Identification of Pest and Disease in The Plant Conservation Center - Bogor Botanical Garden (PKT-KRB) Ecological Park Cibinong, Bogor, West Java, Indonesia

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Abstract. The purpose of this study were: (1) to determine the pests and diseases infestation of plants in the Plant Conservation Center - Bogor Botanical Garden (PKT-KRB) Ecological Park area in Cibonong, Bogor Regency, (2) to determine the extent of damage that has been attacked by the pests and diseases. Sampling method was made by creating sample plots of 20m x 50m size with sampling intensity of 10% in the selected area at bioregion of Sumatera and of Kalimantan. The result of study showed that plants damage in those areas were dominated by hollow leaves caused by caterpillar pests i.e. at bioregion of Sumatera (37.84%) and of Kalimantan (40.23%). In addition, it was found that the secondly dominated infestation was alga leaf spot (Cephaleuro virescens) that has caused spots on leaf. Infestation intensity of the disease was of 35.14% at bioregion of Sumatra and of 28.74% at of Kalimantan, while the intensity of plants damage at bioregion of both were 36.00% and 42.44%, respectively. The scale of damage in both bioregions was included as score 2, which was the medium category (≥26-50%).

1. Introduction

The Center for Plant Conservation (PKT) of the Bogor Ecology Park or commonly called the Ecopark is an extension of the Bogor Botanical Gardens in the Cibinong Science Center Botanic Garden (CSC-BG), has an area of 32 hectares, built in 2002. Ecopark is part of the Bogor Botanical Gardens (KRB), because its management is still under KRB management. The plant collection is designed to depict the flora of the lowland bioregion of the Indonesian island. The plants in Ecopark are vegetations that are suitable for the diversity of Indonesian ecosystem types that are compatible with CSC-BG environmental conditions. The collection of plants are arranged in such a way based on the bioregion, namely Sumatera, Java-Bali, Nusa Tenggara, Kalimantan, Sulawesi, Maluku and Papua [1].

The development of engineering ecosystems is generally susceptible to crop damage caused by biotic factors (living organisms) and abiotics (physical environment). Therefore, the act of protecting artificial plantations cannot be considered as a temporary solution to the problem of damage, or merely as an emergency measure, but rather directed to recognize and evaluate all potential sources of damage, so that large damage can be avoided.
The Protection of plantations prioritizes the early prevention or development of forest damage through silvicultural planning and good management. If it can be realized then the procedure will be more effective than direct control after a large damage occurs. Therefore, the techniques for preventing and controlling Plant Pest Organisms (OPT) in artificial plantations need immediate attention. This effort must be taken because the pest problem is an integral part of man-made forest management activities. Many factors can cause damage to artificial forests, both originating from outside the forest and factors related to the development of the plantation forest itself. One of the causes of forest damage from living organisms is forest disease. Forest disease can cause losses including inhibiting growth and reducing the quantity and quality of yields.

The aim of the study are: 1) to know caterpillar and disease that attacking in plant in The Plant Conservation Center - Bogor Botanical Garden (PKT-KRB) Ecological Park, 2) to know stage of plant damage that infected caterpillar and disease in The Plant Conservation Center - Bogor Botanical Garden (PKT-KRB) Ecological Park.

2. Method

2.1. Materials
The materials used in this research are: tallysheel, to record data obtained from the field, a map of the area, to obtain location data and species distribution at the Bogor Ecological Park PKT Botanical Garden, magnifying glass / binocular loop, to directly observe objects that are seen directly in the field, fabric meters to measure the circumference of plants, GPS to determine the coordinates of the location of research, hygrometers to measure temperature and humidity, cameras to document research results, dissecting microscopes and compound microscopes to observe objects that are not visible directly on field, herbarium & oven tools to process and dry plant specimens, computers and printers to process the collected data, and compile and print it into research reports and stationery.

2.2. Procedure
The research method used is direct exploration in the field by determining purposive sampling plot samples. Conducted on a study plot measuring 20 m x 50 m, with a sampling intensity of 10% of the total area of each bioregion. The selected bioregion as samples are Sumatera and Kalimantan which have greater area than other regions. Besides, two bioregions of those will not change of function, area change differently with other bioregions as Java-Bali, Nusa Tenggara, Sulawesi, Maluku and Papua.

2.3. Data analysis
The data used in this research are data obtained from direct observations in the field and laboratory observations. Data were taken descriptively to determine the intensity of damage caused by pests and diseases using the Natawigena formula [2], as follows:

\[
P = \frac{a}{a + b} \times 100\%
\]

Information:
\[P = \text{Damage intensity (\%)}\]
\[a = \text{The number of trees (leaves and stems) that are attacked}\]
\[b = \text{Number of trees (leaves and stems) that are not attacked}\]

The scale score of pest and disease attacks:
\[0 = \text{normal}; 1 = 0 - 25\% \text{ (mild); 2 = 26 - 50\% \text{ (medium); 3 = 51-75\% \text{ (severe); 4 = 76-100\% (very severe)}}\]
3. Result and discussion

Based on the observations through direct observation in the field, damage intensity for each bioregion is obtained, which is presented as follows in Table 1.

**Table 1. Intensity of damage on every bioregion**

| No | Bioregion | Total of Individual | Total of individual that infected (a) | Total of individual healthy (b) | Intensity of damage (%) |
|----|-----------|---------------------|--------------------------------------|---------------------------------|-------------------------|
| 1  | Sumatera  | 100                 | 36                                   | 64                              | 36.00                   |
| 2  | Kalimantan| 205                 | 87                                   | 118                             | 42.44                   |

3.1. Damage Type

Based on the type of damage caused by pests or diseases, the following results are in Figure 1.

![Figure 1. Type of damage that caused by pest and disease on bioregions of Sumatera (a) and Kalimantan (b)](image)

3.2. Type of pest, disease and impact of infestation

The following Figure 2 and Figure 3 show some types of caterpillar, disease and impact of infestation against plant. In some smaller trees, caterpillar pests are very influential on the growth and development of trees, even in larger attacks can cause tree death. This is because the caterpillar pests attack the leaves used by trees to carry out photosynthesis. Disruption of the photosynthesis process affects the reduced amount of food obtained by the tree, so that the growth and development of the tree becomes disrupted, even in some cases can cause death.
3.3. Disease Scoring

Subsequent observations were made through scoring of pests and diseases. The observation results through scoring based on disease attacks showed in the Sumatera bioregion, the number of plants that were still in normal condition or not attacked by pests and diseases, were greater than 64% compared to the Kalimantan bioregion 57.56%. Similarly, minor attacks were still dominated by the Sumatera bioregion by 13% compared to the Kalimantan bioregion which was only 9.27%. However, in the Kalimantan bioregion, moderate and severe attacks were more prevalent (16% and 9.27%) than in the Sumatera bioregion (12% and 3%). This is related to the diameter class in the Kalimantan bioregion which is still dominated by young plants (sapling level) so that the type of attack is mostly caused by caterpillar pests that leave scars in the leaves. Whereas very severe attacks are more common in the Sumatera bioregions (8%) than the Kalimantan bioregions (7.80%). This is related to the high humidity level in the Sumatera bioregions, dominated by algae attacks (Cephaleuros virescens) which
occur mostly in this bioregion. This is in accordance with the characteristics of the algae itself which can grow at high humidity levels. Based on [3] that the infection of leaf by parasitic green algae of the genus *Cephaleuros* on many woody trees are mostly during high humidity and warm rainy weather. Meanwhile, dimensions of microscopic structures of *C. virescens* of the family Trentepohliaceae, order Trentepohliales and the division Chlorophyta, are often varies influenced by collecting seasons, host plants and environmental conditions [4].

In Sumatera bioregion, the algae of *Cephaleuros virescens* has been attacking of *Cinnamomum burmani* for light and very severe attack, of *Orophea hexandra* for moderate attack, of *Santiria laevigata* for severe attack, of *Hopea sangal* and *Vatica pauciflora* for very severe attack. As for Kalimantan bioregion, it has been attacking of *Canarium hirsutum* and *Uvaria ovalifolia* for light attack, *Uvaria ovalifolia* for moderate and very severe attack, *Alstonia angustifolia* for very severe attack. Parthasarathy [5] reported algal leaf spot (red rust) attack by *Cephaleuros virescens* on Indian sandalwood (*Santalum Album*). The characteristic of attack was as few or numerous, circular orange patches, scattered on the upper surface of the leaf. It sometimes colonizes the leaf petiole and mild shoots. Based report from [6], in Thailand, it has caused of an algal leaf spot on Para rubber (*Hevea brasiliensis*), additional feature are circular orange to dark brown lesions on both leaf surfaces. Based on [7], the damage occurs due to the increasing reduction in the area of photosynthetic of the leaf. After that in Thailand, [8] also reported *C. virescens* (Trentepohliales, Ulvophyceae) has caused a leaf spot on rambutan (*Nephelium lappaceum*). Before, [9] reported *C. solutus* has caused a leaf spot on durian (*Durio zibethinus*). In Himachal Pradesh India, the first report about *C. virescens* attack on quince (*Cydonia oblonga*) by [10]. The first report of algal leaf spots was caused by *C. virescens* on longan trees (*Dimocarpus longan*) in India by [11]. Also in India, *C. virescens* commonly infect mango and litchi leaves [12].

![Figure 4](image)

**Figure 4.** Scoring of plant damage that caused caterpillar and disease. Remark: 0=normal, 1=0-25% (light), 2=26-50% (middle), 3=51-75% (heavy), 4=76-100% (very heavy)

3.4. **Types of Healthy Plants (Scale 0)**

Based on the observations above, it was found that the results of healthy plant species were dominated by *Hopea sangal* (10.94%), *Orophea hexandra* and *Garcinia celebica* with each (9.38%) for the Sumatra bioregion, whereas for the Kalimantan bioregion, it was quite varied, namely dominated by *Canarium hirsutum* (7.63%), *Tetractomia tetandra* (6.78%), *Aphanamixis polystachya* and *Lepisanthes alata* (5.93%).

Whereas for light attacks ≤ 25% is quite diverse, dominated by *Cinnamomum burmani*, *Endospermum diadenum* and *Slooetia elongata* (15.38%) with average diameter classes respectively 7.83, 13.95 and 8.96 cm for the Sumatra bioregion, and for the Kalimantan bioregion; *Canarium*
hirsutum, Uvaria ovalifolia, Bridelia glauca and Cassia fistula (10.53%) with average diameter classes of 16.1, 2.9, 5.8 and 5.2 cm, respectively.

For types with moderate attack category 26-50%, the Sumatra bioregion is dominated by Cinnamomum iners, Orophea hexandara and Vatica pauciflora (16.67%) with diameters ranging from 23.20, 4.90 and 7.44 cm and for Kalimantan bioregion remains dominated by Uvaria ovalifolia types (15.67%) 15%) with an average diameter of 5.4 cm. Whereas 51-75% for severe attacks on Sumatra bioregion is quite varied, dominated by Artocarpus cf. glaucus, Santiria laevigata and Nepheleium or rambutan (33.33%) with an average diameter of 4.3, 17.5 and 5.48 cm respectively, for the Kalimantan bioregion; Cynometra ramiflora, Nepheleium mangayi and Shorea leprosula with an average attack intensity of 10.53%, average diameter of 12.1, 3.3 and 11.4 cm.

For very severe attacks, 76-100% on the Sumatran bioregion, there are 8 types of plants that fall into this category, including Cinnamomum burmani, Cinnamomum iners, Clausena excavata, Flacourtia rakam, Hopea sangal, Malotus mollissimus, Syzygium acuminatissimum and Vatica pauciflora with each of them. 12.5% with a variety of diameter classes also starting from 3.25, 14.87, 1.24, 8.66, 14.59, 4.43, 21.62 and 5.25 cm, while for the Kalimantan bioregion; Alstonia angustifolia and Uvaria ovalifolia are categorized as very severe attack, namely - 18.75% with an average diameter of 15.1 and 4.6 cm.

4. Conclusion

Pests and diseases that attack plants in the PKT area of the Bogor Ecological Park Botanical Garden are caterpillar pests found in the Vatica pauciflora and Sloetia elongata plants in Sumatra bioregion and Macaranga gigantea, Phaleria octandra and Aphanamixis polystachya plants in the Kalimantan bioregion. As for the disease that attacks are dominated by algae attack on the leaves of Cephalapus virescens.

The level of damage to plants that have been attacked by pests and diseases in the area of PKT Bogor Botanical Gardens Ecological Park is the Sumatra bioregion, experiencing damage intensity of 36.00%. Whereas the Kalimantan bioregion experienced damage intensity of 42.44%.

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