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Influence of Seed Moisture Content on Seed Germination and Quality in Canes

Research Article

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Abstract

A comprehensive laboratory study entitled "Influence of seed moisture on germination and seed quality in in Canes: *Calamus thwaitesii* and *Calamus nagabettai"* was undertaken at the Department of Forest Biology and Tree Improvement, College of Forestry, Sirsi, During 2014-15.The initial fruit moisture content was 48.72 per cent and 31.52 per cent and the germination of fresh fruits was found to be 61.33 and 38.66 per cent in *Calamus thwaitesii* and *Calamus nagabettai* respectively. Subsequently there was much difference in germination per cent in response to reduction in moisture content while drying the seeds. Significantly higher moisture content was observed in fresh seeds in both the species i.e. immediately after collection. Lowest moisture content was observed in seeds dried for 30 days drying under shade. The moisture content of 30.61 per cent and 18.15 per cent was found to be critical moisture content for seeds as below this germination was zero in *Calamus thwaitesii* and *Calamus nagabettai* respectively. Higher germination (61.33 per cent) and germination parameters were observed in seeds immediately after collection (T_1). The lowest germination (20.00 per cent) was observed in seeds dried for 15 days drying under shade (T_4) in Calamus thwaitesii. In Calamus nagabettai , T_1 treatment recorded significantly higher germination (38.66 per cent). The lowest germination (14.66 per cent) was observed in seeds dried for 10 days drying under shade (T_3). In general, moisture content of seeds was decreased with increasing drying period and leads to decline in seed germination and seed quality parameters in both the species and effect was more pronounced in *Calamus nagabettai* compared to *Calamus thwaitesii*.

Keywords: Moisture content; Germination viability; Vigour index

Introduction

Rattans are climbing palms belonging to the family *Arecaceae* (*Palmae*). Wood of rattans is strong, with medium density, yet much lighter than other hardwoods and extremely pliable. Because of these desirable characters, it is extensively used in the manufacture of a wide range of furniture and handicrafts items for low, medium and high end markets [1]. It is a major non-wood forest product after timber in South East Asia. The rattan industry has become a labor intensive and rural (or forest) based with increasing prospects for earning foreign exchange. The severe depletion in the rattan resources resulted in an urgent need for effective conservation and propagation measures to be taken. The available resources in Karnataka are scarce to meet the demands of the cane industry creating a wide gap between demand and supply. But this can be reduced by augmenting the existing resources by large scale cultivation of canes in the State. The demand for nursery grown seedlings has increased manifold for planting under social forestry programme and massive afforestation programme taken up by the government agencies. Lack of standard nursery techniques hinders such attempts. Even poor natural regeneration, low rate of seed germination makes the situation worst in case of certain Cane species. Rattan resource is getting depleted considerably due to over exploitation and reduction in habitats [2]. Planting in natural habitat without disturbing the existing vegetation

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is a simple way to increase the rattan resource. The large scale cultivation warrants detailed knowledge of propagation methods and their growth attributes.

Moisture content is a decisive factor in maintenance of recalcitrant seed quality. In these seeds, the sub cellular water is strangely associated with macromolecular surfaces, assuring the stability of membranes and macromolecules. Water loss during the drying process causes the series of metabolic alterations, acting on the control of growth regulators, amount and type of proteins and sugars, presence of free radicals, physical water status, among others, resulting in the onset of the deterioration process. This moisture was termed as critical moisture content when a significant reduction in germination percent was observed and as lethal moisture content when no germination occurs [3]. *Rattans* are the economically important recalcitrant species which lose their viability within few days under natural conditions, when the seed moisture content reduces below a high critical value. The seeds of some species will not tolerate any slight change in its desiccation level, that are termed as recalcitrant while others will survive to far lower rate of moisture content is orthodox seeds [4]. Storage environment is obviously very important in extending the life of seeds. The ideal metabolic rate in storage will conserve as much of the stored food reserves in the seeds as possible, yet operate at a level that maintains the integrity of the embryos. Although, seeds are propagated virtually no systematic work has been done either for their multiplication or to know the causes for their dormancy and poor germination. There is a need to study influence of seed moisture content on seed germination and quality in Canes in enhance the seed quality for better and quick germination.

Material and Methods

A natural population of *Calamus thwatesii* was identified in a semi- evergreen forest of Katagal forest range, Honnavar division, Uttara Kannada in the month of April and *Calamus nagabettai* was identified in evergreen forest of Kukke Subramanya, Sulllia taluk in Dakshina Kannada in the month of July (Plate -1). The fruits were randomly collected from ten mature mother trees, when the fruit colour turns to yellow. Soon after collection, the fruits were brought to the laboratory in gunny bags, processed to get clean, pure seeds of high physiological quality. The outer coat of the fruit is extracted by manual pressing; the fruits are macerated and thoroughly washed under running water to remove all pulp that is adhered to the fruit. Finally the seed is allowed to air dry in laboratory condition. Since the difference in the seed collection period, the experiments were conducted separately. Immediately after collection fruits outer coat removed in the laboratory. After seed processing, seeds were dried under shade in a well-ventilated place to study the effect of moisture content on seed germination. For each treatment, 400 seeds were used and samples were drawn in random in every five days interval up to 30 days of shade drying in both the species. In each sample, 100 seeds were used for moisture analysis and other three hundred were used for sowing in three replications in the nursery bed for germination test. Aftercare like watering and weeding was done regularly in the beds as and when required throughout the experimental period. A sample of 15- 20 seeds course grinded and same was subjected for oven for 80 °C for 17 hours then seed moisture content was recorded for both the species. Seed moisture content test was carried out by oven dry method as per the procedures of ISTA [5]. The experiment was conducted using complete randomized design (CRD) design with three replication in both the species separately.

The treatment details are as follows

T_1 : Immediately after collection (Fresh seed)

T_2 : 5 days drying under shade

T_3 : 10 days drying under shade

T_4 : 15 days drying under shade

T_5 : 20 days drying under shade

T_6 : 25 days drying under shade

T_7 : 30 days drying under shade

Results and Discussion

The data on seed moisture content of *Calamus thwaitesii* and *Calamus nagabettai* as influenced at different drying intervals are presented in the Table 1 and depicted in Figure 1. Moisture content was significantly influenced by the treatments of different drying intervals. Moisture content of seeds was decreased with increasing drying period of seeds. Significantly higher moisture content of

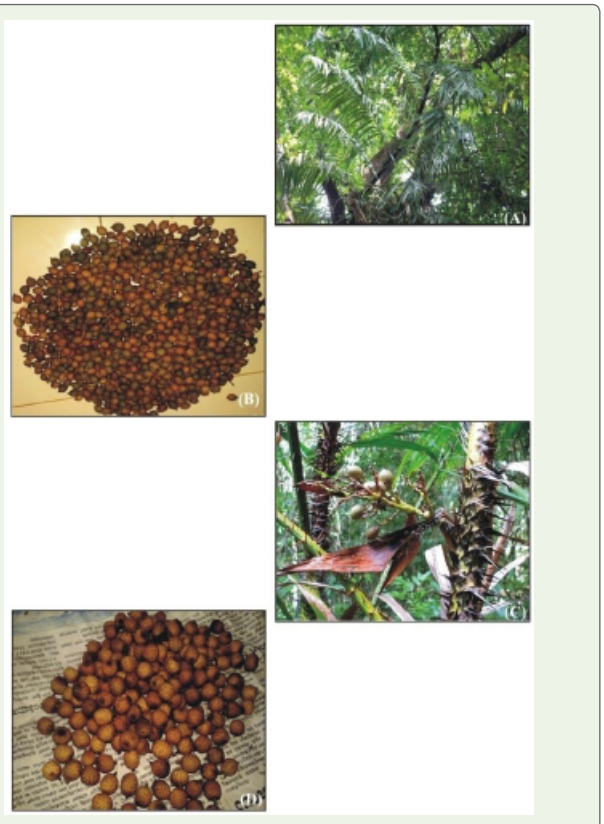

Plate 1: A View of (A) *Calamas thwaitesii* (B) fruits of *Calamas thwaitesii* (C) *Calamas nagabettai* tree in natural habitat (D) fruits of *Calamas nagabettai.*

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Table 1: Influence of seed drying on seed moisture content and seed germination in *C. thwaitesii* and *C. nagabettai*

Treatments	Seed Moisture content (%)		Germination (%)	
	C. thwaitesii	*C. nagabettai*	*C. thwaitesii*	*C. nagabettai*
T_1 : Immediately after collection (fresh seed)	48.72	31.52	61.33 (51.54)*	38.66 (38.44)
T_2 :5 days of drying under shade	43.64	25.24	42.66 (40.77)	25.24 (30.15)
T_3 : 10 days of drying under shade	39.48	18.15	26.33 (30.87)	14.66 (22.51)
T_4 : 15 days of drying under shade	30.61	9.84	20.00 (26.56)	0.00 (0.00)
T_5 : 20 days of drying under shade	19.24	9.35	0.00 (0.00)	0.00 (0.00)
T_6 : 25 days of drying under shade	18.30	9.11	0.00 (0.00)	0.00 (0.00)
T_7 : 30 days of drying under shade	17.94	9.80	0.00 (0.00)	0.00 (0.00)
SEm±	3.01	1.85	2.39	1.30
CD @ 5%	9.13	5.62	7.25	3.93

* - Figures in parenthesis are arc sign transformed values

Table 2: Influence of seed drying on speed of germination, peak value and root length in *C. thwaitesii* and *C. nagabettai*

Treatments	Speed of germination		Peak value		Seedling dry weight (g)	
	C. thwaitesii	*C. nagabettai*	*C. thwaitesii*	*C. nagabettai*	*C. thwaitesii*	*C. nagabettai*
T_1 : Immediately after collection (fresh seed)	1.32	0.81	1.02	0.64	0.23	0.73
T_2 :5 days of drying under shade	0.99	0.64	0.71	0.46	0.20	0.71
T_3 : 10 days of drying under shade	0.51	0.45	0.48	0.23	0.17	0.64
T_4 : 15 days of drying under shade	0.35	0.00	0.33	0.00	0.15	0.00
T_5 : 20 days of drying under shade	0.00	0.00	0.00	0.00	0.00	0.00
T_6 : 25 days of drying under shade	0.00	0.00	0.00	0.00	0.00	0.00
T_7 : 30 days of drying under shade	0.00	0.00	0.00	0.00	0.00	0.00
SEm±	0.05	0.02	0.03	0.02	0.01	0.03
CD @ 5%	0.14	0.07	0.08	0.07	0.02	0.1

Table 3: Influence of seed drying on shoot length, seedling dry weight and vigour index in *C. thwaitesii* and *C. nagabettai*

Treatments	Shoot length (cm)		Root length (cm)		Vigour index	
	C. thwaitesii	*C. nagabettai*	*C. thwaitesii*	*C. nagabettai*	*C. thwaitesii*	*C. nagabettai*
T_1 : Immediately after collection (fresh seed)	11.50	7.20	17.11	8.40	1754	603
T_2 :5 days of drying under shade	10.28	6.90	16.80	7.77	1155	420
T_3 : 10 days of drying under shade	10.00	5.80	12.00	7.10	645	189
T_4 : 15 days of drying under shade	9.16	0.00	11.20	0.00	407	0.00
T_5 : 20 days of drying under shade	0.00	0.00	0.00	0.00	0.00	0.00
T_6 : 25 days of drying under shade	0.00	0.00	0.00	0.00	0.00	0.00
T_7 : 30 days of drying under shade	0.00	0.00	0.00	0.00	0.00	0.00
SEm±	0.47	0.32	0.53	0.32	40.82	19.73
CD @ 5%	1.40	0.98	1.55	0.97	120.41	59.86

48.72 per cent was observed in fresh seeds of *Calamus thwaitesii i.e.* immediately after collection (T_1). Lowest moisture content (17.94 per cent) was observed in seeds dried for 30 days drying under shade (T_7). The moisture content of 30.61 per cent was found to be critical moisture content for seeds as below this germination was zero. Fresh seeds (*i.e.* immediately after collection) (T_1) of *Calamus nagabettai* recorded higher moisture content (31.52 per cent). Lower seed moisture content (9.80 per cent) was observed in seeds dried for 30 days drying (T_7). The moisture content of 18.15 per cent was found to be critical moisture content. Critical levels of moisture content vary greatly among species and even among cultivars and seed lots [6]. These results are in line with the finding of Merlin and Palanisamy [7] who studied seed viability and storability of Jackfruit and Chacko and Pillai in *Garcinia gummi-gutta* [8].

Significantly higher seed germination (61.33 per cent) was observed in seeds immediately after collection (T_1) (Figure 2). The lowest germination (20.00 per cent) was observed in seeds dried for 15 days drying under shade (T_4) in *Calamus thwaitesii*. However, the seeds dried for 20 days (T_5) under shade, 25 days drying (T_6), and 30 days drying under shade (T_7) recorded zero per cent of germination. In Calamus *nagabettai* fresh seeds (T_1) recorded significantly higher germination (38.66 per cent) and low (14.66 per cent) was in seeds dried for 10 days drying under shade (T_3). In general, moisture content of seeds was decreased with increasing drying period of seeds and leads to decline in seed germination. These results were augmenting with the findings of Broschat and Donselman in the tropical species (*Dypsis lutescens*,) [9].

Maximum speed of germination value of 1.32 was observed in freshly collected seeds of *Calamus thwaitesii* (T_1) followed by treatment (T_2) for 5 days drying under shade (0.99) (Table 2). The lowest speed of germination of (0.35) was recorded in treatment (T_4) for 15 days drying. Statistically the treatment T_1 and T_2 were on par with each other. In case of *Calamus nagabettai* the maximum speed of germination value of 0.81was observed in freshly collected seed

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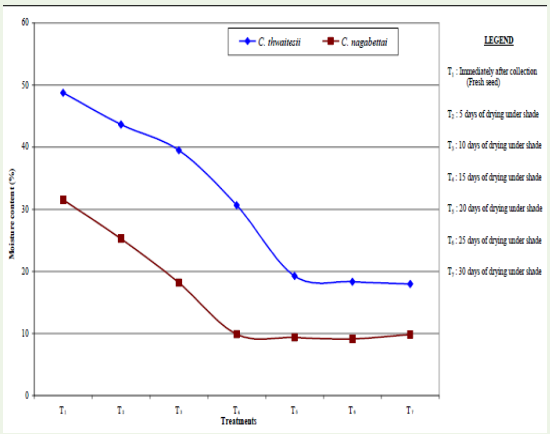

Figure 1: Influence of seed drying on seed moisture content (%) in canes.

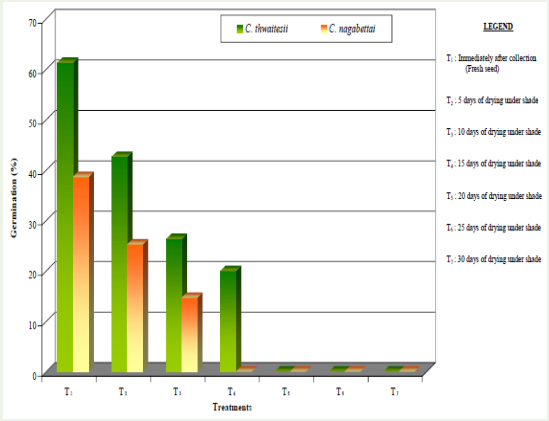

Figure 2: Influence of seed drying on percent germination in canes.

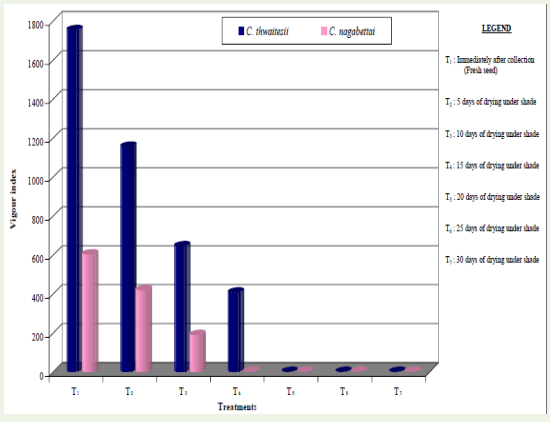

Figure 3: Influence on seed drying on vigour index in canes.

(T_1) and minimum (0.45) was in treatment (T_3) for 10 days drying under shade. Reduction in the moisture content of seeds was lead to no germination in prolonged drying of seeds.

Significantly higher peak values were observed in freshly collected and de-coated seed (T_1) and lowest was in T_4. Treatment in both the species during experimentation. Significantly higher dry weight (0.23g) was noticed in freshly collected de-coated seed (T_1). The lower seedling drying weight (0.15g) was observed in 15 days drying under shade (T_4) in *Calamus thwaitesii*. In case of *Calamus nagabettai* the higher dry weight (0.73 g) was observed in freshly collected de-coated seed (T_1) followed by treatment (T_2) 5 days drying under shade during experimentation. Similar results were also reported by Ezumah in the *Melia dubia*.

Higher shoot length and shoot length was observed in fresh seeds *i.e.* immediately after collection (T_1) than control (Table 3). Lowest shoot length was observed in seeds dried for 15 days drying under shade (T_4) in *Calamus thwaitesii* and *Calamus nagabettai*

There was significant variation in seedling vigour index due to moisture levels in Canes species (Figure 3). The species Calamus *thwaitesii* recorded higher vigour index of 1754 followed by treatment (T_2) 5 days drying. The lower vigour index of 407 was observed in the treatment of 15 days drying under shade (T_4). Similar trend was noticed in *Calamus nagabettai*. These results were augmenting with the findings of Singh et al., in *Azadirachta indica* [10-12].

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