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Nursery Performance of *Murraya koenigii* from Seed in Relation to Potting Media and Hormonal Treatment of Branch Cuttings

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***Abstract*:** Two experiments were laid out to study the effect of potting media and hormonal treatment on nursery performance using seed and branch cuttings respectively in *Murraya koenigii*. In the first experiment, four potting media- pure soil, soil: sand (1:1), soil: sand :FYM (1:1:1) and soil: sand :vermicompost (1:1:1) were used in five replications. In the second experiment, the stem cuttings were taken from healthy plants and treated with thirteen hormonal concentrations: IBA (500, 1000, 1500 and 2000 ppm), NAA (500, 1000, 1500 and 2000 ppm), IBA (500, 1000, 1500 and 2000 ppm) and control (no treatment). This experiment had three replications. The seeds sown in soil: sand: vermicompost (1:1:1) in mid July showed significantly higher germination percentage, germinative energy, survival percentage, collar diameter, number of leaves, length of primary root, fresh shoot weight, fresh root weight, dry weight, root:shoot ratio and seedling quality index. The cuttings treated with treatment IBA 2000 ppm had significantly higher above ground and belowground parameters. The study implies that *Murraya koenigii* can be either regenerated in nursery through seed sowing in mid July using potting mixture of soil: sand: vermicompost (1: 1: 1) and also be propagated by planting branch cutting in first week of August treated with IBA 2000 ppm.

***Keywords*:** Propagation, Germination, Rooting, Growth, Planting stock

Human beings have been utilizing plants for basic preventive and curative health care since time immemorial Recent estimates suggest that over 9,000 plants have known medicinal applications in various cultures and countries (Gopal et al 2014). The medicinal and aromatic crops are now occupying a significant role in Indian agriculture. *Murraya koenigii* Spreng is one such plant that has gained immense attention over the years. *Murraya koenigii*, commonly known as curry leaf or karipatta in Indian dialects, belongs to family Rutaceae and is well known for its characteristic aroma and medicinal value (Jagadeeshkanth et al 2017). *Murraya koenigii* is well distributed in tropical and subtropical areas of Sri Lanka, Malaysia, Indonesia, Southern China and India (Dahlia et al 2017). It is also common in subtropical parts of Jammu and Kashmir. This plant adorns every house yard of Southern India. Curry leaf is a popular leaf-spice used in very small quantity for their distinct aroma due to the presence of volatile oil and their ability to improve digestion. Curry leaf is widely used in Indian cookery for flavouring foodstuffs. The leaves have a slightly pungent, bitter and feebly acidic taste, and they retain their flavour and other qualities even after drying. Curry leaf is also used in many of the Indian Ayurvedic and Unani prescriptions (Singh et al 2014). Leaves and roots are traditionally used as analgesic, curing piles, inflammation, itching and are useful in leucoderma and blood disorders.

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 to standardize the propagation of *Murraya koenigii* through seeds in different potting media and branch cuttings treated with different hormones to obtain its quality planting material for its artificial regeneration.

MATERIAL AND METHODS

The study was carried out in homogeneous conditions in the open nursery conditions of Division of Agroforestry, Sher-e-Kashmir University of Agriculture Sciences and Technology of Jammu (SKUAST-J) located at Chatha, Jammu, India. The experimental site is situated at an altitude of 332m above msl at 32^0 40' N latitude and 74^0 58' E longitudes. The experimental site falls in subtropical zone.

Seed collection, extraction, preparation of potting media and seed sowing: The disease-free plants of *Murraya koenigii* were identified and marked after an initial survey. Ripened fruits (berries) were collected in July 2019. 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. The soil was sandy loam. Soil, sand, well decomposed farm yard manure (FYM) and vermicompost (VC) were mixed in proper proportions to get the requisite media (treatments), pure soil (soil only),

soil:sand (1:1), soil:sand:FYM (1:1:1) and soil: sand: vermicompost (1:1:1). There were five replications in this experiment. The experiment was laid in CRD design. Two seeds per polybag (16cm x 24cm) were sown uniformly to a depth of one cm in each treatment. The polybags were watered and weeded regularly per requirement. Germination parameters (number of days taken for germination, germination percentage, survival percentage and germinative energy) were estimated since the beginning of experiment and remaining parameters [number of leaves, average shoot length (cm), collar diameter (mm), primary root length (cm), total seedling fresh weight (g), fresh shoot weight (g), dry shoot weight (g), fresh root weight (g), dry root weight (g), root: shoot ratio (dry weight basis), sturdiness quotient and seedling quality index] were recorded after 90 sowing. Sturdiness quotient was calculated by using the formula given by Chauhan and Chauhan (1997) and seedling quality index was estimated using the formula given by Dickson et al (1960).

Collection, preparation and treatment of branch cuttings: Branches from the plants already marked for seed collection were harvested in first week of August 2019. Cuttings of length 12-15 cm with at least 3-4 buds were immediately prepared from these branches. The prepared cuttings were bundled in the sets of 15 in order to dip in 13 different treatments (3 hormones each at 4 concentration levels viz. 500, 1000, 1500 and 2000 ppm and one control). Thereafter, basal portion of each bundle of cuttings was dipped in requisite concentrations of rooting hormones for 10-15 seconds (a quick dip method) and were planted 7-8 cm deep in the polythene bags of 16cm x 24 cm containing field soil. The soil was sandy loam with 7.81-pH. A light overhead watering was given immediately after planting so that cuttings get settled. Afterwards, the cuttings were irrigated as per requirement. Weeding was done at equal interval with proper care without disturbing the planted cuttings. The experiment was conducted in Completely Randomized design (CRD) with 3 replications. The growth and development characteristics of stem cuttings were recorded after 90 days from their planting by uprooting the whole plant except sprouting percentage, which was recorded after 45 days from planting. The observations included: sprouting percentage, number of shoots, average shoot length (cm), number of leaves per plant, number of lateral roots, root length (cm), fresh root biomass (g) and dry root biomass (g).

The dry weight of the roots was recorded using digital electronic balance by drying the roots separately in the oven at 60°C for 48 hours and weighing the dried samples.

Data analysis: The data of both the experiments were analysed using the technique of variance (ANOVA) in accordance with procedure outlined by Gomez and Gomez (1984). The effect of different treatments was tested at 0.05 level of significance. The percentage data were transformed using angular transformation.

RESULTS AND DISCUSSION

Germination parameters and survival per cent: All the germination parameters (germination percentage, number of days taken for germination and germination energy) were significantly influenced by the potting media (Table 1). The survival percentage was also significantly influenced by the potting media (Table 1).

The treatment soil:sand:vermicompost (1:1:1) exhibited highest seed germination (96.00%), minimum number of days taken for germination (13.40 days) and maximum germinative energy (52.00%) (Table 1). The value of germination percentage and germination energy in treatment soil: sand: vermicompost (1:1:1) was statistically as par with respective values in soil: sand: FYM (1:1:1) but superior to soil only and soil: sand (1:1) respectively. In case of survival per cent, the value in soil:sand:vermicompost (1:1:1) was statistically superior to all the remaining treatments (Table 1). The numbers of days taken for germination was minimum in soil:sand:vermicompost (1:1:1) which was statically as par with soil: sand: FYM (1:1:1) but inferior to soil only and soil:sand (1:1), respectively.

Table 1. Effect of different potting media on germination, days taken to germination*, germination energy and survival percentage*

Treatments	Germination (%)	Number of days taken for germination	Germination energy (%)	Survival (%)
Soil only	90.00 (73.54)*	16.2	34.00	86.68 (68.78)*
Soil:Sand(1:1)	78.00 (64.87)*	18.4	14.00	79.45 (63.24)*
Soil:Sand:FYM (1:1:1)	94.00 (78.92)*	14.0	46.00	95.78 (78.71)*
Soil:Sand: VC(1:1:1)	96.00 (82.61)*	13.4	52.00	98.00 (82.41)*
Mean	89.50 (72.48)*	15.5	36.50	89.97 (73.28)*
CD (p=0.05)	11.31 (9.21)*	1.2	10.90	7.39 (10.71)*

*Figures in parenthesis are transformed (angular) value

Above ground parameters: The treatments (potting media) exhibited significant effect on all the studied aboveground seedling parameters (shoot length, collar diameter, number of leaves per plant, number of leaves, fresh shoot weigh and dry shoot weight) (Table 2).

The media soil: sand: vermicompost (1:1:1) had the maximum value for parameters- shoot length (14.05 cm), collar diameter (2.42 g), number of leaves (10.6), fresh shoot weight (2.01 g) and dry shoot weight (0.92 g). Shoot length and number of leaves in soil: sand: vermicompost (1:1:1) were statistically at par with the respective values in soil: sand FYM (1:1:1) and soil only but statically superior to soil:sand(1:1). In case of collar diameter, fresh shoot weight, the values in soil: sand: vermicompost (1:1:1) were statistically at par only with the respective values in soil: sand: FYM (1:1:1) but superior to both soil only and soil: sand (1:1). The dry shoot weight in soil: sand: vermicompost (1:1:1) was statistically superior to all the remaining treatments (Table 2).

Below ground parameters: Table 3 shows that the effect of treatments was significant on length of primary root, fresh root weight and dry root weight.

The maximum root length (19.1 cm), fresh root weight (2.70 g) and dry root weight (1.39 g) were recorded in soil: sand: vermicompost (1: 1: 1). The values of length of primary root, fresh root weight and dry root weight were statically superior to the respective values in the remaining treatments (Table 3).

Whole seedling parameters: The potting media significantly influenced all of the whole seedling quality parameters except the sturdiness quotient (Table 4).

The maximum values of total seedling fresh weight, total seedling dry weight, root: shoot ratio and seedling quality index were observed in soil: sand: vermicompost (1:1:1) which were statistically superior to respective values in all other treatments (Table 4).

Effect on aboveground parameters of branch cuttings: The effect on hormonal treatment was significant on sprouting per cent, shoot length and number of leaves (Table 5). However, the effect on number of shoots was non-significant. The treatment IBA 2000ppm had the highest sprouting per cent (56.48%) which was statistically higher than all the remaining treatments. The values of sprouting per cent, shoot length and number of leaves were higher in IBA (500, 1000, 1500 and 2000 ppm) than the respective values in respective concentrations of NAA and IBA (Table 5).

Table 3. Effect of different potting media on belowground seedling parameters

Treatments	Length of primary root (cm)	Fresh root weight (g)	Dry root weight (g)
Soil only	15.7	0.85	0.39
Soil: Sand(1:1)	10.6	0.50	0.26
Soil: Sand: FYM (1:1:1)	17.3	1.35	0.82
Soil:Sand: VC(1:1:1)	19.1	2.70	1.39
Mean	15.7	1.35	0.71
CD (p=0.05)	0.5	0.25	0.05

Table 2. Effect of different potting media on aboveground parameters of seedlings

Treatments	Shoot length (cm)	Collar diameter (mm)	Number of leaves plant^{-1}	Fresh shoot weight (g)	Dry shoot weight (g)
Soil only	12.46	2.04	8.6	1.50	0.55
Soil: Sand(1:1)	10.36	1.63	6.2	0.70	0.36
Soil: Sand: FYM (1:1:1)	13.45	2.29	9.2	1.91	0.75
Soil: Sand: VC(1:1:1)	14.05	2.42	10.6	2.01	0.92
Mean	12.58	2.04	8.65	1.40	0.65
CD (p=0.05)	1.67	0.24	2.3	0.31	0.04

Table 4. Effect of different potting mixture on whole seedling parameters

Treatments	Total seedling fresh weight	Total seedling dry weight	Root: shoot ratio (dry weight basis)	Sturdiness quotient	Seedling quality index
Soil only	2.35	0.92	0.71	13.88	0.006
Soil:Sand (1:1)	1.20	0.61	0.73	12.94	0.004
Soil:Sand:FYM (1:1:1)	3.26	1.55	1.08	13.58	0.011
Soil:Sand: VC(1:1:1)	4.71	2.34	1.51	13.72	0.016
Mean	2.79	1.33	1.00	13.53	0.009
CD (p=0.05)	0.43	0.05	0.07	NS	0.002

Effect on belowground parameters of branch cuttings: Rooting percentage, number of lateral roots and root length varied significantly with hormonal concentration (Table 6). The highest rooting percentage (40.19) and highest number of lateral roots (18.20) were recorded in IBA 2000ppm which were statistically superior to all the remaining hormonal treatments (Table 6). The average root length was also highest (4.47 cm) in IBA 2000ppm which was statistically at par with IBA1500ppm and IBA1000ppm but superior to remaining hormonal treatments. The values of rooting per cent, number of lateral roots and root length were higher in IBA (500, 1000, 1500 and 2000 ppm) than the respective values in respective concentrations of NAA and IBA (Table 6).

Effect of potting media on germination and growth of seedlings: The germination parameters (germination percentage, germination energy and survival percentage), above ground parameters (shoot length, collar diameter, number of leaves, and fresh and dry shoot weight) and below ground parameters (length of primary root, fresh root weight, dry root weight) and whole seedling parameters (total seedling fresh weight, total seedling dry weight, root: shoot ration and seedling quality index) and whole seedling parameters (total seedling fresh and dry weights, root: shoot ratio and seedling quality index) in soil:sand: VC (1:1:1) were

Table 5. Effect of hormonal applications on aboveground parameters of branch cuttings

Treatments	Sprouting percentage	Number of shoots	Shoot length(cm)	Number of leaves
IBA500ppm	22.09 (28.02)	1.600	5.21	6.43
IBA1000ppm	38.81 (38.51)	1.967	5.94	8.93
IBA1500ppm	46.30 (42.86)	3.200	6.17	9.30
IBA2000ppm	56.48 (48.70)	2.967	7.07	13.33
NAA500ppm	20.00 (26.54)	1.667	4.14	5.13
NAA1000ppm	25.56 (30.35)	2.273	4.36	5.43
NAA1500ppm	29.89 (33.12)	1.527	4.76	5.80
NAA2000ppm	33.34 (35.25)	2.010	5.01	6.10
IAA500ppm	19.76 (26.37)	1.700	4.10	5.00
IAA1000ppm	24.67 (29.77)	2.067	4.28	5.53
IAA1500ppm	28.67 (32.35)	2.097	4.75	5.67
IAA2000ppm	32.64 (34.83)	1.670	5.05	6.03
Control	8.78 (17.22)	0.00	0.00	0.0
CD (p=0.05)	2.11 (1.39)	NS	0.45	0.87

Table 6. Effect of hormonal applications on belowground parameters of branch cuttings

Treatments	Rooting Percentage	Number of lateral roots	Root length (cm)
IBA500ppm	18.78 (25.66)	9.83	2.95
IBA1000ppm	23.67 (29.10)	12.17	3.50
IBA1500ppm	31.11 (33.89)	15.43	3.93
IBA2000ppm	41.67 (40.19)	18.20	4.47
NAA500ppm	7.69 (16.06)	3.80	1.23
NAA1000ppm	12.39 (20.59)	5.90	1.60
NAA1500ppm	14.80 (22.61)	6.87	1.94
NAA2000ppm	16.67 (24.07)	7.07	2.17
IAA500ppm	6.97 (15.29)	3.73	1.16
IAA1000ppm	12.11 (20.35)	5.77	1.58
IAA1500ppm	14.39 (22.28)	6.47	1.88
IAA2000ppm	16.34 (23.83)	7.00	2.08
Control	0.00 (0.00)	-	-
CD (p=0.05)	1.69(1.38)	1.82	1.04

superior to remaining potting media. Similarly, the number days taken for germination were lowest in soil:sand:VC (1:1:1), which was lower than remaining potting media. This implies treatment soil:sand:VC (1:1:1) was overall superior with respect to germination parameter, above ground, below parameters. Mugloo et al (2015), Sood et al (2018), Ram and Sood (2019) also reported similar findings in respective seedlings of *Picea smithiana, Oroxylum indicum* and *Terminalia bellirica*. The highest germination parameters (germination per cent, germination energy and survival per cent in soil:sand:VC (1:1:1) in the current study could be due to fact that media containing soil:sand:VC (1:1:1) could have higher aeration porosity and water holding capacity which ultimately increases the speed of seed emergence (Bharadwaj 2013). Speady and early emergence of seedlings in Soil:Sand: VC (1:1:1) might have provided longer period of growth in this media leading to better performance of seedlings. Further, vermicompost possesses higher nutrient content than FYM (Sheikh and Dwivedi 2017) and also reported to have bioactive principles, which are considered to be beneficial for root growth, root initiation, germination and growth of plants (Zaller et al 2007). Ram (2017) found higher contents of available N, P and K in soil:sand:VC (1:1:1) than soil:sand:FYM (1:1:1) and soil only respectively. All of this might have also accelerated the growth of seedlings in soil:sand:VC (1:1:1) in the present study.

Effect of hormonal treatment of growth and development of branch cuttings: The above ground parameters (sprouting per cent, number of shoots, shoot length and number of leaves) were significantly affected by hormonal treatment. All the pre-said parameters in treatment IBA 2000ppm were significantly superior to remaining hormonal applications. The below ground parameters namely rooting percentage and number of lateral roots was significantly higher in treatment of cuttings with IBA 2000ppm than the remaining treatments. However, root length in IBA 2000ppm was highest but statically at par with IBA 1500ppm and IBA 1000ppm but statistically superior to remaining treatments. This also implies that overall IBA 2000 ppm is also superior in belowground parameters. Further, a majority of growth parameters had higher values in IBA (2000ppm, 1500 ppm, 1000ppm and 500pm) than in the respective concentrations of NAA and IAA. These results are consistent and corroborates with the findings of earlier workers, who demonstrated that IBA was most effective auxin in triggering rooting in stem cuttings than IAA and NAA (Babaie et al 2014). The role of IBA in improving both rooting percentage and development of roots have been reported by Hartman et al (2011). Amri et al (2010) reported similar findings in IBA treated African Blackwood (*Dalbergia melanoxylon*) cuttings that produced maximum number of roots. Rana and Sood (2012) also reported IBA to be more effective than NAA and IAA in inducing root and development of *Ficus roxburghii* branch cuttings. The overall better growth and development with IBA treatment in the current study could be because of its greater stability, transportability, ability to produce roots and consequently results in lower morality in plants in the current study. Further, this could also be attributed to the fact that growth hormones determine cell elongation and cell division thereby promoting roots length (Abidin and Baker 1984) and consequently resulting better overall growth of the cuttings.

CONCLUSION

The current study indicates potting media plays a significant role in germination and development of seedlings from seed. The hormonal concentration also influenced rooting and development of branch cuttings of *Murraya koenigii*. To obtain better growth germination and growth of plants from seed origin, potting media containing soil:sand:VC (1:1:1) should be used. The seedlings can also be obtained by treating branch cuttings IBA 2000 ppm.

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