Quantitative and Qualitative Analysis of Weed Vegetation in Coffee Plantations in Bener Meriah Regency

Dewi Farahdiba, Baidhawi*, Nasruddin, Laila Nazirah, Ismadi

Department of Master of Agroecotechnology, Faculty of Agriculture, UniversitasMalikussaleh, Aceh, Indonesia

*Corresponding author Email: baidhawi@unimal.ac.id

Abstract

Coffee plants are an essential commodity widely cultivated in Bener Meriah Regency, Aceh Province. This study aims to determine the composition of dominant weed types and weed structures in Arabica coffee plantations in Bener Meriah Regency through weed vegetation analysis. Weed vegetation analysis is carried out in two ways, namely quantitative and qualitative. The research was conducted from November 2023 to March 2024 in 5 sub-districts. Weed sampling was carried out on five location plots per sub-district by placing a square measuring 1 m x 1 m diagonally to analyze the number of weeds, the number of individuals, and abundance. The study's results found 2,408 individuals and 35 species of weeds, namely 28 species of broadleaf weeds, three species of puzzles, three species of grasses, and one species of ferns. Spilanthes paniculata Wall weed. Ex DC or jotang is the most dominant weed, with an absolute density value of 392 (SDR 11.82). The absolute frequency value is dominated by Oxalis debilis or calincing. Meanwhile, the highest absolute dry weight was weeded S. paniculata Wall. Ex DC and A. conyzoides with values of 923.3 and 836.2. The life cycle of weeds showed that eight species (22.85%) had annual life cycles, and 27 species (77.15%) had annual life cycles. Stratification is classified as class 3, with as many as 14 species. Sociability is classified as 4th degree as many as 13 species. All weeds are classified as vitality 1. Meanwhile, the periodicity is only nine weed species that do not have flowers, seeds, and fruits.

Keywords: *Wide Leaves, Diversity, Grass, Puzzles.*

1. Introduction

Coffee is an important crop widely cultivated in Indonesia as a livelihood and a source of farmer income. In approximately 20 years, the area and production of coffee plantations in Indonesia have increased very significantly, one of which is Gayo Arabica coffee from Aceh Province.

Gayo Arabica Coffee has complex taste and flavor characteristics, light acidity, and its viscosity (heavy body) is strong and the sensation of thick taste, which also makes Gayo Arabica Coffee in great demand in various foreign countries. In Bener Meriah Regency, there are approximately 47,000 ha of Gayo Arabica Coffee planted at an ideal altitude of 900-1,700 meters above sea level with a temperature between 18-250C and a humidity between 90-92%:

The Arabica Gayo coffee plantation has experienced many disturbances so that it has experienced a decrease in the growth of coffee bean quality production caused by several factors, such as cultivation techniques, climate change, and the attack of plant pest organisms (OPT) such as weeds.

The existence of these weed plants that compete with coffee plants in obtaining essential elements for their growth and development, thus interferes with the production of coffee beans. Therefore, it is necessary to analyze weed vegetation to choose the proper control.

This study aims to determine the composition and structures of the dominant weed types in Arabica coffee plants in Bener Meriah Regency.

2. Method

The research was carried out from November 2023 – March 2024 on coffee plantations in Bener Meiah Regency, which are located at coordinates 4o 33 50 – 4o 54 50 North Latitude and 96o 40 75 – 97o 17 50 East Longitude with an altitude between 600 – 1,500 meters above sea level. Weed vegetation was sampled in five sub-districts: Permata, Bandar, Bukit, Timang Gajah, and Pintu Rime Gayo.

The tools used are a meter, knife, scissors, square 1 m x 1 m, hoe, shovel, writing stationery, GPS, camera, and oven. The materials used were envelopes measuring 33 x 43 cm, labels, manila paper, thread, and interview questionnaires. Climate data in the form of rainfall, air humidity, and air temperature for the last 10 years was obtained from BPS Bener Meriah. The height data of the place was obtained from the Agriculture and Food Office of Bener Meriah Regency.

In obtaining data, the research was carried out through a survey on five plots of weed sample locations in each sub-district. Sorting and identifying weeds is carried out in the laboratory based on weed type, number of individuals, and abundance of each species. Quantitative analysis of weed vegetation includes density, frequency, and dry weight. While qualitative describes weeds' life cycle, sociability, stratification, periodicity, and vitality. The quantitative data analysis uses Microsoft Excel software using the following formulas:

1. Absolute Density (AD) = Number of individuals of a particular weed species in the sample plot.
2. Relative Density of a Species (RD)
   $$RD\ (\%) = \frac{Absolute\ density\ of\ species}{The\ sum\ of\ the\ absolute\ densities\ of\ all\ types} \times 100\%$$
3. Absolute Frequency (AF) = The number of sample tiles that contain a specific species.
4. Relative Frequency of a Species (RF)
   $$RF\ (\%) = \frac{The\ absolute\ frequency\ value\ of\ a\ type\ of\ quantity}{Absolute\ frequency\ values\ of\ all\ types} \times 100\%$$
5. Absolute Dry Weight (ADW) = Total dry weight of a given species in the example tile
6. Relative Dry Weight of a Species (RDW)
   $$RDW\ (\%) = \frac{Absolute\ dry\ weight\ of\ a\ species}{Total\ dry\ weight\ of\ all\ types} \times 100\%$$
7. Key Values
   KV = Relative Density + Dry Weight S
   Relative + Relative Frequency
8. Summed Dominance Ratio (SDR)
   SDR (%) = KV / 3

3. Result and Discussion

3.1. Results of Quantitative Data Analysis

The results of weed identification in Arabica coffee plantations in Bener Meriah Regency found as many as 2,408 individuals and 35 species of weeds. The weeds found consisted of 4 types, namely broadleaf weeds (DL), as many as 28 species; puzzle (TK), three species; grass (RT), three species; and ferns (PK), as many as one species (Table 1).

3.1.2. Absolute Density

The results of observations on weeds from Bener Meriah Regency, plants of the Spilanthes paniculata Wall. Ex DC or jotting species became the most dominant weeds, with the highest absolute density (KM) value of 392 and a dominance level (SDR of 11.82).

Table 1. Composition of Types of Weeds in Coffee Plantations in Bener Meriah Regency (Based on the Highest to Lowest SDR Values)

It	Weed species	MILES	KN (%)	FM	FN (%)	Bkm	BKN (%)	NP (%)	SDR
1.	Spilanthes paniculata Wall. Ex DC. (DL)	392	16,28	16	6,43	923,3	12,75	35,5	11,82
2.	Ageratum conyzoides L. (DL)	368	15,28	16	6,43	836,2	11,54	33,3	11,08
3.	Galinsoga parviflora (DL)	194	8,06	16	6,43	526,0	7,26	21,7	7,25
4.	Oxalis debilis (DL)	247	10,26	18	7,23	149,6	2,07	19,6	6,52
5.	Bidens pilosa L. (DL)	170	7,06	13	5,22	288,0	3,98	16,3	5,42
6.	Nepali persicaria (DL)	100	4,15	15	6,02	359,1	4,96	15,1	5,04
7.	Commelina diffuses Burm. F. (DL)	79	3,28	11	4,42	510,1	7,04	14,7	4,91
8.	Galinsoga quadriradiata (DL)	107	4,44	8	3,21	344,3	4,75	12,4	4,14
9.	Digitaria violascens (RT)	87	3,61	12	4,82	83,8	1,16	9,6	3,20
10.	Amaranthus spinosus L. (DL)	62	2,57	6	2,41	322,5	4,45	9,4	3,15
11.	Drymaria is blume. (DL)	77	3,20	8	3,21	141,3	1,95	8,4	2,79
12.	Dichrocephala integrifolia (DL)	20	0,83	7	2,81	261,2	3,61	7,2	2,42
13.	Eleutheranthera ruderalis (Sw.) Sch. Bip. (DL)	15	0,62	5	2,01	333,8	4,61	7,2	2,41
14.	Pilea michrophylla (DL)	81	3,36	8	3,21	28,3	0,39	7,0	2,32

15.	Artemisia vulgaris (DL)	32	1,33	7	2,81	186,6	2,58	6,7	2,24
16.	Rumex crispus (DL)	11	0,46	6	2,41	247,7	3,42	6,3	2,10
17.	Ipomoea cairica L. (DL)	12	0,50	4	1,61	277,1	3,83	5,9	1,98
18.	Ludwigia adscendens L. (DL)	17	0,71	5	2,01	192,8	2,66	5,4	1,79
19.	Ageratina altissima (DL)	62	2,57	4	1,61	67,2	0,93	5,1	1,70
20.	Mitracarpus hirtus L. (DL)	32	1,33	6	2,41	91,1	1,26	5,0	1,67
21.	Plantago major (DL)	15	0,62	6	2,41	122,9	1,70	4,7	1,58
22.	Hedera helix (DL)	17	0,71	5	2,01	145,5	2,01	4,7	1,57
23.	Richardia brassiliensis (DL)	32	1,33	4	1,61	118,1	1,63	4,6	1,52
24.	Cyperus imbricatus Retz. (TK)	16	0,66	5	2,01	115,0	1,59	4,3	1,42
25.	Christella dentate (PK)	28	1,16	7	2,41	39,3	0,54	4,1	1,37
26.	Cardamine pensylvanica (DL)	25	1,04	4	1,61	76,3	1,05	3,7	1,23
27.	Digitaria ciliaris Retz. (RT)	17	0,71	5	2,01	57,3	0,79	3,5	1,17
28.	Oxalis stricta (DL)	13	0,54	5	2,01	68,8	0,95	3,5	1,17
29.	Kyllinga brevifolia Rottb. (TK)	22	0,91	4	1,61	57,3	0,79	3,3	1,10
30.	Richardia scabra L. (DL)	17	0,71	3	1,20	58,2	0,80	2,7	0,90
31.	Cyperus cyperoides (TK)	10	0,42	4	1,61	15,2	0,21	2,2	0,74
32.	Eleusine indica (RT)	10	0,42	2	0,80	46,2	0,64	1,9	0,62
33.	Blumea lacera Burm. F. (DL)	4	0,17	3	1,20	34,4	0,48	1,8	0,62
34.	Urtica dioica L.(DL)	8	0,33	1	0,40	78.9	1,09	1,8	0,61
35.	Persicaria longiseta (DL)	9	0,37	1	0,40	39,9	0,55	1,3	0,44
	Sum	2408	100	24,8	100	7243,4	100	300	100

Description: KM (Absolute density), KN (Relative density), FM (Absolute frequency), FN (Relative frequency), BKM (Absolute dry weight), BKN (Relative dry weight), NP (Important value), SDR (Summed dominance ratio). DL (Leibar leaves), RT, TK, PK.

Fig 1. (A.) *Spilanthes paniculata Wall*. ex DC. (B.) *Ageratum conyzoides*, (C.) *Galinsoga parviflora*, and (D.) *Oxalis debilis*

Report weed plants of the broad-leaved type that flower with the species S. paniculata from the family Asteraceae significantly dominating in the highlands (mountains) in the upstream, middle and downstream parts of the Cianjur watershed, West Java. The environmental conditions are similar to coffee plantations in Bener Meriah Regency, surrounded by mountains. Weeds S. paniculata It can grow up to 2,200 meters above sea level and likes moist soil with good drainage and full/partial sun.

3.1.3. Absolute Frequency
Meanwhile, the absolute frequency (FM) value was dominated by clinching weeds (Oxalis debilis), with a total occurrence or frequency of 18 plots out of a total of 25 plots. This weed appeared in almost every sampling plot and coffee plantation sub-district and was more abundant than the weed S. paniculata Wall. Ex DC or jotang was found in only 16 out of 25 plots (not in Bandar District).

According to interviews obtained on a survey of coffee plantations in Bandar District, weed control there is carried out with a type of treatment and must be routinely done, namely the application of herbicides twice and felling twice per year, or pruning three times and the use of herbicides once. Herbicide application is carried out after weed removal so that the part of the weed left behind is entirely dead. Both controls are recognized as adequate for the environmental conditions of coffee plantations of farmers in the area in controlling jotang that spreads beans with the help of wind and living creatures.

3.1.4. Absolute Dry Weight
Weeds S. paniculata Wall. Ex DC and A. conyzoides It is the weed with the highest dry weight compared to 35 other types of weeds with values of 923.3 and 836.2. The high dry weight of the two weeds is due to the availability of space for weeds to grow and sunlight and poor shade that weeds use for photosynthesis [8].

Inversely proportional to the lowest absolute dry weight value, which is C. peroxides and P. Michrophylla, with values of 15.2 and 28.3 due to its less than optimal growth. The two weeds cannot compete with other plants, including coffee [9]. According to v nutrients from the environment, its existence is below stable.

Weed dry weight describes the pattern of weeds in accumulating products from photosynthesis. It is integrated with environmental factors so that the lower the dry weight, the more inhibited the growth of weeds, and the higher the dry weight, the better the growth. This is undoubtedly one of the benchmarks for land tenure, and the competitiveness of weeds for cultivated plants is also getting higher [11].

Plants that live with high levels of density play an essential role in a given region for their survival and have the potential to interfere with the existence of native plants in achieving nutritional needs and other vital resources for the survival of future generations [12].

3.2. Weed Qualitative Data

3.2.1. Life Cycle

The weed life cycle from the qualitative data shows seasonal and annual weeds. Eight species (22.85%) of weed plants have a seasonal life cycle, while the other 27 species (77.15%) of weeds live with an annual cycle (Table 2). The data shows the dominance of annual weeds.

Table 2. Qualitative data on weeds in Coffee Plantations in Bener Meriah Regency (Alphabetically)

It	Weed species	Life cycle	Stratification (class)	Sociability	Vitality	Periodicity Leaf	Flower	Seed	Fruit
1.	Ageratina altissima	Seasonal	3	4	1	✓	✓	✓	✓
2.	Ageratum conyzoides L.	Seasonal	3	4	1	✓	✓	✓	✓
3.	Amaranthus spinosus L.	Seasonal	3	4	1	✓	✓	✓	✓
4.	Artemisia vulgaris	Annual	3	1	1	✓	-	-	-
5.	Bidens pilosa L.	Annual	3	4	1	✓	✓	✓	✓
6.	Blumea lacera Burm. F.	Seasonal	5	1	1	✓	✓	✓	✓
7.	Cardamine pensylvanica	Annual	1	3	1	✓	✓	✓	✓
8.	Christella dentate	Annual	2	3	1	✓	-	-	-
9.	Commelina diffuses Burm. F.	Annual	5	4	1	✓	✓	✓	✓
10.	Cyperus peroxides	Annual	3	2	1	✓	✓	✓	✓
11.	Cyperus imbricatus Retz.	Annual	3	2	1	✓	✓	✓	✓
12.	Dichrocephala integrifolia	Seasonal	3	1	1	✓	✓	✓	✓
13.	Digitaria ciliaris Retz.	Annual	3	3	1	✓	✓	✓	✓
14.	Digitaria violascens	Annual	3	3	1	✓	✓	✓	✓
15.	Drymaria is blume.	Annual	4	3	1	✓	✓	✓	✓
16.	Eleusine indica	Annual	2	3	1	✓	✓	✓	✓
17.	Eleutheranthera ruderalis (Sw.) Sch. Bip.	Seasonal	3	4	1	✓	✓	✓	✓
18.	Galinsoga parviflora	Seasonal	4	4	1	✓	✓	✓	✓
19.	Galinsoga quadriradiata	Annual	3	4	1	✓	✓	✓	✓
20.	Hedera helix	Annual	5	4	1	✓	-	-	-
21.	Ipomoea cairica L.	Annual	5	4	1	✓	-	-	-
22.	Kyllinga brevifolia Rottb.	Annual	1	3	1	✓	✓	✓	✓
23.	Ludwigia adscendens L.	Annual	3	3	1	✓	-	-	-
24.	Mitracarpus hirtus L.	Seasonal	2	3	1	✓	✓	✓	✓
25.	Nepal persicaria	Annual	4	3	1	✓	✓	✓	✓
26.	Oxalis debilis	Annual	1	4	1	✓	-	-	-
27.	Oxalis stricta	Annual	1	2	1	✓	-	-	-
28.	Persicaria longiseta	Annual	4	1	1	✓	✓	✓	✓
29.	Pilea michrophylla	Annual	2	2		✓	✓	✓	✓
30.	Plantago major	Annual	2	1	1	✓	✓	✓	✓
31.	Richardia brassiliensis	Annual	3	4	1	✓	-	-	-
32.	Richardia scabra L.	Annual	2	4	1	✓	✓	✓	✓
33.	Rumex crispus	Annual	5	1	1	✓	✓	✓	✓
34.	Spilanthes paniculata Wall. Ex DC.	Annual	5	5	1	✓	✓	✓	✓
35.	Urtica dioica L.	Annual	1	1	1	✓	-	-	-

Description: Stratification of class 1 (< 20 cm), class 2 (21 – 40 cm), class 3 (41 – 60 cm), class 4 (61 – 80 cm), class 5 (> 80 cm)

According to [13], annual weeds such as Blumea lacera Burm. F., Spinous amaranth, Dichrocepala integrifolia and Eleutheranthera ruderalis (Sw.) Sch. Bip. It is often found in food crops, horticulture, or land before processing. This is the basis for the fact that the types of seasonal weeds found are less common in each sub-district in Bener Meriah Regency because the average coffee cultivated is more than five years old. This type of annual weed can grow quickly and produce seeds in a short time, so the new land for research is dominated by weeds that have a yearly life cycle compared to weeds that have an annual life cycle.

3.2.2. Stratification

Qualitative data can be based on stratifiikasii or shading levels. The data shows that the weed species in Bener Meriah Regency are dominated by three weeds, namely 14 species, between 41-60 cm. Stratiifiikasii is classified as meineingah and must be acted upon immediately. The height of the weed indicates the level of nutrients obtained by the weed so that its potential to continue to grow is higher.

Stratification is also closely related to microclimate conditions. Providing shade affects microclimate conditions by decreasing light intensity, decreasing air temperature, and increasing humidity. This creates microclimate conditions suitable for weeds that prefer moist habitats, such as A. altissima, A. conyzoides, A. vulgaris., A. spinosus, and B. pilosa (Hartono et al., 2022).

Soil pH conditions and soil integrity as light intensifications greatly support Lebar leaf weeds growing clipart and inhibiting the aerial pair. This is in line with Deingan et al. (2023), which indicates that the leaf weed of Leibar is more likely to absorb the N element and use the leaf weed more, as well as the growth of the leaf.

3.2.3. Sociability

Qualitative data shows that each weed species in the Coffee Plantation social 4 has as many as 13 weeds. This illustrates that weeds in Bener Meriah Regency grow colonies/groups of trees, covering the land surface in the plots observed.

In addition, according to [16], the prediction of weed sociability also needs to be done to detect the relationship of weeds with other types of weeds that contain allelochemicals (phytotoxic content). Some of the allelochemical content of weeds is negative because it inhibits seed germination, bud formation, plant growth, and development and reduces crop yields. Weeds suspected to contain allelochemicals are A. conyzoides, A. spinosus, C. diffusa, E. indica, and L. adscendens. In essence, weed allelopathy threatens cultivated crops and causes economic losses.

3.2.4. Vitality

The results of qualitative data show that the weed species in coffee plantations in Bener Meriahi Regency are included in vitality 1; this vitality describes the plants that are more than the basic and meimiiliikii hiccup sites. This allows for good competition for weeds because they excel in obtaining nutrients. The fertility of weed plants causes the plants to grow in the form of food.

3.2.5. Periodicity

Qualitative data showed that of the 35 types of weeds found, nine weed species did not have flowers, baijiu, or fruits. This means that weed fertility in coffee plantations is quite high. This is why the relational time of weeds and the time of weed application greatly affect plant production.

Most of the weeds in coffee plantations that have reached the pollination and fruiting process have increased the weed concentration for the coffee plantations. Therefore, prevention before the flowering phase must be carried out as early as possible (preventive). The actions that can be taken care of tillage, planting spacing, planting patterns, mulching, and the use of LCC (Legume Cover Crop) [19]

3.2.6. Summary of Phytosocialogics

Based on the facts of the quantitative and qualitative data on the observed history, it can be shown that the geography of sugar is not far from the sugar generics.

This is caused by the geographer's character, who does not have a beirbeida in a way that is not a way of thinking between the islands. Seimua veigeitasii Coffee plantations in five sub-districts are potentially affected disturbances caused by the growth of 35 jeiniis speisiieis weeds that are beirbeida.

Jeiniis weed that grows meirata dii liima keimatan teirseibut is from jeiniis Spiilantheis paniiculata Wall. eix DC or jotang. Let's say that the weed jeiniis laiin who is also beirpoteinsii grows in the area that is beirbeida seipeirtii Ageiratum conyzoiideis L. (Bandotan), Oxaliis deibiiliis (Caliinciing), and Galiinsoga parviiflora (Loseih).

Speisiieis weed Spiilantheis paniiculata Wall. Ex DC (Jotang) from the results of qualitative analysis of weeds that are dominant and must be carried out in the vegetative phase so that they do not have to be weeded, this is supported by quantitative data that describe the closeness and freikiinsii of the emergence of weeds that are dominated by other weeds. According to several studies means the disadvantage of peirsaian kopii keitiika beirsaiing deingan beibeiirapa jeiniis weed that Have a High Life power.

4. Conclusion

The results of weed identification in Arabica coffee plantations in Bener Meriah Regency in five sub-districts were found as many as 2,408 individuals, which were divided into 28 types of broadleaf weeds, three types of puzzle weeds, three types of grass weeds, and 1 type of fern weed. Spilanthes paniculata Wall weed. Ex DC is the most dominating weed, evidenced by the absolute density value 392 (SDR 11.82). Oxalis debilis weed has a high absolute frequency value compared to other weeds, with 18 out of 25 plots of total occurrence. Meanwhile, the highest absolute dry weight was weeded S. paniculata Wall. Ex DC and A. conyzoides with values of 923.3 and 836.2. The life cycle of weeds showed that eight species (22.85%) had annual life cycles, and 27 species (77.15%) had annual life cycles. Stratification is classified as class 3, with as many as 14 species. Sociability is classified as 4th degree as many as 13 species. All weeds are classified as vitality 1. Meanwhile, the periodicity is only nine weed species that do not have flowers, seeds, and fruits.

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