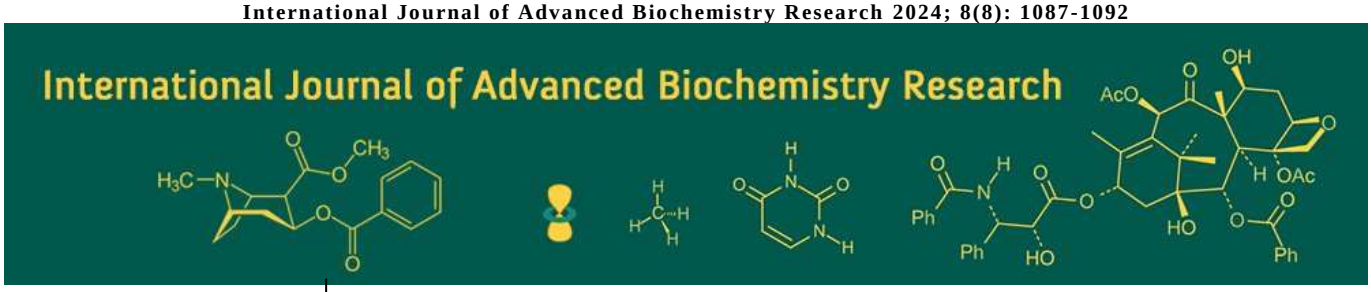

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Evaluation of the relative root growth of *Albizia procera* seedlings grown under various treatment conditions in a nursery

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Abstract
The comparison of the seedlings was done based on a combination of different pre-sowing treatments (soaking for 24 hours in (normal water (T_1), Cooling boiled water (T_2), Cow urine (T_3), Beejamrutha (T_4) and control (T_5), container types (side perforated polythene bag of size (9 inche × 5 inch) (C_1), root trainer of size 150 cc (C_2) and 275 cc (C_3) and growing mediums (Sand: Soil: Vermicompost (1:1:2) (M_1), Sand: Soil: Vermicompost (1:2:1) (M_2), Sand: Soil: FYM (1:1:2) (M_3), Sand: Soil: FYM (1:2:1) (M_4), Sand: FYM (1:1) (M_5), Sand: vermicompost (1:1) (M_6), Soil: FYM (1:1) (M_7), Soil: vermicompost (1:1) (M_8). The testing parameters consider some best growth of roots like root dry weight, total seedling dry weight, root: shoot ratio, root length, root thickness, number of secondary roots, percent fibrous roots, and nodule number. On the basis of the test report it was observed that the seedlings raised in the nursery were found to be suitable for overall quality seedling production of *Albizia procera* in the treatment combination $T_3C_1M_6$, i.e. pre-sowing seed treatment T_3 (seeds soaked in cow urine for 24 hours), polybag C_1 of size (9 inch x 5 inch), filled with growing medium Sand + Vermicompost (1:1) (M_6).

Keywords: Pre-sowing treatment, container type, growing medium, root growth parameters, *Albizia procera*

Introduction
Albizia procera provides excellent fuel, fodder, and small timber for making agricultural implements. Besides, it is an important nitrogen-fixing tree and helps in ameliorating soil productivity. The timber is usually employed in making materials for carts, carriages, small handle tools, and agricultural implements and also provides fodder during lean periods of summer when green fodder is scarce in the region. The genus *Albizia procera* is one amongst and belongs to the subfamily Mimoseae of the family Leguminosae. It is a highly valued multipurpose tree legume and is regarded as a potential fodder resource (Stewart and Dunsdon, 2000) [11]. This is used in dropsy, pain, rheumatism, convulsions, delirium, and septicemia (Kirthikar and Basu, 2000) [6] and has shown high potential in the soil reclamation process during the early phase of mine spoil restoration in a dry tropical environment (Singh *et al*., 2004) [10].

It is used for afforestation, a good component of the agroforestry system because of its hardy nature, fast growth, excellent fodder, higher calorific value, and can be successfully planted in saline soil. Its hard seediness leads to dormancy developing in seed primarily of seed coat which impedes proper and complete germination. Interest in producing quality seedlings by application of improved and modern nursery techniques has increased in recent years (Gera and Ginwal, 2002) [3]. The success of a plantation program largely depends on prompt germination, enhanced growth by applying different growing media, and even on the containers in which seeds are sown. The present study was initiated to compare *A. procera* seedlings grown in a combination of different pre-sowing treatments, containers, and growing mediums. So the present study aims to produce mass healthy successful seedling production and to get better seedling establishment.

Materials and Methods

The present investigation entitled "Comparative root growth performance of *Albizia procera* seedlings raised in different treatment combinations in nursery condition" was conducted at the Majhgaon farm area Department of Silviculture and Agroforestry, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan (Himachal Pradesh) during 2017-2018. The experimental site is situated in the mid hill, sub-tropical zone of Himachal Pradesh situated at an elevation of 1250m above mean sea level. It lies 14 km southeast of Solan town, representing 30°55'N latitude and 76°11'E longitude. The area represents a sub-tropical to sub-temperate type of climate. May and June are the hottest months, whereas December and January are the coldest months.

Seed collection and experimental design

The seeds were collected from Forest Research Institute, Dehradun in the beginning of March to mid-April 2017. The seeds were dried in the shade for 25 days and all the foreign materials were removed. The sowing of pre-treated seeds was done on 1st Aug 2017. The experiment was laid out in Factorial CRD (Complete Randomization Design) having three factors i.e. five pre-sowing treatments (soaking for 24 hours in (normal water (T_1), cooling boiled water (T_2), cow urine (T_3), Beejamrutha (T_4)) and control (T_5)), three container types (side perforated polythene bag of size (9 inch × 5 inch) (C_1), root trainer of size 150 cc (C_2) and 275 cc (C_3), and eight growing mediums in different proportion (Sand: Soil: Vermicompost (1:1:2) (M_1), Sand: Soil: Vermicompost (1:2:1) (M_2), Sand: Soil: FYM (1:1:2) (M_3), Sand: Soil: FYM (1:2:1) (M_4), Sand: FYM (1:1) (M_5), Sand: Vermicompost (1:1) (M_6), Soil: FYM (1:1) (M_7), Soil: Vermicompost (1:1) (M_8) with three replication per treatment. The observations shoot dry weight (g), root dry weight (g), total seedling dry weight (g), root and shoot ratio (dry weight basis), root length (cm), root thickness (cm), number of secondary roots, percent fibrous roots (%) and nodule number (no.) were recorded on May 1, 2018.

Shoot dry weight (g)

Shoots were separated and dried in an electric oven at 65 °C for 72 hrs. Shoot dry weight was expressed as the mean weight of samples in grams.

Root dry weight (g)

Roots were separated and dried in an electric oven at 65 °C for 72 hrs. Root dry weight was expressed as the mean weight of samples in grams.

Total seedling dry weight (g): For dry seedling weight, the root and shoot were separated from the seedling and dried in an electric oven at 65 °C for 72 hrs. The sum of these components gave dry weight per seedling.

Root and shoot ratio (Dry weight basis): The ratio was worked out on a dry weight basis by dividing the weight of the shoot dry by the root dry weight of each plant separately.

Root length (cm): The length of the tap root was recorded in centimeters using a measuring scale by placing it horizontally on the ground.

Root thickness (cm): Root thickness of the seedling was measured in centimeters using a digital vernier caliper.

Number of secondary roots: The uprooted seedlings were washed with a gentle flow of water to expose the roots. The number of roots that were emitted from the tap root of the plant above radical was calculated.

Percent fibrous roots (%): It was calculated as the total dry weight of fibrous roots divided by the total dry weight of a total number of primary and secondary roots (total no. of replication plants) multiplied by a hundred.

Nodule number (no.): Nodule number was counted as the number of nodules present in the root of the seedlings.

Statistical Analysis: The data was analyzed using the technique of analysis of variance (ANOVA) in accordance with the procedure outlined by Gomez and Gomez (1984). The effect of different treatments was tested at a 0.05 level of significance.

Results and Discussion

Effect of pre-sowing treatment, container type, and growing media (T×C×M) on growth parameters

Shoot dry weight (g)

Albizia procera seedlings raised in polybags of size 9 inch × 5 inch (C_1) filled with a growing medium consisting of sand + vermicompost (1:1) and seeds treated with cow urine for 24 hours $T_3C_1M_6$ resulted in the highest shoot dry weight of 8.73 g. However, the interaction was statistically non-significant. The least was obtained for $T_5C_2M_4$ (1.98).

Root dry weight (g)

The growing medium consisting of sand + vermicompost (1:1) raised seeds soaked in cow urine for 24 hours raised in a polybag of size 9 inch × 5 inch i.e., $T_3C_1M_6$ resulted in significantly highest root dry weight 3.30 g was significantly at par with $T_1C_3M_8$, $T_1C_1M_1$ and $T_2C_1M_5$, $T_3C_2M_5$, and $T_4C_1M_3$. A significant result was obtained for $T_5C_2M_4$ which was at par with $T_5C_1M_4$ (0.03 g), $T_4C_3M_1$, and $T_4C_3M_2$ (0.04 g). Garaniya and Bapodra (2015) [2] reported the highest seedling growth parameter for *Abrus precatorius* seeds treated with cow urine for 8 hours and sown in a growing medium consisting of sand and soil.

Total seedling dry weight (g)

The perusal of data in Table 3 reveals that *Albizia procera* seedlings raised in polybags of size 9 inch × 5 inch (C_1) filled with growing medium consisting of sand + vermicompost (1:1) raised of seeds soaked in cow urine for 24 hours i.e., $T_3C_1M_6$ resulted in significantly highest total seedling dry weight of 12.03 g, which was at par with $T_3C_1M_3$, $T_3C_1M_4$ and $T_3C_1M_5$. The lowest value was obtained for $T_5C_2M_4$. The results reported in the present study are also supported by the findings of Anand *et al.*, (2012) [1].

Root length (cm)

The data of Table 4 reveals that *Albizia procera* seedlings given the pre-sowing treatment of soaking in cow urine for 24 hours raised in polybags of size 9 inch × 5 inch and filled with a growing medium consisting of sand + vermicompost (1:1) i.e., $T_3C_1M_6$ resulted in significantly highest root

length of 17.73 cm, which was at par with $T_1C_1M_7$, $T_2C_1M_1$ and $T_3C_1M_8$. The significantly lowest value of root length 8.70 cm was noticed in the $T_5C_2M_4$ treatment combination which was significantly at par with $T_2C_2M_1$, $T_1C_2M_8$, and $T_3C_2M_6$. The larger volume of container size and low growing density allowed the seedlings to grow vigorously and healthy compared to smaller size containers. Samir *et al.* (2016) [9] reported enhanced growth in seedlings of litchi (*Litchi chinensis*) and khirni (*Manilkara hexandra*) when grown in potting media containing soil+ sand+ vermicompost mixture.

Root thickness (mm)

The perusal of data in Table 5 reveals that *Albizia procera* seeds soaked in cow urine for 24 hours were raised in polybags of size 9 inch × 5 inch and filled with growing medium consisting of sand + vermicompost (1:1) i.e., $T_3C_1M_6$ resulted in significantly highest root thickness of 7.66 mm. The significantly lowest value of 0.84 mm was found for $T_5C_2M_4$. This was significantly at par with $T_5C_2M_4$ and $T_4C_2M_2$. Garaniya and Bapodra (2015) [2] reported the highest seedling growth parameter for *Abrus precatorious* seeds treated with cow urine for 8 hours and sown in growing media consisting of sand and soil.

Root and Shoot ratio (Dry weight basis) (g)

The perusal of data in Table 6 reveals that *Albizia procera* seedlings raised in polybags of size 9 inch × 5 inch (C_1) filled with a growing medium consisting of sand + vermicompost (1:1) and seeds soaked in cow urine for 24 hours i.e., $T_3C_1M_6$ resulted in significantly highest shoot and root ratio of 0.38 g. The significantly least value of 0.02 g was obtained for $T_5C_2M_4$ which was significantly at par with $T_5C_2M_3$ and $T_5C_1M_1$. Amit *et al.*, (2020) [12] studied the effect of pre-sowing seed treatments on root growth and survival of Ber (*Zizyphus mauritiana* L.). The result indicated that there was a significant effect of soaking seed with cattle urine. The seedlings had a good number of secondary roots, the length of secondary roots, root: shoot ratio, fresh weight of roots, and dry weight of roots were also higher with this treatment.

Number of secondary roots: The seedlings raised in a combination of seeds treated with cow urine 24 hours raised in polybags of size 9 inch × 5 inch and filled with growing medium sand + vermicompost (1:1) i.e., ($T_3C_1M_6$) recorded significantly the highest number of secondary roots (9.67) in the seedlings, which was significantly at par with $T_4C_1M_4$ and $T_4C_1M_8$. The lowest numbers of secondary roots 2.33 were noticed in the $T_5C_2M_1$. This result is thus in agreement with the findings of Amit *et al.*, (2020) [12].

Percent fibrous roots (%)

Among different treatment combinations of pre-sowing treatments, container type, and growing media (Table 8), the seedling of seeds soaked in cow urine for 24 hours raised in polybags of size 9 inch × 5 inches and filled with growing media of sand + vermicompost (1:1) i.e., ($T_3C_1M_6$) recorded significantly highest percent fibrous roots (56.87%), which was significantly at par with $T_4C_2M_2$, $T_3C_1M_4$, and $T_2C_1M_6$. The lowest percent of fibrous roots (18.15%) was noticed in the $T_5C_2M_3$. This was significantly at par with $T_5C_2M_4$ and $T_5C_2M_7$. Qaisar (2001) [8] on the other hand, revealed that the best root growth and maximum number of roots for *Dalbergia sissoo* and *Acacia catechu* occurred in a growing medium consisting of soil + sand + compost.

Nodule number

The perusal of data table 9, the seedlings raised after soaking in cow urine for 24 hours as pre-sowing treatment (T_3) were raised in polybags of size 9 inch × 5 inch (C_1) and filled with a growing medium of sand + vermicompost (1:1) (M_6) ($T_3C_1M_6$) recorded significantly maximum nodule number of 50.00. This was significantly at par with $T_1C_2M_5$ and $T_1C_2M_1$, $T_1C_3M_4$, $T_1C_3M_5$, and $T_1C_3M_5$. The significant minimum value for nodule number (11) was, however, noticed in the $T_5C_2M_3$ treatment combination which was significantly at par with $T_5C_2M_3$, $T_5C_2M_6$, and $T_5C_2M_4$. Md. Ariful Islam *et al.*, (2019) [5] found the potting media, highest nodulation, growth parameters, shoot dry and fresh weight, shoot-root ratio, and biomass were found in a combination of soil + cow dung + phosphorus (0.16 g/polybag).

Table 1: Effect of pre-sowing treatment, container type, growing media, and their interaction on shoot dry weight (g) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	6.97	5.17	5.19	5.11	5.17	3.59	3.90	4.22	4.07	3.62	3.87	3.85	8.14	4.23	0.03	4.13	4.96	2.13	3.53	2.18	4.76	3.06	2.28	3.36
M2	7.14	6.06	7.47	7.89	5.63	3.40	4.43	4.49	5.33	5.00	4.77	5.03	7.80	0.08	0.06	2.65	6.7	2.15	3.37	4.07	6.52	3.72	3.05	4.43
M3	5.68	6.33	4.27	4.76	7.37	5.11	6.20	6.23	8.13	3.31	3.77	5.07	6.16	1.98	5.27	4.47	3.87	2.56	3.67	3.03	3.97	2.21	4.75	3.64
M4	7.08	6.13	3.72	6.31	4.23	3.35	4.07	3.88	9.93	3.85	6.24	6.67	8.00	0.12	4.18	4.10	2.21	1.98	3.13	2.44	4.14	4.13	4.82	4.36
M5	7.98	3.90	6.57	5.81	5.50	3.73	4.96	4.73	8.23	3.93	7.07	6.58	6.59	5.50	9.83	7.31	3.92	2.12	2.54	2.5	4.94	4.70	5.15	4.86
M6	8.23	5.32	7.13	7.56	7.93	4.70	5.23	5.95	8.73	8.43	7.76	8.14	6.45	3.03	2.67	4.05	5.13	2.31	3.2	3.55	6.30	4.29	4.00	4.96
M7	7.66	0.11	4.93	4.23	9.53	5.60	7.52	7.55	7.87	3.45	5.48	5.60	7.49	2.02	2.76	4.09	5.08	1.99	2.64	3.16	5.10	4.29	3.20	4.19
M8	7.66	0.18	6.83	4.89	6.80	4.70	5.14	5.55	7.53	4.97	6.02	6.17	5.70	0.08	7.87	4.55	4.65	2.06	3.1	2.6	4.79	2.79	4.07	3.89
Mean	7.55	4.15	5.76	5.82	6.52	4.27	5.18	5.32	7.48	4.57	5.62	5.89	7.04	2.13	4.08	4.42	4.82	0.99	3.02	2.94	5.06	3.65	3.91	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.85	0.66	1.08	1.47	1.86	2.41	N.S

Table 2: Effect of pre-sowing treatment, container type, growing media, and their interaction on root dry weight (g) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	0.32	0.63	1.21	0.72	0.84	0.24	0.59	0.55	2.87	0.25	0.81	1.39	0.34	0.18	0.04	0.18	0.16	0.62	0.11	0.30	0.90	0.36	0.64	0.63
M2	0.41	0.08	0.29	0.26	0.52	1.32	0.48	0.77	2.49	0.20	1.03	1.24	0.23	0.26	0.04	0.18	0.52	0.07	0.17	0.24	0.76	0.33	0.53	0.54
M3	0.18	0.28	1.10	0.52	0.97	0.09	0.53	0.53	1.04	0.42	0.32	0.59	0.33	0.19	0.19	0.24	0.38	0.05	0.23	0.22	0.46	0.21	0.59	0.42
M4	2.69	0.60	0.17	1.15	0.47	0.35	0.37	0.40	1.27	0.43	1.17	0.96	0.93	0.18	1.08	0.73	0.09	0.03	0.09	0.08	1.07	0.50	0.42	0.66
M5	0.70	0.42	0.30	0.47	0.33	0.63	0.60	0.52	3.13	0.33	1.64	1.76	0.93	0.16	0.29	0.46	0.07	0.23	0.24	0.18	1.16	0.38	0.50	0.68
M6	0.72	0.10	0.82	0.55	0.98	0.11	1.32	0.80	3.30	0.25	2.21	1.78	0.75	0.10	0.17	0.34	0.49	0.09	0.64	0.41	1.26	0.14	0.92	0.78
M7	2.13	0.25	0.73	1.04	0.29	0.27	0.85	0.47	0.57	0.48	0.45	0.50	0.62	0.13	0.13	0.29	1.49	0.54	0.62	0.88	0.96	0.33	0.62	0.64
M8	1.38	0.09	0.31	0.59	1.14	0.22	0.55	0.64	0.78	0.15	1.81	0.91	1.03	0.26	0.15	0.48	0.42	0.23	0.34	0.33	0.81	0.17	0.79	0.59
Mean	1.07	0.31	0.62	0.66	0.69	0.40	0.66	0.58	1.93	0.31	1.18	1.14	0.64	0.18	0.26	0.36	0.45	0.23	0.31	0.33	0.92	0.30	0.63	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.06	0.04	0.07	0.10	0.12	0.16	0.27

Table 3: Effect of pre-sowing treatment, container type, growing media, and their interaction on total seedling dry weight (g) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	4.89	0.28	8.76	4.65	3.33	2.51	3.01	2.85	6.28	0.20	6.32	4.52	7.91	0.70	3.06	3.89	0.39	0.25	0.28	0.22	3.92	1.52	2.65	2.70
M2	10.38	0.43	0.45	3.75	4.15	2.47	3.60	3.41	8.39	0.22	4.70	4.79	2.77	0.71	2.05	1.84	1.04	0.99	1.13	0.79	4.56	1.41	0.82	2.27
M3	10.09	0.13	6.67	6.3	4.75	3.16	4.43	4.11	6.85	0.22	5.94	4.40	3.62	0.45	2.98	2.35	0.37	0.22	0.23	0.27	4.64	1.36	2.13	2.71
M4	3.29	1.58	0.54	1.81	3.32	0.07	3.16	2.95	6.35	0.32	3.17	3.56	6.08	0.11	1.79	2.66	0.41	0.07	0.20	0.27	3.29	1.08	0.91	1.76
M5	10.87	3.76	4.55	6.73	3.57	2.96	3.20	3.24	7.96	0.19	6.71	8.78	6.14	0.49	2.52	3.05	0.78	0.28	0.32	0.43	5.94	2.33	3.29	2.42
M6	5.85	0.15	1.44	2.48	5.42	3.79	4.87	4.69	12.03	0.16	7.84	6.05	5.55	0.15	2.25	2.65	0.87	0.25	0.52	0.42	4.2	1.7	1.35	3.85
M7	8.28	0.33	9.33	5.98	5.02	3.14	4.14	4.10	10.08	0.16	6.83	5.82	2.36	0.32	7.27	3.31	0.69	0.26	0.56	0.36	4.42	1.66	3.77	3.28
M8	1.22	5.27	0.89	2.46	4.22	2.93	3.48	3.54	10.23	0.32	4.07	6.09	4.95	0.14	6.57	3.89	1.34	0.32	0.99	0.78	4.03	2.09	2.04	2.72
Mean	7.23	1.49	4.08	4.27	4.22	2.88	3.74	3.61	8.60	0.22	5.70	5.50	4.92	0.38	3.56	2.96	0.74	0.23	0.37	0.44	4.38	1.64	2.12	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.79	0.61	0.99	1.36	N.S	2.22	3.85

Table 4: Effect of pre-sowing treatment, container type, growing media and their interaction on root: shoot ration (dry weight basis) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	0.04	0.12	0.23	0.14	0.16	0.06	0.15	0.13	0.37	0.06	0.20	0.22	0.03	0.29	0.03	0.13	0.14	0.04	1.33	0.06	0.2	0.03	0.20	0.15
M2	0.05	0.13	0.03	0.03	0.09	0.38	0.10	0.10	0.36	0.15	0.21	0.24	0.07	0.03	0.05	0.05	0.02	0.30	0.66	0.06	0.11	0.08	0.17	0.12
M3	0.03	0.04	0.25	0.10	0.13	0.01	0.08	0.08	0.12	0.12	0.08	0.11	0.09	0.01	0.06	0.07	0.05	0.09	0.03	0.05	0.11	0.09	0.03	0.15
M4	0.37	0.09	0.04	0.18	0.11	0.10	0.09	0.08	0.12	0.11	0.18	0.14	0.04	0.01	0.02	0.03	0.04	0.02	0.03	0.04	0.20	0.10	0.08	0.11
M5	0.08	0.10	0.04	0.08	0.06	0.16	0.12	0.12	0.37	0.08	0.23	0.26	0.01	0.10	0.09	0.07	0.15	0.09	0.13	0.12	0.23	0.08	0.09	0.13
M6	0.08	0.01	0.11	0.07	0.12	0.02	0.25	0.22	0.38	0.22	0.28	0.29	0.09	0.03	0.2	0.11	0.11	0.03	0.06	0.08	0.18	0.11	0.28	0.18
M7	0.27	2.27	0.14	0.24	0.03	0.04	0.11	0.11	0.07	0.13	0.08	0.08	0.29	0.27	0.23	0.27	0.08	0.06	0.04	0.07	0.18	0.07	0.19	0.15
M8	0.18	0.5	0.04	0.11	0.16	0.04	0.10	0.09	0.10	0.03	0.30	0.14	0.09	0.11	0.10	0.12	0.18	0.30	0.19	0.10	0.16	0.06	0.19	0.15
Mean	0.14	0.07	0.10	0.11	0.10	0.09	0.12	0.17	0.25	0.06	0.20	0.18	0.09	0.23	0.10	0.12	0.09	0.08	0.06	0.08	0.18	0.08	0.16	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.07	0.06	0.09	0.13	0.16	0.21	0.36

Table 5: Effect of pre-sowing treatment, container type, growing media, and their interaction on root length (cm) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	15.67	12.47	14.70	14.28	17.40	8.60	14.37	13.76	17.47	9.60	8.9	12.32	17.43	8.60	12.80	12.94	14.37	12.67	8.67	11.90	15.53	10.39	13.81	13.24
M2	13.40	9.57	12.43	11.80	17.37	9.69	12.31	13.46	17.69	10.20	9.53	13.16	13.67	9.63	13.47	12.26	13.53	10.53	8.90	10.99	14.81	9.92	12.26	12.33
M3	8.40	9.67	13.90	10.66	13.37	8.50	8.42	12.10	17.90	10.77	13.23	12.63	11.67	10.30	13.93	11.97	14.20	10.33	8.20	11.01	12.31	9.59	12.74	11.54
M4	9.70	9.93	12.4	10.68	8.60	6.47	12.13	11.73	16.73	11.27	14.53	11.51	10.3	9.77	13.73	11.27	13.23	8.70	9.6	10.37	10.99	9.55	13.21	11.25
M5	15.90	9.50	14.97	13.46	17.7	8.60	11.04	12.24	17.57	9.37	12.21	13.05	16.40	7.57	11.63	11.87	13.63	9.57	8.53	10.58	15.09	8.92	13.20	12.40
M6	19.67	11.13	14.37	13.39	11.60	17.30	10.50	13.47	17.73	11.97	14.73	14.54	17.73	9.40	12.70	13.28	13.50	12.80	15.50	13.93	16.45	12.52	12.16	13.71
M7	16.47	10.33	11.87	12.89	15.60	10.27	12.12	12.66	17.00	9.50	10.23	12.24	11.60	6.50	11.50	9.87	12.87	11.50	12.70	12.36	17.07	9.62	11.72	12.80
M8	11.4	8.73	13.73	11.29	10.37	11.3	15.25	12.31	17.70	10.10	14.97	14.1	15.4	10.3	14.57	13.42	10.5	10.23	12.73	11.16	13.43	10.13	13.8	12.45
Mean	13.83	10.29	13.55	12.55	14.80	10.22	12.51	12.84	15.80	10.10	11.98	13.29	14.28	9.01	13.04	12.11	13.23	10.79	10.60	11.54	14.46	10.08	12.86	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.27	0.21	0.34	0.47	0.59	0.76	1.32

Table 6: Effect of pre-sowing treatment, container type, growing media, and their interaction on root thickness (mm) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	6.95	3.89	4.66	5.17	3.27	3.30	4.13	3.57	7.31	2.59	4.86	5.25	2.03	4.55	1.64	2.74	2.33	1.56	1.75	1.88	4.58	3.05	3.41	3.68
M2	2.36	1.82	2.64	2.28	4.37	2.07	3.47	3.30	7.30	3.27	2.76	4.78	2.77	0.95	2.55	2.09	1.94	1.15	2.53	1.87	3.95	1.85	2.79	3.33
M3	5.24	2.95	4.83	4.34	4.15	4.48	3.28	3.97	4.29	3.43	5.00	4.24	2.29	1.17	1.51	1.66	2.99	0.94	2.43	2.12	3.79	2.57	3.21	3.19
M4	6.05	3.97	1.67	3.89	3.67	3.32	3.75	3.58	4.21	2.64	5.49	4.12	2.25	1.97	2.71	2.31	2.75	0.84	1.88	1.81	4.19	2.69	3.10	2.86
M5	3.98	3.44	2.34	3.25	3.05	2.05	2.85	2.65	5.00	7.57	3.28	4.58	2.26	2.33	3.42	2.67	3.82	4.46	1.74	3.34	4.15	4.03	2.73	3.64
M6	4.38	1.36	4.65	3.46	5.26	3.00	4.39	4.22	7.66	3.42	5.33	6.27	3.24	1.37	1.66	2.09	4.17	2.15	1.23	2.72	4.41	2.26	3.45	4.20
M7	7.29	2.66	3.45	4.47	4.79	2.95	3.07	3.60	7.16	3.42	6.68	6.09	4.08	3.85	4.55	4.16	4.78	1.74	1.56	2.70	5.82	2.92	3.86	3.37
M8	2.78	1.57	3.24	2.53	3.64	2.86	5.45	3.98	5.58	3.64	3.74	4.32	2.53	3.45	2.46	2.81	3.35	1.82	2.66	2.61	3.58	2.67	3.51	3.25
Mean	4.88	2.71	3.44	3.67	4.03	3.00	3.80	3.61	6.44	3.79	4.64	4.96	2.68	2.46	2.56	2.57	3.52	1.83	1.85	2.40	4.31	2.76	3.26	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.04	0.03	0.05	0.07	0.09	0.11	0.19

Table 7: Effect of pre-sowing treatment, container type, growing media, and their interaction on several secondary roots of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	3.00	2.67	5.00	3.56	6.33	3.33	4.00	4.56	6.33	4.00	5.00	5.11	4.00	1.33	2.00	2.44	4.00	2.33	1.00	2.44	4.67	2.53	3.67	3.62
M2	3.22	2.11	4.00	3.11	5.33	2.00	5.33	4.22	9.00	5.67	5.67	6.78	3.00	2.67	1.33	2.33	4.33	3.67	3.33	3.78	4.80	3.33	4.00	4.04
M3	3.00	4.00	4.00	3.67	6.00	2.00	5.00	4.33	3.67	4.33	3.33	3.78	3.00	2.67	1.67	2.44	2.67	3.33	6.00	4.00	3.87	3.60	3.47	3.64
M4	3.00	5.00	2.67	3.56	7.00	3.67	4.33	5.00	6.67	4.33	9.00	6.67	7.00	1.33	3.00	3.78	4.00	3.00	5.33	4.11	5.93	3.53	4.40	4.62
M5	6.33	1.67	3.33	3.78	5.67	6.33	3.67	5.22	7.33	5.33	4.33	5.67	4.00	3.33	5.00	4.11	4.00	4.00	2.33	3.44	4.53	4.73	4.07	4.44
M6	5.33	3.33	4.00	4.22	5.00	3.00	6.33	4.78	9.67	5.33	6.00	7.00	8.33	3.67	4.00	5.33	5.00	5.00	4.67	4.89	6.27	4.4	5.07	5.76
M7	4.67	6.00	6.00	5.56	5.33	6.00	5.00	5.44	8.00	6.33	5.33	6.56	9.33	2.33	5.00	6.56	5.67	4.33	4.00	4.67	7.47	4.67	5.13	5.24
M8	6.00	7.00	5.00	6.00	5.00	4.00	3.33	4.11	3.33	4.00	5.33	4.22	9.00	1.67	3.00	4.56	5.33	3.67	3.00	4.00	5.93	3.73	4.07	4.58
Mean	4.29	4.00	4.25	4.18	5.71	3.79	4.63	4.71	6.75	4.92	5.50	5.72	6.33	2.38	3.13	3.94	4.38	3.67	3.71	3.92	5.43	3.82	4.23	

	T	C	M	T × C	C × M	T × M	T × C × M
$CD_{0.05}$	0.40	0.31	0.50	0.69	1.13	0.87	1.95

Table 8: Effect of pre-sowing treatment, container type, growing media, and their interaction on per cent of fibrous roots (%) of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	56.17	49.00	54.07	53.31	52.27	56.67	45.90	51.31	45.00	31.20	53.00	49.38	31.20	55.15	33.44	39.93	35.55	40.00	27.91	34.49	42.54	50.00	44.51	45.69
M2	55.27	39.00	40.58	45.95	47.34	51.33	39.82	46.16	52.33	44.13	59.00	54.35	44.13	41.26	36.33	40.57	43.86	40.00	21.74	35.20	39.67	47.67	46.01	44.45
M3	47.93	37.33	45.44	43.57	49.53	46.67	49.50	48.40	48.33	39.77	56.33	50.67	39.77	33.29	48.00	40.35	33.41	24.54	27.62	28.52	43.78	42.22	40.90	42.30
M4	54.56	31.33	55.46	48.12	49.00	54.00	44.33	49.11	43.00	61.71	40.33	43.26	61.71	43.82	57.00	54.18	34.71	23.11	47.30	35.04	50.35	41.83	45.64	45.94
M5	50.60	50.33	52.33	51.09	55.34	45.78	49.33	50.04	56.87	56.26	53.00	57.29	56.86	48.33	34.33	46.51	38.23	40.00	45.45	41.22	48.82	48.19	50.68	49.23
M6	55.40	49.33	50.33	51.69	57.41	45.00	51.50	51.14	42.00	42.33	49.95	49.41	42.33	38.49	50.00	43.61	41.67	40.00	30.19	37.28	45.99	46.97	46.93	46.63
M7	47.07	46.33	47.00	46.80	65.36	44.67	44.67	51.56	55.55	51.00	52.67	50.25	51.00	45.11	52.22	49.44	39.53	18.15	24.45	27.38	48.92	41.53	44.81	45.09
M8	45.93	45.67	53.33	48.31	56.21	53.00	50.33	53.51	53.70	39.00	51.67	51.67	39.00	50.00	48.50	45.83	45.25	23.03	47.97	38.75	52.14	44.19	46.52	47.62
Mean	52.46	43.54	49.82	48.61	54.18	49.64	46.92	50.16	51.99	49.57	50.79	50.79	45.75	44.43	44.98	45.05	39.03	31.11	34.08	34.74	46.53	45.33	45.75	

	T	C	M	T × C	C × M	T × M	T × C × M
SEm±	1.04	0.80	1.31	1.79	2.27	2.93	5.08
$CD_{0.05}$	2.89	3.15	3.65	5.00	6.32	8.16	14.14

Table 9: Effect of pre-sowing treatment, container type, growing media, and their interaction on nodule number of *Albizia procera* seedlings

	T1				T2				T3				T4				T5				C1	C2	C3	Mean
	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean	C1	C2	C3	Mean				
M1	47.33	30.00	36.67	38.00	33.33	30.33	31.67	34.11	48.00	38.67	42.00	42.89	47.33	20.00	38.00	35.11	17.67	13.63	17.33	15.78	35.87	31.73	32.00	33.20
M2	49.00	34.67	42.33	43.33	33.67	28.33	30.00	32.67	46.33	41.67	45.67	47.89	27.33	24.00	26.33	25.89	19.67	13.53	13.67	13.22	35.40	31.20	31.53	32.71
M3	45.00	37.67	38.33	40.33	33.67	24.33	31.00	33.00	48.33	37.33	44.00	46.56	36.33	14.67	34.33	28.44	15.67	11.33	13.67	15.22	36.47	27.20	33.60	32.42
M4	46.00	39.33	43.67	43.00	35.00	29.67	32.00	34.89	42.33	39.67	41.33	41.11	35.00	26.33	28.33	29.89	21.33	13.67	18.33	17.11	37.73	30.60	33.20	34.84
M5	49.33	32.67	46.33	42.78	34.67	27.67	31.33	29.56	37.67	42.67	46.67	42.33	36.33	17.00	22.67	25.33	26.67	14.00	25.67	22.11	37.07	35.20	36.13	36.13
M6	55.67	38.67	44.67	46.33	47.33	28.00	31.33	36.56	50.00	39.00	44.00	42.67	41.33	20.00	25.00	28.78	33.33	11.45	15.33	19.89	38.40	33.53	39.40	37.11
M7	47.33	46.67	47.00	47.00	40.67	33.00	35.67	36.11	48.33	44.33	46.67	49.22	24.00	27.67	29.67	27.11	27.00	16.67	19.33	21.00	35.27	29.93	34.33	33.18
M8	49.67	36.00	44.33	43.33	38.33	27.00	37.67	34.33	47.33	46.33	45.00	49.44	44.67	34.00	33.33	37.33	28.33	20.00	15.67	21.33	34.80	29.40	33.60	32.60
Mean	45.04	40.58	43.42	43.01	36.08	31.67	33.96	33.90	47.79	42.71	45.29	45.26	35.29	22.96	30.96	29.74	22.04	13.71	18.88	18.21	36.00	32.23	33.85	

	T	C	M	T × C	C × M	T × M	T × C × M
SEm±	0.95	0.74	1.20	1.65	2.08	2.69	4.66
$CD_{0.05}$	2.65	2.05	3.35	4.59	N.S	N.S	12.98

Conclusion

Based on the results of the present experiment, it may be recommended that seeds should be treated with cow urine for 24 hours. The rapid growth of seedlings after cow urine treatment might be due to the presence of growth-promoting substances (Auxins) and nutrients. The seeds are grown in a polybag of size 23 cm × 13 cm the best development of seedlings. However, the selection of suitable media for the container is also essential for the growth and development of quality seedlings. Among all growing mediums, sand + vermicompost (1:1) is suggested best for the growth of the seedlings. The better growth in vermicompost is due to better soil aeration and texture thereby reducing soil compaction and water retention capacity.

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