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Weeds Vegetation in Rubber Plantations at Different Altitudes in Indragiri Hulu District, Riau Province, Indonesia

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ABSTRACT

The rubber plantations owned by smallholders in Indragiri Hulu Regency are inseparable from management problems, especially the management of weeds. This study identifies and analyzes dominant weed types at two different heights, namely 6 m asl and 28 m asl. In this study, the parameters of the observations and calculations are important value indexes such as density, frequency, dominance, and significant values. Then, there is the diversity index or diversity index and similarity index. The method used in this study is a field survey method with different altitude levels, employing purposive sampling in rubber plantation areas in Sekip Hulu Village, Rengat District, Indragiri Hulu Regency. The results showed that based on the SDR value, the 3 most dominating weeds in rubber plantations at an altitude of 6 m asl were *Asystasia gangetica*, *Eleusine indica* and *Syzygium polyanthum* which each obtained SDR values of 50.05%, 12.11% and 8.01%. , while at an altitude of 28 m asl, it was dominated by *Ottochloa nodosa*, *Clidemia hirta*, and *Melastoma malabathricum*, which respectively obtained SDR values of 56.34%, 15.39%, and 9.97%. Based on the value of diversity or diversity value, it shows that, as the altitude increases, the number of weed species found decreases from a height of 6 masl to 28 m asl. The importance of this weed vegetation study lies in selecting the most appropriate control method, whether mechanical, chemical, or biological, in Rubber plantations.

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INTRODUCTION

Rubber tree (*Hevea brasiliensis*) is a high-value plantation crop. The latex produced by this Brazilian-origin plant can be processed into rubber sheets, blocks, or crumb rubber, which serve as raw materials for downstream industries (Suwarto & Octavianty, 2012).

Approximately 88.93% of Indonesia's total rubber plantation area consists of smallholder plantations. This indicates that smallholder plantations play a significant role in determining Indonesia's total rubber production. Indragiri Hulu Regency is one of the largest natural rubber-producing regions in Riau Province, ranking fourth. In 2019, the total area of smallholder rubber plantations in Indragiri Hulu reached 35,716 ha, with a total production of 49,769 tons, while productivity stood at 1.53 tons/ha (Directorate General of Plantations, 2019).

Smallholder rubber plantations in Indragiri Hulu Regency face various management challenges, particularly regarding weed control. One of the consequences of weed-related issues is reduced yield and productivity, which is suspected to be caused by competition between weeds and rubber trees for resources. According to Palijama et al. (2012), weeds are a type of plant pest organism (OPT) that can hinder the growth, development, and productivity of cultivated plants. Weed vegetation has high adaptability and competitiveness, with community composition varying across locations, even within the same type of crop (Arfianto, 2016).

According to Imaniasita *et al*. (2020), weed dominance and population in an area are influenced by various environmental factors such as nutrients, light, soil cultivation, planting distance, and plant age. Hidayah (2011) also stated that altitude affects environmental factors such as humidity, temperature, rainfall, and light intensity, ultimately impacting weed diversity and dominance.

Identifying and recognizing dominant weed species is a crucial step in determining effective weed control strategies. One commonly used method is weed vegetation analysis, which aims to study weed species composition and vegetation structure or weed groupings within a given area (Paiman, 2020).

Previous research on weed species at different altitudes was conducted at 4 meters above sea level (m asl) and 104 m asl, as reported in the journal titled "Inventory of Weed Species in Rubber (*Hevea brasiliensis*) Plantations at Different Altitudes in Negeri Liang, Teluk Elpaputih District, Central Maluku Regency" (Ramlan *et al*., 2019). The study concluded that as the altitude of rubber plantations increases, more weed species are found.

However, to date, no research has been conducted on rubber plantations at 6 masl and 28 masl in Indragiri Hulu Regency. Therefore, this study aims to identify the weed species present in these two locations and analyze their dominance, frequency, density, diversity index, and similarity index. Consequently, this study addresses the existing research gap and provides more specific data on the influence of altitude on weed presence in smallholder rubber plantations in the region.

MATERIALS AND METHODS

This study was conducted in smallholder rubber plantations in Sekip Hulu Village, Rengat District (coordinates: 0°22'41"S - 102°32'25"E), and Kota Lama Village, West Rengat District (coordinates: 0°22'37"S - 102°23'14"E), Indragiri Hulu Regency, Riau Province, from October to November 2020. Data analysis was carried out in the Agronomy Laboratory of the Faculty of Agriculture and Animal Science, UIN Sultan Syarif Kasim Riau.

The materials used in this study included burlap sacks, labels, raffia strings, newspapers, and weed samples. The equipment used included a measuring tape, scissors, stakes, rulers, gloves, scales, writing materials, GPS (*Global Positioning System*) for locating coordinates, the Plantsnap and Gbif applications, identification guidebooks, an altimeter application (to measure altitude), a camera, and a 3-in-1 soil tester (to measure pH, soil temperature, and soil moisture).

This study employed a field survey method using purposive sampling, where sample locations were selected to represent the diversity of weeds present in the rubber plantation. The research was conducted in rubber plantations located in Sekip Hulu Village (6 meters above sea level) and Rengat Barat District (28 meters above sea level). Samples were collected from a main block measuring 30 m × 50 m at each site, with 24 plots of 1 m × 1 m per location, resulting in a total of 48 plots. Each plot was examined for weed identification, recording, and labeling. The recorded weeds were then separated by species, dried in an oven at 70–80°C for 24 hours, and weighed to determine their dry weight. The observed abiotic factors included soil pH, altitude, soil moisture, soil temperature, air temperature, average air humidity, and average rainfall.

Observation Parameters

Absolute Density = Σ individuals of a specific weed species per sample plot Relative Density = (Absolute density of a species / Σ total density of all species) x 100% Absolute Frequency = Σ plots where a species is found / Σ total observation plots Relative Frequency = (Absolute frequency of a species / Σ absolute frequency of all species) x 100% Absolute Dominance = Dry weight / sample plot area Relative Dominance = (Absolute dominance of a species / Σ absolute dominance of all species) x 100%.

The second parameter is the Shannon-Wiener diversity index, often referred to as the diversity index. The criteria for this parameter are as follows: if the diversity index (H') is < 1, it is considered low; if 1 < H' < 3, it is moderate; and if H' > 3, it is classified as high. The diversity index is calculated using the following formula:

$$H' = -\Sigma (pi)(\ln.pi)$$

Where: H' = Diversity Index pi = Ratio of a species' importance value to the total importance value of all species (ni/N)

The third parameter is the Summed Dominance Ratio (SDR), which indicates the dominance level of weed species in a community. The formula for SDR is as follows:

$$SDR = \text{Importance value} / 3$$

The fourth parameter is the Sorenson similarity index, which expresses the similarity in species composition between two compared communities. A higher similarity index indicates a more homogeneous species composition between the two communities, and vice versa. The formula is:

$$S = [(2xJ) / (A+B)] \times 100\%$$

Where: S = Similarity Index A = Total species in location A B = Total species in location B J = Shared species between the two locations

According to Krebs (1978) in Afrianti *et al.* (2015), the similarity index criteria are as follows: >75% indicates very high similarity, 50%-75% indicates high similarity, 20%-50% indicates low similarity, and <25% indicates very low similarity.

RESULTS AND DISCUSSION

Research Location

The study was conducted in two locations. The first location, Block 1, is situated at an altitude of 6 meters above sea level (masl) in Sekip Hulu Village, Rengat District. The total area of the rubber plantation in Block 1 is 0.4 hectares. The rubber trees in this area are approximately 13 years old. According to interviews, the clones used in this block are not the superior clones recommended by the government. The research site also contains three longitudinal ditches. Weed control was conducted through mechanical methods (using a grass-cutting machine) and chemical methods (herbicide application).

The second research location, Block 2, is at an altitude of 28 masl in Kota Lama Village, West Rengat District. The total area of the rubber plantation in Block 2 is 1 hectare. The rubber trees in this block are approximately 15 years old. Based on interviews, the clones used in this block are superior clones. Weed control was conducted mechanically (using a grass-cutting machine) twice a year.

Weed Identification

The identification of weed species in both observation blocks revealed differences, as shown in Table 1. The weeds in the rubber plantation in Block 1 consist of three types of grass weeds, two types of fern weeds, and seven types of other weeds. The recorded weeds consist of 11 families, 12 species, with a total of 1,719 individuals. The three weed species with the highest number of individuals are *Asystasia gangetica* (creeping foxglove), *Eleusine indica* (Indian goosegrass), and *Spermacoce alata* (winged false buttonweed).

Slightly different from Block 1, Block 2 consists of two types of grass weeds, one type of sedge weed, two types of fern weeds, and four types of broadleaf weeds. A total of 7 families, 9 species, and 1,589 individuals were recorded in Block 2. Based on this data, the three weed species with the highest number of individuals in Block 2 are *Ottochloa nodosa, Scleria lithosperma*, and *Clidemia hirta. Weed identification data can be seen in Table 1.*

Table 1. Identification of Weed Types in Block 1 and Block 2

No	Name	Species	∑individuals Block 1	∑individuals Block 2
Grassy Weeds				
1	Sarang buaya	*Ottochloa nodosa* (Kunth) Dandy	246	1253
2	Belulang	*Eleusine indica* (L.) Gaertn.	55	29
3	Ilalang	*Imperata cylindrica* (L.) P. Beauv.	38	-
Broadleaf weeds				
4	Ara sungsang / rumput israel	*Asystasia gangetica* (L.) T. Anderson	1155	46
5	Senduduk bulu	*Clidemia hirta* (L.)	-	88
6	Rumput setawar	*Spermacoce alata* Aubl	73	-
7	Tanaman salam	*Syzygium polyanthum* (Wight) Walp.	52	-
8	Senduduk	*Melastoma malabatricum* L.	4	30
9	Sembung rambat	*Mikania micrantha* Kunth	15	-
10	Pacing tawar	*Hellenia speciosa* (J.Koenig) S.R.Dutta	7	-
11	Meniran	*Phyllanthus urinaria* L.	2	-
12	Kacang ruji	*Pueraria phaseoloides* (Roxb.) Benth	-	1
Fern weeds				
13	Paku sayur	*Diplazium esculentum* (Retz.) Sw.	52	-
14	Suplir	*Adiantum cunninghamii* Hook.	20	-
15	Pakis pita	*Pteris cretica* L.	-	4
16	Paku ribu - ribu garege halus	*Lygodium microphyllum* (Cav.) R. Br.	-	1
Sedge weeds				
17	*Florida Keys nut-rush*	*Scleria lithosperma* (L.) Sw		137
		Total	**1.719**	**1.589**

Table 1 conclude that broadleaf weeds are more commonly found in blocks one and two compared to grasses, sedges, or ferns. The diversity of certain weed groups can be influenced by environmental factors (Perdana *et al*., 2013). In this case, the high number of broadleaf weed species in both blocks is due to light availability. Light is closely related to the photosynthesis rate, which affects the vegetative and generative growth of plants (Subrata & Setiawan, 2018).

The light intensity in the rubber plantation in both blocks is influenced by the age and planting distance of the rubber trees. In Block 1 and Block 2, the age of the rubber trees is approximately ±13 years and ±15 years, respectively. In Block 1, the canopy is already open, allowing sufficient light for broadleaf weeds to dominate. Additionally, the availability of water from the drainage channels on the land supports the development and dominance of broadleaf weeds. In Block 2, the rubber trees are around ±15 years old, and the canopy is beginning to shed leaves, allowing more sunlight to reach certain areas while others remain shaded. This condition explains why broadleaf weeds are the most frequently found weed group, although they do not hold the highest population dominance.

Weed Dominance

Weed dominance refers to the ability of a weed species to compete with other weed species and dominate a specific agroecosystem. The presence of weed dominance can be observed from the differences in the population of a species within a certain area. This dominance is expressed through various indicators, such as coverage, basal area, biomass, and volume. To identify the dominant weed species in an area, the Importance Value Index (SDR) can be used. The SDR value is obtained from the relative density, relative dominance, and relative frequency and importance value (Tjitrosoedirdjo *et al*., 1984 in Rosmanah *et al.,* 2017). The weed composition structure data in Block 1 at an elevation of 6 m asl can be seen in Table 2.

Table 2. Weed Composition Structure in Block 1 at an Elevation of 6 m

No	***Species***	**6 m asl (block 1)**				
		DR%	**FR %**	**KR%**	**INP**	**SDR %**
1	*Asystasia gangetica* *	61,89	21,05	67,19	150,14	50,05
2	*Eleusine indica* **	0,97	21,05	14,31	36,33	12,11
3	*Syzygium polyanthum**	5,22	15,79	3,03	24,04	8,01
4	*Diplazium esculentum* ***	8,20	9,47	3,03	20,70	6,90
5	*Ottochloa nodosa* **	3,77	7,37	3,20	14,34	4,78
6	*Spermacoce alata* *	5,48	2,11	4,25	11,83	3,94
7	*Imperata cylindrica* **	5,38	3,16	2,21	10,74	3,58
8	*Mikania micrantha* *	0,86	8,42	0,87	10,15	3,38
9	*Melastoma malabatricum* *	4,94	3,16	0,23	8,33	2,78
10	*Adiantum cunninghamii* ***	1,74	4,21	1,16	7,12	2,37
11	*Hellenia speciosa* *	1,33	2,11	0,41	3,84	1,28
12	*Phyllanthus urinaria* *	0,21	2,11	0,12	2,43	0,81
	Total	100	100	100	300	100

Note: DR = Relative Dominance, FR = Relative Frequency, KR = Relative Density, INP = Importance Value Index, SDR = Summed Dominance Ratio. (*Broadleaf weeds, **Grassy weeds, ***Fern weeds, ****Sedge weeds).

Asystasia gangetica is the most dominant weed in Block 1, with an SDR value of 50.05% (Table 2). This high SDR value is accompanied by the highest values in relative dominance, relative frequency, relative density, and importance value index, which are 61.89%, 21.05%, 67.19%, and 150.14%, respectively. The second and third most dominant weeds in the rubber plantation at an altitude of 6 meters above sea level (masl) are *Eleusine indica (L.)* and *Syzygium polyanthum*, with SDR values of 12.11% and 8.01%, respectively. The weed composition structure data in Block 2 at an elevation of 28 m asl can be seen in Table 3.

Table 3. Weed Composition Structure in Block 2 at an Elevation of 28 m

No	*Species*	28 m asl				
		DR%	FR %	KR%	INP	SDR %
1	*Ottochloa nodosa ** *	58,17	32,00	78,85	169,02	56,34
2	*Clidemia hirta * *	17,95	22,67	5,54	46,16	15,39
3	*Melastoma malabatricum**	12,03	16,00	1,89	29,92	9,97
4	*Scleria lithosperma **** *	5,76	12,00	8,62	26,38	8,79
5	*Eleusine indica ** *	4,10	5,13	1,83	11,26	3,75
6	*Asystasia gangetica * *	0,66	5,33	2,89	8,88	2,96
7	*Pteris cretica *** *	0,81	4,00	0,25	5,06	1,69
8	*Pueraria phaseoloides * *	0,51	1,33	0,06	1,90	0,63
9	*Lygodium microphyllum****	0,02	1,33	0,06	1,42	0,47
	JUMLAH	100	100	100	300	100

Note: DR = Relative Dominance, FR = Relative Frequency, KR = Relative Density, INP = Importance Value Index, SDR = Summed Dominance Ratio. (*Broadleaf weeds, **Grassy weeds, ***Fern weeds, ****Sedge weeds).

Table 3, *Ottochloa nodosa* is the most dominant weed in Block 2, with the highest SDR value of 56.34%. This high SDR value is supported by the highest values obtained by *Ottochloa nodosa* in relative dominance, relative frequency, relative density, and the importance value index, which are 58.17%, 32.00%, 78.85%, and 169.02%, respectively. The second and third most dominant weeds are *Clidemia hirta* and *Melastoma malabathricum*, with SDR values of 15.39% and 9.97%, respectively.

Based on both tables, it can be concluded that in Block 1, *Asystasia gangetica* obtained the highest SDR value, accompanied by high values in relative density, relative dominance, relative frequency, and the importance value index. This occurred because, as observed in the field (Block 1), there is a longitudinal trench between the rows of trees. It is suspected that the location's proximity to water and partial shading from the canopy suits the growth conditions of this weed. *Asystasia gangetica*, a broad-leaved weed classified as a C3 plant, thrives in such conditions. This is supported by Marisa and Salni (2013), who stated that *Asystasia gangetica* is easily found along roadsides, abandoned gardens, and riverbanks. Additionally, this weed is known as an invasive species capable of producing a large number of seeds, estimated at around 27 million seeds per hectare, which can be ejected up to 6 meters, germinate easily, and quickly dominate an area (Priwiratama, 2011; Adetula, 2004, in Asbur *et al*., 2018).

Another possibility is that weed management practices indirectly influence dominance. For instance, using herbicides. The repeated use of the same herbicide (both in active ingredients and mode of action) over a long period in a particular area can lead to the dominance of herbicide-resistant or tolerant weed populations (Putra *et al*., 2021).

In Block 2, *Ottochloa nodosa* achieved the highest SDR value, followed by the highest values in relative density, relative frequency, relative dominance, and the importance value index. Factors contributing to weed dominance in an area include plant age and environmental factors. In this case, the age of the rubber trees significantly affects the canopy, which in turn influences light intensity. In rubber trees aged approximately 15 years, leaf shedding begins, creating canopy gaps.

According to Buajan *et al*. (2017), light intensity increases as the gap size increases, allowing some areas in the plantation to receive direct sunlight while others remain shaded. *Ottochloa nodosa* is a weed with the ability to reproduce vegetatively and generatively, thriving in areas exposed to direct sunlight. Simangunsong *et al.* (2018) noted that *Ottochloa nodosa* is a C4 plant with good adaptability to dry and hot environments. Their research also showed that higher light intensity stimulates the growth and development of *Ottochloa nodosa*, whereas higher humidity levels inhibit its growthEnvironmental factors, particularly climate, play a crucial role in vegetation differences across regions. Climatic factors influencing plant growth include air temperature, sunlight intensity, humidity, and wind. Altitude affects regional temperature, which ultimately influences plant growth patterns. According to Warnock, Randle, and Lindstrom (1993), regional variations in topography, geography, and weather conditions lead to differences in plant species, cropping patterns, cultivation methods, and socio-economic conditions.

Continuous cropping patterns and favorable climatic conditions can increase the complexity of plant pest disturbances, including pest infestations, diseases, and weed competition. Environmental factors also impact plant physiological processes, with temperature and light being key determinants. Light, as the primary energy source for plants, plays a significant role in various metabolic activities.
Weed composition differs between highland and lowland areas. In higher-altitude regions, weed species diversity tends to be greater, but the number of individual weeds is relatively lower. Conversely, in lowland areas, the number of individual weeds is higher, but species diversity is lower. Additionally, according to Santosa (2008), weed species composition may change randomly over time or as a response to environmental changes due to seasonal variations or modifications in agronomic practices.

Diversity Index

The diversity of a community can be assessed by the number of species composing it. High diversity indicates a large number of species, while low diversity suggests fewer species (Sumekar, 2017). According to Nahlunnisa et al. (2016), several indices are commonly used to measure species diversity, such as the Simpson index, Brillouin index, Shannon-Wiener index, and Brill index. However, the most frequently used is the Shannon-Wiener index (H’). The characteristic of this index is that the higher the H’ value, the greater the species diversity. In this study, the diversity index was calculated using the Shannon-Wiener formula and interpreted based on the diversity index criteria proposed by Odum (1996) in Nurudin *et al.* (2013). The Diversity Index Criteria can be seen in Table 4.

Table 4. Diversity Index Criteria

Diversity Index Categories	
H' < 1	Low Diversity
1< H'<3	Moderate Diversity
H' > 3	High Diversity

Diversity index of the two blocks, located at an altitude of 6 meters above sea level (masl) and 28 masl, obtained values of 1.22317 and 0.83378, respectively (Table 4). Referring to Table 4.5, the diversity index for Block 1 is classified as moderate, while Block 2 falls into the low category. This finding is consistent with the conclusion drawn by Hgairtety et al. (2017). In their study conducted at elevations of 100 masl, 200 masl, and 300 masl, it was concluded that the higher the altitude, the fewer the weed species. This statement aligns with the results obtained in this study.

Table 5. Diversity Index Values

Location	Indeks diversitas Shannor Wiener
Block 1 (elevation 6 m asl)	1,22317
Block 2 (elevation 28 m asl)	0,83378

Similarity Index

The similarity index is an index used to express the degree of similarity in species composition between two compared communities. The higher the similarity value obtained, the more similar the species composition between the two communities (Nurjaman *et al.*, 2017). The following are the similarity values between the two elevation levels, 6 meters above sea level (masl) and 28 masl:

Table 6. Sorensen Similarity Index at Two Elevations

Elevation	A	B	J	S%	Note
6 mdpl and 28 mdpl	12	9	4	38,10	Low

Note: S = similarity index, A = total number of species in location A, B = total number of species in location B, J = number of shared species between the compared locations.

To interpret the similarity index values, several criteria can be used:

Table 7. Sorenson Similarity Index Criteria

Criteria	Value
>75%	Very High
>50% - 75%	High
>20%-50%	Low
< 25%	Very Low

Table 6, it can be observed that the similarity index between the two blocks with different elevation levels is 38.10%. This indicates that the species similarity between the two communities is considered low or tends to be diverse. Since the similarity index

(S) is less than 75%, different weed management strategies are recommended for each block. If the similarity index were greater than 75%, it would imply that the two communities are homogeneous or uniform, leading to the same weed management approach. Conversely, when the compared communities are diverse, different management strategies are recommended.

Environmental Factors The distribution of vegetation, species diversity, density, and similarity index between the two communities can be influenced by environmental factors. The following are the abiotic factor data observed in the two blocks:

Table 8. Abiotic Factors at an Altitude of 6 m asl and 28 m asl

Environmental Factors	Block 1	Block 2
Potensial of Hydrogen Soil	6-7	6,5-7
Altitude	6	28
Soil Moisture	Dry	Dry+
Soil Temperature (°C)	28	28

Source: Primary Data

Table 9. Climate Data of Indragiri Hulu Regency in October

Environmental Factors	Block 1	Block 2
Air Temperature (°C)	24-34,2	23,2-32
Average Air Humudity (%)	86 %	88%
Average Rainfall ini October (mm)	20,637	

Source: BMKG Japura Meteorological Station

Based on the table above, differences in the data can be observed. The slight variation in soil pH parameter results is suspected to be influenced by maintenance activities and weed control methods. According to interviews conducted at both locations, it was found that in Block 1, weed control was carried out using herbicides when necessary and mechanical control every three months. Regarding fertilization, the management admitted to rarely applying fertilizers. In Block 2, weed control was conducted mechanically twice a year, and fertilization was also rarely performed. It can be concluded that minor differences in land management, specifically the use of herbicides, can affect soil acidity or pH levels.

In addition to the differences in soil pH parameters, no significant differences were found in other parameters. This is likely due to the minimal elevation difference and proximity between Block 1 and Block 2, which played a key role in the slight data variation. However, the calculation of the importance value index, diversity index, and species composition similarity yielded different and diverse results. The slight differences in abiotic environmental data in the table above can influence the number of weed individuals, species diversity, and species composition similarity between the two blocks. It can be concluded that there are differences in abiotic factors with increasing elevation, leading to diverse weed species found in the two locations with different elevations, which require different handling methods based on the dominant weed species in each area. This finding is supported by Sari and Rahayu (2013), who stated that weed species diversity can be influenced by internal and external factors. Internal factors include reproductive capacity, competition, and adaptation, while external factors involve climate, soil type, control methods, crop types, and cultivation techniques.

Based on the SDR value, Block 1 at an elevation of 6 meters above sea level (masl) is dominated by broadleaf weeds, while Block 2 at 28 masl is dominated by grass weeds. According to Ramlan *et al*. (2019), the higher the elevation, the more broadleaf weeds can adapt to the growing environment. However, this is not entirely consistent with the SDR values obtained. At 28 masl, broadleaf weeds such as *Clidemia hirta* and *Melastoma malabathricum* only achieved dominance levels of 15.39% and 9.97%, respectively, compared to *Ottochloa nodosa* (a grass weed), which reached a dominance of 56.34%.

The statement by Ramlan *et al.* (2019) is not entirely incorrect. However, in this study, it is suspected that the planting distance and age of the rubber trees influenced the canopy cover. This directly affects the amount of sunlight that penetrates. In Block 2, the planting distance between rubber trees is relatively wider compared to Block 1, leading to differences in sunlight exposure. This is evident as Block 1 is dominated by C3 plants, which typically prefer shaded areas or lower light intensity, while Block 2 is dominated by C4 plants, which thrive in full sunlight exposure.

CONCLUSION

Based on the SDR values, the three most dominant weed species in rubber plantations at an altitude of 6 meters above sea level (masl) were *Asystasia gangetica*, *Eleusine indica*, and *Syzygium polyanthum*, with SDR values of 50.05%, 12.11%, and 8.01%, respectively. Meanwhile, at an altitude of 28 masl, the dominant weed species were *Ottochloa nodosa*, *Clidemia hirta*, and *Melastoma malabathricum*.

The study results indicate that as altitude increases, the number of weed species tends to decrease. Additionally, the similarity index between Block 1 and Block 2 was relatively low, suggesting a significant difference in weed composition between the two locations. This variation in weed dominance implies that weed management strategies should be tailored to the dominant weed characteristics in each location. In Block 1, broadleaf weeds were more dominant, whereas in Block 2, grass weeds were more prevalent. Therefore, weed control methods should be adapted based on the dominant weed species at each altitude.

For future research, it is recommended to further explore effective weed management strategies at different altitudes, considering environmental factors such as soil moisture, temperature, and rubber tree canopy cover.

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