Seed exploration and conservation in Ciremai Mountain National Park and Kerinci Seblat National Park

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Abstract. Seed storage at a seed bank facility is one of the ex situ bioresources conservation strategies in the world's Botanical Gardens. Enrichment of species for seed banks is done through exploration in various forest areas. The exploration and conservation of seeds have been done in Ciremai Mountain National Park (CMNP) on November 7-16th, 2016, and Kerinci Seblat National Park (KSNP) on April 11-20th, 2017. This research aims to search and collect plant seeds and to know the diversity of species from fruiting plants and seeds. Furthermore, this exploration also aims to study a biological seed that support conservation efforts for these plants. Research used an exploratory method at each location. The recording of ecological data includes habitat, altitude, soil pH, soil moisture, and air temperature. This study obtained thirty-two (32) collection numbers in the CMNP area consisted of 20 families and 28 genera; and thirty-three (33) collection numbers consisted of 21 families and 31 genera in the KSNP area. Most of the seeds found are orthodox seeds that can be stored for a relatively long time.

Keywords: Exploration seeds, seeds bank, Ciremai Mountain NP, Kerinci Seblat NP

1. Introduction

Plant diversity in Indonesia, especially on the islands of Sumatra and Java, has declined significantly at this time. Some factors that contribute to the declining of plant diversity are various pressures that change plant population in forest. Besides that, other causes are plant breeding program which can lead to genetic uniformity, a land conversion which can lead to habitat destruction, climate change, invasion of exotic plants, and unsustainable utilization of plant diversity [1]. A combination of major challenges, in situ conservation efforts and ex situ conservation, is needed to prevent the extinction of plant species.

Mount Ciremai National Park (MCNP) located in Java Island was determined based on the Decree of the Minister of Forestry Number 424 / Menhut-II / 2004, dated October 19, 2004, having an area of 15,500 ha. This area is located at coordinates 6°50'-6°58' LS, 108°28'-108°21' BT. While Kerinci Seblat National Park (KSNP) is located on Sumatra island, and geographically located at 1°17'-3°36' LS, 100°31'-102°44' BT. The KSNP is representative of lowland rainforest and a montane forest of Sumatra. This area was designated as a National Park based on Forestry Ministerial Decree No. 192 / Kpts-II / 1996, having an area of 1,386,000 hectares. Three years later in 1999, a National Park was...
declared based on the Decree of the Minister of Forestry and Plantation No.901 / Kpts-V / 1999, having an area of 1,375,349,867 hectares. In June-July 2014, UNESCO designated this area as a world natural rank (Cluster World Natural Heritage of Sumatra), namely the Tropical Rainforest Heritage of Sumatra (TRHS). Although it has being an in situ conservation area, deforestation in these two regions continuously increases causing some of forest ecosystems of the CMNP and KSNP degraded [2].

One effort to reduce the declining of biological resources is to conduct ex-situ conservation, considering it is more intensive, easier to monitor and more flexible in developing it. Ex situ conservation of plants is done through botanical gardens, which has a role for collecting and planting selected plant species equipped with documentation and registration data. In contrast, in situ conservation carried out by a National Park functions for natural conservation, protection of flora and fauna, habitat preservation and sustainable use of biodiversity and ecosystems by applicable regulations.

Seed storage at seed bank facilities is one of the ex-situ bioresources conservation strategies in the world Botanical Gardens [3, 4]. Botanical Garden Conservation Center of Indonesian Institute of Sciences as part of the world Botanic Garden community also has a Seed Bank located in the Registration Sub-Sector and Nursery of the Bogor Botanical Gardens. Seed banks can be seen as a strategic conservation vehicle considering: (1) the size of seeds that are generally relative small is only need small storage space to be able to gather the widest variety of plants, and (2) seed storage technology today has developed so rapidly that it is possible to carry out seed storage for years without losing significant viability [5].

Enrichment of species for seed banks is carried out through exploration in various forest areas and their own botanical gardens. Exploration of seeds in the Ciremai Mountain National Park and Kerinci Seblat National Park is an activity carried out to find and collect plant seeds. Besides exploration, it is also necessary to study the biology of seeds that will support conservation efforts for these plants.

2. Materials and methods

2.1 Study site

This research was conducted in two regions in two different periods. The period of exploration is based on information from residents on the fruiting season in the two regions. The duration of each region is 10 days of two teams of 5 people. Exploration in the Ciremai Mountain National Park area was carried out on November 7-16th, 2016. The location was explored on Mount Ciremai, Kabupaten Kuningan, West Java, as many as 5 locations namely Cibereum, Ciayakan, Kondang amis, Cigowong and Cigoong located at an altitude of 531-1,810 m asl. The height represents three zones, namely the highland zone, sub-montane zone, and montane zone to be able to obtain plants that represent the zone. While the Kerinci Seblat National Park area was conducted on April 11-20th, 2017. The locations explored were (1) Bukit Tapan Resort, Sungai Ning Village, Kecamatan Sungai Bungkal, Kota Sungai Penuh with an altitude of 990-1,360 m asl and (2) Gunung Tujuh Resort, Sungai Jernih Village, Kecamatan Gunung Tujuh, Kabupaten Kerinci, located at an altitude of 1800-2050 m asl. Besides, this location was chosen because it is a transition between lowland forests and mountain forests that have a high diversity of flora.

2.2 Plant samples and sampling method

The method used is an exploratory method to obtain fruit and seeds of plant species from their natural habitat. Activities carried out included plant collection, identification, making herbarium vouchers, and research on selected species. The collection includes the seeds contained in the location of exploration. Documentation was also carried out during exploration activities. Agro-ecological data retrieval was done using several tools including GPS, termohygro, pH meter, Lux meter, altimeter, camera.

Plant collection in the field is the most important aspect of exploration activities. The method of harvesting the seeds was done by harvesting directly from the fruiting tree. Each fruit and seed
specimen was carried out by characterization, measurement of moisture content and checking its viability to determine the storing character of the plant seeds. The method of measuring moisture content is carried out using a constant Temperature Oven with the formulation [6]:

\[ KA = \frac{(M2 - M3)}{(M2 - M1)} \times 100\% \]

When M1 is Weight of the weighing bottle/container with cover in gm, M2 is Weight of the weighing bottle/container with cover and seeds before drying and M3 is Weight of the weighing bottle/container with cover and seeds after drying. Seed moisture contents were used to determine the seed storage behavior supported by the available information on the same taxa referred to Seed Compendium and Millenium Bank Kew’s Seed Information Database [7, 8].

3. Results

3.1 Ciremai Mountain National Park (CMNP)

The first area that became the point of exploration was the Cibereum area. The topography of the Cibereum area and its surroundings is generally bumpy located at an altitude of 531-574 m asl and has a high level of forest vegetation. The temperature of this region is ranged of 22-29°C with air humidity of 60-82%. Soil pH is ranged 6 - 6.7 with soil moisture of 60-76%. The composition of the flora of the Cibereum region and its surroundings is very heterogeneous. The species of trees include the *Macaranga* spp, *Diospyros* spp, and *Dillenia* spp.

The second area was the Ciayakan area. Ciayakan has a relatively good upland forest vegetation. This area has an altitude of 535-984 m asl. The dominant species include *Aglaya* sp, *Caryota* sp, *Litsea noronhiae*, *Ficus* spp, *Sterculia oblongata*, *Artocarpus elasticus*, *Ardisia* sp., *Gnetum gnemon*, *Ardisia lanceolata*, *Pinus merkusii* and *Persea* sp. The temperature of this area is ranged of 23-27°C with an average humidity of 77%. The average soil pH is 5.8 with a humidity of 70-78%.

The third area was the Kondang Amis Area. Kondang Amis has highland forest vegetation with an altitude of 739-1203 m asl. The dominant species include *Dysoxylum* spp., *Sterculia oblongata*, *Artocarpus elasticus*, *Villebrunea rubescens*, *Castanopsis* sp., *Schima wallichii*, and *Quercus* sp. The temperature of this area is ranged of 22-27°C with an average humidity of 78%. The average soil pH is 4.8 with a humidity of 75-78%.

The fourth area was the Cigowong Area. The Cigowong area has mountain forest vegetation with an altitude of 1473-1810 m asl. This area is one of the hiking trails leading to the summit of Mount Ciremai. The dominant species include *Ficus* spp., *Litsea angulata* and *Quercus* sp. The temperature in this area is ranged of 20-25.5°C with an average humidity of 75%. The average soil pH is 5.5 with a humidity of 76-81%.

The fifth area was the Cigoong area. Cigoong area is an area that is directly adjacent to the area of the brass botanical garden. This area has highland forest vegetation with an altitude of 767-824 m asl. The dominant species include *Diospyros macrophylla*, *Dillenia* sp, *Calamus* sp., *Pandanus* sp., *Lasianthus* sp., *Pinanga coronata*, *Castanopsis* sp., *Quercus* sp., *Ficus* spp., *Sandoricum koetjape* and *Litsea* sp. The temperature of this area is ranged of 24-29°C with an average humidity of 76%. The average soil pH is 5.5 with a humidity of 70-78%.

In this exploration, there were thirty-two (32) species of seed collection for 10 days of exploration in five (5) locations at the Ciremai Mountain National Park (table 1). The seed collection consisted of 20 families and 28 genera. Some collections were stored in the Bogor Botanical Garden Seed Bank and other collections were tested for germination to determine the viability of the seeds. Seeds with a small amount cannot be measured their moisture content and cannot be stored in the seed bank of the Bogor Botanical Gardens.
Table 1. Profile of exploration results in Gunung Ciremai National Park Area

| No Collection | Plant species | Family | Storage behaviour | Moisture Content (%) | Site |
|---------------|---------------|--------|-------------------|----------------------|------|
| IRF 015 | Melicope sp. | Rutaceae | Orthodox | 14.43 | Cibeureum |
| IRF 016 | Aglaia sp. | Meliaceae | Recaltsitsran | 45.5 | Cibeureum |
| IRF 017 | Pinanga coronata (Blume ex Martelli) Blume | Arecaceae | Intermediate | 26.29 | Cibeureum |
| IRF 018 | Chisocheton macrophyllus King | Meliaceae | Recaltsitsran | 44.53 | Cibeureum |
| IRF 019 | Kibara sp. | Monimiaceae | Recaltsitsran | 61.31 | Cibeureum |
| IRF 020 | Heritiera javanica (Blume) Kosterm. | Arecaceae | Intermediate | 20.49 | Cibeureum |
| IRF 021 | Ardisia lanceolata | Myrsinaceae | Orthodox | 29.34 | Ciayakan |
| IRF 022 | Sandoricum koetjape (Burm.f.) Merr. | Meliaceae | Recaltsitsran | 47.14 | Ciayakan |
| IRF 023 | Canarium hirsutum Willd. | Burseraceae | Orthodox | 12.86 | Ciayakan |
| IRF 024 | Croton argyratus Blume | Euphorbiaceae | Orthodox | 10.37 | Ciayakan |
| IRF 025 | Toona sureni (Blume) Merr. | Euphorbiaceae | Orthodox | 10.37 | Ciayakan |
| IRF 026 | Aleurites moluccana (L.) | Euphorbiaceae | Orthodoxy | Not stored* | Ciayakan |
| IRF 027 | Archidendron sp. | Leguminosae | Recaltsitsran | 28.72 | Ciayakan |
| IRF 028 | Diosxylum sp. | Meliaceae | Recaltsitsran | Not stored* | Kondang Amis |
| IRF 029 | Calamus manan Miq. | Arecaceae | Intermediate | 20.18 | Kondang Amis |
| IRF 030 | Quercus sp. | Fagaceae | Recaltsitsran | 42.41 | Kondang Amis |
| IRF 031 | Ficus fistulosa Reinw. ex Blume | Moraceae | Orthodox | 11.98 | Kondang Amis |
| IRF 032 | Caryota sp. | Arecaceae | Intermediate | 37.98 | Kondang Amis |
| IRF 033 | Mallotus sp. | Euphorbiaceae | Orthodox | 11.56 | Kondang Amis |
| IRF 034 | Diosxylum sp. | Meliaceae | Recaltsitsran | 55.16 | Kondang Amis |
| IRF 035 | Elaeocarpus pierrei Koord. & Valeton | Elaeocarpaceae | Recaltsitsran | 17.44 | Cigowong |
| IRF 036 | Unidentified | Orchidaceae | Orthodox | Not stored* | Cigowong |
| IRF 037 | Quercus sp. | Fagaceae | Recaltsitsran | 43.99 | Cigowong |
| IRF 038 | Elaeocarpus angustifolius Blume | Elaeocarpaceae | Recaltsitsran | 15.47 | Cigowong |
| IRF 039 | Dacrydium sp. | Araucariaceae | Orthodox | 18.21 | Cigowong |
| IRF 040 | Castanopsis sp. | Fagaceae | Recaltsitsran | Not stored* | Cigowong |
| IRF 041 | Lasiathanus sp. | Rubiaceae | Orthodox | 8.63 | Cigoyong |
| IRF 042 | Lasiathanus cyanocarpus Jack | Rubiaceae | Orthodox | 6.77 | Cigoyong |
| IRF 043 | Diospyros macrophylla Blume | Ebenaceae | Recaltsitsran | 20.26 | Cigoyong |
| IRF 044 | Syzygium sp. | Myrtaceae | Recaltsitsran | 30.51 | Cigoyong |
| IRF 045 | Horsfieldia sp. | Myristicaceae | Recaltsitsran | Not stored* | Cigoyong |
| IRF 046 | Dipterocarpus retusus Blume | Dipterocarpaceae | Recaltsitsran | Not stored* | Cigoyong |

*not stored means that the amount is not large so no moisture content and seed storage are tested

3.2 Kerinci Seblat National Park

The first area that became the point of exploration was Bukit Tapan Resort, Sungai ning Village, Sungai Bungkal district, and Sungai Penuh city. The topography of the Bukit Tapan area and its
surroundings is generally runny and bumpy located at an altitude of 990-1360 m asl. This area has mountain forest vegetation with an altitude of 900–1500 m asl. The temperature of this area is ranged of 18–28°C with air humidity of 76–81%. Soil pH is ranged 6 – 6.2 with soil moisture 55 - 60%. The flora composition of the Bukit Tapan area and its surroundings is very heterogeneous. The species of trees include the tribes of Lauraceae, Fagaceae, Fabaceae, Apocynaceae, Dipterocarpaceae, Meliaceae, and Arecaceae.

The second area was Gunung Tujuh Resort, Sungai Jernih Village, Gunung Tujuh district, and Kerinci regency. Gunung Tujuh Lake is a forest area for interesting tourism objects with a lake that reaches 1,000 ha and the highest lake in Southeast Asia. This area has relatively good forest vegetation. The dominant vegetations include Podocarpaceae, Clusiaceae, Meliaceae, Araliaceae, Ericaceae, and Rutaceae. Mount Seven Lake is located at an altitude of 1800-2050 m asl. The temperature in this area is ranged of 23–25.5°C with an average humidity of 76%. Average soil pH is 6.2 with a humidity of 76-81%.

In this exploration, thirty-three (33) species were obtained during 10 days of exploration at two (2) resorts in the Kerinci Seblat National Park area (table 2). The species were classified into 21 families and 31 genera. Some collections were stored in the Bogor Botanical Garden Seed Bank and other collections were tested for germination to determine the viability of the seeds. The seeds with a small amount cannot be measured their moisture content and cannot be stored in the seeds of the Bogor Botanical Garden.

Table 2. Profile of exploration results in Kerinci Seblat National Park

| No. collection | Plant names       | Family             | Storage behaviour | Moisture content (%) | Site                  |
|----------------|-------------------|--------------------|-------------------|----------------------|-----------------------|
| IRF302         | Elaeocarpus sp.   | Elaeocarpaceae     | Intermediate      | Not stored*          | Resort Bukit Tapan    |
| IRF303         | Toona sureni (Blume) Merr. | Meliaceae              | Orthodox          | 8.8                  | Resort Bukit Tapan    |
| IRF304         | Dendrobium bigibbum Lindl. | Orchidaceae         | Orthodox          | Not stored*          | Resort Bukit Tapan    |
| IRF305         | Lasianthus sp.    | Rubiaceae          | Orthodox          | 14.54                | Resort Bukit Tapan    |
| IRF306         | Elaeocarpus sp.   | Elaeocarpaceae     | Orthodox          | Not stored*          | Resort Bukit Tapan    |
| IRF307         | Cymbidium bicolor Lindl. | Orchidaceae         | Orthodox          | Not stored*          | Resort Bukit Tapan    |
| IRF308         | Schima wallichii Choisy | Theaceae           | Recalcitrant      | Not stored*          | Resort Bukit Tapan    |
| IRF309         | Ficus deltoidea Jack | Moraceae           | Orthodox          | 16.6                 | Resort Bukit Tapan    |
| IRF310         | Not identified    | Theaceae           | Orthodox          | Not stored*          | Resort Bukit Tapan    |
| IRF311         | Alyxia sp.        | Apocynaceae        | Orthodox          | Not stored*          | Resort Bukit Tapan    |
| IRF312         | Gnetum sp.        | Gnetaceae          | Orthodox          | Not stored*          | Resort Bukit Tapan    |
| IRF313         | Medinilla sp.     | Melastomataceae    | Orthodox          | 11.79                | Resort Bukit Tapan    |
| IRF314         | Aleurites moluccanus (L.) Willd. | Euphorbiaceae   | Orthodox          | 33.53                | Resort Bukit Tapan    |
| IRF315         | Viburnum sp.      | Adoxaceae          | Recalcitrant      | 33.52                | Resort Bukit Tapan    |
| No. collection | Plant names                  | Family              | Storage behaviour | Moisture content (%) | Site                |
|---------------|-----------------------------|---------------------|-------------------|----------------------|---------------------|
| IRF316        | Castanopsis sp.             | Fagaceae            | Recalcitrant      | Not stored*          | Tapan               |
|               |                             |                     |                   |                      | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF317        | Quercus sp.                 | Fagaceae            | Recalcitrant      | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF318        | Psychotria sp.              | Rubiaceae           | Recalcitrant      | 7.6                  | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF319        | Liparis sp.                 | Orchidaceae         | Orthodox          | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF320        | Begonia areolata            | Begoniaceae         | Orthodox          | 15.4                 | Resort Bukit        |
| Miq.          |                             |                     |                   |                      | Tapan               |
| IRF321        | Castanopsis sp.             | Fagaceae            | Recalcitrant      | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF322        | Spatoglothis sp.            | Orchidaceae         | Orthodox          | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF323        | Cheilocostus speciosus      | Costaceae           | Intermediate     | 7.15                 | Resort Bukit        |
| (J.Koenig)    |                             |                     |                   |                      | Tapan               |
| C.D.Specht    |                             |                     |                   |                      |                     |
| IRF324        | Arundina sp.                | Orchidaceae         | Orthodox          | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF325        | Flacourtia rukam            | Flacourtiaceae      | Orthodox          | Not stored*          | Resort Bukit        |
| Zoll & Mor.   |                             |                     |                   |                      | Tapan               |
| IRF326        | Rubus sp.                   | Rosaceae            | Orthodox          | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Tapan               |
| IRF327        | Sloanea sigun               | Elaeocarpaceae      | Recalcitrant      | Not stored*          | Resort Bukit        |
| (Blume) K. Schum. |                     |                     |                   |                      | Gunung Tujuh        |
| IRF328        | Pyrenaria serrata           | Theaceae            | Intermediate     | 31.75                | Resort Bukit        |
| Blume         |                             |                     |                   |                      | Gunung Tujuh        |
| IRF329        | Alyxia sp.                  | Apocynaceae         | Orthodox          | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Gunung Tujuh        |
| IRF330        | Passiflora sp.              | Passifloraceae      | Intermediate     | 44.41                | Resort Bukit        |
|               |                             |                     |                   |                      | Gunung Tujuh        |
| IRF331        | Cinnamomum sp.              | Lauraceae           | Recalcitrant      | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Gunung Tujuh        |
| IRF332        | Calamus manan               | Arecales             | Intermediate    | Not stored*          | Resort Bukit        |
| Miq.          |                             |                     |                   |                      | Gunung Tujuh        |
| IRF333        | Podocarpus sp.              | Podocarpaceae       | Recalcitrant      | Not stored*          | Resort Bukit        |
|               |                             |                     |                   |                      | Gunung Tujuh        |
| IRF334        | Begonia alveolata           | Begoniaceae         | Orthodox          | 15.4                 | Resort Bukit        |
| T.T.Yu        |                             |                     |                   |                      | Gunung Tujuh        |

*not stored means that the amount is not large so no moisture content and seed storage are tested

4. Discussion

There were sixty-five (65) species of seed collection for 20 days of exploration in two (2) locations at the CMNP and KSNP. In general, the species collected are species that bloom and have fruit throughout the year. Most types of targets were not successfully collected because this species was not in the fruiting period when exploration was carried out. Meliaceae and Orchidaceae were the most collected families (figure 1). Most members of the Meliaceae are widespread throughout the tropics and subtropic. Most of these families are perennial plants. Orchidaceae is an epiphytic plant that
widespread throughout the tropical rain forest. Some of these families are flowering and fruiting period at a certain time [9].

In the CMNP, Meliaceae was found the most fruiting family (6 species and 5 genera), followed by Euphorbiaceae (3 species) and Arecaaceae (3 species). The fruiting species of Meliaceae were *Chisocheton macrophyllus*, *Sandoricum koetjape*, *Dysoxylum* sp., *Aglaia* sp. and *Toona sureni*. Most of these species produce seeds with recalcitrant storage behavior characters. Only *Toona sureni* has orthodox seeds. Species from the Meliaceae are generally recalcitrant seed species and mostly grow in lowland rainforest [7].

Dominant fruiting species in Kerinci Seblat National Park is Orchidaceae (5 species), followed by Elaeocarpaceae (3 species) and Arecaaceae (3 species). Orchidaceae members that was fruiting when collected were *Dendrobium bigibbum*, *Liparis* sp., *Spatoglothis* sp., and *Arundina* sp. Most of these species produce seeds with orthodox storage behavior characters. Species from the Orchidaceae are generally Orthodox seed species and adapted to almost every environment on earth and can be found from the dry scrubland to the snow-covered mountain [7, 10].

![Figure 1](image1.png)

**Figure 1.** (a) Collection results based on the number of species and genus in Ciremai Mount National Park and (b) Collection results based on the number of species and genus in Kerinci Seblat National Park.

Recalcitrant seeds are most commonly found in CMNP, and intermediate and orthodox seeds are most commonly found in KSNP (figure 2). The seeds obtained in the CMNP area are mostly recalcitrant seeds (53%) , while as many as 12 species of seeds (38%) are orthodox seeds. The recalcitrant seeds found are *Dipterocarpus retusus*, *Diospyros macrophylla*, *Elaeocarpus pierrei*, *Chisocheton macrophyllus*, *Sandoricum koetjape*, etc. Thus, the seeds obtained in the KSNP area are mostly orthodox (58%), while as many as eight species of seeds (26%) are recalcitrant seeds. The orthodox seeds found are *Begonia areolata*, *Aleurites moluccanus*, *Ficus deltoidea*, *Flacourtia rukam*, etc. The difference of species composition of two locations is due to each location having different environmental conditions (figure 3).
4.1 Description of Selected Species

4.1.1 Elaeocarpus sp. (Elaeocarpaceae). Elaeocarpus sp. is widespread in Old World [9]. This species is collected in the form of fruit at the Bukit Tapan Resort and found at an altitude of 1198 m asl. This species has characteristics with pearl-like fruit which are often colorful. Elaeocarpus spp. seeds are usually used by local people for handicrafts.

4.1.2 Toona sureni (Blume) Merr. (Meliaceae). Toona sureni was collected in the form of fruit at Bukit Tapan Resort. This species is found in many areas of the highland rainforest to the mountains. Toona sureni spread in Bhutan, China, India, Indonesia, Malaysia, Myanmar, Nepal, Papua New Guinea, Thailand, at an altitude of 1200-2700 m asl [11]. It has capsule-shaped fruit, seeds winged at both ends. This species is useful for timber and medicinal plant [10].

4.1.3 Dendrobium bigibbum Lindl. (Orchidaceae). Dendrobium bigibbum Lindl. was collected in the form of fruit at Bukit Tapan Resort. It spread in Indonesia (Maluku). This species is epiphytic plant. This species has characteristic with micro seed in capsule.

4.1.4 Cymbidium bicolor Lindl. (Orchidaceae). Cymbidium bicolor Lindl. is terrestrial or lithophytic orchid. It found in lowland and lower montane forests, up to 1.630 m asl [10]. This species was collected in the form of fruit in Ficus sp. at Bukit Tapan Resort. It grows at an altitude of 1340 m asl. This orchid species is usually associated with moss.

4.1.5 Schima wallichii Choisy (Theaceae). Habitat of Schima wallichii is mixed in dipterocarp forests, kerangas, coastal and low-montane forests, up to 2400 m asl [10]. This species was collected in the form of fruit at Bukit Tapan Resort and usually grows at an altitude of 800-1800 m asl. It spread in Bhutan, India, Laos, Myanmar, Nepal, Thailand and Vietnam. This species is flowering in April-May and November-December [12]. This species fruit is characteristics by capsule-shaped, sub-globose, dehiscent; number of seeds 3-5 and winged all around.

4.1.6 Ficus deltoidea Jack (Moraceae). Ficus deltoidea Jack was collected in the form fruit at the Bukit Tapan Resort. This species has characteristics with small figs, ripen yellow green with a bright red ostiole. It spread in Thailand, Peninsular Malaysia, Sumatra, Java, Kalimantan, Sulawesi, Maluku; and was introduced to India, Pakistan, and Indochina [13].
4.1.7 *Aleurites moluccanus* (L.) Willd. (Euphorbiaceae). *Aleurites moluccanus* (L.) Willd. was collected in the form of fruit at Bukit Tapan Resort. It spread in Brunei, Cambodia, China, Cook Islands, Fiji, Polynesia, Indonesia, Kiribati, Laos, Malaysia, Marshall Islands, Myanmar, New Caledonia, Norfolk Island, Papua New Guinea, Philippines, Samoa, Solomon Islands, Thailand, Tonga, Vanuatu, Vietnam [11]. This species is characteristics by drupe-shaped, round or squashed fruit, and creamy pale yellow seeds [10].

4.1.8 *Castanopsis* sp. (Fagaceae). *Castanopsis* sp. widespread in South & East Asia, Malesia, and California [9]. This species has characteristics with a nut and one to three in each cupule. This species is collected in the form of fruit at Bukit Tapan Resort and found in the mountain forest with an altitude of 1343 m asl. *Castanopsis* sp associated with *Calamus* sp., *Baccaurea* sp., *Bauhinia* sp., and *Shorea* sp. This species is often found eaten by animals.

4.1.9 *Quercus* sp. (Fagaceae) *Quercus* sp. widespread in Eurasia, west Malesia, and America. Some species of *Quercus* had morphology look like *Castanopsis* [9]. This species has characteristics with the fruit is a nut called an acorn or oak nut borne in a cup-like structure known as a cupule; each acorn contains one seed. This species is collected in the form of fruit at Bukit Tapan Resort and found in the mountains with an altitude of 1341 m asl.

4.1.10 *Cheilocostus speciosus* (J.Koenig) CDSpecht (Costaceae) Collect This species was collected in the form of fruit at Bukit Tapan Resort. *Cheilocostus speciosus* spread in sub-continent Indians, South China, Taiwan, Indochina, Malesia (including Singapore) to Micronesia and Australia [14]. This species has characteristics with capsules red, globose, seeds black and glossy.

4.1.11 *Rubus* sp (Rosaceae). *Rubus* sp. widespread in a world-wide mainly montane forest [9]. This species was collected in the form of fruit at Bukit Tapan Resort and found on the edge of the river. It is an herbaceous plant with old blackish-red fruits while the young are bright red.

4.1.12 *Sloanea sigun* (Blume) K. Schum. (Elaeocarpaceae). *Sloanea sigun* was collected in the form of fruit at Gunung Tujuh Resort. This species grows in forests with an altitude of 800 m asl. This species has fruit sub-globose shaped capsule, up to 6 cm in diameter, greenish-yellow or brown-yellow, 4-valvate, woody, with rigid prickles. Seeds are shiny, black to brown, with aril at base and ventral side [10]. The distribution is in Yunnan S (Cambodia, India, Indonesia, Malaysia, Myanmar, Thailand) [15].

4.1.13 *Pyrenaria serrata* Blume (Theaceae). *Pyrenaria serrata* native range is Tropical & Subtropical Asia [9]. This species has characteristics with Fruit ovoid-globose, glabrescent, bluntly 5-6-ridged and indehiscent. This species is collected in the form of fruit at Gunung Tujuh Resort. *Pyrenaria serrata* spread in Indonesia, Thailand, and Malaysia[16].

4.1.14 *Passiflora* sp. (Passifloraceae). *Passiflora* sp. was collected in the form of fruit at Gunung Tujuh Resort, on the edge of mountain forests with an altitude of 1474 m asl. This species has characteristics with red fruit-color a type of berry, round to oval, juicy interior filled with numerous seeds and seeds coated with mucus.

4.1.15 *Cinnamomum* sp. (Lauraceae). *Cinnamomum* sp. widespread in indo-Australia [9]. This species has characteristics with fruit drupes containing a hard centre. This fruit are globular, and turn from green to black as they mature. This species was collected in Gunung Tujuh Resort at altitude 1495 m asl. The species was associated with *Khortalsia* sp., *Calamus* sp., and several species of Myrtaceae.
Figure 3. (a) Cymbidium bicolor Lindl, (b) Ficus deltoidea Jack, (c) Quercus sp., (d) Passiflora sp., (e) Spatoglothis sp., (f) Cheilocostus speciosus (J.Koenig) C.D.Specht, (g) Rubus sp.

4.1.16 Calamus manan Miq. (Arecaceae). Calamus manan widespread in Paleotropical, lowland and lower montane rain forests [9]. This species has characteristics with fruit globose to ovoid-shaped, covered in 15 vertical rows, yellowish scales in the form of fruit [10]. This species is collected at
Gunung tujuh Resort at altitude 1598 m asl. This plant associate with *Boea macrophylla*. These species are useful for furniture.

4.1.17 *Begonia alveolata* TTY T.T.Yu (Begoniaceae). This species is collected in the form of fruit at Mount Seven Resort. This species is collected at altitude 1000-1500 m asl. *Begonia alveolata* spread in Yunnan and Vietnam [17].

5. Conclusion

Thirty-two (32) collection numbers of seeds were obtained at the Ciremai Mountain National Park area consisted of 20 families and 28 genera. Then, thirty-three (33) collection numbers were obtained at the Kerinci Seblat National Park area consisted of 21 families and 31 genera. Recalcitrant seeds are most commonly found in Ciremai Mountain National Park and intermediate and orthodox seeds are most commonly found in Kerinci Seblat National Park area.

Acknowledgments

This research was funded by DIPA/Indonesian Government Funding Scheme Year 2016-2017: (Thematic/Core Competence Scheme: Seed Conservation of Rare, Orchid and Potential Plants in Indonesian Seed Banks). Many thanks to Dr. Siti Roosita Ariati for permitting to use the Nursery Unit of Registration and Nursery Department, Center for Plant Conservation, Botanic Gardens - LIPI. We were also grateful for generous assistance from all team members of LIPI Botanic Gardens Seed Bank: Mr. Harto, Mr. Aulia Hasan Widajaya, Rosita, Ahati, Jajat dan Sukron Ma'mun.

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