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Seed germination in CITES listed *Cycas beddomei* and its bearing in its conservation

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सीआईटीईएस में सूचीबद्ध *सायकस बेडोमि* का बीज अंकुरण एवं इसके संरक्षण के दौरान वृद्धि

के. नेताजी, वाई. महेश, डी. अशोक एवं एम. वेंकट रमना

सारांश

सायकस बेडोमि डायर सीआईटीईएस (परिशिष्ट-I) के अंतर्गत स्थानिक एवं लुप्तप्राय प्रजाति के रूप में भारत के पूर्वी घाटों से संग्रहित कर सूचीबद्ध किया गया है। अंकुरों का बड़े पैमाने पर उत्पादन हेतु, लेखकों ने बीज सुप्तावस्था को निष्क्रिय करके, अंकुरण में तीव्रता लाकर एवं अंकुरण प्रतिशत में वृद्धि हेतु बीज अंकुरण की नवीन प्रविधि को प्रस्तावित किया है। इस विधि द्वारा उत्पन्न नवोद्भिदों से अपेक्षाकृत तेजी से प्रवल मूल विकसित होते हैं जो उनके जीवित रहने की प्रत्यास्था को सुनिश्चित करती है। इस प्रविधि में कम खर्च होती है एवं इस जाति के बड़े पैमाने अंकुरों पर पुनर्रोपण कार्यक्रमों के लिए उपयुक्त है साथ ही यह अन्य संकटग्रस्त जातियों की संख्या वृद्धि में सहायक है।

ABSTRACT

Cycas beddomei Dyer, is an endemic and endangered, CITES (Appendix I) listed species from the Eastern Ghats of India. For large scale production of seedlings, the authors proposed a new seed germination technique with the objectives of disabling seed dormancy, quickening germination and improving germination percentage. The seedlings raised through this method develop coralloid roots faster that guarantee their survivability. The method is cost effective and suggestable for large scale species restoration programmes of this otherwise threatened species.

Keywords: Conservation, Endemic species, Animal scarification,Vermicompost & Cocopeat Method

INTRODUCTION

Cycas beddomei, is an endemic and endangered, CITES (Appendix I) listed species from the Eastern Ghats of India (CITES, 2003, IUCN, 2019). Multiple issues place this species in the threatened status. Its populations suffer from habitat loss and fragmentation due to activities connected to deforestation programmes, principally the extraction of commercial timber species, tourism, road construction and other developmental activities. Frequent forest fires during the coning period and severe insect attacks on fronds and foliage threaten its survival. Species restoration programmes are essential to revive their populations in view of its endemicity and restricted distribution. Vegetative propagation through bulbils and suckers is a common practice in widely cultivated species such as *Cycas revoluta* Thunb. and *C. rumphii* Miq. (Whitelock, 2002). But this is not practicable in *C. beddomei*. The only option raising this species in large scale is conceivable from seeds but again, the seed germination period is about 5 to 7 months and even 1 year which is truly quite long (Khuraijam & al., 2015). Here, the seeds are large, smooth, shining, ellipsoid/ovoid and flattened/compressed. They consist of outer very thick pulpy, smooth, shining layer (sarcotesta), thin fibrous layer, and inner smooth, hard, stony layer (sclerotesta) and a well-developed endosperm and embryo. Various physical and chemical pre-treatments of seeds are in practice to remove physical dormancy, expedite seed germination and enhance the percentage of germination and a study with reference to *C. beddomei,* was attempted with limited success (Salamma & al., 2016). Physical pre-treatments include manual or mechanical removal of outer sarcotesta, treating the seeds with hot water at

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higher temperatures (60°-100°C) or soaking them in cattle dung. The chemical pre-treatments include treating the seeds in different concentrations of Sulfuric acid (H_2SO_4), Gibberellic acid (GA3), and Potassium nitrate (KNO_3) and fungicides (Zarchini & al., 2011). These pre-treatments may break the physical seed dormancy but may damage viable seeds since acids used in treatments damage the embryo and endosperm and reduce the germination percentage. The other disadvantage with it that it inhibits the development of coralloid root for symbiotic association, which is more crucial for seedling survival, growth and development. The germination period could be reduced to 120 to 140 days in 40 to 60% of sown seeds but since the remaining seeds continue to germinate for 6 months (180 days) (Zarchini & al., 2011). It delays gardeners to transplant these seedlings to plastic bags. Further these procedures are laborious and not cost effective. For large scale production of seedlings, the authors proposed a healthier method, the objectives of which include disabling seed dormancy and quickening germination and improving germination percentage, and early development of coralloid roots for symbiotic association to increase the survivability.

MATERIAL AND METHOD

The fertilized ovules develop and attain maximum size and turn into greenish yellow between October and November. They start turning dark brown during January and February and this is appropriate time for harvesting. The fully ripen seeds are large, ovoid, smooth, shining, brownish, omit the pungent smell and they are feed for birds, rodents (mice, rats, squirrels, porcupines, mongoose, and other wild animals (black bucks, bears, deer and elephants). Owing to its tiny habit the seed cones are just above the ground level and they are easily catchable by the wild animals. The birds and wild animals are consuming the outer pulpy sarcotesta and helping in the removal of physical seed dormancy in the natural habitats. Surprisingly there are large number of discarded seeds were available nearby female plants. The discarded and dispersed seeds collected from the natural habitats of *C. beddomei,* and used for germination studies. After collection from the field they are sun dried until one - two week in the early and late hours and to avoid fungal infections in the storage. After drying, the seeds are stored at room temperature (20 °C to 22 °C) until the second week of July (120 to 150 days) by spreading them on the floor.

Germination beds are prepared in the third week of July when the monsoon received wholly and the day temperatures with 22 °C to 28 °C and humidity with 70 to 80 %. The ideal time for seed sowing is June to August but not April to July (Khuraijam & Roy, 2015). The RCC rings with the height of 1 foot (12 inches) and 3 feet diameter were chosen for germination. A perforated black polythene sheet was used to block the ground of the ring. Eight inches height field is prepared with mixed (3:1) Vermicompost and Cocopeat layer above the polythene sheet. To avoid fungal contamination seeds are soaked 8 - 12 hours in the warm water (100°C) prior to sowing. The soaked seeds are placed horizontally on the vermicompost and cocopeat layer with a 1 inch gap between the seeds. The seeds are completely covered with mixed vermicompost and cocopeat layer in 3 inches height. Plastic bird nets were used to close the surface of rings and watered twice a week and avoided watering during rainy days.

The seeds are sown in the third week of July (on 18th 2020) and the first sign of first leaf (frond) emergence was noticed in a few seeds in third week of August (on 16th 2020) in 28 days. The plastic bird nets were removed from the rings after the first leaf emergence. In a short span of 1 – 2 weeks, other seeds also got germinated. Sprouted seeds with a radicle of 8 – 10 cm long and plumule with emerged first leaf were considered as fully germinated. The early development of lateral roots and symbiotic association were noticed when the plumule gives out its second leaf. In the fourth week of August (on 23rd 2020) the seedlings are transferred into nursery bags (8 × 10 inches) containing red soil and vermicompost in 3:1 ratio. The time period from the day of seed sowing to the seedlings transfer into nursery bags took hardly one month (30 days). 100 seeds were sown for each bed out of its 90 seeds got germinated and the percentage of germination is calculated as 90% by using the formula (Per cent of germination = Number of seeds germinated/ Total number of seeds × 100 s). (**Fig. 1 & 2**)

RESULTS AND DISCUSSION

The germination period was reduced to 30 days from 120 to 190 days and germination percentage was enhanced to 90% and (>) from 40 to 60%. The germination happened in a short span without much gap and all are ready for transferring into nursery bags at a time.

The RCC rings provided a stable environment for seeds. The greater moisture holding capacity of vermicompost aided in the early sprouting of seeds. The cocopeat in the bed-facilitated in preventing compacting, providing aeration and made an easy access to the fixing of radicle. Rich nutrients and moisture in the vermicompost aided in the fast growing of radicle into primary root and its lateral roots and development of plumule for early emerging leaf. The beneficial microorganisms

Fig. 1. *Cycas beddomei* Dyer., **A & B**. Ripen seeds; **C–E**. Animal discarded seeds; **F**. Soaked seeds; **G–J**. Seed sowing; **K–N**. Sign of germination; **O**. Seedlings with first foliage.

which present in the vermicompost helped in the early symbiotic association and development of coralloid root. After transferring seedlings into nursery bags, they are placed on the 1 foot height (12 inches) sand bed to avoid fixing of the root into the ground and avoid damage of apical roots while transferring to the field. This ensures greater survival rate.

The large scale collection of animal discarded seeds for species restoration programmes is difficult, in this case we can collect the fully ripen seeds and in the net and green house conditions the rats or wild animals (in zoological and deer parks) can be used for scarifying the seeds with prior permission from the National/State Board for Wildlife (NBWL/SBWL). With their pungent smell the seeds attract the rats and they nicely eat the pulpy outer layer and scarify the seeds and these could be used for germination. The method of scarification by the rats practically tested by the authors in the *C. circinalis* L., an endemic cycad to southern Western Ghats.

CONCLUSION

The authors presented a germination method for *Cycas beddomei* in which they succeeded in breaking physical dormancy, accelerating germination, enhance germination percentage and survival rate. The germination period was reduced to 30 days from 120 to 190 days and germination percentage was enhanced to 90% and (>) from 40 to 60%. With this method, transferring seedlings is easy. They can be shifted easily to the nursery bags without damaging apical roots. The method is simple, natural, cost-effective, and appropriate for large-scale germination. This method is also suggestible for seed germination of other *Cycas* species.

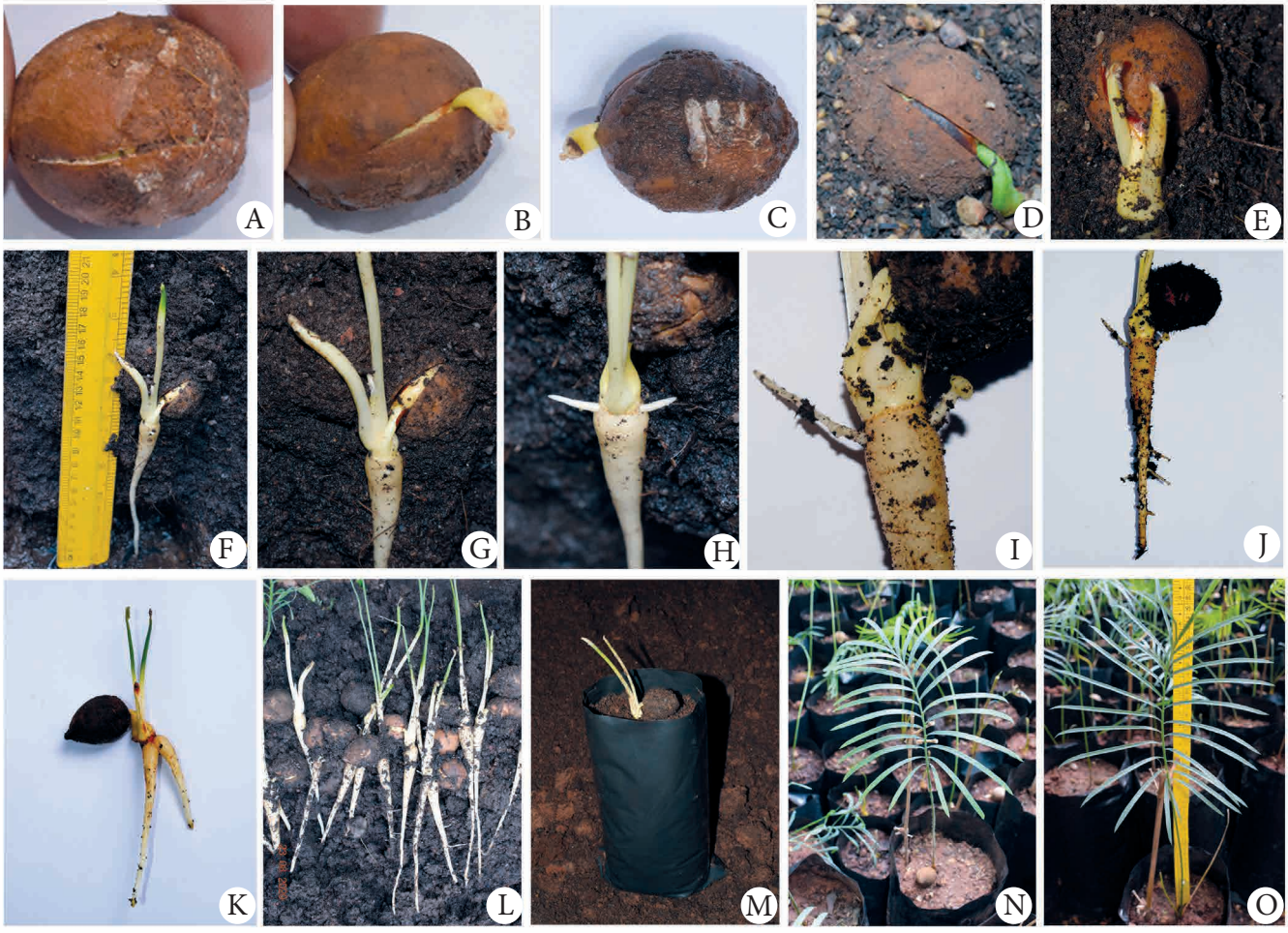

Fig. 2. *Cycas beddomei* Dyer., **A–E**. Sarcotesta breaking, emerging radicle and plumule; **F & G**. Germinated seeds with primary root and emerging foliage; **H–J**. Lateral root development and symbiotic association; **K–L**. Seedlings for transplanting into nursery bags; **M–O**. Transplanting and established seedlings in nursery bags.

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