

Original Research Article

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Characterization of Fruit Morphological Parameters and Effect of Pre-Sowing Treatment in *Phoebe Cooperiana*: An Economically Important Wild Edible Fruit of Arunachal Pradesh

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ABSTRACT

The experiment was conducted to characterize the fruit morphological parameters and to study the effect of different pre-sowing treatment on seeds of wild edible fruit tree *Phoebe cooperiana* U.N Kanjilal ex A. Das. of Arunachal Pradesh. Fruit and seed morphological parameters were based on 100 fruits collected from Lower Dibang district of Arunachal Pradesh. Eight pre-sowing treatments in three replications were given to the seeds before sowing at Department of Tree Improvement nursery, College of Horticulture and Forestry, Pasighat, Arunachal Pradesh. The average fruit weight for the 100 fruits was recorded to be 9.64 ± 1.90 g; fruit length 3.62 ± 0.37 cm; fruit diameter 2.42 ± 0.59 cm; seed weight 3.10 ± 0.70 g; seed length 2.45 ± 1.01 cm; seed diameter 1.35 ± 0.24 cm; pulp weight 6.69 ± 1.10 g; pulp thickness 1.07 ± 0.10 cm and pulp-fruit ratio 0.64 ± 0.21 . Significant differences in germination were observed across the treatments. The study revealed that treatment T₅ (soaking in 0.05% gibberellic acid for 12 hrs) showed highest germination percentage (51.40) followed by T₄ (soaking in 2 % H₂O₂ 12hrs). Although by soaking of seed in water the germination percentage was significantly lower (40.14% and 38.34%) it can be resorted as an economical method of seed treatment for higher seedling production.

Keywords

Tapir, Germination, Gibberlic acid, Adi

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Introduction

The consumption and sale of wild edible fruits is a habit for scores of people residing in rural areas. Besides being the only source of nutritional supplement (Ruel *et al.*, 2005; Balemie *et al.*, 2006; Seal, 2011) for which they can afford and or access, wild edible fruits are also known to subsidize family

income (Falconer, 1990; Seal *et al.*, 2014; Chakravarty *et al.*, 2016) of rural people. Lately, many wild edible fruits such as Anola, Rambutan, star fruits, Jackfruit, *etc.* have attained greater importance and there is large scale commercialization of the species. Systematic domestication and integration into mainstream agriculture have ensured sustainable harvest without affecting natural

gene-pool. But for many, wild extraction is still followed and patterns and frequency of extraction has turned out to be unsustainable. The demand that began to emerge from urban areas has entailed huge economic prospects to collectors, contractors and retailers. Consequently the scale of extraction has escalated imposing severe ecological threat to these species.

In Arunachal Pradesh, India *Phoebe cooperiana* U.N Kanjilal ex A. Das fruits are highly demanded throughout the state. The tree is tall with compact crown attaining the height of approximately 30 metres and girth of 3 metres (Plate 1). It belongs to family *Lauraceae* and mainly distributed in tropical and subtropical rainforest of northeast India along the foothills of Eastern Himalayas upto an altitude 1600 m above msl. Popularly known as Mekhai in Assam, it has many local names in Arunachal Pradesh viz- Tapir/Tapil (Adi), Sangcher/Jishir (Nyishi), Samper (Apatani), Hisir (Galo), Educhi (Idu Mishmi) etc. The fruit is a berry which is 2-3.5 cm long, ellipsoid in shape, the immature fruit is greenish and black on ripe, inner part of the ripen fruit is oily, yellowish green with characteristic aroma and bitter taste (Plate 2). Fruits are available from September to December with an average cost ranging between Rs. 400/- to Rs. 500/- for 100 fruits in local markets. In addition, the tree is known for its quality timber with a compact crown and a clean bole of 15-18m length which is in high demand mainly by plywood industries. Owing to the desirable timber characters as well as edible nature of fruits, there is a huge demand for planting material of this species among the local community, forestry and private sectors as well. Many farmers have started raising nurseries of the species and a single seedling can fetch a price of upto Rs.80/-. However, the species has not received the limelight it deserves from the scientific community. As per of now, there is

no information on the basic morphological, nutritive characters of the fruits and neither on the ecology, reproductive biology and propagation methods of the species. In addition, the species is facing tremendous anthropogenic pressure from indiscriminate felling (Payum *et al.*, 2013) and harvest of immature fruits. Consequently, population sizes have dwindled and natural regeneration scanty effecting population build up.

Presently there is a huge demand for planting material of the species but since the vegetative methods of propagation have been not been developed, the only method of regeneration is from seeds. But with very few matured seeds available for multiplication the challenge is to produce maximum plantable seedlings from available seeds. In this regard, standardizing pre-sowing treatment for maximum germination becomes necessary. The use of pre-sowing treatments for acceleration and enhancement of seed germination of some wild edible fruit trees include those of *Ziziphus mauritiana* and *Macadamia integrifolia* (Mbor, 2012), *Elaeocarpus serratus* (Dahanayake *et al.*, 2013), *Terminalia chebula* (Hossain *et al.*, 2013), *Manilkara hexandra* (Bajaniya *et al.*, 2018). Considering the overall lack of information on the species and the need to obtain information on the germination patterns of the species, we characterize fruit morphological parameters and investigate effects of pre-sowing treatment on seed germination of *Phoebe cooperiana* in the nursery condition.

Materials and Methods

Matured fruits of *Phoebe cooperiana* were collected during the month of November (2016) from Jia (Giya) under Roing Forest Range (28°03'32" N latitude; 95°46'03" E longitude, at 169 m elevation), Lower Dibang Valley District, Arunachal Pradesh.

Characterization of fruit morphology

Hundred fruits were used for characterizing fruit morphological parameters. Fruits weight was measured using electronic (digital) balance and expressed in gram (g). The fruit length is the linear extended space from top point of the fruit to bottom point of the fruit apex. Fruit length and diameter was measured at the longest and widest point using Digital Calliper and expressed in centimetre (cm). After pericarp was removed, the seed weight was taken using electronic Balance and expressed in gram (g). Seed length and diameter was measured at the longest and widest point using Digital Calliper and expressed in centimetre (cm).

Pulp weight was estimated using formula:
= (Fruit weight – Seed weight) g

Pulp thickness was estimated using formula:
= (Fruit diameter – Seed diameter) cm

Pulp-fruit ratio was determined by formula:
= (Pulp weight/ Fruit weight)

Pre-sowing treatment

Seeds were depulped manually and shade dried for one day for studying the effects of different pre-treatment on the germination parameters. A total of 300 seeds in three replicate with 100 seed per replicate were taken separately for each treatment for germination experiment in nursery condition. Each replicate of seeds were subjected to the following treatments: (T₁) - Control without any treatment; (T₂) - Soaking in water for 12 hours; (T₃) - Soaking in water for 24 hours; (T₄) - Soaking in 2 % Hydrogen peroxide (H₂O₂) for 12 hours, (T₅) - Soaking in 0.05 % Gibberellic acid (GA) for 12 hours, (T₆) - Soaking in 0.1% Gibberellic acid (GA) for 12 hours, (T₇) - Soaking in 0.1% Potassium nitrate (KNO₃) for 12 hours, (T₈) - Soaking in 0.5% Potassium nitrate (KNO₃) for 12 hours.

Immediately after the pre-treatments, seeds were sown in prepared nursery beds and mulching was done. Watering was carried out regularly as per the requirement and observed daily for initiation and progress of germination until no more germination was observed. The first germination was started on 37th day after sowing which was expressed as days to initial germination and was taken as visible signs of successful germination and data was recorded. The number of days on which the last seedling emerged was recorded and expressed as days to final germination. It took 70 days to complete the germination experiment from the date of sowing.

The various germination parameters such as germination percentage, peak value and germination value were calculated at the end of the experiments. Each treatment and the control were laid in Completely Randomized Design. Values of germination percentage were transformed (arcsine-square-root transformation) prior to analysis and were back transformed for tabular presentation. The obtained data was analysed using the analysis of variance procedure (ANOVA) variance following the model suggested by Panse and Sukhatme (1985). At the end of the germination period, the germination percentage, peak value, germination values were calculated using the following equations:

Germination percentage

The germination test was carried out in which four replicates of 100 seeds each were used (ISTA, 2003). The germination percentage was calculated using the formulae as:

Germination Percentage =

Number of seeds germinated
-----x 100
Total number of seeds used

Peak value

Peak value was calculated as the maximum mean daily germination (MDG) reached at any time during the period of test (Czabator, 1962).

Germination value

Czabator's formula (1962), which quantifies germinative energy by combining speed and completeness of germination, was used for evaluation of the treatments.

Germination Value = Final DGS X Peak value; where DGS is (Daily Germination Speed)

Results and Discussion

The average fruit weight for the 100 fruits was found to be 9.64 g, fruit length 3.62cm and fruit diameter was 2.42cm, while seed weight, seed length and seed diameter was found to be 3.10 g, 2.45cm and 1.35cm, respectively (Table 1). The fruits are much larger than those of its close associate *Phoebe goalparensis*, an important timber species of the region (Jana and Singh, 2017) but slightly smaller than that of *Elaeocarpus floribundus*, the Indian olive (Bhowmick, 2017). Seed morphological parameters are also comparable to those of *Elaeagnus latifolia*, an underutilized fruit of the region (Patel *et al.*, 2015) which showed mean seed weight of 3.19 g, seed length 2.80 cm and seed diameter 1.29 cm. One of the most important fruit parameters among edible fruits are the pulp content and pulp fruit ratio. These characters increase the marketability of the fruit. Average pulp weight, pulp thickness and pulp-fruit ratio was found to be 6.69 g, 1.07cm and 0.53 respectively (Table 1). These values are comparable to the pulp weight (3.67 to 10.33 g) and pulp-fruit ratio (0.57 to 0.80) of Jamun (Singh *et al.*, 2016; Rakesh,

2013), pulp thickness (5.64 to 6.72 mm) and pulp-fruit ratio (0.69 to 0.74) of *P. nepaulensis* (Rymbai *et al.*, 2016).

Effect of different pre-sowing treatments on seed germination values of *P. cooperianais* presented in Table 2. The maximum germination percentage (51.40 %) was recorded in the treatment T5 (soaking in 0.05 % GA for 12 hours). This higher germination percent confirmed the role of Gibberellic acid as a stimulatory agent (Cetinbas and Koyuncu, 2006; Negi and Sharma, 2011). The highest germination value of T5 was followed by T4 (44.49 %) which was at par with T6 (44.45 %). The control (T1) seeds without any treatment showed lowest (31.88 %) germination values, indicating to need for giving pre-sowing treatments to increase seedling production. Further, by imposing various seed treatments, the speed of germination has been significantly enhanced, which is an added advantage, given the recalcitrance nature of the seed where viability rapidly declines with time. In similar study, pericarp removed (depulped seeds) treated with soaking overnight in 0.05% gibberellic acid, soaking in water for overnight and soaking in 2 % hydrogen peroxide for 12hrs before sowing resulted in earlier onset of enhanced germination in *Phoebe goalparensis* (Jana and Singh, 2017). The results reported in the present study were also supported by the findings of the many other authors. For example Murugesu (2011); Anand *et al.*, (2012); Azad *et al.*, (2012); Hossain (2014); Vijayalakshmi and Renganayaki (2017) have shown soaking of seeds in gibberellic acid and water has shown very good results.

There were highly significant ($p < 0.05$) differences among the treatments for peak value and germination value (Table 2). Treatments with higher germination percentages (T5, T4, and T6) also showed

higher peak and germination values. This indicates a better measure of seed performance which is a prerequisite for the fast and uniform seed germination that, guarantees rapid and good seedling growth in the field (Shuaibu *et al.*, 2015; Al-Absi, 2010). The rapid and complete germination of

seeds is usually a desirable objective in the production of tree seedlings. Hence the findings indicate the need of seed pre-treatment in *Phoebe cooperiana* due to scarcity of matured seeds available for regeneration.

Table.1 Characterization of fruit morphological parameters

| S.N. | Characters | Values |
|------|---------------------|------------|
| 1 | Fruit weight (g) | 9.64± 1.90 |
| 2 | Fruit length (cm) | 3.62± 0.37 |
| 3 | Fruit diameter (cm) | 2.42± 0.59 |
| 4 | Seed weight (g) | 3.10± 0.70 |
| 5 | Seed length (cm) | 2.45±1.01 |
| 6 | Seed diameter (cm) | 1.35± 0.24 |
| 7 | Pulp weight (g) | 6.69± 1.10 |
| 8 | Pulp thickness (cm) | 1.07± 0.10 |
| 9 | Pulp-fruit ratio | 0.64± 0.21 |

Table.2 Effect of pre-sowing treatment on germination parameters of seeds of *P. cooperiana* under eight treatments in nursery condition

| Treatments | Germination % (Arcsine) | Peak Value | Germination Value |
|----------------------------------------------|-------------------------|-------------|-------------------|
| T1 - Control | 28.17 (31.88) | 0.40 | 0.16 |
| T2 - H ₂ O 12hrs | 41.63 (40.14) | 0.75 | 0.57 |
| T3 - H ₂ O 24hrs | 38.53 (38.34) | 0.64 | 0.40 |
| T4 - 2 % H ₂ O ₂ 12hrs | 49.14 (44.49) | 0.82 | 0.68 |
| T5 - 0.05 % GA 12hrs | 61.02 (51.40) | 1.02 | 1.01 |
| T6 - 0.1 % GA 12hrs | 49.08 (44.45) | 0.78 | 0.61 |
| T7 - 0.5 % KNO ₃ 12hrs | 42.02 (40.37) | 0.69 | 0.49 |
| T8 - 0.1 % KNO ₃ 12hrs | 30.32 (33.28) | 0.50 | 0.26 |
| Mean ± SE | 42.49 ± 2.26 | 0.70 ± 0.06 | 0.52 ± 0.08 |
| (Range) | 28.17 - 61.02 | 0.40 - 1.02 | 0.16 - 1.01 |
| M.S.S | 343.27 | 0.11 | 0.20 |
| F- Test | 8.08** | 12.24** | 11.47** |
| C.D. (5%) | 6.84 | 0.17 | 0.24 |
| C.V. (%) | 9.66 | 13.65 | 26.24 |

**Significant at the 0.05 p-level.

Plate.1 *Phoebe cooperiana* tree



Plate.2 Fruits of *Phoebe cooperiana*



Although the present investigation reveals that the depulped seeds of *Phoebe cooperiana* can be treated with soaking for 12 hours in 0.05% gibberellic acid (T₅) for best germination response, pre-sowing treatments of soaking in water for 12 hours (T₂) and soaking in water for 24 hours (T₂) of depulped seeds can give cost effective germination for large scale production of seedling with minimum cost, time, and labour. Therefore, considering availability of fund, resources and feasibility these pre-sowing treatments could be adopted by the forest department, nursery owners, farmers, NGOs, and researchers for economic cultivation of this species.

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