Original Research Article

Effect of Pre-Sowing Treatment on Seed Germination of Melia composita under Laboratory Conditions

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 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 24hr.

Keywords: Germination, Seed, Pre-Sowing Treatment, scarification and seed viability

1. Introduction:

India is an agriculture -based country, its population depends upon Agriculture directly or indirectly. The total geographical area of our country is about 328 million hectare in the world, out of which total forest cover is about 7,12,249 (sq. km) and the geographical % is about 21.67 (FSI Report 2019). The target of National forest policy 1988 is to substantially increase in forest tree cover through afforestation. The pressure on valuable forest resources has increased due to an upsurge in a population explosion and developmental activities. The decline in forest cover and low sustained yield results in the shortage of fuel wood in rural areas. Forest -based industries go through problems facing

during the want of sustainable supply of wood, and results in import of timber, pulp and paper, wood products from other countries.

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 (Swaminathan et al., 2012). 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. It belongs to family *Meliaceae* and is native to Indian Sub-continent it is deciduous in nature (Murugesan et al., 2013). 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. Its height is usually about 20 m and having straight cylindrical bole of 9 m. This species shows good growth when grown in deep fertile sandy loam soil but it can be grown on variety of soils (Orwa et al., 2009). 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 (Parthiban et al., 2009). 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 (Kaol et al., 2004). *Melia composita* is one of such species reported to have no adverse effect on under storey agriculture crops (Kumar *et al.*, 2017, Parmar *et al*., 2018). 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, high pulp recovery and exceptional fibre strength as compared to traditional raw material (Sarvannan et al. 2013).

Melia species contains the seed dormancy problem which results in very poor seed germination due to the hard seed coat of this species. Sometimes conditions are favourable for germination but it does not germinate because of the seed dormancy. The seed have hard endocarp and therefore quite difficult to germinate. Physical dormancy can be overcome by the mechanical scarification, acid treatment, and hot water treatment (Rolston, 1978). 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. Hence, study was conducted to record the effect of pre-sowing treatment on seed germination of *Melia composita* under laboratory conditions.

2. Material 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.

Seed collection and experimental design : 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 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.
- 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.
- 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.
- Seed viability was determined through tetrazolium test.

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

- 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.

$$\text{Germination per cent} = \frac{\text{Number of normal seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

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

Vigour Index-I: It was calculated by using following formula:

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

Vigour index-II: Standard germination (percentage) × Average seedling dry weight (mg)

- 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.
- Seedling dry weight was measured after the final count in the standard germination test (30days). 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:

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 (2005) reported that on treating with H_2SO_4 seeds of *Acrocarpus fraxinifolius* results in maximum germination % and germination value.

Similarly, Bimlendra and Toky (1993) 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.

Seed germination (%):The inquisition of data in Table 1 showed the differences in seed germination percentage of *Melia composita* 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.* (1998) 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. (2021) reported positive effect on seeds treated with H_2SO_4 on germination of *Melia azedarach.* Also, Gupta and Bhardwaj (2005) reported that on treating with H_2SO_4 seeds of *Acrocarpus fraxinifolius* results in maximum germination %.

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 + GA_3 (100ppm)	8hrs	60.33	51.67
	16hrs	68.33	56.00
	24hrs	71.67	59.33
Control (without treatment)		50.33	43.67
C.D. at 5%		4.362	3.717

Root length (cm) : 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.* (2010) 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

Shoot length (cm) : 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).

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

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

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.* (2008) 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.

Vigour index -I: 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.

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

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 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:

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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