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Effect of Seed Size, Pre Sowing Treatment and Potting Mixture on the Seedling Growth of *Parkia roxburghii* G. Don Seeds

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A B S T R A C T

The experiment was conducted at Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan. The seeds were graded into small (L_1), medium (L_2) and large size (L_3) on the basis of length. The seeds subjected to seven pre sowing treatments were sown in potting mixture consisting of soil, sand and FYM in four different ratios. The experiment was laid out in nursery conditions in randomized block design (RBD factorial) with three replications to determine most suitable seed size, pre sowing treatment and potting mixture for seedling growth parameters of *Parkia roxburghii*. It was evident from the study that large size seeds (L_3) excelled all other grades in all seedling growth parameters. The seeds treated with boiling water and soaking for 24 hrs (T_5) registered significantly maximum seedling growth parameters. The seeds sown in potting mixture consisting of soil, sand and FYM in ratio 1:2:4 (M_4) registered significantly maximum seedling growth parameters.

Introduction

Tree bean, *Parkia roxburghii* G. Don, belongs to the family Leguminaceae and subfamily Mimosoidae, is a lesser known nutritious, leguminous tree which grows luxuriantly in North East India and South East Asia. It is also known as yongchak in Manipuri and Zongtan in Mizoram. It is distributed in India, Bangladesh, Burma (Myanmar), Thailand and the Malaysian region. The various plant parts like pods, seeds and flowers are consumed by the people of Mizoram, Manipur and Nagaland, raw or in various preparations such as salads and curries. It is a valued diet supplement and different edible parts of the plant are used medicinally. The pods are known to cure stomach disorders and regulate liver functions. The oil extract of the plant possesses insecticidal properties and the woods can be used as a source of paper pulp (Thangjam and Maibam, 2006). The tree bean being a fast-growing leguminous species with multiple uses is considered suitable for

reclamation of abandoned jhum land. Being a legume it would also help enrich the soil through nitrogen fixation. It is valued for its subsistence products and as an important source of cash income (Rocky and Sahoo, 2002). Moreover, the tree provides fuel wood for the local people of these states. Hence, the planting of these trees should be promoted in India for conservation of natural resources and improving the livelihood of hill farmers in the region.

Despite a variety of uses, unfortunately the tree bean plants are under threat due to overharvesting of pods and seeds. The seeds of *Parkia* have a low percentage of germination in the field and the dormancy of its seeds has been attributed to the presence of inhibitor as well as the impermeable seed coat. A prerequisite in any planting programme is an assured supply of seeds (FAO, 1995). Seed is such a key element in plant production that it exercises a profound influence on the success or failure of both artificial and natural regeneration and it is of fundamental importance since both artificial and natural regeneration start with it. The bigger seed size and more seed weight contains more amount of reserve food material in contrast to the germinating seedlings of smaller seed size and lesser seed weight which have only small quantity of reserve food material to bank upon before it is able to manufacture its own food material by process of photosynthesis (Athaya, 1985). Thus, seedlings from large sized fruit could establish in wider range of environmental conditions. The hard and impermeable seed coat prevents the entry of moisture and gaseous exchange delaying germination. So, pre-sowing treatments are used not only to ensure the rapid germination but it also decreases labour, cost and time for nursery production. The better growth of the seedling is the result of available nutrients during the seedling growth period and these nutrients can be supplied either by chemical fertilizers, organic manures or some other means. The most important propagation media are soils, sand and FYM. It has been seen that continuous use of chemical fertilizer posed a serious threat to the environment and led to residual effect in food product. Organic manure is considered imperative for human and animal health. Most commonly used organic manure is FYM in which cattle dung constitute the major source of nutrients and the application of seed treatments and FYM as soil supplement may improve the performance of this species but knowledge and information about the response of this species to organic manure are scarce. No systematic work has been done on seed size and seedling growth parameters of *Parkia roxburghii* so far thus hampering the afforestation program of this valuable species. As a result of these factors, it is necessary to standardise the seed size, pre sowing treatment and potting mixture for producing quality seedlings.

Materials and Methods

The experiment was conducted at the Majhgaon nursery of the Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, located at 30^0 51′ N latitude and 76^0 11′ E longitude. The climate of Nauni area ranges from sub-tropical to sub-temperate and experiences 850 mm to 1300 mm precipitation, major part of which is received during July and August. During the study period maximum rainfall 361 mm was received during July. May- June was the hottest months, whereas December and January were coldest months.

Material collection

The seeds were obtained from Manipur during month of July, 2014. Diseased seeds

were discarded. The seeds with no visible sign of injury were graded into three categories based on length of seeds as given below:

Category	Size
L_1	Small (<1.6 cm)
L_2	Medium (1.6- 1.8 cm)
L_3	Large (> 1.8 cm)

Pre-sowing treatments

The graded seeds were subjected to seven different pre- sowing treatments:

Code	Treatment
T_1	Control
T_2	Soaking in water at room temperature for 24 hrs
T_3	Soaking in water at room temperature for 48 hrs
T_4	Boiling water treatment and soaking for 12 hrs
T_5	Boiling water treatment and soaking for 24 hrs
T_6	Conc. H_2SO_4 2 min. dip and then washing
T_7	Conc. H_2SO_4 4min. dip and then washing

Potting mixture (v/v)

Potting mixture used to fill poly bags consisted of soil, sand and farmyard manure (FYM) in four different proportion as given below:

Code	Description	Ratio
M_1	Soil: Sand: FYM	1:1:1
M_2	Soil: Sand: FYM	1:2:2
M_3	Soil: Sand: FYM	1:2:3
M_4	Soil: Sand: FYM	1:2:4

Germination

The seeds were sown in different potting mixture during august, 2014 at the polyhouse in a randomised block design (RBD). A sample of 150 seeds per treatment was taken for conducting the experiment.

Seedling growth studies

For seedling growth studies, four seedlings per replication were randomly selected and carefully uprooted without breaking the roots at the end of growing season. The following attributes were measured.

Seedling length (cm)

Seedling length was recorded in centimetres using a scale from root tip to the top/ tip of shoot.

Seedling length = Shoot length + Root length

Root length (cm)

The length of tap root was recorded in centimetres using measuring scale by placing it horizontally on the ground.

Shoot length (cm)

It was measured with the help of meter scale from leading shoot tip to the collar region of the seedling at the ground surface.

Collar diameter (mm)

Collar diameter of seedling was measured in millimetres (mm) by using digital calliper.

Statistical analysis

The data obtained from the experiment was subjected to statistical analysis as per the methods described (Gomez and Gomez, 1984).

Results and Discussion

Effect of seed size, pre sowing treatment and potting mixture on *Parkia roxburghii* seedling growth parameters

Table 1 shows that the seed size, pre sowing treatment, potting mixture and their interaction had a significant effect on seedling growth parameters of *Parkia roxburghii*.

Root length

The data shows that seed size exerted significant effect on root length. The significantly maximum root length (17.14 cm) was recorded in seedlings from large size seeds (L_3) and minimum value (11.11 cm) was recorded from small size seeds (L_1). Among the pre sowing treatments, maximum (16.77 cm) root length was recorded in T_5 which was statistically at par with T_6 (15.64 cm) while the minimum (10.64 cm) root length was recorded in T_1. The seedlings grown in potting mixture M_4 showed maximum (16.57 cm) root length while minimum (11.35 cm) root length was shown by seedlings grown in potting mixture M_1.

Shoot length

Seed size had a significant effect on shoot length. The maximum (18.58 cm) shoot length was recorded in seedlings from large size seeds (L_3) and significantly minimum value (12.67 cm) was observed in small size seeds (L_1). Among the pre sowing treatments, maximum shoot length was recorded in T_5 which was statistically at par with T_6 and minimum (12.64 cm) shoot length was recorded in T_1 which was statistically at par with T_2. The seedlings grown in potting mixture M_4 showed maximum (18.02 cm) shoot length while minimum (12.97 cm) shoot length was observed in seedlings grown in potting mixture M_1.

Seedling length

The data shows that the seed size, pre sowing treatment, potting mixture had a significant effect on seedling length. The maximum seedling length (35.72 cm) was obtained when large size seeds (L_3) were used for sowing. The minimum (23.78 cm) seedling length was recorded in small size seeds (L_1). Among the pre sowing treatments maximum seedling length was recorded in T_5 (34.96 cm) and minimum in T_1 (23.28 cm). The seedlings grown in potting mixture M_4 showed maximum seedling length (34.59 cm) while seedlings grown in potting mixture M_1 showed minimum seedling height (24.32 cm).

Collar diameter

Seed size and potting mixture had a significant effect on collar diameter of the seedlings while the effect of pre sowing treatment was non-significant. Among the seed size, significantly maximum (4.62 mm) collar diameter was recorded in L_3 and significantly minimum (3.87 mm) collar diameter was recorded in L_1. Though non-significant, maximum collar diameter (4.62 mm) was recorded in T_5 and minimum in T_1 (3.92 mm). The maximum (4.70 mm) collar diameter was recorded in potting mixture M_4 while minimum (3.33 mm) collar diameter was recorded in potting mixture M_1.

Effect of seed size and potting mixture interaction (LxM) on *Parkia roxburghii* seedling growth parameters

It is evident from table 2 that seed size and potting mixture had a significant effect on seedling growth parameters of *Parkia roxburghii.* In the interaction between seed size and potting mixture (LxM), maximum (19.93 cm)root length was found in L_3M_4 and minimum root length (8.14 cm) was recorded in L_1M_1 which was statistically at par with

L_1M_2 (10.17 cm). The maximum (21.02 cm) shoot length was found in L_3M_4 while minimum shoot length (9.58 cm) was recorded in L_1M_1. The maximum (40.95 cm) seedling length was found in L_3M_4 while the minimum seedling length 17.72 cm was recorded in L_1M_1. The maximum (5.11 mm) collar diameter was recorded in L_3M_4 which was statistically at par with L_3M_3 (4.67 mm) while minimum (3.30 mm) collar diameter was recorded in L_1M_1 which was found to be statistically at par with L_1M_2 (3.74 mm) and L_2M_1 (3.92 mm).

Effect of pre sowing treatment and potting mixture interaction (TxM) on *Parkia roxburghii* seedling growth parameters

The interaction of pre sowing treatments and potting mixture had a significant effect on seedling growth parameters of *Parkia roxburghii*, as observed from table 3. In the interaction between pre sowing treatment and potting mixture (TxM), maximum (19.58 cm) root length was recorded in T_5M_4 which was statistically at par with T_5M_3 (17.33 cm), T_4M_4 (16.47 cm), T_6M_4 (18.61 cm) and T_7M_4 (17.89 cm) while significantly minimum (7.48 cm) root length was recorded in T_1M_1 which was found to be statistically at par with T_1M_2 (9.31 cm), T_2M_1 (9.39 cm) and T_3M_1 (10.73 cm).

Similarly, the maximum (21.79 cm) shoot length was recorded in T_5M_4 which was statistically at par with T_5M_3 (19.02 cm), T_6M_4 (20.10 cm) and T_7M_4 (19.01 cm) while significantly minimum 10.06 cm shoot length was recorded in T_1M_1 which was found to be statistically at par with T_1M_2 (11.88 cm), T_2M_1 (11.60 cm), T_3M_1 (12.33 cm) and T_4M_1 (12.79 cm). The maximum (41.37 cm) seedling length was recorded in T_5M_4 which was statistically at par with T_5M_3 (36.36 cm), T_6M_4 (38.71 cm) and T_7M_4 (36.90 cm) while minimum (17.53 cm) seedling length was recorded in T_1M_1 which was found to be statistically at par with T_1M_2 (21.19 cm), T_2M_1 (20.99 cm) and T_3M_1 (23.07 cm). Though non-significant maximum (5.03 mm) collar diameter was recorded T_5M_4 while minimum (3.33 mm) collar diameter was recorded in T_1M_1.

Effect of seed size on seedling growth parameters under nursery conditions

The seed size exerted significant effect on *Parkia roxburghii* seedling growth parameters under nursery conditions. Large size seeds (L_3) registered significantly highest root length (17.14 cm), shoot length (18.58 cm), seedling length (35.72 cm) and collar diameter (4.62 mm). This may be ascribed to the fact that large size seed contained more nutrient reserve, energy pool and biochemical contents which might have stimulated better seedling growth. The small size seeds accounted for lesser food material and biochemical contents leading to poor seedling growth. The results are thus, in agreement with Owoh *et al.*, (2011), who reported that large size seeds produced maximum seedling length and collar diameter in *Gmelina arborea*. Similarly, Mwase and Mvula (2011) revealed that large size seeds produced highest seedling length and diameter growth in *Bauhinia thonningii*. Similar growth characteristics for large size seeds has been reported by several researchers in many species. Maximum height and collar diameter in *Jatropha curcas* (Singh and Saxena, 2009), shoot length and root length in *Azadirachta indica* (Uniyal *et al.*, 2007), shoot and root growth in *Sapindus emerginatus* (Venkatesh *et al.*, 2010) and root length and shoot length in *Hardwickia binate* (Ponnammal *et al.*, 1993).

Table.1 Effect of seed size, pre sowing treatment and potting mixture on seedling growth Parameters under nursery conditions

Treatments	Root length (cm)	Shoot length (cm)	Seedling height (cm)	Collar diameter (mm)
Effect of seed size				
L_1	11.11	12.67	23.78	3.87
L_2	13.68	15.27	28.95	4.37
L_3	17.14	18.58	35.72	4.62
SEm±	0.389	0.343	0.598	0.065
$CD_{(0.05)}$	1.08	0.95	1.95	0.183
Effect of pre sowing treatments				
T_1	10.64	12.64	23.28	3.92
T_2	12.34	14.06	26.40	4.10
T_3	13.32	14.89	28.21	4.20
T_4	14.17	15.37	29.54	4.30
T_5	16.77	18.19	34.96	4.62
T_6	15.64	17.20	32.84	4.50
T_7	14.98	16.19	31.16	4.37
SEm±	0.59	0.52	0.91	0.11
$CD_{(0.05)}$	1.66	1.45	1.45	NS
Effect of potting mixture				
M_1	11.35	12.97	24.32	3.83
M_2	13.05	14.50	27.55	4.16
M_3	14.93	16.55	31.48	4.45
M_4	16.57	18.02	34.59	4.70
SEm±	0.45	0.39	0.69	0.075
$CD_{(0.05)}$	1.25	1.09	2.27	0.21

L: Seed size category, T: Pre sowing treatments, M: Potting Mixture

Table.2 Interaction effect of seed size and potting mixture (LxM) on seedling growth parameters under nursery conditions

Interaction (LxM)	Root length (cm)	Shoot length (cm)	Seedling height (cm)	Collar diameter (mm)
L_1M_1	8.14	9.58	17.72	3.29
L_1M_2	10.17	11.58	21.75	3.74
L_1M_3	12.13	14.00	26.14	4.16
L_1M_4	13.99	15.53	29.52	4.29
L_2M_1	11.07	12.73	23.79	3.92
L_2M_2	12.87	14.41	27.28	4.33
L_2M_3	14.99	16.44	31.43	4.51
L_2M_4	15.80	17.51	33.31	4.71
L_3M_1	14.84	16.59	31.44	4.26
L_3M_2	16.11	17.50	33.62	4.42
L_3M_3	17.69	19.20	36.89	4.67
L_3M_4	19.93	21.02	40.95	5.11
SEm±	1.03	0.91	**1.58**	0.17
$CD_{(0.05)}$	2.17	1.74	**3.93**	0.62

L: Seed size category, M: Potting Mixture

Table.3 Interaction effect of pre sowing treatment and potting mixture (TxM) on seedling Growth parameters under nursery conditions

Interaction (TxM)	Root length (cm)	Shoot length (cm)	Seedling height (cm)	Collar diameter (mm)
T_1M_1	7.48	10.06	17.53	3.33
T_1M_2	9.31	11.88	21.19	3.90
T_1M_3	12.37	13.96	26.32	4.15
T_1M_4	13.89	14.68	28.08	4.29
T_2M_1	9.39	11.60	20.99	3.60
T_2M_2	11.80	13.39	25.19	3.93
T_2M_3	13.61	15.20	28.81	4.38
T_2M_4	14.56	16.06	30.61	4.49
T_3M_1	10.73	12.33	23.07	3.69
T_3M_2	12.51	14.07	26.58	4.04
T_3M_3	14.50	16.17	30.67	4.41
T_3M_4	15.52	17.01	32.53	4.64
T_4M_1	11.72	12.79	24.51	3.88
T_4M_2	13.38	14.70	28.08	4.13
T_4M_3	15.12	16.52	31.64	4.44
T_4M_4	16.47	17.48	33.94	4.74
T_5M_1	14.31	15.23	29.54	4.24
T_5M_2	15.84	16.73	32.58	4.51
T_5M_3	17.33	19.02	36.36	4.71
T_5M_4	19.58	21.79	41.37	5.03
T_6M_1	13.17	14.92	28.09	4.09
T_6M_2	14.51	15.63	30.14	4.37
T_6M_3	16.26	18.16	34.41	4.58
T_6M_4	18.61	20.10	38.71	4.95
T_7M_1	12.64	13.84	26.49	3.98
T_7M_2	14.01	15.08	29.09	4.27
T_7M_3	15.36	16.82	32.18	4.45
T_7M_4	17.89	19.01	36.90	4.78
SEm±	1.19	1.04	2.15	0.20
$CD_{(0.05)}$	3.31	2.89	5.99	NS

T: Pre sowing treatments, M: Potting Mixture, NS: Non significant

Effect of pre sowing treatments on seedling growth parameters under nursery conditions

The present investigation concluded that different pre sowing treatment had a significant effect on *Parkia roxburghii* seedling growth parameters under nursery conditions. The seeds treated with boiling water and soaking for 24 hours produced significantly maximum root length (16.77 cm), shoot length (18.19 cm), seedling length (34.96 cm) and collar diameter (4.62 mm). This may be ascribed to the fact that hot water has ability to degrade and soften the seed coat and leaching out the chemical inhibitors, which might have increased germination process and subsequent seedling growth. The result find support from Vijayakumar and Selvaraju (2013), who revealed that soaking the *Cassia auriculata* seeds in hot water, produced maximum root and shoot length. Jamwal *et al.*, (2013) showed that *Zizyphus mauritiana* seeds soaked in water for 48 hours recorded maximum root length, seedling height and collar diameter. Similarly, Azad *et al.*, (2011) revealed that height and diameter growth of *Acacia auriculiformis* seedlings originated from the seeds with hot water treatment were significantly higher than other pre sowing treatments. Soliman and Abbas (2013) concluded that the seeds of *Cassia*

fistula treated with H_2SO_4 (36 N) for 2 minutes and soaked in hot water (100^0 C) produced significantly highest plant height and root length.

Effect of potting mixture on *Parkia roxburghii* seedling growth parameters under nursery conditions

Sowing of *Parkia roxburghii* seeds in the different potting mixture was found to significantly support the seedling growth. The data indicates that among different ratio of soil, sand and FYM, potting mixture consisting of soil, sand and FYM in ratio 1:2:4 (M_4) produced significantly highest root length (16.57 cm), shoot length (18.02 cm), seedling length (34.59 cm) and collar diameter (4.70 mm). The increment in growth performance is attributed to the organic carbon and nitrogen provided by organic manure.

This improves the soil physiochemical properties which further contribute to the better growth of seedlings. Bali *et al.,* (2013) reported that optimum germination and growth for *Terminallia bellirica* was in silt loam soil + FYM + sunken beds combination. Chand *et al.,* (2007) reported that seeds of *Terminalia tomentosa* sown in soil medium consisting of soil, sand and FYM in the ratio of 2:1:1 resulted in significantly maximum seedling height, collar diameter whereas, the soil medium having soil, sand and FYM in the proportions 1:1:1 produced highest root length. Sekepe *et al.,* (2013) reported that plant height of *Cassia abbreviate* was the only parameter which was significantly increased by top garden soil while other growth parameters were not influenced by growth media. Menaie *et al.,* (2010) reported that plant height and number of leaves were higher in soil mixture which contained sand: peat-moss:humus in equal proportions (1:1:1) for *Cassia nodosa* and *Cassia fistula* seedlings. Thakur *et al.,* (2000) found sand + soil + FYM as the best potting medium for the development of healthy seedlings with nodulated roots and better growth in *Albizia lebbeck.*

Interaction effect of seed size and potting mixture (LxM) on *Parkia roxburghii* seedling growth parameters under nursery conditions

The combined effect of seed size and potting mixture had a significant effect on seedling growth parameters. The large size seeds (L_3) sown in potting mixture consisting of soil, sand and FYM in ratio 1:2:4 (M_4) exhibited significantly maximum root length (19.93 cm), shoot length (21.02 cm), seedling height (40.95 cm) and collar diameter (5.11 mm). The results find the support from the findings of Attri (2011) who concluded that large size seeds of *Sapindus mukorossi* sown in vermicompost and FYM @(10t/ha) produced maximum shoot length, root length, seedling height and collar diameter. Similarly, Suresha *et al.,* (2007) recorded maximum root and shoot length of *Sapindus emerginatus* seedling in large size seeds sown in a mixture of sand + soil + humus (1: 1: 1).

Interaction effect of pre sowing treatments and potting mixture (TxM) on *Parkia roxburghii* seedling growth parameters under nursery conditions

In the present study, the interaction effect of pre sowing treatments and potting mixture (TXM) under nursery condition showed significant variation for seedling growth parameters. The interaction effect of pre sowing treatment and potting mixture (TXM) revealed that seeds subjected to boiling water treatment and soaking for 24 hours (T_5) and subsequent sowing in potting mixture consisting of soil, sand and FYM in ratio 1:2:4 (M_4) exhibited significantly maximum root length (19.58 cm), shoot length (21.79 cm), seedling height (41.37 cm) and collar

diameter (5.03 mm). Nath *et al.*, (2007) reported maximum seedling growth parameters for *Albizzia lebbeck* seeds treated with conc. H_2SO_4 for 3 minutes and sown in growing media consisting of sawdust. Karthikeyan *et al.*, (2006) observed similar results when used sand as germinating media. According to them germination and seedling growth were best when seeds soaked in water and germinated in sand with vermicompost which gave maximum seedling height, stem girth, root length, and percentage of germination. Hassanein (2010) reported maximum seedling growth of *Bauhinia variegate* and *Delonix regia* in scarified seeds sown in sand media.

In conclusion, Nursery studies indicated that large size seed L_3 (>1.8 cm length) of *Parkia roxburghii* proved significantly better as compared to other seed size with respect to seedling growth. The seeds treated with boiling water and soaking for 24 hours (T_5) outclassed all other treatments. The seeds sown in potting mixture M_4 (soil: sand: FYM in ratio 1:2:4) showed better growth than other potting mixture. The study recommends the large size seeds L3 (>1.8 cm length) treated with boiling water treatment and soaking for 24 hours to break the dormancy along with potting mixture consisting of soil: sand: FYM in ratio 1:2:4 for better seedling growth.

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