germination of *Murraya koenigii*. The peak value ranged from 3.09 to 6.35 among different treatments. The maximum peak value was registered in treatment S_6 (6.35) followed by S_7 (5.45) and S_5 (4.79) and treatment S_6 was statistically superior to all other treatments. However, the minimum peak value (3.09) was

recorded in S_1.e., control which was statistically at par with S_2 and S_3.

3.5 Mean Daily Germination (%)

Data presented in Table 2 revealed that different growing media exerted significant effect on mean daily germination in *Murraya koenigii*. The value for mean daily germination ranged from 2.27 % to 4.26 % with respect to different treatments. The maximum value for mean daily germination was recorded in treatment S_6 (4.26%) followed by treatment S_7 (3.87) and S_5 (3.70) and treatment S_6 was significantly different from all other treatments. However, the minimum value (2.27 %) for mean daily germination was recorded in S_1 i.e., control which was statistically at par with S_2.

3.6 Germination Value

Data presented in Table 2 revealed that different growing media exhibited significant effect on germination value of *Murraya koenigii*.

The germination value ranged from 7.02 to 27.15 among different treatments. The maximum germination value was recorded in treatment S_6 - 27.15 followed by S_5 -17.72 treatment S_6 was statistically superior to all other treatments. However, the minimum germination value (7.02) was recorded in S_1 (control) which was statistically at par with S_2.

3.7 Seedling Shoot Length (cm)

Appraisal of data presented in Table 3 revealed that different growing media had significant effect on seedling shoot length in *Murraya koenigii*. The mean value for seedling shoot length ranged from 14.22cm to 17.60 cm among different treatments. The maximum seedling shoot length was recorded in treatment S_6 (17.60 cm) followed by S_7 (17.13) and S_5 (17.03) and treatment S_6 and S_7 were statically at par with each other. However, the minimum value for seedling shoot length (14.22) was recorded in S_1 i.e., control which was significantly different from all other treatments. There was 23.76% increase in seedling shoot length in treatment S_6 over control.

3.8 Seedling Root Length (cm)

The perusal of data presented in Table 3 revealed that different growing media exhibited significant effect on seedling root length in *Murraya koenigii*. The mean value for seedling root length ranged from 14.55 cm to 18.90 cm among different treatments. The maximum seedling root length was recorded in treatment S_6 (18.90 cm) followed by S_7 (18.22) and S_5 (17.83) and treatment S_6 was significantly different from all other treatments. However, the minimum value for seedling root length (14.55cm) was recorded in treatment S_1 i.e., control which was significantly different from all other treatments. There was 29.89% increase in seedling root length in treatment S_6 over control.

Vermicompost is rich in beneficial microorganisms such as bacteria and fungi, which aid in nutrient cycling and promote a healthy soil environment. These bacteria can help break down organic debris and make nutrients more available to plants. Vermicompost includes growth-promoting substance such as plant hormones and enzymes that can boost root formation and overall plant growth. Cocopeat also known as coir fiber pith or coir dust is a natural and renewable resource produced from coconut husks. Cocopeat is a multipurpose soil conditioner and growing medium. It increases the porosity of the potting mixture. As a result, the soil will become airier and looser, which helps in root growth more effectively. The plants porosity capacity facilitates the maintenance of its water capacity.

Fresh seed having good vigour and moisture in early stage and media provide good moisture, aeration and water holding capacity which might shorten germination duration [10]. “Mixture of growing media vermicompost plays important role which contain plant growth regulating materials such as humic acid and plant growth regulators like auxin, gibberellins material, such as humic acid and cytokines which are responsible for seedling growth” [11]. The superiority of soil + sand + vermicompost media in the present studies over other treatments could be attributed to the conductive effect of this medium mixture on water holding capacity, porosity, soil aeration and supply of substantial amount of nutrient specially nitrogen and micro nutrients for good root and shoot growth. Similar findings have been reported by Bhardwaj and Sood, [12] where “the supply of plant water and air to the growing plants can be greatly influenced by the physical composition of growing media which may further affect the anchorage, nutrient and water holding capacity of the medium. These characteristics directly influence the seedling emergence and vigor and consequently to seedling quality. The early germination of seeds may be due to the beneficial effects of the mixed media as they

have better water retention capacity, porosity and soil aeration".

"Further increase in height of seedling with Soil + Sand + vermicompost media might be due to the reason that it stimulates nutrient uptake especially nitrogen which has a role in the assimilation of numerous amino acids that all subsequently incorporated in proteins and nucleic acid which the most of the biochemical reaction occurs. Higher aeration porosity and water holding capacity ultimately increase the speed of seed emergence" (Bhardwaj, 2013). Vermicompost possess higher nutrient content than FYM Sheikh and Dwivedi, [13] and also reported to have bioactive principles which was considered to be beneficial for growth of plants. Zaller, [14] and Ram, [15] found higher content of available N, P and K in the soil + sand + vermicompost (1:1:1) than soil + sand + FYM (1:1:1). This might have also accelerated the growth of seedling in the present study.

The potting media of soil + sand + vermicompost (1:1:1) significantly influenced the studied parameters which may be attributed to better porosity and higher nitrogen content occurring in vermicompost in this medium than that of the remaining media. These studies are in agreement with the finding of Sharma et al*.* [16] in *Murraya koenigii*, Sood et al*.* [17] in *Terminalia bellirica* and Devamavadgi et al*.* [18] in different tree species (*Acacia nilotica*, *Albizia lebbeck*, *Dalbergia sissoo*, *Gliricidia sepium*, *Inga dulce* and *Azadirachta indica*) [19,20].

4. CONCLUSION

The experiment was conducted to evaluate the effect of different growing media on seed germination and growth parameters of *Murraya koenigii.* The growing media of (Soil + Sand + Vermicompost) in ratio (1:1:1) in treatment T_6 exhibited maximum value for seed germination and growth parameters viz., maximum germination percentage (86.00 %), early initiation of germination (10.00 days), early completion of germination (20.33 days), peak value (6.35), mean daily germination (4.26 %), germination value (27.15), shoot length (17.60 cm) and seedling root length (18.90 cm). The current study indicates that potting media plays a significant role in germination and development of seedlings from seed. To obtain better germination and growth of plants from seed origin, potting media containing Soil:Sand:VC (1:1:1) should be used.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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