

Seed and Seedling Quality of Some Multipurpose Tree Species of Arid and Semi-Arid Regions

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Abstract

The study was undertaken to evaluate the seed and seedling quality of three multipurpose tree species viz., *Albizia lebbek*, *Acacia catechu* and *Melia azadirach* under controlled environmental conditions. Seeds were categorized on test weight basis viz., large, medium and small sized and subjected to hot and cold water treatments. All the species achieved high germination within 21 days after hot water treatments as compared to cold treatments. Plant height and root weight was recorded maximum in large size seeds irrespective of treatments. Higher seed germination, maximum fresh and dry weight of leaves, shoots and roots were observed from hot water treatment seeds ; however the effect of cold water treatments was more pronounced with respect to seedling growth, number of nodules and biomass production. Morphological characters were greatly influenced and biomass production increased as a result of increase in seed weight and size.

Key words : *Albizia lebbek*, *Acacia catechu*, *Melia azadirach*, Germination, Test weight.

Raising tree seedlings and its plantations is the costliest and potentially the riskiest phase of sustained yield in forestry. Availability of suitable planting stock in fairly large quantities and of good quality is also the biggest snag in executing plantation program. In general, the most of tree species, the seedlings are raised from the seed. Successful raising of seedling stock depends on many factors and two of the most important are seed and its quality. Besides, inherent genetic variability in seeds, the seeds vary in size and weight but this aspect is rarely taken into consideration while raising seedlings. Nothing much has been done with regard to seedling variation due to different in seed stock in terms of seed size and weight. Hence, the studies with regard to seed and seedling quality were conducted in three multipurpose tree species namely, *Albizia lebbek*, *Acacia catechu*, *Melia azadirach*.

Methods

The present investigation on three multipurpose species viz. *Albizia lebbek*, *Acacia catechu*, *Melia azadirach* were carried in the Department of Forestry, CCS Haryana Agricultural University,

Hisar. Seeds were collected and graded into three major categories based on the test weight, size viz., large, medium and small sized. The graded seeds of each class were given hot and cold water presowing treatments. The treated seeds were sown in polythene bags, for each set 100 seeds with three replications were taken. The polythene bags were kept in mist chamber having controlled temperature and humidity. Observations were recorded after 60 and 120 days of germination, for germination percentage, plant height, fresh and dry weight of roots, leaves and stems, root-shoot ratio, number of nodules and biomass production. The results were analyzed statistically and level of significance was calculated at 1%.

Results and Discussion

The seed germination was increased as a result of increase in seed size and weight. Hot water treatment was found much more effective as compared to cold water treatment for all the three categories of seed. Significant variation among all classes of seed size occurred due to treatment (Table 1).

Maximum seedling height was achieved when

Table 1. Effect of pre-sowing treatments on germination and height of seedlings. S₁ = Large seeds, S₂ = Medium seeds, S₃ = Small seeds, NS =Non -significant.

Species	Cold water treatment						Hot water treatment						
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	
Germination (%)													
<i>Albizia lebbek</i>	69.2	65.3	33.2	93.2	79.9	69.9							
<i>Acacia catechu</i>	60.3	45.4	39.1	83.2	53.3	43.3							
<i>Melia azadirach</i>	63.1	43.5	33.3	73.2	59.9	43.3							
Height of Seedlings (cm)													
Species	Cold water						Hot water						P ≤ 0.01
	60 days			120 days			60 days			120 days			
	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	
<i>Albizia lebbek</i>	34.67	31.33	29.00	106.67	68.33	39.33	26.50	21.33	16.83	36.00	24.00	17.67	5.06
<i>Acacia catechu</i>	28.67	25.17	17.33	87.50	62.50	54.00	20.00	17.83	14.50	27.67	20.33	17.17	3.76
<i>Melia azadirach</i>	13.67	11.00	9.33	17.83	16.00	13.33	15.33	12.50	11.83	20.33	16.83	15.17	NS

seedlings raised from cold water treated seeds after 60 and 120 days of sowing. Significant difference between large and small size seeds for seedling

height was observed due to either hot or cold water treatments in *Albizia lebbek* and *Acacia catechu* species but the difference was non-significant in

Table 2. Effect of pre-sowing treatments on fresh and dry weight (g) of leaves and shoot after 60 and 120 days. NS = Non-significant, FW-Fresh weight, DW-Dry weight.

Species		Cold water					
		S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Albizia lebbek</i>	FW	0.53	0.50	0.37	3.31	2.78	1.10
	DW	0.25	0.38	0.24	2.36	1.59	0.89
<i>Acacia catechu</i>	FW	0.26	0.20	0.13	3.86	3.05	2.74
	DW	0.13	0.10	0.07	2.34	2.00	1.74
<i>Melia azadirach</i>	FW	–	0.12	0.08	0.08	0.29	0.15
	DW	0.06	0.04	0.04	0.10	0.05	0.06
Dry Weight (g) of Shoot							
Species		Cold water					
		S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Albizia lebbek</i>	FW	0.45	0.50	0.34	4.96	2.63	1.21
	DW	0.20	0.23	0.24	3.33	1.57	0.81
<i>Acacia catechu</i>	FW	0.17	0.14	0.08	3.57	2.84	2.33
	DW	0.09	0.07	0.05	2.23	1.74	1.42
<i>Melia azadirach</i>	FW	0.12	0.07	0.06	0.19	0.17	0.10
	DW	0.05	0.05	0.03	0.12	0.11	0.07

Table 2. Continued.

Species		Hot water						$P \leq 0.01$
		60 days		120 days				
		S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	
<i>Albizia lebbek</i>	FW	0.40	0.37	0.41	1.34	0.50	0.35	NS
	DW	0.27	0.20	0.21	0.87	0.32	0.25	NS
<i>Acacia catechu</i>	FW	0.14	0.14	0.07	0.42	0.28	0.12	0.19
	DW	0.13	0.13	0.26	0.22	0.18	0.07	NS
<i>Melia azadirach</i>	FW	0.12	0.14	0.17	0.08	0.03	0.05	NS
	DW	0.09	0.12	0.06	0.03	0.04	0.03	NS

Dry Weight (g) of Shoot

Species		Hot water						$P \leq 0.01$
		60 days		120 days				
		S ₁	S ₂	S ₃	S ₁	S ₂	S ₃	
<i>Albizia lebbek</i>	FW	0.41	0.22	0.21	1.26	0.57	0.32	NS
	DW	0.25	0.14	0.14	0.88	0.41	0.24	0.32
<i>Acacia catechu</i>	FW	0.14	0.12	0.05	0.29	0.22	0.11	0.23
	DW	0.10	0.08	0.05	0.17	0.13	0.06	0.17
<i>Melia azadirach</i>	FW	0.13	0.19	0.09	0.12	0.18	0.07	NS
	DW	0.08	0.10	0.06	0.11	0.13	0.05	NS

case of *Melia azadirach* (Table 1).

Variation with fresh weight of leaves of seedlings raised from different size of seeds was found to be non-significant for all the species except *Acacia catechu*. The percentage increase in fresh weight of leaves varied from 5 to 20 times by 120 days as compared to 60 days observation in three species. Maxi-

imum increase was found in *Melia azadirach*. The effect of pre-sowing treatment with cold water was more in comparison to hot water treatment. Similar trend was evident for dry weight of leaves and it was non-significant irrespective of treatment and different categories of seeds in three species (Table 2).

Seedling raised from *Albizia lebbek* from large

Table 3. Effect of pre-sowing treatments on fresh and dry weight (g) of roots and root : shoot ratio after 60 and 120 days.

Species		Cold water					
		60 days		120 days			
		S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Albizia lebbek</i>	FW	0.21	0.33	0.14	2.67	2.64	1.47
	DW	0.16	0.16	0.08	1.55	1.41	0.55
<i>Acacia catechu</i>	FW	0.07	0.06	0.08	2.59	2.23	2.06
	DW	0.04	0.04	0.04	0.01	0.82	0.76
<i>Melia azadirach</i>	FW	0.06	0.05	0.04	0.26	0.29	0.23
	DW	0.03	0.04	0.02	0.17	0.16	0.15

Root : shoot ratio

Species		Cold water					
		60 days		120 days			
		S ₁	S ₂	S ₃	S ₁	S ₂	S ₃
<i>Albizia lebbek</i>		0.58	0.57	0.61	0.36	0.46	0.73
<i>Acacia catechu</i>		0.59	0.58	0.77	0.53	0.63	0.65
<i>Melia azadirach</i>		0.96	1.07	0.80	1.05	0.87	0.96

azadirach, the dry weight of shoot was more in seedlings raised with hot water treatment at 120 days of sowing (Table 2).

The weight of roots increased with an increase in time period. Among the three size seeds, maximum weight of roots was found in seedlings raised from large size seeds irrespective of the treatments to the seeds except in *Melia azadirach*. In *Melia azadirach*, it was noticed that root weight was almost two times more in medium size seeds as compared to large seeds after 120 days. However, this variation due to size of seeds was found to be non-significant in all the three species. The pattern of variation due to treatments in dry weight of roots in different categories of seeds in all the three species tested to be same as that of fresh weight of roots (Table 3).

In *Albizia lebbek*, variation in ratio of root to shoot was minimum in seedlings raised from cold water treated seeds after 60 days (Table 3). However, it varied from 0.36 (large seeds) to 0.73 (small seeds) after 120 days. Interestingly, the higher ratio was observed due to hot water treatment at both the 60 and 120 days of observation. The ratio increased with a decrease in seed size. Similar trend was occurred in *Acacia catechu*. However, in *Melia azadirach*, the ratio was found to be approaching same in all the treatments.

The total biomass production due to seed size was found to be statistically non-significant for all the species (Table 4). However, maximum biomass was produced in large size seeds and it decreased with a decrease in seed size. In general, maximum biomass was observed at 120 days in *Albizia lebbek* and *Acacia catechu* seedlings raised from large size seeds treated with cold water, while in *Melia azadirach* maximum biomass achieved in medium size seeds, i.e., 1.5 to 2 times more than the large and small size seeds, respectively. However, this variation was seen to be non-significant.

The variation in nodulation was found to be statically non-significant and it varied in different tree species (Table 4). Maximum nodulation was observed in *Albizia lebbek* treated with cold water after 120 days. The number of nodules increased with time and it was found to increase by 2 to 5 times depending upon the species. No nodulation was observed in *Melia azadirach*.

The germination test is universally accepted and used as seed quality test. Seed germination varied not only among the species but also within the species. Some researchers were of the opinion that seed size often controls the germination (4, 5). Our findings are in consonance that the larger seeds germinated more than the small size seeds. Variability in morphological characters was found to be influenced by seed size (3). Seedlings raised from large seeds were more sturdy and faster in growth. This was evident in the present study and many earlier worker supported this hypothesis in many other tree species (4—6). The root-shoot ratio was observed to be higher in *Albizia lebbek* and *Acacia catechu* with decreasing size in 60 days. However, this ratio was found to be the same for all the three seed size classes in 120 days old seedlings. This clearly indicates that the seedlings raised from small size seeds taken more time to establish and grow. It was indicated that the no. of leaflet, biomass production and growth rate varies with seed weight (7). Seedlings from the low weight class had the highest root : shoot ratio. Root : shoot ratio was highest in *Acacia catechu* indicating its adaptability to dry regions.

The studies with regard to nodule formation are of much importance in leguminous trees. A maximum number of nodules after 60 and 120 days were observed in *Albizia lebbek* treated with cold water. It was also studied the nodulation pattern in different species and found that nodulation take place after 50 days of sowing and it decreased with age (8). Similar results were obtained in the present study except that the time of nodulation was after 60 days of sowing. Biomass production decreased with decrease in size of seed. This cause of variation may be due to genetic character of the species. Some researchers also reported the same opinion (7). Conclusively, it is established that the growth rate of seedlings is proportional to seed weight. A few scientists were also of the view that bigger embryos have more nutrients to supports more growth (9, 10). It was also seen that for higher seed germination, hot water treatment was found more effective but for the overall seedling growth cold treatment showed better results.

Conclusion

Higher seed germination, maximum fresh and dry

weight of leaves, shoots and roots were observed from hot water treatment seed. However, the effect of cold water treatments was more pronounced with respect to seedling growth, number of nodules and biomass production. Morphological characters were greatly influenced and biomass production increased as a result of increase in seed weight and size.

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