



Physical and Physiological Changes During Seed Deterioration in *Simarouba glauca* DC

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Abstract

Investigations were carried out with the fifteen seed sources of *Simarouba glauca*, to elucidate information on the best seed source in terms of storage potential. The results of the study on physical and physiological observations during seed storage illustrated that Akola seed source performed better for hundred seed weight, seed germination, root and shoot length, dry matter production and vigour index, followed by Trichy and Mettupalayam. As age advanced, all the physical and physiological parameters reduced. As a result it has broader implications in the aspects of application in the field of Forestry, especially in the seed storage strategies.

Keywords: Vigour Index; Dry Matter; Germination; Seed Source Variation; Storage Conditions

Introduction

Simarouba glauca is one such ideal versatile multipurpose oil seed tree, which could be grown on a large scale in wastelands because of its high drought tolerance. The seed contains 50 per cent of edible fatty acids. The cultivation of this species has dual benefits i.e., to enable the country to march towards self-sufficiency in oil production as well as "Greening of the environment" a popular logo of global concern.

The longevity of seed in storage is largely influenced by the genotypes, history of seed taken into storage, moisture content of seed, container in which it is packed and temperature of the storage environment. Large-scale production of good quality seed requires storage for more than one season.

If not properly guarded, seed material will rapidly deteriorate and completely lose its viability in due course. The knowledge of storage potential of seeds is essential for effective seed management. Furthermore, the seeds are influenced by their place of birth due to climatic and edaphic factors. The seed source variations are

reported in many tree species with respect to their storage potential [1,2]. Delineation of the best seed source for individual species is an important milestone in establishing a successful population of trees. Hence, available sources have to be evaluated in terms of storage potential to choose the best source for seed collection. The physical, physiological and biochemical status of seed greatly influences their life span [3]. Asserted, "seed deteriorates during prolonged storage, but the rate of deterioration varies greatly among the species and provenance". There is a little study with respect to storage even since its introduction and hence, storage studies for different seed sources of *Simarouba glauca* was under taken. The study will evacuate the gap which now exists as there is no standard protocol like what happens during the physical and physiological changes during seed deterioration in the *Simarouba glauca* seeds.

Materials and Methods

The experimental materials for the present study consisted of fifteen seed sources of *Simarouba glauca* DC selected from six agroclimatic zones of Tamil Nadu, three from Karnataka and one each from Maharashtra, Orissa and Gujarat. Seeds from individual trees

from a source were mixed and used as a seed source. The actual locations of the seed sources and their geographic location are given in Table 1. The experiments were carried out at Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupal-

layam (11°9'N; 76°56'E; 300 m MSL; 830 mm rainfall) during 2022-2024. The software used for the purpose of statistical analysis is SPSS software.

Table 1: Details of the seed sources.

Sl.No.	Name of the seed sources	District/Location	State	Latitude	Longitude
1.	Thiruvannamalai	Thiruvannamalai	Tamil Nadu	12°15'N	79°07'E
2.	Vandavasi	Thiruvannamalai	Tamil Nadu	12°30'N	79°30'E
3.	Salem	Salem/Danishpet	Tamil Nadu	11°36'N	78°35'E
4.	Coimbatore	Coimbatore	Tamil Nadu	11°1'N	76°58'E
5.	Mettupalayam	Coimbatore	Tamil Nadu	11°19'N	76°56'E
6.	Trichy	Trichy/Kumalur	Tamil Nadu	11°10'N	78°49'E
7.	Mukkombu	Trichy	Tamil Nadu	10°48'N	78°42'E
8.	Thoothukudi	Thoothukudi	Tamil Nadu	8°48'N	78°11'E
9.	Nagercoil	Kanyakumari/Keeriparai	Tamil Nadu	8°21'N	77°22'E
10.	GKVK 1	Bangalore/GKVK campus	Karnataka	12°58'N	77°35'E
11.	GKVK 2	Tumkur/Tiptur	Karnataka	13°20'N	77°08'E
12.	Shankaranti	Bangalore/Hebbal	Karnataka	12°56'N	77°35'E
13.	Akola	Akola	Maharashtra	20°42'N	77°02'E
14.	Bhubaneshwar	Bhubaneshwar	Orissa	20°15'N	85°52'E
15.	S.K.Nagar	Banaskantha	Gujarat	21°07'N	73°40'E

The seeds collected from different sources were cleaned thoroughly to remove ill-filled, immature and insect damaged seed. Then, they were dried under shade to bring the moisture content to 8 ± 0.5 per cent. The seed samples drawn from different seed sources were evaluated initially for various physical and physiological as detailed below. After initial evaluation, the seeds were packed source wise in plastic containers and stored under ambient conditions. These samples drawn at 4, 8 and 12 months after storage, and the observation viz: hundred seed weight, germination, shoot length, root length and dry matter production were recorded. The number of replicates per treatment was four.

Results and Discussion

The present experiment revealed that the seeds collected from Akola (Maharashtra) recorded the highest hundred seed weight of 98.64 g followed by Mettupalayam (92.41 g) and Trichy (88.11 g)

and lowest was recorded in Mukkombu (53.27 g) of Tamil Nadu (Table 2). Similar variation in physical parameters due to seed sources were reported in teak [4], sandal [5,6], neem [7], *Albizia lebbek* [8], and *Acacia nilotica* [9].

The percentage germination is an excellent indicator of growth potential and survival of seeds, irrespective of factors responsible for loss of viability [10]. The results of this study depicted that the high initial germination of 75.75 per cent was reduced to 41.60 per cent as the ageing advanced (Table 3). Seed physical characters are strongly correlated to the physiological potential of the seeds. The initial seed stamina and quality are the first and foremost factors, which decide the storage and shelf life of the seed, which in turn is decided by the growing environment of the seeds. Further more, the large amount of embryo tissue which is the "initial capital" (em-

Table 2: Effect of seed source and period of storage on hundred seed weight (g).

Treatment code	Name of the seed sources (S)	Period of storage				Mean
		Initial (P ₀)	4 months (P ₁)	8 months (P ₂)	12 months (P ₃)	
S ₁	Thiruvannamalai	76.23	76.15	70.25	62.43	71.26
S ₂	Vandavasi	68.89	68.46	65.17	60.72	65.81
S ₃	Salem	71.09	71.00	67.53	60.14	67.44
S ₄	Coimbatore	61.95	61.52	58.21	49.56	57.81
S ₅	Mettupalayam	97.32	96.17	91.76	84.38	92.41
S ₆	Trichy	91.70	90.65	89.43	80.65	88.11
S ₇	Mukkombu	56.24	56.14	52.34	48.35	53.27
S ₈	Thoothukudi	80.06	80.00	85.45	80.40	81.48
S ₉	Nagercoil	67.38	65.17	60.12	58.72	62.85
S ₁₀	GKVK - 1	72.40	70.25	68.24	60.41	67.82
S ₁₁	GKVK - 2	69.13	68.14	63.29	58.15	64.68
S ₁₂	Shankaranti	76.65	75.32	72.56	69.44	73.49
S ₁₃	Akola	104.56	101.23	98.21	90.56	98.64
S ₁₄	Bhubaneshwar	88.17	87.56	85.27	80.23	85.30
S ₁₅	S.K. Nagar	66.52	65.23	61.43	55.64	62.20
	Mean	76.55	75.53	72.62	66.65	
		S	M	S x M		
	SEd	2.826	1.459	3.514		
	CD (P = 0.05)	5.597	2.890	7.025		

Table 3: Effect of seed source and period of storage on germination (%).

Treatment code	Name of the seed sources (S)	Period of storage				Mean
		Initial (P ₀)	4 months (P ₁)	8 months (P ₂)	12 months (P ₃)	
S ₁	Thiruvannamalai	71 (57.45)	70 (56.80)	62 (51.95)	33 (55.05)	59.00 (50.31)
S ₂	Vandavasi	76 (60.69)	74 (59.36)	70 (56.80)	38 (38.06)	64.50 (53.73)
S ₃	Salem	81 (64.17)	80 (63.69)	75 (60.01)	36 (36.87)	68.00 (56.18)
S ₄	Coimbatore	64 (53.14)	62 (51.94)	58 (49.60)	41 (39.81)	56.25 (48.63)
S ₅	Mettupalayam	90 (71.93)	87 (68.92)	79 (62.78)	44 (40.68)	75.00 (61.08)
S ₆	Trichy	86 (68.23)	82 (64.93)	77 (61.43)	51 (45.57)	74.00 (60.04)
S ₇	Mukkombu	68 (55.55)	64 (53.13)	60 (50.77)	40 (39.21)	58.00 (49.67)
S ₈	Thoothukudi	80 (63.44)	77 (61.39)	71 (57.43)	43 (40.97)	67.75 (55.81)
S ₉	Nagercoil	74 (59.38)	72 (58.06)	67 (54.95)	46 (42.71)	64.75 (53.77)
S ₁₀	GKVK - 1	70 (56.90)	68 (55.57)	62 (51.94)	39 (38.65)	59.75 (50.76)
S ₁₁	GKVK - 2	71 (57.43)	70 (56.51)	65 (53.74)	41 (39.81)	61.75 (51.87)
S ₁₂	Shankaranti	69 (56.18)	67 (54.94)	62 (51.98)	45 (42.13)	60.75 (51.31)
S ₁₃	Akola	89 (70.71)	86 (68.23)	80 (63.44)	48 (43.86)	75.75 (61.56)
S ₁₄	Bhubaneshwar	75 (60.07)	73 (58.73)	67 (54.98)	37 (37.46)	63.00 (52.81)
S ₁₅	S.K. Nagar	73 (58.70)	70 (56.80)	65 (53.74)	42 (40.39)	62.50 (52.41)
	Mean	75.8 (60.93)	73.4 (59.27)	68.0 (55.70)	41.6 (40.08)	
		S	M	S x M		
	SEd	1.768	0.913	3.537		
	CD (P = 0.05)	3.538	1.827	7.076		

(Figures in parentheses indicates arc sine transformed values).

bryo weight) in heavy seeds was positively related to the superior growth of seedlings when compared to that of small seeds.

Several authors have made affirmative statements on the positive influence of seed weight over seed germinability [11-13]. Several authors reported the ecological influence on the seed characteristics on germination [7,13].

From the results, it is also confirmed that heavier seeds of Akola gave higher germination per cent (89) with least reduction upto 8th month and thereafter shows a fast decline to 48 per cent from ninth month to twelfth months of storage. The same trend was also noticed in the next best source of Mettupalayam. Similar results were reported by [2] in *Acacia nilotica*. The influence of seed sources on seed germination has been reported in many tree spe-

cies such as *Acacia senegal* [14], *Tectona grandis* [20], *Cedrus deodara* [15], *Azadirachta indica* [7] and *Albizia lebbek* [16].

In the present investigation, Akola seed source exhibited longest root, shoot length and dry matter production followed by Trichy and Mettupalayam when compared to all other seed sources (Table 4, 5 and 6). The Akola seed source initially maintains the root and shoots length upto 8th months of storage and thereafter a drastic reduction was found from 9.79 cm to 7.47 cm for root length and from 7.82 cm to 5.58 cm for shoot length. This was due to the progressive fall in the physiological stamina leading to deterioration in seed. However, the rate of reduction in shoot length was faster than root length. The results were in confirmation with findings of [9] in *Casuarina equisetifolia* and [2] in *Acacia nilotica*.

Table 4: Effect of seed source and period of storage on root length (cm).

Treatment code	Name of the seed sources (S)	Period of storage				Mean
		Initial (P ₀)	4 months (P ₁)	8 months (P ₂)	12 months (P ₃)	
S ₁	Thiruvannamalai	9.14	9.03	8.56	6.31	8.26
S ₂	Vandavasi	9.48	9.21	8.74	6.42	8.46
S ₃	Salem	10.07	9.98	9.73	6.94	9.18
S ₄	Coimbatore	9.13	9.03	8.91	6.43	8.37
S ₅	Mettupalayam	13.14	13.08	12.56	9.94	12.18
S ₆	Trichy	11.00	12.97	11.37	8.61	10.98
S ₇	Mukkombu	9.46	9.21	8.24	6.23	8.28
S ₈	Thoothukudi	10.45	10.24	9.54	7.72	9.48
S ₉	Nagercoil	9.63	9.32	8.45	6.41	8.45
S ₁₀	GKVK - 1	10.30	10.18	9.55	7.15	9.29
S ₁₁	GKVK - 2	9.52	9.24	8.91	6.14	8.45
S ₁₂	Shankaranti	11.20	11.00	10.78	8.07	10.26
S ₁₃	Akola	13.76	13.27	12.46	10.20	12.42
S ₁₄	Bhubaneshwar	10.46	10.18	9.43	8.17	9.54
S ₁₅	S.K. Nagar	10.39	10.22	9.72	7.49	9.45
	Mean	10.47	10.41	9.79	7.47	
		S	M	S x M		
	SEd	0.496	0.256	0.782		
	CD (P = 0.05)	0.993	0.512	1.563		

Table 5: Effect of seed source and period of storage on shoot length (cm).

Treatment code	Name of the seed sources (S)	Period of storage				Mean
		Initial (P ₀)	4 months (P ₁)	8 months (P ₂)	12 months (P ₃)	
S ₁	Thiruvannamalai	7.64	7.32	7.05	5.15	6.79
S ₂	Vandavasi	7.85	7.80	7.12	4.96	6.93
S ₃	Salem	8.02	8.00	7.96	5.17	7.28
S ₄	Coimbatore	7.49	7.25	6.98	4.23	6.49
S ₅	Mettupalayam	9.85	9.64	8.85	6.46	8.70
S ₆	Trichy	9.45	9.31	9.08	7.21	8.76
S ₇	Mukkombu	7.34	7.26	6.97	4.84	6.60
S ₈	Thoothukudi	8.20	8.15	7.86	5.12	7.33
S ₉	Nagercoil	7.56	7.43	7.14	4.95	6.77
S ₁₀	GKVK - 1	8.47	8.27	8.04	6.43	7.80
S ₁₁	GKVK - 2	7.92	7.59	7.13	5.18	6.95
S ₁₂	Shankaranti	8.05	7.96	7.24	5.46	7.17
S ₁₃	Akola	10.24	10.05	9.85	7.20	9.33
S ₁₄	Bhubaneshwar	8.78	8.43	8.15	5.96	7.83
S ₁₅	S.K. Nagar	8.23	8.16	7.96	5.43	7.44
	Mean	8.33	8.17	7.82	5.58	
		S	M	S x M		
	SEd	0.309	0.139	0.619		
	CD (P = 0.05)	0.619	0.320	NS		

Table 6: Effect of seed source and period of storage on dry matter production (g).

Treatment code	Name of the seed sources (S)	Period of storage				Mean
		Initial (P ₀)	4 months (P ₁)	8 months (P ₂)	12 months (P ₃)	
S ₁	Thiruvannamalai	0.904	0.902	0.896	0.643	0.836
S ₂	Vandavasi	0.863	0.852	0.824	0.614	0.788
S ₃	Salem	0.915	0.913	0.897	0.632	0.839
S ₄	Coimbatore	0.904	0.901	0.884	0.644	0.833
S ₅	Mettupalayam	0.993	0.981	0.863	0.621	0.864
S ₆	Trichy	1.004	0.987	0.878	0.634	0.873
S ₇	Mukkombu	0.812	0.802	0.787	0.541	0.735
S ₈	Thoothukudi	0.846	0.824	0.804	0.615	0.772
S ₉	Nagercoil	0.893	0.853	0.821	0.608	0.793
S ₁₀	GKVK - 1	0.865	0.824	0.794	0.514	0.749
S ₁₁	GKVK - 2	0.824	0.816	0.798	0.596	0.758
S ₁₂	Shankaranti	0.875	0.843	0.813	0.614	0.786
S ₁₃	Akola	1.050	1.020	0.994	0.826	0.972
S ₁₄	Bhubaneshwar	0.934	0.912	0.820	0.640	0.826
S ₁₅	S.K. Nagar	0.867	0.843	0.814	0.621	0.786
	Mean	0.903	0.884	0.846	0.624	
		S	M	S x M		
	SEd	0.011	0.008	0.020		
	CD (P = 0.05)	0.022	0.017	0.041		

The decline in root and shoot length at twelve months of storage also showed significant reduction in its dry weight, proving that ageing retarded cell multiplication rather than cell elongation. Irrespective of sources, as ageing advanced, a tremendous reduction in seedling dry weight was noticed. However, the rate of reduction in germination percentage was relatively faster than the rate of reduction in dry matter production under ageing. In this study, the magnitude of reduction in seedling length and dry matter production was less in Akola followed by Trichy and Mettupalayam than the other sources (Table 5 and 6). It shows the ability of seeds to withstand the storage conditions. The physiological deterioration of seed vigour in terms of seedling dry weight might be the outcome of deterioration at various levels in the enzyme activity and seed composition. In case of vigour index, highest value

was observed in Akola (75) followed by Mettupalayam (67) and Trichy (66) among all seed sources and decline was noticed as ageing advanced (Table 7). The decline in vigour preceded the decline in germination at all periods of seed storage. This was in agreement with the findings of [9] in *Casuarina equisetifolia* and [2] in *Acacia nilotica*.

Seedling growth and vigor varied with storage conditions and seed source. Variation has been reported in *Casuarina equisetifolia* [1,18], *Azadirachta indica* [19], *Santalum album* and *Tectona grandis* [13] in *Acacia nilotica* [2]. The initial seedling growth and vigour was found to be influenced by the seed source in *Acacia nilotica* [9]. [21] reported that seedling vigour decreased with increase in storage period in *Madhuca latifolia*.

Table 7: Effect of seed source and period of storage on vigour index.

Treatment code	Name of the seed sources (S)	Period of storage				Mean
		Initial (P ₀)	4 months (P ₁)	8 months (P ₂)	12 months (P ₃)	
S ₁	Thiruvannamalai	64	63	56	21	51
S ₂	Vandavasi	66	63	58	23	53
S ₃	Salem	74	73	67	28	61
S ₄	Coimbatore	58	55	51	26	48
S ₅	Mettupalayam	89	85	68	27	67
S ₆	Trichy	86	80	67	32	66
S ₇	Mukkombu	55	51	47	22	44
S ₈	Thoothukudi	68	63	57	26	54
S ₉	Nagercoil	66	61	55	28	52
S ₁₀	GKVK - 1	60	56	49	20	46
S ₁₁	GKVK - 2	58	57	52	24	48
S ₁₂	Shankaranti	60	56	50	28	49
S ₁₃	Akola	93	88	79	39	75
S ₁₄	Bhubaneswar	70	66	55	23	54
S ₁₅	S.K. Nagar	63	59	53	26	50
	Mean	69	65	58	26	
		S	M	S x M		
	SEd	1.388	0.717	2.777		
	CD (P = 0.05)	2.779	1.435	5.558		

Conclusion

The study on the storage potential and viability of Simarouba glauca seeds revealed significant variability in seed characteristics and storage performance across different seed sources. The results highlighted that seeds from the Akola (Maharashtra) source exhibited the best physical and physiological attributes, including the highest seed weight, germination percentage, root and shoot length, and dry matter production. These traits were retained for a longer period, demonstrating better storage potential and seed longevity.

In contrast, seed sources such as Mukkombu (Tamil Nadu) showed the lowest seed weight and had the fastest deterioration rates in terms of germination, seedling growth, and dry matter production. The physiological decline in seed vigour and growth, particularly after eight months of storage, underlines the impact of seed source and storage duration on seed viability.

Overall, the findings emphasize the importance of selecting high-quality seed sources with better storage potential for the large-scale propagation of Simarouba glauca. The study also underscores the necessity of proper storage management to maintain seed viability and vigour, which is crucial for the successful cultivation of this multipurpose tree species, especially in wastelands with varying agroclimatic conditions. The Akola seed source emerged as the most robust in terms of storage resilience and should be prioritized for seed collection and future conservation efforts.

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