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Comparison of soil fertility levels of coffee-based agroforestry land cultivation types based on the QBS-ar soil microarthropod index

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Abstract. Coffee-based agroforestry is a method for dealing with the conversion of forest land into plantations which is considered safe in reducing levels of surface runoff and erosion. This reduction results in lower leaching of trace elements which results in the soil maintaining its fertility. This study aims to evaluate soil fertility in two types of land management in the Ungaran Mountain agroforestry area, Semarang using the QBS-ar soil microarthropod index. Sampling was done in two coffee agroforestry land management types, including Intensive-Semirang; Non-Intensive- Gonoharjo. QBS-ar is carried out by taking soil samples, installing a pitfall trap, and extracting using the Tullgren-Funnel method. Microarthropods from sampling results were identified to order level. The soil physical and chemical factors measured are pH, organic matter, soil moisture, and soil temperature. Biological soil quality was analyzed using the procedure for determining the Eco-Morphological Index (EMI) and QBS-ar index values. The research results show that the QBS-ar index value for the Non-Intensive land type (46) has a high level of fertility compared to the Intensive land type (23). The soil organic matter value is intensive (14.4) and non-intensive (17.8) with soil pH values in the three locations ranging from 5.8–6.4.
Key words: Microarthropods, QBS-ar, Coffee Agroforestry.

Abbreviations: QBS (Quality Biologi Soil); -ar (to Mikroartropoda); EMI (Eco-Morphological Index)

INTRODUCTION

The conversion of land from forest land to plantation land results in disruption to the ecosystem. Disturbed or degraded ecosystems generally experience a decrease in the species composition and abundance of soil fauna due to the decrease or disappearance of a number of plant species, a decrease in the richness of litter deposits, changes in the biological, physical, and chemical properties of the soil, a decrease in the population of soil fauna and microorganisms. Land conversion causes forest land to decrease. One method to overcome the problem of land availability and land productivity uses a land management system in the form of agroforestry [14]; [4].

One form of agroforestry is coffee-based agroforestry. This agroforestry model is able to provide ecosystem services that are almost the same as forests and at the same time can fulfill social, economic, and ecological (conservation) interests. The use of coffee-based agroforestry is a safer method of reducing levels of surface runoff and erosion, this reduction results in lower leaching of hope elements which results in the soil maintaining its fertility ([6]; [14]; [3]).

Soil microarthropods are soil fauna that play an important role in various processes in the soil, including; plays a role in the distribution of organic matter, decomposition rate, nutrient cycling, and the formation of soil structure. The QBS-ar index of soil microarthropods is very suitable for monitoring soil fertility in agroforestry land. The QBS-ar index is based on determining biological shape and adjusting Ecological-Morphological (EMI) values. Calculation of QBS-ar index as the sum of EMI values. Therefore, this study aims to evaluate soil quality in two types of land management in the Ungaran Mountain agroforestry area, Semarang using the QBS-ar soil microarthropod index. [9]; [10]; [12].

MATERIALS AND METHODS

Locus of Research

This research is located on the slopes of Mount Ungaran, which is an agroforestry area based on coffee plants. Based on the type of coffee plant processing, there are 2 types of agroforestry, namely Intensive - Semirang, 7°9'59"S 110°22'51"E (pruning coffee trees, removing other plants, and applying fertilizer); and Non-Intensive Gonoharjo, 7°9‘105"S 110°20‘128"E (coffee plants are allowed to grow overlapping with native forest plants).

Microarthropods Sampling

The methods used include taking soil samples (PCT) and pitfall traps. Soil samples were taken using a shovel with a depth of 10

cm and a diameter of 7 cm. Each hole was given a container of the same size which contained a soap solution. The container was left for 8 hours then taken out and taken to the laboratory for sorting. The soil samples taken were extracted using a Berlese-Tullgren funnel extractor and identified under a stereo microscope (Nikon SMZ 745). Three additional soil samples of 300 grams were taken from each research station for analysis of soil organic matter. Specimens were collected in 70% alcohol solution and identified to order level.

Data analysis

Biological soil quality is analyzed using the procedure for determining the Eco-Morphological Index (EMI) value and the QBS-ar index [10]

RESULTS AND DISCUSSION

The fertility of coffee plantation agroforestry soil shows that Non-Intensive type agroforestry land is more fertile than Intensive type agroforestry land. The level of soil fertility can be seen from the QBS-ar index calculation value for each land by adding up the EMI score values. The QBS-ar index value for the Non-Intensive land type is 46, while for the Intensive land type, the QBS-ar value is 23 (table 1). In general, the high value of the QBR-ar index for Non-Intensive land is determined by the presence of Acari and Coleoptera taxa which are not found in other land types. The presence of the Acari order is influenced by the high level of soil organic matter at that location [1].

Table 1. EMI score values and QBS-ar index on intensive and non-intensive coffee agroforestry land on Mount Ungaran.

TAXA	Score EMI	
	Intensif	Non Intensif
Acari	0	20
Araneae	5	5
Colembola	10	10
Coleoptera	0	5
Diptera	1	1
Hymenoptera	5	5
Orthoptera	1	0
QBS	23	46

This is in accordance with the hypothesis that land with multicultural (non-intensive) cultivation has a better level of soil fertility compared to monocultural (intensive) land cultivation [3]. The differences in QBS-ar index values in the three types of land are supported by organic matter data. The soil organic matter content in the Non-Intensive land type appears to be higher than the Intensive land type (Table 3). The level of organic matter is related to surface flow and

erosion, the lower it is, the lower the leaching of hope elements which results in soil organic matter remaining maintained. Land management activities include pruning plants around coffee trees which allows the loss of sources of organic material [2].

Based on the opinion of [11] the level of surface flow and erosion in coffee-based agroforestry with the Non-Intensive land type is lower than in coffee-based agroforestry with the Intensive type. On intensive land, the application of fertilizer can directly affect organic matter so the QBS-ar value where the application of fertilizer also influences the level of soil acidity which is the habitat for soil fauna including soil microarthropods. Therefore, fewer taxa are found in intensive land compared to non-intensive land.

Table 2. Environmental characteristics of intensive and non-intensive coffee agroforestry areas on Mount Ungaran.

soil moisture	Intensif	Non Intensif
soil temperature	75 ± 0,5	80 ± 0
Soil pH	26 ± 0	24 ± 0,5
Organic Ingredients	5,8 ± 0,13	6,4 ± 0,8
soil moisture	14,4 ± 0	17,8 ± 0

The visible environmental characteristics show differences in organic matter where intensive land has a value 19% lower than non-intensive land (Table 2). The other environmental parameters at each location have values that are not much different. The lowest soil pH is on intensive land with a value of 5.8 and the highest is on non-intensive land at 6.4, which shows that the soil pH on each land is acidic [5].

Environmental characteristics in terms of physical and chemical factors show differences that are not too significant. However, soil in intensive land types tends to have lower values for pH, organic matter content, and soil moisture. This is because greater soil moisture is influenced by the soil temperature in the area where the higher the temperature, the lower the soil moisture level. One of the factors that influence changes in soil temperature and humidity is, among other things, being influenced by the treatment of applying fertilizer to the soil [13]

CONCLUSION

The results of this research show the level of soil fertility in the Intensive and Non-Intensive land types. The QBS-ar index shows that land with the Non-Intensive type has a higher level of soil fertility with a QBS-ar value of 46 and an organic matter content of 17.8 compared to intensive land with a Soil fertility level of 23. The QBS-ar

value on agroforestry land shows that the higher the EMI score, the higher the soil fertility level.

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