Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 2, Issue 3; July-September, 2015 pp. 166-169

http://www.krishisanskriti.org/Publication.html

Influence of Dormancy Breaking Mechanisms on Simarouba Seeds (*Simarouba glauca* DC.)

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Abstract—*The present investigation entitled "Influence of dormancy breaking mechanisms on simarouba seeds (Simarouba glauca DC.)" was carried out during kharif 2014-15 at the Agricultural Research Station, Hanumanamatti, Ranebennur (Taluk), Haveri (Dist.). Among different scarification treatments, significantly maximum (59.75 %) normal seedlings were recorded by scarification mechanism wherein seed coat is scratched by rubbing the seed with sandpaper (T_6). Significantly maximum (77.75 %) germination was recorded by control (with seed coat) (T_1). Rubbing the seed with sandpaper (T_6) recorded significantly maximum root length of 18.59 cm and 19.61 cm, shoot length of 9.80 cm and 13.29 cm, seedling length of 28.39 cm and 33.90 cm, seedling vigour indices-I value of 1696 and 1966 and vigour indices-II value of 1802 and 2397 at 45 and 90 days after planting respectively while maximum (2.218) germination rate indices value was recorded at 45 days after planting.*

Keywords*: Dormancy, Germination, Seedling vigour index*

1. INTRODUCTION

Simarouba (*Simarouba glauca* DC.) belongs to family Simaroubaceae**.** It is an ever green multipurpose tree, native of EL Salvador, Central America. National Bureau of Plant Genetic Resources first introduced it in 1960's to India and was grown in Research Station at Amravathi, Maharashtra. This was brought to the University of Agricultural Sciences, Bangalore in 1986 and systematic research and developmental activities began from 1992 onwards exclusively for soil conservation purpose especially earmarked for waste lands, bald hills and degraded lands. In recent years, it has attained greater importance in terms of its potential for edible oil, industrial vegetable oil and biofuel production. It is a versatile oil tree with productivity potential as high as 2000 kg edible oil per hectare per year with ability to establish well even in marginal and wastelands (Syamasundar and Hiremath, 2001).

Simarouba glauca DC seeds have hard seed coat physical dormancy and hence exhibit poor germination. Even fresh seeds have germination problems as only 60 per cent of seeds are able to produce normal seedlings. Propagation is mainly through seeds and like other oil seeds these seeds can be stored only for a limited period. Several scarification and stratification pre-sowing treatments like complete seed coat removal, mechanical injury of seeds, hot water treatment, dipping the seeds in concentrated H_2SO_4, rubbing the seed with sandpaper, hot air treatment and wet packing in order to overcome seed dormancy are being adopted in several tree seed species which helps in improvement of germination and faster establishment of the seedlings.

The whole idea behind above mentioned treatments to the seeds is to either completely remove the germination impeding seed coat or to reduce its thickness so that the seed could emerge (Baskin, 1998). Removal or reduction in thickness of the seed coat allows the seed to take up water and respiratory gases thus the germination process can be initiated. Hot water treatment to the seeds is known to significantly influence the germination percentage because it simulates the effect of wild fires on the seed where the seed coat is burnt and reduces its thickness, allowing the seed to take in oxygen and water, thus breaking its dormancy (Johnson, 1993). Dipping the seeds in concentrated H_2SO_4 can also effectively reduce the seed coat thickness, allowing the seed to take in oxygen and water through the micropyle (Iqbal, 1994). Mechanical injury to the seeds and rubbing the seeds with sandpaper offer alternatives to acid scarification treatments. Hot air treatment also helps to reduce the hardness of seed coats in order to pave ways for the influx of water and oxygen for mobilization of food reserves in embryo. Wet packing of seeds ably reduces the time required for germination of seeds which has been long known as one of the main merits of soaking treatments to increase germination and emergence rate and in turn to obtain improved emergence (Heydecker and Coolbear, 1977).

The non availability of proper nursery management technique in some forest tree species is the main problem in establishing good planting material. So, in the present study, it is planned to find out the suitable dormancy breaking mechanism for simarouba seeds.

2. MATERIAL AND METHODS

Experiment was undertaken at Biofuel Information and Demonstration Centre (BIDC), College of Agriculture, Hanumanamatti, Dist. Haveri, Karnataka state during 2014-2015 to study the dormancy breaking mechanisms on simarouba seeds (*Simarouba glauca* DC.).The trail was laid out in Randomized Complete Block Design (RCBD) with four replications. The experiment consisted of eight treatments *viz.*, (T_1) Control (with seed coat), (T_2) complete seed coat removal, (T_3) seeds were hammered with a wooden piece to break seed coat (mechanical injury), (T_4) dipping the seeds in hot water of 60^0C for 15 sec, (T_5) dipping the seeds in concentrated H_2SO_4 for 5 sec, (T_6) rubbing the seeds with sand paper, (T_7) seeds were oven dried at 40^0C for 24 hr (hot air treatment) and (T_8) seeds are tied in cloth bag and watered regularly to keep them wet (wet- packing).

Seedlings were raised in polythene bags after imposing dormancy breaking mechanisms as per the requirement of treatments and the observations on germination components such as normal seedlings, abnormal seedlings, hard seeds and dead seeds, root, shoot and seedling length, seedling vigor index and germination rate index were recorded. The data were subjected to the analysis of variance by adopting the appropriate methods as outlined by Panse and Sukhatme (1978) and Sundararaj *et al*. (1972). The critical difference were calculated at five per cent level of significance whenever `F` test was significant.

3. RESULTS AND DISCUSSION

Influence of dormancy breaking mechanisms on normal seedlings, abnormal seedlings, dead seeds, hard seeds and germination percentage in simarouba are presented in table (1).

Table 1: Influence of dormancy breaking mechanisms on normal seedlings, abnormal seedlings, dead seeds, hard seeds and germination percentage in simarouba.

Treatments		Normal seedlings (%)	Abormal seedlings (%)	Dead seeds (%)	Hard seeds (%)	Germination (%)
T_1	Control (with seed coat)	47.75 (43.71)*	07.25 (15.62)	15.00 (22.78)	77.75 (61.85)	77.75 (61.85)
T_2	Complete seed coat removal	41.75 (40.25)	25.00 (30.00)	33.25 (35.21)	41.75 (40.25)	41.75 (40.25)
T_3	Seeds are hammered with a wooden piece to break seed coat	37.00 (37.46)	23.00 (28.65)	35.00 (36.27)	42.00 (40.40)	42.00 (40.40)
T_4	Dipping the seeds in hot water of 60^0C for 15 sec	52.75 (46.57)	20.00 (26.56)	17.25 (24.54)	62.75 (52.39)	62.75 (52.39)
T_5	Dipping the seeds in Conc. H_2SO_4 for 5 sec	50.25 (45.14)	15.50 (23.18)	18.00 (25.10)	66.50 (54.63)	66.50 (54.63)
T_6	Rubbing the seeds with sandpaper	59.75 (50.62)	16.00 (23.57)	20.50 (26.92)	63.50 (52.83)	63.50 (52.83)
T_7	Seeds are oven dried at 40^0C for 24 hours	0.00 (00.00)	05.00 (12.92)	75.00 (60.00)	20.00 (26.57)	20.00 (26.57)
T_8	Seeds are tied in cloth bag and watered regularly to keep them wet	48.50 (44.14)	13.00 (21.13)	29.25 (32.74)	57.75 (49.43)	57.75 (49.43)
Mean		**42.22 (40.52)**	**15.59 (23.25)**	**30.41 (33.46)**	**11.78 (20.07)**	**54.00 (47.29)**
S.Em ±		0.96	1.39	1.53	0.79	1.40
CD at 5%		2.82	4.08	4.49	2.32	1.42

*Figures in parentheses are angular transformed values

Significant differences on per cent normal seedlings were recorded among the scarification mechanisms. Significantly maximum (59.75 %) normal seedlings with minimum (3.75 %) hard seeds were recorded by scarification mechanism wherein seed coat is scratched by rubbing the seed with sandpaper (T_6). The mechanical scarification by sandpaper had the highest speed of germination may be due to impermeability of seed coat to water and gases was overcome by seed coat breaking. The results are in agreement with the findings of Eisvand *et al. (*2006) wherein they reported that mechanical scarification by sandpaper was the most appropriate treatment to allow the seed coat to water uptake with no adverse effect on embryo in *Astragalus siliquosus* and noticed increase in germination up to 95 per cent. The researchers Okunlola *et al.* (2011) also studied pre-treatments on breaking the seed dormancy of *Parkia biglobosa* and they revealed that mechanically scarified with sandpaper gave higher germination of 83.3 per cent. Further Youssef *et al.* (2012) in a study to break seed dormancy in *Cupressus atlantica* Gaussen, by scarification with sand paper, noticed increase in the germination rate of Atlas cypress up to 67 per cent, indicating that the species possess essentially an exogenous dormancy (physical dormancy) due to the hard seed coat (hardseededness). Further they noticed that removing the thick cellular layer beneath the seed coat by hand scarification with abrasive paper attained almost full germination. Significantly minimum (5.00 %) abnormal seedlings were recorded by hot air treatment wherein seeds were oven-dried for 24 hours at 40^0C (T_7). Significantly minimum (15.00 %) dead seeds were recorded by scarification mechanism of control (with seed coat) (T_1). Significantly maximum (77.75 %) germination was recorded by scarification mechanism of control (with seed coat) (T_1).

Influence of dormancy breaking mechanisms on root length, shoot length and seedling length (cm) at 45 and 90 days after sowing (DAS) in simarouba are presented in table (2).

Table 2: Influence of dormancy breaking mechanisms on root length, shoot length and seedling length (cm) at 45 and 90 days after sowing (DAS) in simarouba

Treatments	Root length (cm)		Shoot length (cm)		Seedling length (cm)	
	45 DAS	90 DAS	45 DAS	90 DAS	45 DAS	90 DAS
T_1-Control (with seed coat)	17.45	18.98	9.02	11.85	26.47	30.83
T_2 -Complete seed coat removal	17.39	18.86	8.49	11.83	25.88	30.68
T_3-Seeds are hammered with a wooden piece to break seed coat	12.97	18.80	8.02	11.27	24.99	30.07
T_4-Seeds are dipped in hot water of 60^0C for 15 sec	18.17	19.50	9.74	13.28	27.90	32.79
T_5-Dipping the seeds in Conc. H_2SO_4 for 5 sec	17.87	19.45	9.50	12.37	27.36	31.82
T_6-Rubbing the seed with sandpaper	18.59	19.61	9.80	13.29	28.39	32.90
T_7-Seeds are oven dried at 40^0C for 24 hours	0.00	0.00	0.00	0.00	0.00	0.00
T_8- Seeds are tied in cloth bag and watered regularly to keep them wet	17.46	19.19	9.14	12.18	26.60	31.37
Mean	**14.98**	**16.80**	**7.96**	**10.75**	**23.45**	**27.55**
S.Em ±	1.41	0.49	0.45	0.33	0.61	0.57
CD at 5%	4.15	1.43	4.15	0.97	1.80	1.68

The same mechanical scarification treatment (T_6) also recorded significantly higher root length of 18.59 cm and 19.61 cm, shoot length of 9.80 cm and 13.29 cm, seedling length of 28.39 cm and 32.90 cm at 45 and 90 days after planting respectively. The maximum values of all the above mentioned parameters were recorded by scarification mechanism wherein seed coat is scratched by rubbing the seed with sandpaper (T_6). These present findings are in agreement with the findings of Abubakar and Maumuna (2013) wherein they reported that treatment of mechanical scarification (sand paper) was effective in the breaking seed dormancy of *Parkia biglobosa* which gave the germination percentage of 90 per cent within the shortest period of time of just two days as compared to other treatments.

The scarification mechanism of rubbing the seed with sandpaper (T_6) also recorded significantly highest seedling vigour indices-I value of 1696 and 1966 and vigour indices-II value of 1802 and 2397 at 45 and 90 days after planting respectively and maximum germination rate indices value (2.218) at 45 days after planting (Table 3).

Table 3: Influence of dormancy breaking mechanisms on seedling vigour index- I (SVI- I) and SVI- II and Germination rate index at 45 and 90 days after sowing (DAS) in simarouba

Treatments	SVI - I		SVI – II		GRI
	45 DAS	90 DAS	45 DAS	90 DAS	45DAS
T_1-Control (with seed coat)	1263	1473	2058	2397	1.637
T_2-Complete seed coat removal	1080	1281	1080	1281	1.762
T_3-Seeds are hammered with a wooden piece to break seed coat	808	1165	881.5	1262	1.359
T_4-Seeds are dipped in hot water of 60^0C for 15 sec	1475	1725	1751	2056	2.185
T_5-Dipping the seeds in Conc. H_2SO_4 for 5 sec	1376	1599	1820	2116	1.858
T_6-Rubbing the seed with sandpaper	1696	1966	1802	2089	2.218

T_7-Seeds are oven dried at 40^0C for 24 hours	0000	0000	0000	0000	0.000
T_8- Seeds are tied in cloth bag and watered regularly to keep them wet	1288	1523	1536	1811	2.008
Mean	**1124**	**1342**	**1366**	**1622**	**1.628**
S.Em ±	70	39	75	65	0.040
CD at 5%	205	115	219	190	0.130

Increase in per cent normal seedlings, root length and shoot length can be attributed to the increase in the values of seedling vigour index and germination rate index.

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