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Seed Germination study in *Decaschistia cuddapahensis* Paul et Nayar - an endemic plant of Palakonda hill ranges, southern Eastern Ghats

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ABSTRACT

Seed germination rates under different treatment were studies in Decaschistia cuddappahensis, an endemic plant of southern Eastern Ghats in Palakonda hill ranges. Matured dried seed were collected in January-February and the seeds were germinated on the soil and sand bed made in to narrow furrows in the University net house. The seeds are reniform and feature physical dormancy with matured embryo. The seed viability is around 50% and germination percentage is about 40% and germination duration was 7-14 days. The seed percent range under physical scarification is 20-40% and seed soaked for 12 hours has produced high germination rate. Nicking has increased the seed germination rate. While the scarification through chemicals seed germination is 7-50%.

Keywords; Dry deciduous forests, endemic, seed dormancy, seed germination rate

1. INTRODUCTION

Shrubs in dry deciduous forests usually produce seeds having impermeable coats owing to the presence of palisade layer composed of Malphigian cells which prevents water to reach the embryo in the seeds (Baskin and Baskin 2014). This type of dormancy is refered as Physical Dormancy (PY) and seeds of this category will not germinate immediately after their dispersal and sometimes can persist in the soil till dormancy is broken under favourable environmental conditions (Jaganathan 2018). Especially in tropical areas with marked annual wet and dry seasons seeds of many species germinate at the beginning of wet season (Baskin and Baskin 2014). In the natural conditions, seasonal temperature fluctuations, hot summer season leading to increase in soil temperature, incidence of fire may induce dormancy break up (Jaganathan 2017) and treatments like wet and hot water treatments, mechanical scarification and acid scarification can also break dormancy (Baskin et al., 2000).

Endemism is a special criterion in conservation of any area. The word 'endemic' is ascribed to any taxon which has a restricted distribution. Owing to their narrow distributional zonation, endemic species became important target for global conservation efforts. A total of 145 endemic species occur in Eastern Ghats, of them majority occur in protected area network. Among them, 24 species occur in southern Eastern Ghats, but still 26% of them occurred in Reserve forests that occur outside the protected area network. *Decaschistia cudappahensis* is one such endemic species that occur in soutjern Eastern Ghats. Most of the endemic species in Eastern Ghats show narrow range of distribution. Aggressive colonization by invasive plant species such as *Hyptis suaveolens, Lantana camara, Chromolaena odorata, Prosopis juliflora, Ageratum conyzoides, Senna tora, Senna uniflora, Parthenium hysterophorus* are posing survival threat to native plant diversity.

The genus Decaschistia has three species namely *Decaschistia cudappahensis, Decaschistia crotonifolia* and *Decaschistia rufa* that occur in southern Eastern Ghats and of them Decashistia cuddapahensis is endemic to southern Eastern Ghats of Kadapa region. *Decaschistia cudappahensis* is a perennial shrub and usually branchlets in the range of 5-14 arise from the base. The plant will shed their leaves in the month of February and new leaves will commence in June. Flowers are yellow, solitary, axillary and the plant flowers during November and December. Fruit type is capsule and it is enclosed in calyx, Seeds are black to brownish in color, reni form and gets dispersed in February to March Pullaiah and Chennaiah 1997). Information about the germination ecology of *Decaschistia cudappahensis* is little known, hence the effect of different treatments that can break the dormancy in the seeds was carried out.

2. MATERIAL AND METHODS

The seeds of *Decaschistia cudappahensis* were collected from natural habitat of Plankonda hill ranges and Vangimalla Reserve Forest (N 14^0 17′ 40″ E 78^0 49′ 35″ at an altitude of 620m. Fresh dried and matured fruits with seeds were collected in polythene bags and brought to the laboratory. The seeds are washed in distil water, air dried and then used for germination studies. Further, a floating test was carried out to separate healthy seeds from unhealthy seeds and the floating seeds were removed and considered as empty seeds (Figure 1.).

Seed viability test

For the assessment of seed viability TTZ test (2,3,5 triphenyl tetrazolium chloride) was used. Seeds are small, reni form and very hard. Sharp edge blade was used to cut the hard seed longitudinally and were soaked for 24 hours and later transferred to 1% solution of TTZ and kept for 24 hours observation. The seeds were washed in water and cut horizontally to observe if the endosperm tissues have taken the red stain or not.

For the germination test studies, both nicked and non-nicked seeds were used for each treatment having 25 seeds in a batch. After treatment seeds are directly sown on the seed beds prepared in the Green house on a narrow furrows at a depth of 2-3cm. Watering was done regularly and germination was observed for a total of four weeks. Radicle emergence was recorded as criterion of germination. Germination percentage was calculated as Number of seeds germinated/Total number of seeds in the replicate X 100.

Counts of germinated seeds were made atleast three times per week for a period of six weeks. Seeds were treated as follows: 1. Untreated seeds as control, 2. Soaked in tap water for 12 hrs, 24 hrs and 48 hrs, 3. Treated with hot water (50^0C for 5 seconds) 4. Treated with 0.2% Hg Cl2, 4. Treated with Hydrogen peroxide, 5. Treated with concentrated sulphuric acid, 6. Treated with Ethyl alcohol, 7. treated with sodium hypochlorite for both nick and non-nicked seeds.

3. RESULTS AND DISCUSSION

The seed is reniform and weight of the seed is in the range of 0.093 to 0.102g. The Tri Phenyl Tetrazolium Chloride test revealed 40-60% of viable seeds among the replicates. A total of 100 seeds comprising of each fifty nicked and non-nicked seeds are tested for germination. Among them 21 nicked seeds (42%) got germinated and lower germination percentage (11 seeds, 22%) was recorded when non-nicked seeds are sowed on the sand bed. It was observed that a range of 7-14 days have taken for germination among nicked seeds and almost equal range (6-18 days) was recorded among the non-nicked seeds. It indicates that plants did not show profound change germination duration between the two seeds even though the germination is induced by nicking the seed coat.

In the germination test rules, two germination counts are usually mentioned: the first count which is the day when approximately two-thirds of the germinable seeds are expected to germinate and the final count is the end of the test period (Bedell 1998). When the germination period was observed among the germinated seeds it has yielded varied patterns. In the first week 59.6% of seeds got germinated and in the second week 32% germination was observed and in the third week a lower percent (6.4%)

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of germination was recorded. Thus, majority of seeds got germinates rapidly with in a two weeks once imbibition is initiated. It indicates that *Decaschistia cudappahensis* seeds possess impermeable seed coats and non-dormant embryos and similarly a study on seed germination on *Loxopterygium gusango*, a threatened plant in South America has also produced seeds with impermeable seed coats and the dormancy was broken by high temperatures in the summer season (Agarwal 1996).

Figure 1: *Decachistia cuddappahensis* in its natural habitat in Palakonda hill ranges

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Figure 1A: mature and dried seeds

Figure 1B: Seeds showing red stain after seed viability TTZ test

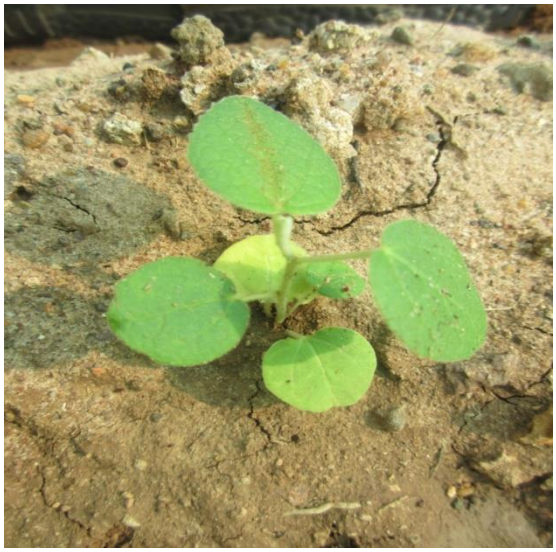

Figure 1C: Seed germination with intact cotyledons, hypocotyls and new leaves **Figure 1D**: Seedling after establishment

Table 1. Percent of seed germination and duration of germination among the 12 different treatments carried out on *Decaschistia cuddapahensis* seeds

S.No	Treatments to break Dormancy	Germination period (days)	Germination percentage (%)
1	Normal water -48 hr (Non-nick)	7-10	30
2	Normal water -24 hr (Non-nick)	10	20
3	Normal water -12 hr (Non-nick)	7	40
4	$HgCl_2$ (Non-Nick)	7-19	40
5	H_2O_2 (Nicked)	7-19	40
6	H_2O_2 (Non-Nicked)	0	0
7	H_2SO_4 (Nicked)	10	20
8	H_2SO_4 (Non-Nicked)	10-19	40
9	C_2H_5OH (Nicked)	7	30
10	C_2H_5OH (Non-Nicked)	0	0
11	NaOCl (Nicked)	7-10	50
12	NaOCl (Non-Nicked)	0	0

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Treatments to break Dormancy

The results of germination percentage, for each of the 12 different treatments carried out on a replicate of 20 seeds were provided in the Table 1. A high germination percentage (50%) was recorded among the seeds which are nicked and treated with NaOCl. It was also observed that no germination was recorded among the non-nicked seeds even though they are treated with NaOCl. A contrast observation was observed when concentrated H_2SO_4 was used in which non-nicked seeds got germinated (40%) in higher proportion against the lower germination percentage in nicked seeds (7%). Similar kind of observation was recorded when Hydrogen Peroxide was used as the treatment; a higher percent (40%) was observed when nicked seeds were treated and no germination occurred among non-nicked seeds. When seeds are treated with Mercuric Chloride, a decent level of germination (40%) was recorded among the non-nicked seeds. When seeds are soaked in normal water for a period of 12 hours, 24 hrs and 48 hrs, germination of 40%, 20% and 30% respectively are recorded. Thus for a better germination among the non-nicked seeds the treatments such as using Mercuric Chloride and H_2SO_4 are the ideal dormant breakers and among the nicked seeds the treatments such as using NaOCl, Hydrogen Peroxide and just sowing below 2-3 cm depth has yielded better results.

Similar results in *Pterospermum marsupium* has revealed that its germination is very poor in the range of 15-20% (Barmukh and Nikam, 2008). They suggested that 20 minutes treatment in normal water produced good results and exposure to 60 minutes is detrimental to seed germination. While physical scarification by rubbing the seeds with sand paper has also improved seed germination in *Pterocarpus marsupium* and *Pterocarpus santalinus* (Dayanand and Lohidas, 1988) and acid scarification has also increased the seed germination in the order of 15-43% in these two species. Soaking of *Decaschistia cuddappahensis* seeds in water for 12 hrs has shown decent germination (40%) and this result are decreased when the soaking duration as increased and similar results were observed for *Stereospermum suaveolens* tree in which seeds soaked for 20 minutes has yielded better results (Trivedi and Joshi, 2014). We found no significant difference when the seeds were germinated in different substrates like garden soil, forest soil and coco peat as the germination percentage is in the range of 25-30% although coco peat was found to be an ideal substrate for germination among *Hardwickia binata* and *Stereospermum suaveolens* tree species (Trivedi and Joshi, 2014).

4. CONCLUSIONS

The seed viability of *Decaschistia cudappahensis* is around 50% which indicates a good grade among the fresh matured seeds. Further, majority of seeds germinated within the first week and the seed germination duration is between 7-14 days. The seed percent range under physical scarification is 20-40% and seed soaked for 12 hours has produced high germination rate.. Nicking (rupturing of seed coat physically) has increased the seed germination rate. While the scarification through chemicals seed germination is 7-50%. Among the non-nicked seeds, seed treatments with Mercuric chloride and concentrated sulphuric acid has resulted in higher seed germination. Among the nicked seeds, the seed germination percent is higher when concentrated sulphuric acid is used. Autochory is the mode of seed dispersal and this mode would have helped this plant to get disperse in to different kind of environments. In these forests, although the plant is endemic they are not under threat as decent level of populations are noticed but in few patches in the forest inventory. The seed germination results indicate that the need of soil moisture is the key factor in the success of germination. Hence, in these dry deciduous forests the distribution and availability of better soil moisture sites would have lead to the clumped distribution of *Decaschistia cuddappahensis* shrub.

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Author contribution

The two authors declare that they have no conflict of interest. C. Ankalaih has done the field work and helped in draft preparation and M. Sridhar Reddy has involved in writing the draft and field work as well.

Ethical approval

Decaschistia cuddapahensis - an endemic plant from Palakonda hill ranges, southern Eastern Ghats, India was observed in the study. The ethical guidelines for plants & plant materials are followed in the study for sample collection & identification.

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Conflicts of interests

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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