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Diversity and Abundance of Plants In Dry Climate in Mexican Park, Bogor Botanical Gardens

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Abstract

Dry climate plants are plants that can adapt in a dry environment. The Mexican Park located in the Bogor Botanical Garden has a very varied species of dry climate plants. The study aims to find out the diversity and abundance of dry-climate plants in the Mexican Park, as well as the factors that influence the dry climatic plants that can grow in the Bogor Botanical Garden. The research was carried out by direct exploration method by creating three spaces of 5m x 5m, 10mx 5m and 10m x 10m. Data analysis techniques in this study use quantitative analysis. The results of the research showed that the diversity and abundance of dry climate plants in the Mexican Park of the Bogor Botanical Garden found 15 species with a total of as many as 120 individuals. The Important Value Index (INP) of dry climate plants at all observation spots obtained a value of 2.8667%, with the highest INP being the Rhoeo discolor, so the diversity and abundance of dry-climatic plants in the Mexican Park of the Bogor Botanical Gardens can be categorized as moderate. Dry climate plants can grow in the Bogor Botanical Garden because this Mexican Park makes it very similar to its original habitat, so the nutrition and climate elements are what influence the growth factor of the plant dry climate in the Mexican Garden of Bogor.

Introduction

In our lives, the climate has a huge influence in determining the survival of biodiversity. Therefore, plants and plant growth depend on the climate to be cultivated in a particular area. The productivity of a plant will increase or decrease depending on its climate conditions. There is an influence of this climate, when going to cultivate a plant, have to know what plants can grow and grow in the climate conditions in that region (Heksaputra et al., 2013).

The component or element of climate conditions consists of temperature, wind, humidity, evaporation, rainfall, and the intensity of sunlight. All these elements have a huge influence on a plant and the growth of a plant (Santoso, 2016). The dry climate plants are very interesting to study because they have very unique characteristics and structures, one of which is the structure of the leaves (Surakusumah, 2014).

In conditions of dry climate plants, they need strategies to save water and protect themselves from intense sunlight, which was later called adaptation (Schader, 2021). Plants adapt to a dry climate to get water, store water, and prevent water loss. For example, the Yucca plant that has long roots for access to water sources and the cactus plant that opens their stomata at night to reduce water loss through sweating (Dowd, 2019).

Indonesia belongs to a country that has a tropical climate with two seasons, namely the rainy season and the rain season (Agung et al., 2019). Climatologically, the region of Bogor belongs to a wet tropical climate and a very humid tropical climates. Based on the high rainfall intensity as recorded by the central statistical body of the Province of West Java rainfall in December 2020 in the city of Bogor 261,1 mm/day (BPS Jabar, 2020). Despite its tropical climate, dry climate plants are able to grow in the Mexican Park, the Bogor Botanical Garden, such as agave, yucca, cactus, and other succulent plants.

Bogor Botanical Garden has a unique attraction, as it presents different plants in each of its hosts and one of them is the Mexican Park. The Mexican park is made to resemble its original habitat with dry and deserted conditions and makes it an exotic park. The park contains a collection of dry-climate plant species that number more than 100 species. All of these plants are arranged on land given shrubs, white corals, cream, old red, and black. This plant is native to various countries, such as Central America and the United States including Mexico (Advontura, 2021).

Bogor Botanical Gardens are often the site of biodiversity research, one of which is the study of the diversity of epiphytes in Gymnospermae by Aditya et al. (2014). According to the results of the survey, there is no study of dry climate plants, especially in the Bogor Garden. From there, this research will focus on the species of dry plants that are in the Bogor Garden.

The study aims to calculate the value of the diversity and abundance of dry climate plants in the area of the Mexican Park of the Bogor Botanical Gardens. The research is also aimed at identifying the factors that have a major influence on the growth of dry climate plants that can grow in the city of Bogor that has high precipitation, soil pH, light intensity, humidity, as well as different temperature temperatures from dry climates in general.

Methods

Orientation of Field

Field orientation is carried out as the initial stage to establish the example range position. The observation location carried out in the Mexican Park of Bogor BotanicalGardens uses the exploration research method by conducting direct observation of dry climate plants by way of exploration, where this method is intended to record the species of dry climatic plants and use the sample range method to collect the abundance of species data.

Receiving Data

Examples taken in this observation are placed on the part of the Mexican Park area of the Bogor Botanical Gardens which is thought to represent plant habitats of dry climate. The sizes of the sample spacecraft used vary, the samples are 5 m x 5 m, 10 m × 5 m and 10 x 10 m. the three sample plots are used to represent the area of the Mexican Park in Bogor Botanical Gardens. There are three types of examples and they are described as follows:

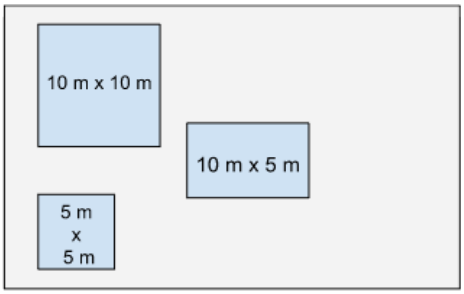

Figure 1. Sketch Sampling Research

Parameters of Research

The observed parameters include the number of species, the number Of individuals, and the degree of plant diversity. Supporting parameters observed include research, light intensity, air temperature, humidity, and soil pH.

Processing of Data

Important Value Index Data collected and then calculated (INP). According to the Hidayat (2018) the INP amounts are calculated by the formula:

1. Revenue (K) = Number of individuals
2. Relative Density (RP) = The density of a species x 100% of the density of all species
3. Frequency (F) = Number of spots found by a type
4. Relative frequency (FR) = Frequency of a type x 100% of the frequencies of the whole type
5. Dominance (D) = Number of base field widths of a type of width

6. Relative Dominance (DR) = Dominance of a species x 100% dominance of the whole species
7. Important Value Index (INP) = RP + FR + DR

Diversity and Abundance.

1. Percentage of Species Abundance (PRi) (Effendi, 2019)

$$PRi = \frac{ni}{N} \times 100\% \quad (1)$$

PRi = relative abundance of type I
n = number of individual types
N = total number of species

2. Diversity Index with Shannon and Wiener formulas (Krebs, 1989, Patty & Rifai, 2013)

$$H' = -\Sigma \{\frac{\frac{ni}{n}}{ln} \times \frac{ni}{n}\} \quad (2)$$

The results obtained can then be categorized into 3 categories, namely:
A. If H' < 1, then the diversity index is categorized as low.
B. If 1 < H' < 3, then the diversity index is categorized as medium.
C. If the result is H' > 3, then the diversity index is categorized high.

3. Indices of evenness or uniformity (E) (Effendi, 2019)

$$E = \frac{H'}{Ln\ S} \quad (3)$$

E = Indices of evenness or uniformity
H' =The Shannon-Wiener Index
S = Number of types

Results and Discussion

The results of the research showed that the area of the Mexican Park of Bogor Botanical Gardens has a wide range of dry-climate plant species from the lower level to the seed level. Lower-level plants are found in this area more than semai level plants. Data acquisition of species that are in the Mexican Park of Bogor Botanical Garden can be seen in Table 1.

Table 1. Number of species of observation plot

No.	Local Name	Scientific Name	ni	Σ in every plot		
				Plot 1	Plot 2	Plot 3
1	Kaktus Apel Peru	*Cereus repandus (L.) Mill*	3	3	-	-
2	Kaktus Tiang Pagar Meksiko	*Lophocereus marginatus (D.C) S. Arias & Terrazas*	1	1	-	-
3	Kaktus Pir Berduri Brazil	*Brasiliopuntua brasiliensis (Wild)*	1	1	-	-
4	Kaktus Pir Berduri	*Opuntia ficus indica L mill*	4	4	-	-
5	*Mauritius Hemp*	*Furcraea foetida*	6	6	-	-
6	Yucca Daun Kurva	*Yucca Glorisa ver tristis*	7	7	-	-
7	Adam Hawa	*Rhoeo discolor*	29	19	7	3
8.	Pohon Naga	*Dracaena draco (L.) L.*	2	-	-	2
9.	Agave Potatorum	*Agave potatorum zucc.*	3	-	-	3
10.	Agave	*Agave vivipara L. marginata Trel.*	49	-	-	49
11.	Si Pedang Berduri	*Agave vivipara var. Vivipara*	2	-	-	2
12.	Agave	*Agave sp.*	5	-	-	5
13.	Agave	*Agave fourcroydes*	4	-	4	-
14.	Kaktus Mawar	*Pereskia grandifolia* Haw. (Cactaceae)	2	-	2	-
15.	Kaktus Karang	*Euphorbia lactea*	2	-	2	-

Based on Table 1, there are 15 species with a total of 120 individuals consisting of cacti, yucca and agave. Each plant has a different morphology, but the three types of plants have similarities. The three types of plants are included in dry climate plants. Where dry climate plants are the symbol of the Bogor Botanical Gardens, the Mexican Garden. Plants in dry climates can grow fertile and well if the environmental conditions are bright and get enough sunlight.

A parameter that shows the role of the species in its community is called the Important Value Index or INP of plant species on the community. According to Permadi et al (2016) the high tolerance and habitat conditions of an environment to the appearance of species of plants in a particular area indicate that the plant is able to adapt to its environment. The higher the value of the species of a plant, the higher the level of control over the community, and vice versa. Species that successfully occupy almost all of the resources available to other species indicate that the plant species is the dominant within a community.

According to Hidayat (2018) basically species with high INP values can develop and grow in areas with high soil temperature and acidity. This is in accordance with the conditions of the area of the Mexican Park of the Bogor Botanical Gardens which has soil humidity that tends to be dry and has a fairly high acidity value, pH ranging between 6-7 (Table 3).

The species of plants that have a higher INP than other plants is understood to be that the growing species is quite dominant on some ranges, thus causing the value of the species' dominance to be high. Species of plants that have a high INP generally spread across the observatory. As for the plant species with the highest index of other species, *Rhoeo discolor* was 0.6366%, while the lowest Important Value Index was *Euphorbia lactea* with a value of 0.0720%.

According to Table 2, the plant species *Yucca glorisa ver tristis* occupies the highest abundance value of other plants with a percentage of 0.058%, while the species with the lowest percentages of abundance are occupied by two distinct species: *Lophocereus marginatus (D.C) S. Arias & Terrazas* and *Brasiliopuntua brasiliensis (Wild)* with a value of 0.008%.

The following observed parameter is the type diversity index (H') to compare various plant communities, where the higher the H' value, the better the conditions of the community. The high level of the index of diversity of a plant community can depend on the number of species and the individual number of each species or seen from its species wealth. The result of the calculation, the index of plant diversity of the dry climate of the Mexican Park of Bogor Gardens is 2,406 (Table 2).

The results of the analysis showed that dry-climate plants at the site of observation had a moderate categorized diversity (H' = 2,406) despite individual hardness values between high species (E = 1,634) and low type dominance values (C = 0,2375) (Tabel 2). This suggests that dry climate plants really dominate significantly and the proportion of abundance between species is not much different. The high redness index value (E = 1,634) also refers to the fact that the habitat conditions in the Mexican Park area are stable and have no disturbances in the ecosystem

Table 2. Indices Of Diversity and Abundance of Dry Climate Plants in The Mexican Garden, Bogor Botanical Gardens

No.	Scientific Name	PRi	E	C	INP	H'
1.	*Cereus repandus (L.) Mill*	0,0250	0,0839	0,0006	12,3818	0,0922
2.	*Lophocereus marginatus (D.C) S. Arias & Terrazas*	0,0083	0,0000	0,0001	0,0783	0,0399
3.	*Brasiliopuntua brasiliensis (Wild)*	0,0083	0,0000	0,0001	0,1176	0,0399
4.	*Opuntia ficus indica L mill*	0,0333	0,1080	0,0011	0,0803	0,1134
5.	*Furcraea foetida*	0,0500	0,0836	0,0025	0,1728	0,1498
6.	*Yucca Glorisa ver tristis*	0,0583	0,0852	0,0034	0,2076	0,1658
7.	*Rhoeo discolor*	0,2417	0,1019	0,0584	0,6366	0,3432
8.	*Dracaena draco (L.) L.*	0,0167	0,0984	0,0003	0,2225	0,0682
9.	*Agave potatorum zucc.*	0,0250	0,5254	0,0006	0,1850	0,5772

No.	Scientific Name	PRi	E	C	INP	H'
10.	*Agave vivipara L. marginata Trel.*	0,4083	0,0940	0,1667	0,3257	0,3657
11.	*Agave vivipara var. Vivipara*	0,0167	0,0984	0,0003	0,0852	0,0682
12.	*Agave sp.*	0,0417	0,0823	0,0017	0,2821	0,1324
13.	*Agave fourcroydes*	0,0333	0,0818	0,0011	0,1908	0,1134
14.	*Pereskia grandifolia* Haw. (Cactaceae)	0,0167	0,0984	0,0003	0,0720	0,0682
15.	*Euphorbia lactea*	0,0167	0,0984	0,0003	0,0720	0,0682

Table 3. Physical-Chemical Parameters of The Observation Plots

No.	Plot	Size	Physical-Chemical Parameters			
			Temperature (˚C)	Humidity (% RH)	Ph Land	Light Intensity (rtcol)
1	1	5x5	36	49,5	7	1521,6
2	2	10x5	37,7	46,5	6.0	1545,6
3	3	10x10	34,9	52,3	6,5	266,9

The results of the measurement of physical-chemical factors on each observation sample site in the Mexico Park Area of the Bogor Botanical Gardens can be seen in Table 3. Based on the data obtained, it is known that environmental conditions such as air temperature, humidity, soil pH, and light intensity are abiotic factors that affect the growth and development of dry climate plants in the Mexican Park Area of the Bogor Botanical Garden. Measurement of air temperature, humidity, and light intensity using lux meters, while measurement of soil pH using soil meters (Nabila et al., 2021).

Dry climate plants are plants that can store a lot of water reserves, so that when an area is dry, this dry climate plant does not die. Dry plants can grow in the area of the Bogor Gardens because the Mexican Park is made so similar to its original habitat, so these dry climate plants are able to grow and survive. As for the factors affecting the growth of plants in the Mexican Park of Bogor Botanical Gardens is the pH of the soil 6.5-7, air temperature with a susceptibility to 34-37 C, air humidity 46.5-52.3 %RH, and adequate light intensity about 266.9 – 1545,6 rcol (Table 3). With pH, air temperature, humidity, and adequate light intensity, plants can thrive and be satisfied with their nutrients.

Conclusions

Dry climate plants in the Mexican Park of the Bogor Botanical Gardens are found as many as 15 species with a total of 120 individuals. The Important Value Index (INP) of dry climate plants in the Mexican Park of the Bogor Botanical Gardens at all observation sites obtained an INP result of 2.8667%. *Rhoeo discolor* has the highest index value compared to other species, at 0.6366%, while *Euphorbia lactea* has the lowest index with a value of 0.0720%. Then the highest percentage of species abundance (PRi) is *Yucca glorisa ver tristis* with 0,0583, while species with the lowest percent of specia abundance are occupied by two distinct species: *Lophocereus marginatus (D.C) S. Arias & Terrazas* and *Brasiliopuntua brasiliensis (Wild)* with a value of 0.0083. The results showed that dry-climate plants at the observation site had a moderate diversity that can be categorized (H' = 2,406) despite individual hardness values between high species (E = 1,634) and low type dominance values (C = 0,2375). This suggests that dry climate plants really dominate significantly and the proportion of abundance between species is not much different. The high redness index value (E = 1,634) also refers to the fact that the habitat conditions in the Mexican Park area are stable and have no disturbances in the ecosystem. Dry-climate plants can grow in the area of the Mexican Park of the Bogor Botanical Gardens because Mexican Parks are made so very similar to the original plant habitat, so that nutrition, air temperature, soil pH, air humidity, and light intensity can be met. As for this study, one of them can be developed directly compared to the original Mexican Park.

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