Storage techniques of the twenty seed species of urban forests

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Abstract. To guarantee the continuous supply of seed for supporting plantation programs in city forests, techniques to store the seeds that can prolong their life are required. The objective of the paper was to review the seed storage techniques of 20 (twenty) species of city forest trees, with locally named as: asam jawa, ampupu, bungur, cempaka kuning, cemara laut, damar, gmelina, jati, johar, kenari, kayu afrika, kecapi, mangium, mindi, pulai, rasamala, sawokecik, suren, tusam, and tanjung. The storage techniques of those twenty seed species are classified based on their physiological characteristics, i.e: orthodox (asam jawa, ampupu, bungur, cemara laut, gmelina, jati, johar, kenari, kayu afrika, kecapi, mangium, mindi, pulai, rasamala, sawokecik, suren, tusam, and tanjung), recalcitrant (damar and kecapi), and intermediate (cempaka kuning, kayu afrika, rasamala and suren). The review results indicates that (1) The techniques to store orthodox seeds are to put the seeds in a room with a temperature of 0°C-20°C with a relative humidity of 40%-50% and a seed moisture content of 5% - 7%, (2) recalcitrant seeds are stored at a temperature of 12°C-15°C with a relative humidity of 60% - 70%, and a seed moisture content of 20%-35%, and (3) intermediate seeds storage applies the temperature of 20°C and seed moisture content of 12% - 17%.

1. Introduction
City forest or urban forestry is a specific area with a number of trees or woody vegetation managed in urban and suburban areas (e.g cities, towns, villages etc) [1, 2]. The goals of urban forestry include sustain tree health, performing aesthetics, protecting flora and fauna, enhancing the physical, biological, economic, and social environment of the community. According to [3] a city forest is a site where the trees are grown within urban areas either in state or privately owned lands that serves as a buffer environment for water and air management, flora and fauna habitats and other ecosystem services. It is important to note that the area is set by the authorities as urban forest.

Considering the importance of city forest development, efforts are needed to support the success of plantation. One of the important factors is the availability of quality seeds in a sustained-adequate quantity. To ensure the availability of seeds for a long time, it requires techniques to store the seeds to prolong their life. The main goal of seed storage is to ensure the procurement of quality seeds for a planting programme. An inappropriate storage will lead to the decrease of seed viability.

Before storing seeds, we need to pay attention to their physiological characteristics. Based on the seed characteristics, in [4] we generally classify seed into two categories i.e: orthodox and recalcitrant. However, [5] pointed out another category that is set between the two categories, to be called as intermediate. Orthodox seeds can be stored under cold and dry conditions, while recalcitrant seeds will die if stored under such manner [6]. Intermediate seeds can be stored under dry conditions but can not stand to the exposure of low temperature [7].
There are many species of forest trees that can be grown in a city forest, among others, 20 (twenty) selected species belonging to three categories of physiological characteristics of seeds. Understanding the seed, physiological characteristics is important for city forest managers. Therefore, this paper will review the seed storage techniques of asam jawa (Tamarindus indica L.), ampupu (Eucalyptus urophylla S.T. Blake), bungur (Lagerstroemia speciosa (L.) Pers.), cempaka kuning (Michelia champaca L.), cemara laut (Casuarina equisetifolia L.), damar (Agathis loranthifolia Salisb), gmelina (Gmelina arborea Roxb.), jati (Tectona grandis L.f.), johar (Cassia siamea Lam.), kenari (Canarium indicum L.), kayu afrika (Maesopsis emenii Engl.), kecapi (Sandoricum koetjape (Burm.f) Merr.), mangium (Acacia mangium Willd.), mindi (Melia azedarach L.), pulai (Alstonia scholaris (L.) R.Br.), rasamala (Altingia excelsa Noronha), sawo kecik (Manilkara kauki (L.) Dubard), suren (Toona sureni (Blume) Merr.), tusam (Pinus merkusii Jungh.& de Vriese) and tanjung (Mimusops elengi L.).

2. **General features of 20 species of city forest**
The botanical and ecological features of the twenty species of the city forest is described in table 1.
| No. | Local and latin names | Family       | Distribution                                                                 | Utilization                                                                 | Botanical and ecological types                                                                 |
|-----|------------------------|--------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| 1.  | Asam jawa *(Tamarindus indica* L.) | Fabaceae     | - Tropical areas [8] <br> - Spread out in the Island of Java - Indonesia [11] | - The pulpy fruit is used as materials for food and traditional medicine industries [11] <br> - The tree is good for windbreak, shading and erosion break [11] | - The tree could reach a height of 30 m, branchless trunk of (1 to 2) m, and a diameter of 2 m [9] <br> - Grow in low lands up to highland areas (> 1000 m a.s.l) [11] <br> - Grow well in a rainfall of 500-1500 mm/year, in sandy to clay soil and less fertility soils [8, 35] |
| 2.  | Ampupu *(Eucalyptus urophylla* S.T. Blake) | Myrtaceae    | - Naturally grow in the eastern part of Indonesia, such as Mount Mutis-Soe and East Timor island [12] | - The timber is used as raw materials for building and making pulp and paper. The tree is good for reforestation and shading tree [11, 13] | - The tree height can reach 35 m with a diameter of about 120 cm [11] <br> - Grows at an altitude of 200 to 1500 m a.s.l with a rainfall of 130 to 2400 mm/years [14] <br> - It grows well in a good drained site and tolerance to compact and acid soils, as well as fire resistance [14] |
| 3.  | Bungur *(Lagerstroemia speciosa* (L.) Pers.) | Lythraceae   | - Distributed in many areas of Indonesia such as Sumatra (Riau, Jambi, South Sumatera), throughout Java | Utilized as ornamental trees in the city. Part of the plant such as leaf can be used to cure malaria, boiled leaves and ripe fruits are good for diabetes and the | - The tree height can reach about 10 to 45 m [11] <br> - Grow in either low lands or highland areas up to 800 m a.s.l. as well as on marginal soils [11] |
| No. | Local and Latin Names                  | Family          | Distribution                                                                 | Utilization                                                                 | Botanical and ecological types                                                                 |
|-----|---------------------------------------|-----------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 4.  | Cempaka kuning (*Michelia champaca* L.) | Magnoliaceae    | Sumatera, Java, Kalimantan, Sulawesi and Sunda kicil Islands [15]            | - Used for shading trees in urban areas and one of the essential oil producing plant [11] | - It can be grown on wet soil or waterlog, but not on peat soil. In addition, the species can grow in dry soils, less fertilized and savanna. The species is preferred to wet climate [16] |
| 5.  | Cemara laut (*Casuarina equisetifolia* L.) | Casuarinaceae   | Spread out in Sumatra, Kalimantan, Sulawesi, Java, Madura, Ternate and Halmahera [15] | - The wood has the best quality of fuelwood in the world [11]                | - Tree height can reach up to 15 m to 25 m with a diameter of about 30 cm to 40 cm [11]    |
|     |                                       |                 |                                                                                | - The economic value of the wood is very good due to its utilization for wood carpentry. It is also a beautiful tree for ornamental plants in urban green lines [11] | - Grows in a variety of locations and climate, from coastal areas to high mountain slopes, with warm tropical and semi arid climates [20] |
|     |                                       |                 |                                                                                |                                                                                | - Grows at an altitude of 0 to 1500 m a.s.l. The best site to grow is in the coastal areas with a soil pH of 5 to 8. Tolerance to drying season is 6 to 8 months. Maximum temperature of 30°C to 35°C and minimum 7°C to 18°C. |
| No. | Local and latin names             | Family         | Distribution                                                                 | Utilization                                                                                                                                     | Botanical and ecological types                                                                 |
|-----|----------------------------------|----------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.  | Damar (*Agathis loranhi folia* Salisb) | Araucariaceae | Planted as damar seed sources in Sukabumi (West Java), Baturaden (Central Java), Banyuwangi and Probolinggo (East Java) [14] | Planted in urban areas as road side plants or shading trees. The timber is good for carpentry which is a high economic valuable tree. Produces resin gum and is an important export ingredient [11] | Mean annual rainfall of 1400 mm [11]                                                                                                             |
| 7.  | Gmelina (*Gmelina arborea* Roxb.) | Verbenaceae   | Is an exotic species. The distribution in Indonesia include Java, Kalimantan and Nusa Tenggara. Seed sources plantation are in Central Java, East Java and East Kalimantan [14] | Planted as regreening plants in urban areas. The wood is used for carpentry wood [11]                                                                 | - Grows naturally at an altitude of 0 to 800 m a.s.l with a rainfall rate of 120 to 3000 mm/year. The species grow in deep soils, fertilize, and bad drainage [14] |
| 8.  | Jati (*Tectona grandis* L.f.)    | Verbenaceae   | Distributed throughout Java, South Sulawesi, Southeast Sulawesi, Sumbawa, Maluku, and Lampung [16] | - The timber is good for carpentry and furniture. The wood is durable and expensive. Jati is wind resistance and hence good for wind break [11] | - The tree can reach a height of 45 m with a diameter > 150 cm [11]                                                                 |
|     |                                  |                |                                                                              | - Grows at an altitude of 0 to 900 m a.s.l with a rainfall of 1500 to 3000 mm/year. It requires deep soil, fertilizer, good drainage and neutral pH to grow. Tolerance to compact |                                                                                                                                                    |
| No. | Local and latin names | Family     | Distribution                                                                 | Utilization                                                                 | Botanical and ecological types                                                                 |
|-----|-----------------------|------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| 9.  | Johar (*Cassia siamea* Lam.) | Caesalpiniaceae | It originates from South and southeast Asia which includes Indonesia, the distribution is widely spread in tropical areas [15] | Widely used for greening, ornamental or protective plants in the urban areas. The wood is widely used for firewood, its leaves for fodder. In addition, effective for erosion control and land reclamation [11] | Can grow in wide climatic ranges, but grows better in lowland with a rainfall of 500-2800 mm/years, mean temperature of 20°C to 31°C, dry season for 4 to 8 months. Cannot grow at an altitude >1300 m a.s.l, cannot stand to temperature >10°C. Preference of moist soils, good drainage, fertilize, pH of 5.5 to 7.5, but can grow on marginal sites [15] |
| 10. | Kenari (*Canarium indicum* L.) | Burseraceae | Natural distribution is in Sulawesi, Maluku Islands and Papua [11] | Kenari can be used as shade plants, because of the evergreen-dense canopy. The fruit, in this case the seeds are edible, while the outside of the seed (exocarp) can be used as handicraft materials. The wood can be used as wood tools [11] | Grows in the lowland tropical rain forests, but can be cultivated at an altitude of more than 600 m above sea level. [11] |
| No. | Local and latin names | Family | Distribution | Utilization | Botanical and ecological types |
|-----|------------------------|--------|--------------|-------------|--------------------------------|
| 11. | Kayu afrika (*Maesopsis emenii* Engl.) | Rhamnaceae | This species grows naturally in the tropical areas of East Africa. First, introduced to Indonesia was in West Java [15] | Kayu afrika is a fast growing species, with leafy leaves that can be used as a reforestation plant in urban areas, especially in relatively high altitude areas. The wood is popular in the community therefore it is suitable for the development of the community forests. The leaves can be used as fodder [11] | This species grows well at an altitude of 100-1500 m a.s.l with a rainfall of 1400-3600 mm / year. It grows well in deep, fertile and free from waterlog soils, tolerant of infertile soil, sandy soils, and acidity [15] |
| 12. | Kecapi (*Sandoricum koetjape* (Burm.f) Merr.) | Meliaceae | This species originates from Indo-China and West Malaysia, has developed into landrace and widely accepted in tropical Asia, especially Indonesia, Malaysia, Phillipine, Thailand, and Vietnam [15] | The fruit is edible. The wood can be used for making furniture. The plant is growing fast with a nice shape of canopy that makes it good for ornamental and shading trees. The bark can be utilized as medicine to cure scabies and the mixed-boiled roots and gingers are used to cure diarrhea [11] | - This tree is deciduous, with a height that reaches 45 m - branchless of 2/3 of the total height [11] |
|     |                        |        |              |             | - Grow well at the altitude of 0 to 1000 m a.s.l and be able to survive in areas with a long dry season. Preference to clay or sandy fertile soil and contain of humus [15] |
|     |                        |        |              |             | - The tree height attains to 25 to 30 m and diameter of 70 to 90 cm [11] |
13. Mangium (*Acacia mangium* Willd.) **Leguminosae**

- Natural distribution is in Indonesian Papua and The Island of Maluku. The sources of seed source are found in Subanjeri (South Sumatera), Banten, Bogor and Purwakarta (West Java) [14].

- The plant is used as shading trees in urban areas. The canopy and leaves are able to absorb a high concentration of Carbon, so it is good to mitigate air pollution. The timber is worth as a substitution to carpentry wood [11]

- Grows well at the altitude of 500 to 1200 m a.s.l, with an annual rainfall of >1920 mm/year. Grows on sandy soil, less nutrition and bad drainage [14]

- These species are fast growing plants, plant height can reach 20 to 25 m, with a diameter of more than 100 cm [11]

14. Mindi (*Melia azedarach* L.) **Meliaceae**

- Natural distribution is found in Java, Bali, East Nusa Tenggara and West Nusa Tenggara [16].

- It is also found many in highland in Bogor, Sukabumi, Cianjur and Bandung (West Java) and Bondowoso (East Java) [14].

- The flower can be used as medicine for headaches, leaf for exuviate urine and helminth, and the fruit for fever relief, the roots for scabies treatment. Natural insecticide can be extracted from mindi leaves. The plant grows quickly with beautiful flowers that make it suitable for a garden in urban areas [11]

- Grows well at an altitude of 700 to 1400 m a.s.l, with the rainfall of >900 mm/year. Grows on a good drainage system, fertilizer and sandy soils. Resistance to cool temperature [14]

- Tree height could reach to 40 m with branchless stem with a height of 20 m, a diameter around 185 cm and no buttressed [11]

15. Pulai (*Alstonia scholaris* (L.) R.Br.) **Apocynaceae.**

- Distribution areas are throughout Indonesia [16].

- The main utilization of this species is its timber and used a lot for carpentry. The bark is useful for malaria, fever and cholera medicines.

- Growth distribution is in secondary swamp areas up to the high altitude area of about 1000 m a.s.l. The plant has a straight trunk, the height may reach up to 40 to 45 m, a
| No. | Local and latin names | Family | Distribution | Utilization | Botanical and ecological types |
|-----|-----------------------|--------|--------------|-------------|------------------------------|
| 16. | Rasamala (Altingia excels Noronha) | Hamamelidaceae | Natural distribution in the forests of Priangan and Bukit Barisan mountains. The sources of the Seed have been found in Sukabumi and Cianjur (West Java). Rasamala forest is also found in Bedugul, Bali [35] | The wood can be utilized for building and construction materials. The plant may be used as shading trees along the road sides due to the dense-evergreen of the canopy [11] | diameter of 40 to 60 cm [11] |
| 17. | Sawokecik (Manilkara kauki (L.) Dubard) | Sapotaceae | Natural distribution is in the Island of Java along the south coast of Banyuwangi and Karimun, Java. Outside Java they are found in Bali, Buton, Sulawesi, Kangean, Pulau We | The wood is good for carving materials in Bali. It is also used for furniture. The wood is durable so it is enable to submerge in a mud and soil. The fruit is edible, the flower can be used as a medicine. The plant has a strong root that is good for conservation | - Grows at an altitude of 600 to1000 m a.s.l [35]  
- The tree may reach of > 50 m high, and a diameter up to 150 cm. The stem is erected and straight [11]  
- The tree height may reach 30 m, possesses a thick trunk with a diameter of > 100 cm [11] |
| No. | Local and Latin names | Family | Distribution | Utilization | Botanical and ecological types |
|-----|----------------------|--------|--------------|-------------|-------------------------------|
| 18. | Suren (*Toona sureni* (Blume) Merr.) | Meliaceae | Growth distribution in Indonesia are Sumatera, Java, and Sulawesi. [11,16] | The wood is used a lot for carpentry and carving. The tree can be roadside and shading plants [11] | - Grows at an altitude of 1200 m a.s.l on fertile soil, in the mountains, climate type of A to C, with mean annual temperature of 22°C [11,16] - The tree reaches a height of 40 m and a diameter of 200 cm [11] |
| 19. | Tusam (*Pinus merkusii* Jungh. & de Vriese) | Pinaceae | Natural distribution is found in Aceh, South Sumatera and Jambi. Plantation forests are spread out in the Island of Java, Sumatera and Sulawesi. Seed sources are planted in Sumedang and Banjaran (West Java), Baturaden and Paninggaran (Central Java) and Sempolan (East Java) [39] | The wood is used for carpentry and tool woods. The resin is utilized for turpentine industry. The beautiful stem form and its’ needle leaves allows the plant able to be ornamental and shading trees, especially in a highland of urban areas [11] | - The Height of a tree may reach up to 20 to 60 m with a diameter of 100 cm, no buttressed [11] |
| No. | Local and latin names | Family | Distribution | Utilization | Botanical and ecological types |
|-----|----------------------|--------|--------------|-------------|--------------------------------|
| 20. | Tanjung (*Mimusops elengi* L.) | Sapotaceae | Distribution in Indonesia including Aceh, South Sumatera, Lampung, Java, Bali, Southeast Sulawesi, Maluku, Nusa Tenggara and Indonesian Papua [15] | The timber is good for construction. The fragrance flowers, the dense crown makes this species convenient to be in the roadside or a shading tree. [11] | Generally grows on fertile soil with an altitude of > 600 m a.s.l. [15]  
- Reaches a tree of 25 m, branchless height of 8 to 17 m with a diameter up to 100 cm, buttressed up to 2 m. [11] |
3. Seed characteristics and storage techniques of twenty species of city forests

Seed storage techniques of twenty species are categorized based on their physiological characteristics, i.e orthodox seeds (asam jawa, ampupu, bungur, cemara laut, gmelina, jati, johar, kenari, mangium, sawokecik, tusam, and tanjung), recalcitrant seeds (damar and kecapi) and intermediate seeds (cempaka kuning, kayu afrika, mindi, rasamala, and suren). Storage techniques of the seeds are summarized in table 2.

Table 2. Seed storage techniques of twenty species of city forest.

| No. | Seed species                     | Seed characteristics | Storage techniques                                                                 |
|-----|----------------------------------|----------------------|-----------------------------------------------------------------------------------|
| 1   | Asam jawa (*Tamarindus indica* L.) | Orthodox             | Seeds should be stored at low temperatures (5-10°C). At this temperature, the viability of seeds can be prolonged for several years [8]. Storing the seeds in a porous gunny sack will be able to increase their potential viability and vigor of seedlings after being storage for 12 weeks [43]. |
| 2   | Ampupu (*Eucalyptus urophylla* S.T. Blake) | Orthodox             | Seeds can be stored up to 3.5 years with an initial moisture content of 10%, placed in an air-conditioned room (T 18-20°C, Rh 50-60%), pack in an air-tight container (plastic bag or tin). The germination capacity achieves 90% [44]. |
| 3   | Bungur (*Lagerstroemia speciosa* (L.) Pers.) | Orthodox             | Seeds are air dried and stored in a closed container. Stored in a low moisture content. Viability maintained even after 2 years, in hermetic storage at room temperature. Germination increases during the first 3-12 months of storage [45]. |
| 4   | Cempaka kuning (*Michelia champaca* L.) | Intermediate         | Seeds are stored at cold room temperatures (5°C). The viability can be maintained for 7 months [46]. |
| 5   | Cemara laut (*Cassuarina equisetifolia* L.) | Orthodox             | The seeds are resistant to drying. Before storage, the seeds are dried under the sun to a moisture content of 5-6%. Packed in a tin and placed under room temperature. Durability of storage up to 3 months [47]. |
| No. | Seed species                      | Seed characteristics | Storage techniques                                                                                                                                 |
|-----|----------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 6   | Damar (*Agathis loranthis Salisb*) | Recalcitrant         | Seeds are air dried for 24 hours to get 30% of moisture content, then add fungicide of mancozeb + karbendazim (Delsene MX-200) with a dosage of 4.01-4.05 g/kg seeds. Packed in a plastic bag and placed either in an air-conditioned room (T 18-20°C, Rh 50-60%) or a regular room (T 28-33°C, Rh 60-70%). This condition can keep the germination capacity of 70% for 9 months [48]. |
| 7   | Gmelina (*Gmelina arborea* Linn.)  | Orthodox             | Seeds are stored at a low moisture content of 5-8%. Drying for two days to get 5-8%. Packed in an air tight container. Placed in an air-conditioned room (T 18-20°C, Rh 50-60%). The viability can be maintained for 12 months with germination capacity of 60-70% [49, 50]. |
| 8   | Jati (*Tectona grandis* Linn.f.)  | Orthodox             | Seeds are stored at a temperature of < 20°C and a relative humidity of < 60% [51].                                                                 |
| 9   | Johar (*Cassia siamea* Lamk.)     | Orthodox             | No specific method of storage required. Packed in a plastic bag or tin and place in a regular room [47].                                                                 |
| 10  | Kenari (*Canarium indicum* L.)    | Orthodox             | Seeds are packed in a hermetic container (plastic bag or tin can). Seed moisture content before storage is 5-8%. Air-conditioned room (18°C) is suggested to store the seeds [52]. |
| 11  | Kayu afrika (*Maesopsis emenii* Engl.) | Intermediate | Seeds can be stored under low temperature (4-8°C) by using an impermeable container [53].                                                                 |
| 12  | Kecapi (*Sandoricum koetjape* (Burm.f) Merr.) | Recalcitrant | Seeds have a relatively high moisture content after being extracted from the fruits i.e around 55%. It is suggested to store temporary (during transporting) kecapi in the form of fruits, to keep the water content of the seeds high. The temporary storage can be carried out under room temperature of 18-20°C or a refrigerator (T 7°C) [54]. |
| No. | Seed species                  | Seed characteristics | Storage techniques                                                                                                                                 |
|-----|-------------------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 13  | Mangium (*Acacia mangium* Willd.) | Orthodox             | Seeds are stored at a low moisture content (5-8%) by drying under the sun for two days. Packed in a hermetic container (seeds are put in plastic bags then placed in a tin can). The storage room is either an air-conditioned room or a dry cold storage. By this manner the viability could be maintained for three years [55]. |
| 14  | Mindi (*Melia azedarach* Linn.) | Intermediate         | Seeds should be kept in high moisture content (10-15%). The seed moisture content is decreased by aerating in air conditioned room (T 18-20°C ) on a flat container for 3 days. The seeds will die if the moisture content < 10%. Fresh stones (moisture content ± 22%) are kept in plastic and then stored in a tin can in a cold room with a temperature of 18-20°C, RH 70-80%. Using this treatment, the germination percentage of the seeds can be maintained up to 20-30% after 10-12 weeks in storage [56]. |
| 15  | Pulai (*Alstonia scholaris* (L) R.Br.) | Intermediate         | Seeds are stored at low temperature. Due to its thin seed coat, the viability rapidly losses if it is stored under high temperature [57]. The safe moisture content for storage is around 7.5-9.0%, achieved from aerating the seeds for 2-3 days under room temperature (T ± 25°C, Rh 70-90%). Seeds are then packed in a tight plastic bag (≥4 mm thick) and stored in a cool room (Dry cold storage or refrigerator). The germination capacity reaches 82% after 6 months storage [58]. |
| 16  | Rasamala (*Altingia excelsa* Noronhae) | Intermediate         | Seeds can be stored with their viability remain good when seed moisture content is lowered to 7 - 8% and stored in a cool room or refrigerator with a temperature of 4-8°C by using packaging material formed as a plastic bag with a width of 0.1 [59]. |
| 17  | Sawokecik (*Manilkara kauki* Dubard) | Orthodox             | Moisture content of the seeds should be decreased by drying up, stored in an hermetic container and placed in a low temperature room (air conditioned room or refrigerator) [60]. |
| No. | Seed species | Seed characteristics | Storage techniques |
|-----|--------------|----------------------|--------------------|
| 18  | Suren (*Toona sureni* (Blume) Merr.) | Intermediate | Seeds are drying up to lower their moisture content, then put in a clothed bag and placed in an air conditioned room (T 18-20°C). With this treatment, the viability of the seed can be kept for 4 months with the germination capacity of 56.66% [61]. |
| 19  | Tusam (*Pinus merkusii* Jungh.et de Vriese) | Orthodox | Seed moisture content kept at 5-8% can maintain the viability for a period of 2 years. The container uses a plastic bag that is put in a tin can and placed in a dry cold storage (T 4-8°C, Rh 40-60%) [62]. |
| 20  | Tanjung (*Mimusops elengi* L.) | Orthodox | Seeds are stored in an air conditioned room (T 18-20°C, Rh 50-60%) by using a container of a tight plastic bag, at seed moisture content of 5-8%. The seeds can be stored for a nine-months period [63]. |

The results on storage techniques of the twenty species of city forest indicated that the orthodox seeds should be stored at a low seed moisture content, tightly packing, stored in low temperature and humidity. Contrary to orthodox seeds, the recalcitrant seeds require a high moisture content at the time of storage, preferred mixed medium for storage, porous packaging, room storage at a relatively high temperature and humidity. Seeds of intermediate characteristic are in between of orthodox and recalcitrant features. They need a lowered moisture content like orthodox, but they can not withstand if stored in low temperature and humidity like recalcitrant does [64].

4. Closing Remarks
The availability of a good quality seed is necessary to support the successful planting of 20 tree species in urban forests. The quality seeds are obtained through proper handling of seeds starting from collection, processing to storing the seeds. Through many research and testing activities, the seeds have to be stored based on their physiological characteristics such as orthodox, recalcitrant and intermediate. Considering the characters possessed by each seed species, orthodox forest tree seeds could be prioritized for urban forests. This is due to its capability to be stored in a long period making them more available as planting stock as necessary. However, the recalcitrant and intermediate seed species are also recommended to be planted in city forests, however the seeds should be processed properly before being stored. The best practice is to sow the available fresh seeds as soon as possible for seedling production.

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