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Effect of Pre-sowing Treatment to Break the Seed Dormancy and Seed Germination of *Melia composita* under Laboratory Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Melia composita (Burma dek) is one of the multipurpose fast growing tree species applicable for the agri-silviculture system. In northern India, due to its fast growing and short rotation nature it has developed one of chosen tree species by the farmers under agroforestry. *Melia composita* occurs mostly in tropical moist and dry deciduous forest of Himalayas. The seed have Hard endocarp and

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therefore quite difficult to germinate. There are different types of seed dormancy and it helps in find out the better pre-sowing treatment to assure early and uniform germination of seeds. This leads to minimize the cost of large scale seedlings production. The present study was conducted at Laboratory of Seed Science and Technology, CCS Haryana Agricultural University during 2019 to evaluate the "Effect of pre-sowing treatments on seed germination of *Melia composita*". Five pre-sowing treatments *viz.,* normal water soaking (24, 48 and 72hr), conc. H_2SO_4 (5, 10 and 15 min.), cow dung slurry (5, 10 and 15 days), boiling water (5, 10 and 15 min.), mechanical scarification + GA_3 (100 ppm) (8, 16 and 24hr). In laboratory conditions, maximum germination (64.67 %) and seed viability (74.67%) were recorded in concentrated H_2SO_4 treatment at 15 minute, whereas maximum root length (7.54 cm), shoot length (16.72 cm), root: shoot ratio and seedling dry weight (0.65g) were recorded in mechanical scarification + GA_3 (100 ppm) at 24 hr.

Keywords: Germination; seed; pre-sowing treatment; scarification; seed viability.

1. INTRODUCTION

India is an agriculture -based country, its population depends upon Agriculture directly or indirectly. The pressure on valuable forest resources has increased due to an upsurge in a population explosion and developmental activities. *Melia composita* (Burma dek) is one of the multipurpose fast growing tree species mostly in tropical moist and dry deciduous forest of Himalayas applicable for the agri-silviculture system [1]. In northern India, due to its fast growing and short rotation nature it has developed one of chosen tree species by the farmers under agroforestry [2]. It belongs to family *Meliaceae* and is native to Indian Sub-continent it is deciduous in nature [3]. It has a wider adaptability with annual mean rainfall range of 350-2000 mm, and ascending at the altitude up to 1800m with annual temperature range of about 37- 47 0C. This species shows good growth when grown in deep fertile sandy loam soil but it can be grown on variety of soils [4]. Its fruits are bitter and used to destroy parasitic worms (Srivastava, 1996).

Melia composita has good bleachability property and higher pulp recovery than that of *Eucalyptus* spp. trees indicating its potential and suitability as alternate wood species for pulp production [5]. Fruits of *Melia composita* are helpful for making folk medicine as astringent, antihelminthic and contain highly Oxygenated and modified terpenoids having antibacterial, antifungal, anti-malarial, anticancer, antiviral, and pharmaceutical properties [6]. *Melia composita* is one of such species reported to have no adverse effect on under storey agriculture crops [7,8]. Whereas, Wood of *Melia composita* is an excellent and highly suitable raw material for wood based industries like paper and plywood industries owing to its natural anti-termite property [9].

Melia species contains the seed dormancy problem which results in very poor seed germination due to the hard seed coat of this species. Physical dormancy can be overcome by the mechanical scarification, acid treatment, and hot water treatment [10]. There are different types of seed dormancy and it helps in find out the better pre-sowing treatment to assure early and uniform germination of seeds. Hence, study was conducted to record the effect of pre-sowing treatment on seed germination of *Melia composita* under laboratory conditions.

2. MATERIALS AND METHODS

The present study was conducted in the Department of Seed Science and Technology, CCS Haryana Agricultural University, Hisar during 2019. The experimental site is characterized by semi-arid with hot and dry desiccating winds accompanied by frequent dust storms with high velocity in summer months, severe cold during in winter months and humid warm during monsoon rainy season. The details of different treatments for laboratory experiments are described in the following sub-headings.

2.1 Seed Collection and Preparation

Quality seeds which are physiologically matured were collected from the trees of *Melia composita* growing in research area of Forestry Department, CCS HAU, Hisar. Under lab conditions, the experiment was conducted in Completely Randomized Design (CRD) with 3 replications. The OPSTAT of (Hau) Software was used for analysis the result. The drupes were collected from different trees planted in a row. Fully

matured drupes were collected when they turned from green to yellow colour. Soon after collection, the drupes were dipped in water for 7 days and after that dried in sunlight and pulp was removed from the seeds. Later, brought to the laboratory processed and stored properly.

i. The Fruits of *Melia composita* were sown on a levelled layer of moist sand and covered with uncompressed sand. The bottom layer of sand was loosened by raking before sowing for good aeration. Then drupes which were healthy and mature were subjected to 5 pre-sowing treatments and these drupes were used for germination.

ii. The pre- sowing treatments given to seed to remove dormancy were used i.e. drupes were soaked in normal water for 24, 48, and 72 hrs. drupes were dipped for 5, 10, 15 minutes in Concentrated H_2SO_4 (98%) and then directly washed with plenty of water. In Cow dung slurry drupes were dipped for 5 days, 10 days and 15 days. Slurry was prepared by mixing 1kg of cow dung with 1 litre of water. drupes were boiled in hot water for 5, 10 and 15 minutes. Mechanical scarification was done by using sand paper. It involved breaking and weakening the seed coat. Firstly, drupes were treated with mechanical scarification secondly, GA_3 treatment was given to that drupes which were scarified and soaked in GA_3 for 8 hrs, 16 hrs and 24 hrs at the concentration of 100ppm. In control, drupes were not treated with any pre-sowing treatment (without treatment). For each treatment, 15 fruits were used and this trays were placed in seed germinator at 30^0C temperature with 90% humidity.

iii. Seed viability was determined through tetrazolium test.

$$\text{Viability (\%)} = \frac{\text{No. of stained seeds}}{\text{Total no. of seeds used}} \times 100$$

iv. Germination (%) was calculated by the number of normal seedlings was counted on the 30th day of germination in laboratory condition and were subjected for germination in a seed germinator which was maintained at 30^0C and 90% humidity

$$\text{Germination (\%)} = \frac{\text{No.of normal seed germinated}}{\text{Total no.of seeds sown}} \times 100$$

v. Seedling vigour indices were calculated according to the method suggested by Baki and Anderson (1973).

2.1.1 Vigour Index-I

It was calculated by using following formula:

Standard germination (%) × Average seedling length (cm)

2.1.2 Vigour index-II

Standard germination (percentage) × Average seedling dry weight (mg)

vi. Shoot length was calculated with the use of scale and expressed in centimeters. Root length (cm) Ten normal seedlings from three replications of each treatment were randomly selected at the time of final count of standard germination and average root length was calculated and expressed in centimeters.

vii. Seedling dry weight was measured after the final count in the standard germination test (30 days). Seedlings were dried in a hot air oven for 24 hours at 80 ± 1^0C. The dried seedlings of each replication were weighed and average seedling dry weight was calculated.

3. RESULTS AND DISCUSSION

3.1 Seed Viability (%)

The data given in Table 1 shows the differences in seed viability percentage of *Melia composita* among different pre-sowing treatments at different durations of time. Among all treatments, in concentrated H_2SO_4 treatment seed viability was recorded maximum (74.67%) at 15 minutes which was significantly higher as compared to other treatment durations and was followed by the treatment with mechanical scarification + GA_3 (100 ppm) at 24 hrs (71.67%) and mechanical scarification + GA_3 (100 ppm) at 16 hrs (68.33%). Gupta and Bhardwaj [11] reported that on treating with H_2SO_4 seeds of *Acrocarpus fraxinifolius* results in maximum germination % and germination value. Similarly, Bimlendra and Toky [12] reported that on treating seeds of *Albizzia lebbeck* with Concentrated H_2SO_4 for 15 minutes results in doubling of germination over that of control.

3.2 Seed Germination %

The inquisition of data in Table 1 showed the differences in seed germination percentage of *Melia composite* among different pre-sowing treatments at different durations of time. Among all treatments, in concentrated H_2SO_4 treatment seed germination percentage was recorded maximum (64.67%) at 15 minutes which was significantly higher as compared to other treatment durations followed by mechanical scarification + GA_3 (100 ppm) at 24 hrs (59.33%) and mechanical scarification + gibbrellic acid (100 ppm) at 16 hrs (56.00%). Airi et al. [13] conducted an experiment on seeds of *Semecarpus anacardium and Olea glandulifera* and reported significant increase in germination percentage on treating seeds with sulphuric acid for 5 to 10 minutes. Similarly, Khaiper et al. [14] reported positive effect on seeds treated with H_2SO_4 on germination of *Melia azedarach.* Also, Gupta and Bhardwaj [11] reported that on treating with H_2SO_4 seeds of *Acrocarpus fraxinifolius* results in maximum germination %.

3.3 Root Length

A scrutiny of data in Table 2 indicated the differences in root length of *Melia composita* among different pre-sowing treatments at different durations of time. The perusal of information displayed that root length was significantly influenced by all given pre-treatments and their duration. Among all treatments, in mechanical scarification + GA_3 (100 ppm) treatment root length was recorded maximum (7.54 cm) at 24 hrs which was significantly higher as compared to other treatment durations. This was followed by mechanical scarification + GA_3 (100 ppm) at 16 hrs (7. 27 cm). Mojab et al. [15] carried out study to break the seed dormancy of *Prosopis stephaniana.* Treatments given were such as seed soaking for different durations in sulphuric acid 95-98% (10,20,30 40,50 and 60 minutes), mechanical scarification with sandpaper for 5 minutes, seed soaking in distilled water at 24 and 48 hours and soaking seeds boiling water (95-98^{0}C) for 5 and 10 minutes and control. Results showed that highest germination rate, root and stem length, root and stem fresh weight was found in seeds soaked in Sulphuric acid for 60 minutes.

3.4 Shoot Length

The differences in shoot length of *Melia composita* among different pre-sowing treatments at different durations of time are explained in Table 2. The data revealed that shoot length was significantly influenced by all given pre- treatments and their duration. Among all treatments, in mechanical scarification + GA_3 (100 ppm) treatment shoot length was recorded maximum (16.72 cm) at 24 hrs which was significantly higher as compared to other treatment durations. This was followed by mechanical scarification + GA_3 (100 ppm) at 16 hrs (14.86 cm).

Table 1. Effect of pre-sowing treatment on seed viability % and seed germination % of *Melia composita* under laboratory conditions

Treatment	Duration	Seed viability %	Germination %
Normal water soaking	24hrs	51.33	46.33
	48hrs	53.67	48.33
	72hrs	57.33	50.67
Concentrated H_2SO_4	5 min.	63.33	53.53
	10 min.	68.00	56.33
	15 min.	74.67	64.67
Cow dung slurry	5 days	56.33	50.00
	10 days	64.00	55.33
	15 days	70.33	57.33
Boiling water	5 min.	19.67	13.67
	10 min.	14.33	10.33
	15 min.	12.00	8.00
Mechanical scarification	8hrs	60.33	51.67
+ GA_3 (100ppm)	16hrs	68.33	56.00
	24hrs	71.67	59.33
Control (without treatment)		50.33	43.67

Table 2. Effect of pre-sowing treatments on Root length and Shoot length and root shoot ratio of *Melia composita* under laboratory condition

Treatment	Duration	Root length (cm)	Shoot length (cm)	Root shoot ratio
Normal water soaking	24hrs	4.19	10.18	0.411
	48hrs	4.81	10.52	0.457
	72hrs	4.95	11.17	0.443
Concentrated H_2SO_4	5 minutes	4.47	10.24	0.436
	10 minutes	4.72	10.33	0.456
	15 minutes	4.07	10.07	0.404
Cow dung slurry	5 days	4.54	10.29	0.441
	10 days	5.21	11.32	0.460
	15 days	5.32	11.69	0.455
Boiling water	5 minutes	3.54	7.27	0.860
	10 minutes	3.24	7.11	0.455
	15 minutes	3.02	6.92	0.436
Mechanical scarification + GA_3 (100ppm)	8hrs	6.13	13.59	0.451
	16hrs	7.27	14.86	0.489
	24hrs	7.54	16.72	0.450
Control (without treatment)		4.05	8.52	0.475
C.D. at 5%		0.38	0.84	0.037

3.5 Root: Shoot Ratio

A critical view of data in Table 2 indicated the differences in root:shoot ratio of *Melia composita* among different pre-sowing treatments at different duration. Among all treatments, in mechanical scarification + GA_3 (100 ppm) treatment root length was recorded maximum 16 hrs (0.489). This was followed by mechanical scarification + GA_3 (100 ppm) (0.450) at 24 hrs. Significantly minimum root length (3.02) were recorded in treatment with boiling water at 15 minutes.

3.6 Vigour Index-I

The data in Table 3 stated that Vigour index -I was significantly influenced by all given pre-treatments and their duration. Among all treatments, in mechanical scarification + GA_3 (100 ppm) treatment vigour index-I was recorded maximum (1,439.9) at 24 hrs which was significantly higher as compared to other treatment durations. This was followed by mechanical scarification + GA_3 (100 ppm) at 16 hrs (1,238.7). Significantly minimum Vigour Index -I (79.4) was recorded in treatment with boiling water at 15 minutes. Jinnui et al*.* [16] while working on *Indigofera pseudotinctoria* seeds were soaked with 98% H_2SO_4 for 20 minutes. results showed that conc. H_2SO_4 increasing the germination percentage, germination energy and also vigour index.

3.7 Vigour Index –II

The data in Table 3 revealed that Vigour index-II was significantly influenced by all given pre-treatments and their duration. Among all treatments, in mechanical scarification + GA_3 (100 ppm) treatment vigour index-II was recorded maximum (38.6) at 24 hrs which was significantly higher as compared to other treatment durations. This was followed by mechanical scarification + GA_3 (100 ppm) at 16 hrs (33.0). Significantly minimum Vigour index -II (0.9) was recorded in treatment with boiling water at 15 minutes.

3.8 Seedling Dry Weight (g)

The data in Table 4 clearly revealed the seedling dry weight (mg) was significantly influenced by different pre-sowing treatments at different durations of time under laboratory conditions. Among all treatments, the significantly maximum seedling dry weight of (0.65 g) was registered when the drupes were treated with mechanical scarification + GA_3 (100 ppm) at 24 hrs. However, this was followed by mechanical scarification + GA_3 (100 ppm) at 16 hrs (0.59 g).

Table 3. Effect of pre-sowing treatments on vigour index -I and vigour index – II of *Melia composita* under laboratory condition

Treatment	Vigour index		
	Duration	Vigour index -I	Vigour index -II
Normal water soaking	24hrs	665.2	14.4
	48hrs	740.8	20.3
	72hrs	816.8	22.8
Concentrated H_2SO_4	5 minutes	787.9	18.2
	10 minutes	846.6	22.6
	15 minutes	915.1	18.1
Cow dung slurry	5 days	742.3	18.0
	10 days	914.2	27.1
	15 days	976.3	29.2
Boiling water	5 minutes	147.7	2.9
	10 minutes	107.1	1.9
	15 minutes	79.4	0.9
Mechanical scarification + GA_3 (100ppm)	8hrs	1,018.9	28.4
	16hrs	1,238.7	33.0
	24hrs	1,439.9	38.6
Control (without treatment)		548.9	10.9
C.D. at 5%		63.9	1.7

Table 4. Effect of pre-sowing treatments on Seedling dry weight of *Melia composita* under laboratory conditions

Treatment	Duration	Seedling dry weight (g)
Normal water soaking	24hrs	0.31
	48hrs	0.42
	72hrs	0.45
Concentrated H_2SO_4	5 minutes	0.34
	10 minutes	0.40
	15 minutes	0.28
Cow dung slurry	5 days	0.36
	10 days	0.49
	15 days	0.51
Boiling water	5 minutes	0.21
	10 minutes	0.18
	15 minutes	0.11
Mechanical scarification + GA_3 (100ppm)	8hrs	0.55
	16hrs	0.59
	24hrs	0.65
Control (without treatment)		0.25
C.D. at 5%		0.03

4. CONCLUSION AND RECOMMENDATION

Based on the present study it is concluded that in laboratory conditions, among all the pre-sowing treatments concentrated H_2SO_4 for 15 minutes followed by mechanical scarification + GA_3 (100 ppm) at 24 hrs for seed viability and germination percentage. Seedling growth parameters such as vigour index –I and vigour index –II, root length, shoot length, seedling dry weight was recorded highest in treatment mechanical scarification + GA_3 (10 ppm) at 24 hrs.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Swaminathan C, Vijendrarao R, Shashikala S. Preliminary evaluation of variations in anatomical properties of Melia dubia Cav. wood. International Research Journal of Biological Sciences. 2012;14: 1-6.
2. India State of Forest Report. Forest Survey of India, Ministry of Environment and Forests, Released; 2021.
3. Murugesan S, Senthilkumar N, Rajeshkannan C, Vijayalakshmi, KB. Phytochemical characterization of *Melia dubia* for their biological properties. Der Chemica Sinica. 2013;4: 36-40.
4. Orwa, C, Mutua A, kindt R, Jamanadass, R. and Anthony, S. Agroforestry database: a tree reference and selection guide version 4.0.
   Available: http//www. Worldagroforestry.org/sites/ treesbs/treedatabases.asp)
5. Parthiban KT, Bharathi AK, Seenivasan R, Kamala K, Rao MG. Integrating *Melia dubia* in agroforestry farms as an alternate pulpwood species. Asia-Pacific Agro Forestry Newsletter. 2009;34:3-4.
6. Koul O, Singh G, Singh R, Singh J, Daniewski, W. M. and Berlozenki, S. Bioefficacy and mode of action of some limonoids of salannin group from *Azadirachta indica* and their role in a multi component system against lepidoptran larvae. Journal of Biosciences. 2004;29: 409-416.
7. Thakur DAS, Kumar D, Gunaga RP. Transient allelopathic propensity of *Melia composita* Willd. leaf litter on chickpea (*Cicer arietinum* L.). Indian Journal of Ecology. 2017;44:443-450.
8. Parmar AG, Thakur NS, Gunaga RP. *Melia dubia* Cav. leaf litter allelochemicals have ephemeral allelopathic proclivity. Agroforestry Systems. 2019;93:1347-60.
9. Saravanan V, Parthiban KT, Kumar P, Marimuthu P. Wood characterization studies on *Melia dubia* cav. for pulp and paper industry at different age gradation. Research Journal of Recent Sciences. 2013;2277:2502.
10. Rolston MP. Water impermeable seed dormancy. The botanical review. 1978; 44:365-396.
11. Gupta S, K and Bhardwaj, S D. Pre-sowing seed treatment to improve germination of *Acrocarpus fraxinifolius*. Advances in Plant Sciences. 2005;18:265-267.
12. Bimlendra K, Toky OP. Breaking of seed coat dormancy with acids in some arid zone trees. Journal of Tree Sciences. 1993;12:111-114.
13. Airi S, Rawal R, Samant SS, Dhar U. Treatments to improve germination of four multipurpose trees of central sub Himalaya. Seed Science and Technology. 1998;26:347-54.
14. Khaiper M, Dhanda SK, Ahlawat KS, Chugh RS, Jangra M, Verma P. Effect of pre-sowing treatments on drupe germination of *Melia azedarach* at nursery stage. Agricultural Mehanization in Asia, Africa and Latin America. 2021;52:4569-4577.
15. Mojab M, Hosseini M, Zamani GR, Kohansal A. Evaluation of different dormancy breaking methods on germination and early growth traits of mesquite *Prosopis stephaniana*. In Proceedings of 3rd Iranian Weed Science Congress, Volume 1: Weed biology and ecophysiology, Babolsar, Iranian Society of Weed Science. Iran, 17-18 February 2010;151-154.
16. Jinnui Y, Lixing H, Minge B, Hua Q, Tanjun Z. Effect of different treatments on seed germination of *Indigofera pseudotinctoria*. Journal of Zhejiang Forestry Science and Technology. Iranian Society of Weed Science. 2018;25:57-60.

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