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Germination Response of *Pinus kesiya* in Different Containers and Potting Media in Northeast Region of Nagaland

Sudila Anar* and Afaq Majid Wani

Department of Forest Biology, Tree Improvement and Wildlife Science, College of Forestry, SHUATS, Prayagraj-Uttar Pradesh, India

**Corresponding author*

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A B S T R A C T

The study entitled Germination response of *Pinus Kesiya* in different containers and potting media in Northeast area of Nagaland was carried out during the year 2021- 2022 to see the performance of different types of containers and the most suitable soil media for growth and establishment of *Pinus kesiya* located at Kohima district with the average annual rainfall of 1660.8 mm. The effects of container types and growth medium on the seedling growth and root morphology of *Pinus kesiya* were investigated by using a completely randomized block experimental design. There were six treatments replicated three times with 10 seeds per replication. Both container type and growth medium significantly affected the growth, biomass, and root morphological indexes of *Pinus kesiya* seedlings, but container type had a greater effect on the seedling quality of *Pinus Kesiya* than the growth medium. Among the different containerized raised seedlings, the root trainer (150 cc) raised seedlings produced healthier plant growth as compared to the seedlings raised in Polybags (6×7). Potting mixture of soil: sand: FYM in the ratio of 1:1:1 (M_2) showed the best response in root trainers (C_1) whereas for polybags (C_2) potting mixture of soil: sand: Vermicompost in the ratio 1:1:1 (M_5). And in all parameters the minimum was recorded in M_3(Soil + FYM+ Neem Cake) and M_6 (Neem cake + Sand+ Vermicompost) for root trainers and polybags.

Introduction

Pinus kesiya (Khasi pine) is a three-needle pine, native to Cambodia, China, India, Laos, Myanmar, Philippines, Thailand and Vietnam (Armitage *et al.*, 1980). It belongs to the family Pinaceae and is one of the mostly distributed pines in Asia. In India it grows mostly in Khasi Hills, Naga Hills and Manipur. It occurs at elevations between 800 to 2000 m asl in Khasi Hills and thrives well at elevation range of 1200 to 1400 m asl (Sahni, 1990). As a plantation species *Pinus kesiya* grows very well on sites within the altitudinal range of 700 -1,800m, characterized by a summer rainfall of 1,000 – 2,000 mm and a distinct dry season (Pousujja *et al.*, 1986). For its proper growth it requires moist conditions having an annual rainfall of 200 cm with well–drained soils, while extreme heat or cold conditions

have a detrimental effect on the tree (Krishnamurthi, 1969). *Pinus kesiya* is a tree reaching up to 30 – 35 m tall with a straight, cylindrical trunk. The bark is thick, dark brown, with deep longitudinal fissures (Dkhar and Wani 2021; Missanjo *et al.,* 2013). The branches are robust, red brown from the second year, the branchlets horizontal to drooping. The leaves are needle-like, dark green, usually 3 per fascicle, 15 – 20 cm long, the fascicle sheath 1 – 2 cm long and persistent. The cones are ovoid, 5-9 cm long, often curved downwards, sometimes slightly distorted. The seeds are winged, 6-7 mm long with a 1.5-2.5 cm wing. Pollination is in mid spring, with the cones maturing 18-20 months after (Orwa, 2009).

Materials and Methods

Study site description

The study was conducted in Kohima district at Nagaland, India to evaluate the germination response of *Pinus kesiya* in different containers and potting media during the year 2021-2022. Kohima witnesses a humid subtropical climate. Summer season commences from end of March till May, during June to September the city witness heavy to very heavy rainfall. Kohima has 25°40'N latitudes and 94°07'E longitude. It has an average elevation of 1261 m. The average annual rainfall of Kohima is 1660.8 mm.

Experiment design

The experiment was laid out in Completely Randomized Design (CRD) in open condition. There were six treatments including control replicated three times with several potting media. Each treatment was replicated 3 times with 10 seeds per replication. The seeds were collected from the forest of Kohima district (Nagaland). The cones collected were dried in open air and sunlight for 24 hrs, when the cones were dry enough the seeds were being released by tapping it on a plate / a flat surface. The planting medium for the seed which was used were T_1 Control (Forest soil), T_2 (Soil + FYM + Sand), T_3 (Soil + FYM + Neem Cake), T_4 (Soil + FYM + Vermicompost), T_5 (Soil + Sand + Vermicompost), T_6 (Neem cake + Sand + Vermicompost) taken in 1:1:1 ratio and were filled in two types of containers.C_1 Polybags (6×7) and C_2 Root trainers (150 cc). The parameters recorded include germination percent (%), germination Value (GV), germination Speed, length of the shoots/ seedling (cm), length of roots/ seedlings (cm), number of needles, number of roots/ seedlings, collar diameter (mm), fresh shoot weight (g) dry shoot weight (g), fresh root weight (g), dry root weight (g), root/shoot ratio, total biomass of seedling (g), sturdiness quotient, Dickson quality index. Data obtained was analysed using Fisher's analysis of variance technique.

Results and Discussion

The germination response of different containers and potting media on various growth parameters of *Pinus kesiya* and their trends have been depicted in Table 1, Table 2 and Table 3 respectively. Perusal of data from the Tables reveals that different containers and potting media significantly influenced the different growth and quality parameters of *Pinus kesiya* seedlings. The mean value of various growth parameters of *Pinus kesiya* is affected by different containers and potting media are given in Table 1.The maximum germination percent after one growing season was observed in M_2 (78.91) in root trainers excluding M_6 which was recorded minimum (56.94). Whereas, for polybags the maximum germination percent after one growing season was observed in M_2 (80.16) in polybags excluding M_6 which was recorded minimum (58.19).

The maximum germination value after one growing season was observed in M_2 (39.19) in root trainers excluding M_3 which was recorded minimum (18.16). Whereas, for polybags the maximum germination value after one growing season was observed in M_5 (40.44) in polybags excluding M_3 which was recorded minimum (19.41). The maximum mean germination time after one growing season was observed in M_4 (20.21) in root trainers

excluding M_6 which was recorded minimum (17.56). Whereas, for polybags the maximum mean germination time after one growing season was observed in M_5 (21.46) in polybags excluding M_6 which was recorded minimum (15.65).

The maximum length of shoots/seedlings after one growing season was observed in M_4 (6.49) in root trainers excluding M_6 which was recorded minimum (6.23). Whereas, for polybags the length of shoots/seedlings after one growing season was observed in M_2 (6.64) in polybags excluding M_3 which was recorded minimum (6.50).The maximum length of roots/seedlings after one growing season was observed in M_4 (4.37) in root trainers excluding M_6 which was recorded minimum (4.17). Whereas, for polybags the maximum length of roots/seedlings after one growing season was observed in M_5 (3.69) in polybags excluding M_3 which was recorded minimum (3.57).The maximum number of needles after one growing season was observed in M_4 (64.13) in root trainers excluding M_6 which was recorded minimum (59.20).

Whereas, for polybags the maximum number of needles after one growing season was observed in M_4 (74.80) in polybags excluding M_3 which was recorded minimum (69.40).The maximum after number of roots/ seedlings one growing season was observed in M_2 (7.67) in root trainers excluding M_3 which was recorded minimum (7.20). Whereas, for polybags the maximum number of roots/ seedlings after one growing season was observed in M_5 (7.20) in polybags excluding M_6 which was recorded minimum (6.87). The maximum collar diameter after one growing season was observed in M_2 (0.89) in root trainers excluding M_6 which was recorded minimum (0.82). Whereas, for polybags the maximum collar diameter after one growing season was observed in M_4 (0.80) in polybags excluding M_3 which was recorded minimum (0.77).

The maximum fresh weight of shoots after one growing season was observed in M_4 (1.31) in root trainers excluding M_6 which was recorded minimum (1.27). Whereas, for polybags the maximum fresh weight of shoots after one growing season was observed in M_5 (1.31) in polybags. Excluding M_3 which was recorded minimum (1.28). The maximum fresh weight of roots after one growing season was observed in M_5 (1.41) in root trainers. Fresh weight of roots remains more or less with all the treatments excluding M_6 which was recorded minimum (1.37). Whereas, for polybags the maximum fresh weight of roots after one growing season was observed in M_4 (1.26) in polybag. Fresh weight of roots remains more or less with all the treatments excluding M_3 which was recorded minimum (1.22). The maximum dry weight of shoots after one growing season was observed in M_5 (0.33) in root trainers. Dry weight of shoots remains more or less with all the treatments excluding M_6 which was recorded minimum (0.28).Whereas, for polybags the maximum dry weight of shoots after one growing season was observed in M_5 (0.38) in polybag excluding M_3 which was recorded minimum (0.34). The maximum dry weight of roots after one growing season was observed in M_2 (0.43) in root trainers.

Dry weight of roots remains more or less with all the treatments excluding M_3 which was recorded minimum (0.39).Whereas, for polybags the maximum dry weight of roots after one growing season was observed in M_5 (0.32) in polybag. Dry weight of roots remains more or less with all the treatments excluding M_6 which was recorded minimum (0.30).

The maximum root and shoot ratio after one growing season was observed in M_5 (0.74) in root trainers excluding M_6 which was recorded minimum (0.66).Whereas, for polybags the average maximum root and shoot ratio after one growing season was observed in M_5 (1.24). Root and shoot ratio remain more or less with all the treatments excluding M_3 which was recorded minimum (1.07).

The maximum seedling biomass after one growing season was observed in M_4 (0.74) in root trainers. Seedling biomass remain more or less with all the treatments excluding M_3 which was recorded minimum (0.69).

Table.1 Germination response of *Pinus kesiya* in different containers and potting media on germination characters in one growing season

Treatments notation	Treatments	Germination percent (%)		Germination Value		Mean germination time	
		Root trainers (C_1)	Polybags (C_2)	Root trainers (C_1)	Polybags (C_2)	Root trainers (C_1)	Polybags (C_2)
M_1	Control	73.46	59.58	18.84	20.09	18.09	20.25
M_2	Soil + FYM + Sand	78.91	80.16	39.19	33.05	19.00	18.81
M_3	Soil + FYM + Neem Cake	58.33	74.71	18.16	19.41	14.40	19.01
M_4	Soil + FYM + Vermicompost	69.05	70.30	23.16	24.41	20.21	19.34
M_5	Soil + Sand + Vermicompost	67.72	68.97	21.83	40.44	17.76	21.46
M_6	Neem cake + Sand + Vermicompost	56.94	58.19	31.80	23.08	17.56	15.65
	S. Em ±	2.352	1.967	1.197	1.366	1.328	1.443
	C.D.(P=0.05)	4.986	4.170	2.538	2.897	2.815	3.060

Table.2 Germination response of *Pinus kesiya* in different containers and potting media on morphological characters in one growing season

Treatments notation	Treatments	Length of the shoots/ seedling (cm)		Length of roots/ seedlings (cm)		Number of needles		Number of roots/ seedlings		Collardiameter (mm)	
		Root trainers (C_1)	Polybags (C_2)	Root trainers (C_1)	Polybags (C_2)	Root trainers (C_1)	Polybags (C_2)	Root trainers (C_1)	Polybags (C_2)	Root trainers (C_1)	Polybags (C_2)
M_1	Control	6.36	6.58	4.32	3.66	63.80	74.27	7.33	7.07	0.87	0.78
M_2	Soil + FYM + Sand	6.43	6.64	4.35	3.60	60.53	74.20	7.67	7.07	0.89	0.78
M_3	Soil + FYM + Neem Cake	6.47	6.50	4.35	3.57	62.13	69.40	7.20	7.00	0.83	0.77
M_4	Soil + FYM + Vermicompost	6.49	6.55	4.37	3.64	64.13	74.80	7.33	7.13	0.88	0.80
M_5	Soil + Sand + Vermicompost	6.42	6.55	4.31	3.69	64.07	73.13	7.47	7.20	0.85	0.79
M_6	Neem cake + Sand + Vermicompost	6.23	6.63	4.17	3.65	59.20	74.33	7.27	6.87	0.82	0.78
	S. Em ±	0.186	0.597	0.337	0.552	0.967	1.437	0.856	0.510	0.157	0.100
	C.D.(P=0.0)	0.394	1.265	0.715	1.170	2.049	3.046	1.815	1.080	0.333	0.211

Table.3 Germination response of *Pinus kesiya* in different containers and potting media on Biomass characters in one growing season

Treatments notation	Treatments	Fresh weight of shoots (g)		Fresh weight of roots (g)		Dry weight of shoots (g)		Dry weight of roots (g)		Root and Shoot ratio (g)		Seedling Biomass (g)		Sturdiness Quotient		Dickson Quality index	
		Root Trainers (C_1)	Polybags (C_2)	Root Trainers (C_1)	Poly bags (C_2)	Root Trainers (C_1)	Poly bags (C_2)	Root Trainers (C_1)	Poly bags (C_1)	Root Trainers (C_1)	Poly bags (C_1)	Root Trainers (C_1)	Poly bags (C_1)	Root Trainers (C1)	Poly bags (C1)	Root Trainers (C1)	Poly bags (C2)
M_1	Control	1.29	1.29	1.38	1.23	0.29	0.35	0.42	0.31	0.67	1.09	0.72	0.67	7.31	8.44	0.090	0.070
M_2	Soil + FYM + Sand	1.28	1.29	1.39	1.25	0.31	0.36	0.43	0.31	0.68	1.19	0.71	0.67	7.84	8.49	0.092	0.069
M_3	Soil + FYM + Neem Cake	1.29	1.28	1.39	1.22	0.30	0.34	0.39	0.31	0.72	1.07	0.69	0.67	7.00	8.44	0.081	0.070
M_4	Soil + FYM + Vermicompost	1.31	1.29	1.39	1.26	0.31	0.37	0.42	0.31	0.70	1.13	0.74	0.67	7.38	8.50	0.091	0.071
M_5	Soil + Sand + Vermicompost	1.30	1.31	1.41	1.25	0.33	0.38	0.41	0.32	0.74	1.24	0.72	0.68	7.55	8.51	0.086	0.072
M_6	Neem cake + Sand + Vermicompost	1.27	1.29	1.37	1.23	0.28	0.35	0.40	0.30	0.66	1.19	0.71	0.66	7.80	8.19	0.091	0.068
S. Em ±		0.143	0.119	0.154	0.095	0.161	0.164	0.135	0.128	0.188	0.155	0.296	0.288	0.385	0.304	0.004	0.010
C.D.(P=0.0)		0.303	0.253	0.327	0.202	0.341	0.347	0.286	0.272	0.399	0.328	0.627	0.611	0.816	0.645	0.008	0.021

Whereas, for polybags the maximum seedling biomass after one growing season was observed in M_5 (0.68). Average seedling biomass remain more or less with all the treatments excluding M_6 which was recorded minimum (0.66).The maximum sturdiness quotient after one growing season was observed in M_2 (7.84) in root trainers excluding M_3 which was recorded minimum (7.00).Whereas, for polybags the maximum sturdiness quotient after one growing season was observed in M_5 (8.51) excluding M_6 which was recorded minimum (8.19). The maximum Dickson quality index after one growing season was observed in M_2 (0.092) in root trainers. Dickson quality index remains more or less with all the treatments excluding M_3 which was recorded minimum (0.081).Whereas, for polybags the maximum Dickson quality index after one growing season was observed in M_5 (0.072) M_6 which was recorded minimum (0.068).

M_2 (Soil+ FYM+ Sand) was recorded maximum in germination percent, germination value, number of roots/seedlings, collar diameter, dry weight of roots, sturdiness quotient and Dickson quality index in root trainers whereas for polybags length of the shoots and germination percent recorded maximum similar findings were given by Chand *et al.*, (2007) also observed increased height, collar diameter, fresh and dry weight of seedling raised in potting medium consisting of soil, sand and FYM in different combination. Further, this study is also in conformity with results obtained in *Albizia gummifera* and *Cordia africana* Mulugeta (2014) where shoot and root growth, number of roots, shoot and root dry weight and survival rate of seedlings were significantly influenced by potting mixture.

M_5 (Soil+ Sand+ Vermicompost) was recorded maximum in fresh weight of roots, dry weight of shoots, root and shoot ratio in root trainers whereas for polybags length of roots/seedlings, number of roots/seedlings, fresh weight of shoots, dry weight of shoots, dry weight of roots, root and shoot ratio, seedling biomass, germination value, mean germination time, sturdiness quotient and Dickson quality index similar findings were given by Abdul (2011) indicated higher root length of mango seedlings at combinations of Nekkare cultivar and media composition of Soil: Sand: Compost (1:2:1).

Seedlings grown in root trainers had maximum germination percent, germination value, number of roots/seedlings, collar diameter, dry weight of roots, sturdiness quotient, Dickson quality index as compared to polybags similar findings were given by (Bora *et al.*, 2006). The lateral roots were also found to be significantly higher in root trainer plants than polybag plants (Soman and Saraswathy, 2005).

The germination response of *Pinus kesiya* in different containers and potting media in Northeast region of Nagaland showed that M_2 (Soil+FYM +Sand) is highly recommended for germination in *Pinus kesiya* for root trainers. Whereas for polybags M_5 (Soil+ Sand+ Vermicompost) is highly recommended for germination in *Pinus kesiya*.

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