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The health status of saga tree (*Adenanthera pavonina*) in campus area of Universitas Sumatera Utara (USU)

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Abstract. Saga (*Adenanthera pavonina*) is multipurpose tree species found in the Universitas Sumatera Utara (USU) campus. Along with broken branches and fallen trees on the USU campus, it is necessary to monitor the trees' health. This study aimed to measure the saga trees' health status at the USU campus. The research was conducted by the census method to 153 saga trees. The health monitoring was performed using Forest Health Monitoring (FHM) method. The results showed that the sixth damage type that occurred on saga trees are: cancer, decay further, open wounds, leaves decolourization, loss of dominant tip, and broken or dead branches. Based on its health status, four trees (2.61%) are in the very healthy category, 35 trees (22.88%) are in the healthy category, 88 trees (57.52%) are less healthy, and 26 trees (16.99%) are in the unhealthy category. The damage index value for saga trees at the USU campus is commonly on the moderate category, so maintenance activities are needed to improve tree health and avoid unwanted incidents.

1. Introduction

The campus of Universitas Sumatera Utara is one of the green open spaces areas with 100 hectares. This open space provides social, ecological, and aesthetic benefits for the surrounding community [1]. More than 68 tree species have been planted at the USU campus, including the saga tree (*Adenanthera pavonina*).

Saga is a multipurpose tree species that widely planted in Indonesia. The wood can be used for building materials, bridges, floorboards, and charcoal [2]. Saga does not require specific soil quality; thus, it can grow well in a wide range of soil conditions, ranging from infertile soils to fertile soils. Saga is also often used as a shade plant and is suitable for aesthetics function [3]. At the USU campus, the saga was planted for road shade and distributed at several plots.

As it was planted widely at the campus, saga trees' health needs to be more serious about preventing unwanted incidents on campus. Therefore, tree health monitoring was required to get information on tree health conditions and provide recommendations for further tree maintenance. Information on the condition of tree health can provide their biological functions and management properly. However, the growth will be disrupted if the trees are attacked by pests, diseases, or human activities [4]. Damage caused by pest or disease attacks can result in the disruption of these physiological processes. The tree health can be measured through damage level. This study was conducted to observe saga trees' health status at the USU campus based on these considerations.



2. Materials and methods

The tree health monitoring observation was conducted at the USU campus. Approximately 153 trees of saga trees were observed, and health condition was measured from root to canopy part. All trees are marked with coordinate points using the Global Positioning System (GPS) to present the saga tree distribution.

The method used in this study is the Forest Health Monitoring (FHM) by recording signs and symptoms based on damage definition and the census. While the census method is performed by observing and measuring the tree's physical condition or the saga tree's overall visual symptoms.

Tree damage is measured based on damage assessment criteria according to the FHM method, which consists of three sequential codes that describe damage location, damage type, and tree severity. The tree location of damage can be seen in fig. 1. while the description of the damage to the tree is presented in table 1.

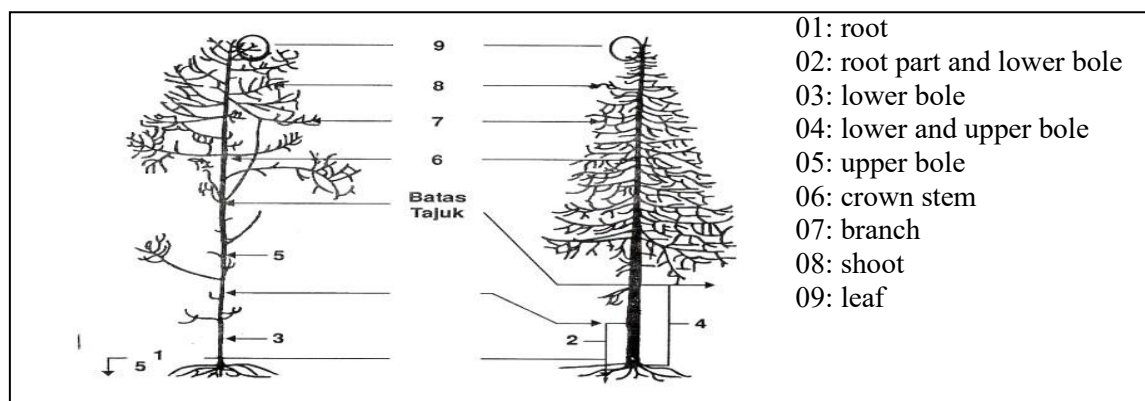


Figure 1. The location of damage according to EMAP.

Observation of damage type (table 1) was carried out on all the tree parts from root to canopy. Each damage is recorded at maximum code 03. If there is damage in the same place, then only the most severe damage is written. After collecting data for the damage type, damage location, and the severity threshold value, the data then recorded into a tally sheet for further analysis.

Table 1. The codification of damage, according to EMAP.

Type of damage	The level of severity (10% - 99%)	Code
Gall/cancer	20%	1
Konk/ decay further	Nil*	2
Open wound	20%	3
Gummosis and resinosis	20%	4
Broken of branches less than 0.91 cm	Nil*	11
Brum in bole and root	Nil*	12
Root broken and dieback less than 0.91 cm	20%	13
Dieback on crown	1%	21
Branch broken and died	20%	22
Brum in crown	20%	23
Damage of leaf	20%	24
Leaf discolorization	30%	25

All measurement parameters are then collected in a damage index (IK): $IK = [x \text{ location of damage} * y \text{ type of damage} * z \text{ severity}]$. Values x, y, and z are weight values that vary depending on the level

of the relative impact of each component on tree growth and resilience. Tree damage is recorded as much as the amount of tree damage that occurs and starts from the lowest code location.

Damage that does not meet the threshold value will be given a value of "0" in its severity. If there are multiple damages simultaneously, all damage is recorded so that its severity can be accurately estimated. The damage index is then calculated on the tree damage index (TDLI) with equation (1).

$$LDI = \sum n_i = 1 (x_i, y_i, z_i) \quad (1)$$

Note: LDI: damage value, x_i : damage type value, y_i : damage location value, z_i : damage severity value. If the LDI value is higher, it indicates that the level of tree damage worsens. LDI class scores will be made to determine the health condition of each tree.

Furthermore, it can be seen the tree damage class based on the index value score with the following criteria:

Healthy class	: 0 – < 5; Lower
damage class	: 6 – 10; Moderate
damage class	: 11 – 15; Heavy
damage class	: 16 – > 21

3. Results and discussion

The tree damage in this study was determined based on the type of damage, location of damage, and severity level. Damage can be caused by abiotic and biotic factors, such as pests, diseases, air pollution, human activities, and other activities. Damage caused by these factors can affect tree health and productivity. Damage may cause a tree's death and affect the long-term survival of a tree [4].

3.1. Damage type

All types of damage will impact decreasing plant growth rates, biomass loss, low canopy conditions, and the worst is mortality [5]. Tree health assessment is an observation process based on symptoms and signs that are naturally caused by any cause related to forest health [6]. Observation results indicate that saga tree damage is commonly found on tree branches and canopies (figure 2). There are 6 (six) types of damage: damage to broken or dead branches (figure 2a) of 148 trees (39%), loss of dominant tip (figure 2b) of 89 trees (23%), leaves change color (figure 2c) 49 trees (13%), open wounds (figure 2d) 38 trees (10%) and cancer (figure 2e) 33 trees (9%). The least damage was found to rot the liver (figure 2f) as many as 24 trees (6%).

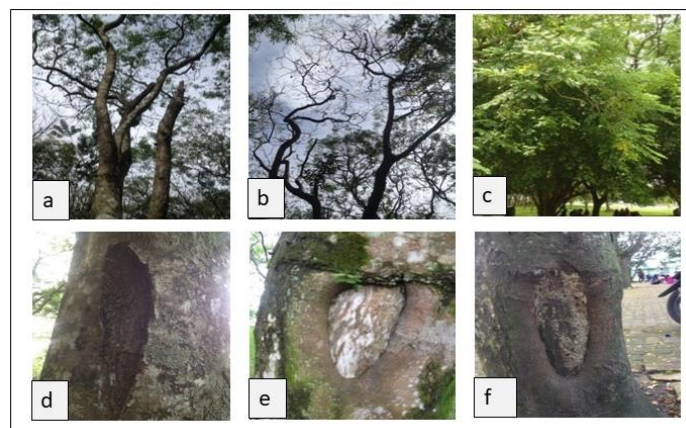


Figure 2. Damage type on saga trees. Broken branch (a), loss of dominant tip (b), Leaves change color (c), open wounds (d), cancer (e), konk (f).

Broken or dead branches are a type of damage often found in saga trees at the USU campus. A total of 148 trees (39%) suffered from this damage. The high percentage of broken or dead branches is probably caused by parasitic and non-parasitic diseases or pests that attack plants [7]. Symptoms appeared as dead branches and fallen leaves. The branch rot caused the broken branch that was found. Damage to the branches, twigs, and leaves will cause unhealthy the canopy that may alter the photosynthesis. Photosynthetic disturbances can result in suboptimal tree growth and reduced wood quality [7].

3.2. Damage location

Based on observations, the saga tree's damage was commonly found in branches, crowns, and trunks (figure 3). The air pollution, human activity, biological factors, and trees' age cause the damages. The highest location was found in the branch, 173 trees (64%), followed by the tree canopy, 165 trees (43%), and the least damage was found in the trunk, 42 trees (11%).

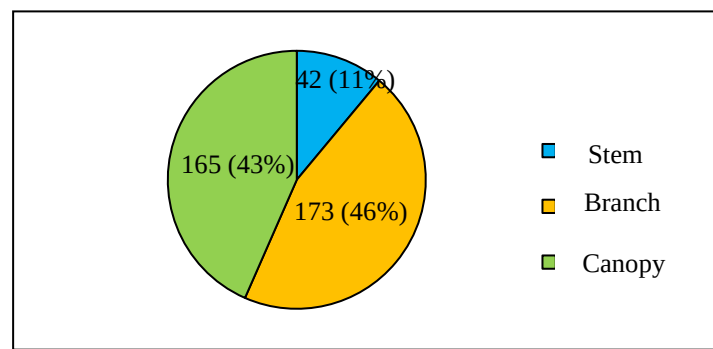


Figure 3. Tree damage is based on its location.

3.3. Crown productivity

The canopy size may describe the general health of trees. The width and dense canopy illustrate the standard rapid growth rate. Small and sparse headings may indicate that sites with less support for tree growth such as competition with other trees, less or excessive humidity, or other influences such as defoliation due to insects, foliar diseases, or wind storms. Tree canopy information can explain several forest ecosystems components such as biodiversity, productivity, forest sustainability, aesthetics, and wild habitat [8].

Based on the scoring of tree canopy conditions, it is known that 48 trees (32%) were in very healthy condition, 103 trees (67%) were in healthy condition, and two trees (1%) were in unhealthy condition. All types of damage will impact decreased growth rates, biomass loss, low canopy conditions, and tree mortality [5].

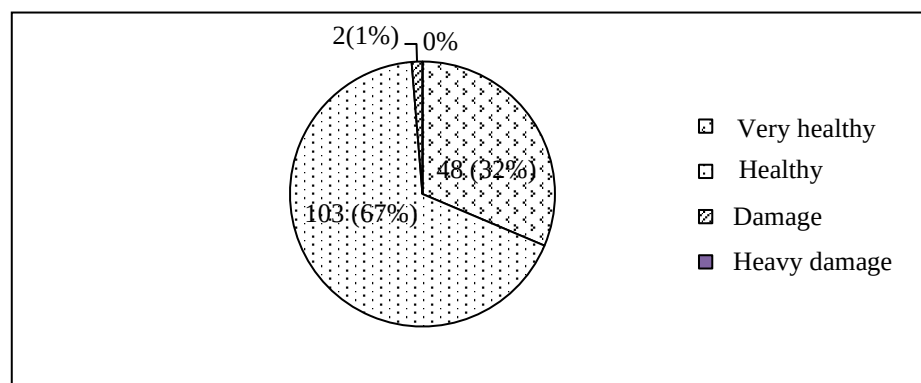


Figure 4. The health status of the saga canopy indicator at the USU campus.

3.4. Tree health level

The level of tree health can be determined by combining the values of indicators of productivity, tree damage, and canopy conditions [9]. The score is given in the range 1-10. The results showed that four saga trees are categorized as very healthy (61%), 35 trees (22.88%) were in healthy condition, 88 trees (57.52%) were less healthy, and 26 trees (16.99%) were unhealthy (figure 5).

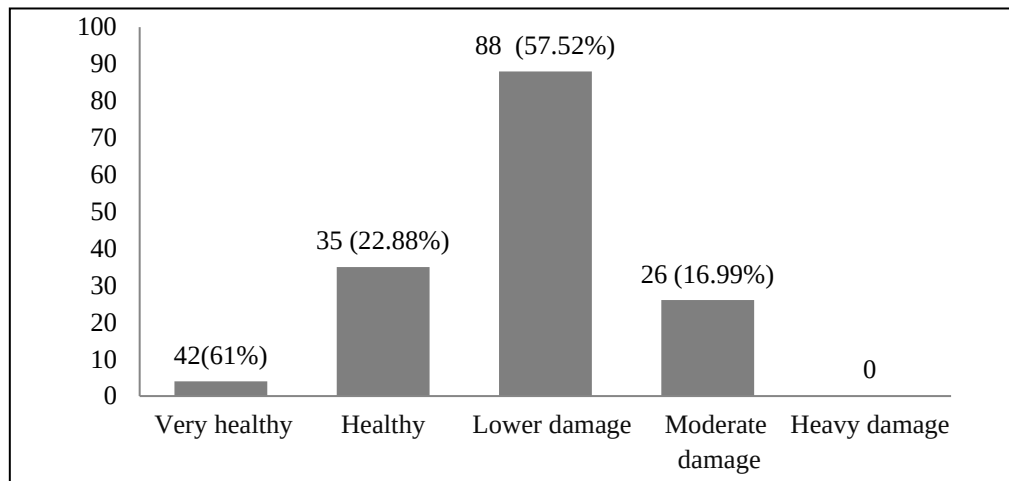


Figure 5. Health status of saga trees (*Adenanthera pavonina* L) on the USU campus.

Based on these results, maintenance activities are urgently needed to prevent further damage. One of the maintenance activities that can be done is pruning. Trimming damaged and dead branches are required to maintain safety and comfort. Besides, the pruning of branches is needed to increase the photosynthesis process [8]. Pruning activities will allow light interception and promote branches and shoot growth. Light interception has an essential role in photosynthesis and assimilation product and partition assimilation towards the sink [10].

In addition to pruning, other maintenance activities that can be carried out were care, felling, wound care, cavity care, buffering, controlling pests and diseases, controlling damage from disturbing plants, and replanting. Maintenance is an indispensable activity for maintaining and caring for trees in a green open space to be well-groomed and healthy.

4. Conclusions

The saga trees on the USU campus are mostly categorized as moderate damage (57.52%) according to the level damage index (LDI). The highest damage location is in the branch at 39% (148 trees). The most common damage to saga trees is 64% (173 trees), and branch canopy damage is 43% (165 trees). Maintenance activities such as pruning need to be done to support tree growth and avoid further damage. Environmental education to the community surrounding campus is also required to prevent vandalism that will cause damage.

References

- [1] Susilowati A, Ahmad A G, Silalahi V and Rachmat H H 2018 *IOP Conf. Series: Earth and Environmental Science* **203** 012028
- [2] Kusmana, Tambunan S 2010 *Brief Information on Adenanthera pavonina L Seeds* (Bogor: BPTH)
- [3] Yuniarti N 2002 *Saga Tree (Adenanthera microsperma T&B.) Atlas of Seeds Indonesian Forest Plants III* (Bogor: BPTH)
- [4] Supriyanto, Kenneth S, Soekotjo and Ngaloken G 2001 *Forest health monitoring plot establishment In Forest Health Monitoring to Monitor the Sustainability of Indonesia Tropical Rain Forest, Volume I* (Bogor: SEAMEO BIOTROP)

- [5] Nuhamara S T and Kasno 2001 *Present status of crown indicator In Forest Health Monitoring to Monitor the Sustainability of Indonesia Tropical Rain Forest, Volume I* (Bogor: SEAMEO BIOTROP)
- [6] Ebbels D L 2003 *Principles of Plant Health and Quarantine* (Wallingford UK: CABI)
- [7] Pracaya 2003 *Mengendalikan Hama dan Penyakit Tanaman [Plant Pests and Diseases Control]* (Jakarta: Penebar Swadaya)
- [8] USDA Forest Service 1999 *Forest Health Monitoring Field Methods Guide* (Washington: USDA Forest Service)
- [9] Enda J and Novizan 2002 *Controlling Plant Pests and Diseases* (Jakarta: Agro Media Library)
- [10] Hariyadi, Purwoko BS and Raden I 2011 *J Agron Indonesia* **39** 3 pp 205-9

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