Morphophysiological characters of binahong (*Anredera cordifolia* (L.) Steenis) with application of natural growth regulators

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Abstract. The morphophysiological study of binahong is still limited. The objective of the research is to identify the morphophysiological characteristics of binahong plants through natural GR application. This study described the relationship of plant length, number of leaves, stomatal density, and the content of chlorophyll leaves of binahong due to the application of natural growth regulators from coconut water combined with red shallot extract, bamboo shoots, and banana weevils. The results obtained in general giving GR can reduce plant length and number of leaves. The highest stomatal density was obtained in the application of coconut water while the lowest as shown in the application of coconut water and bamboo shoots. Chlorophyll a and b, as well as the highest total chlorophyll, are found without growth regulators application and application of a mixture of coconut water, shallot, bamboo shoots and, banana weevils. Chlorophyll a and b and the lowest total chlorophyll are found in the application of coconut water and bamboo shoots.

1. Introduction

The medicinal plant that have potential to be developed into phytopharmaca raw materials because of the secondary metabolite content in binahong. All part of this plant can be used as a medicine. Saponin is one of a secondary metabolite of binahong has the function as antibacterial, antioxidant, and antifungal. The chlorophyll content in leaves is effective as antibiotics, disinfectant, and food [1-3]. The raw materials of binahong for industry was only about 20% from cultivation, rest was forest.

Phytochemical as secondary metabolite compounds contained in plants are very usefull as a source of raw materials and antioxidants. Therefore, to get the number of relatively large bioactive compounds of plant secondary metabolites required abundant enough so that the necessary arrangement substance application of natural GR in plants and improve the morphophysiological characters of binahong. Often the growth regulator is naturally present in plants are below the optimum, so the required resources from the outside to produce a maximum response [4]. The use of synthetic exogenous GR has not been widely applied by farmers and the use of natural GR is an alternative that is easy to obtain, relatively cheap, and safe to use. There are various types of ingredient of plants which are GR sources, such as shallot source of auxin, bamboo shoot source of gibberellin [5,6] and banana weevil and coconut water source of cytokinin [7].
The results study[8] showed that the application of banana weevil extract increased the height of the Inpari variety of rice plant. In young coconut water contains hormones such as cytokines 5.8 g L-1 which can stimulate the growth of shoots and activate the activities of living cells, auxin hormone 0.07 mg L-1 and a little gibberellin and other compounds that can stimulate germination and growth [9]. Therefore, this research aimed to study the morphophysiological characters of binahong with the application of a natural growth regulator.

2. Materials and methods

2.1. Study area and materials
This research was carried out in the research field of Faculty of Agriculture, Universitas Sumatera Utara (32 m asl). The ingredients used are root rhizome of binahong, chicken manure, topsoil, sand, polybag, natural GR, organic insecticides, and fungicides. The tools used are shade houses with 25% of shade, microscopes, and spectrophotometers. The content of natural GR in bamboo shoot, shallots, and banana hump from this materials was describe [10].

2.2. Procedures
The study used a nonfactorial randomized block design with 3 replications. The treatment consists of (1) Control (without treatment of GR) (A0); (2). Coconut water (source of natural GR cytokines) (A1), (3) Coconut water + shallot extract (A2), (4) Coconut water + bamboo shoot extract (A3); (5). Coconut water + banana weevil extract (A4); (6). Coconut water + shallot extract + bamboo shoot extract + extract of banana weevil (A5). The variables observed were plant length, number of leaves, chlorophyll a and b, total chlorophyll, and density of stomata. The analysis of chlorophyll content use the method of Coomb [11].

2.3. Data analysis
Data were subjected to analysis of variance (ANOVA) for comparison of means if there were significant differences then proceed with Duncan's Multiple Range Test at the level of $\alpha = 5\%$ then plotted onto curve lines or bar chart.

3. Results and discussion

3.1. Plant length and number of leaves
The effect of GR application on binahong plant length (cm) is shown in Figure 1. It can be seen that plant length growth is very fast in the third week after natural GR application. However, the highest plant length is found without GR, which means that generally, the application of GR can reduce the length of the plant. The shortest plant is found in coconut water and shallot extract (A2).

Figure 2 shows that the increase in the number of leaves after the GR application occurs is not sharp. The number of leaves without application of GR turned out to be the most leaf, while the application of coconut water (cytokinins) and shallot (auxin) or A2 showed the lowest number of leaves as well as the lowest plant length. The addition of gibberellins to plants will increase the number and size of cells, with photosynthetic yield increasing at the beginning of planting will accelerate the process of vegetative growth of plants (including the growth of new shoots) as well as overcome the dwarfishness of plants. Along with the vegetative growth of plants, photosynthesis results will increase steadily. The real effect of gibberellin on plant height is related to the function of the gibberellins in cell lengthening and division. Gibberellin directly controls the spread of plant cells by changing the orientation of cellulose microfibrils through changes in cortical microtubule orientation and also changes the association between microtubules and plasma membran [12].
3.2. Stomatal density
The effect of the GR application on stomatal density (unit/mm²) is shown in Figure 3. The highest stomatal density was obtained in the application of coconut water (A1). Coconut water containing cytokinins encourages the formation of stomata in the leaf epidermis. The increased density of stomata allows increased absorption of carbon dioxide into the mesophyll tissue so that the results of photosynthesis are more produced [13].

The lowest stomata density was obtained in the application of coconut water and bamboo shoots (A3). The content of gibberellin in bamboo shoots decreases the density of stomata. This is understandable because of the influence of GA, especially in the extension of the segment and stem of the plant and enlarge the leaf area so that it will suppress the formation of stomata in the leaf epidermis.
This was stated by Davies [12] the role of cytokinins in plants, among others, is to regulate cell division, organ formation, enlargement of cells, and organs and participate in the opening and closing of stomata.

![Figure 3](image-url)

**Figure 3.** Density of stomata on binahong with application of natural GR.

### 3.3. Chlorophyll a and b, and total chlorophyll

The effect of natural GR application on the content of chlorophyll a and b, and total chlorophyll is shown in figure 4. The highest chlorophyll a and b and total chlorophyll are found without the application of natural GR.

Some studies state that the application of plant growth regulators increased chlorophyll content in the plant [7,13] while [14] state that the application of plant growth regulators was not significantly effected to the chlorophyll content.

In this study, we found the contradiction that the application of natural GR decreased the chlorophyll content of binahong. This is presumably because the natural GR which is still in the form of fresh extract and not yet available for fermentation, therefore it need a long time so it can affect increasing chlorophyll in the plant, and also suspected that the concentration of natural GR is not precisely used, which in this study concentration of natural GR is not precisely used, 40 ml of natural GR extract per liter of distilled water.

![Figure 4](image-url)

**Figure 4.** The content of chlorophyll of binahong with the application of natural GR.
The high content of chlorophyll in the treatment of a mixture of coconut water, shallot, bamboo shoots, and banana weevils (A5) showed that chlorophyll is affected by the treatment of natural growth regulators cytokinin, gibberellin, and auxin, that each contained in coconut water, shallot, bamboo shoots, and banana weevils. Previous a study [15] stated that gibberellin increased significantly the total chlorophyll content of Mentha piperita.

The high chlorophyll in binahong is excellent because the chlorophyll in binahong as medicinal plant can act as an antibiotic, disinfectant, and food supplements [1].

The lowest of chlorophyll a, chlorophyll a, and total chlorophyll were found in the application of coconut water and bamboo shoots (A3). This indicated that cytokinins in coconut water and gibberellin in bamboo shoots did not support for chlorophyll formation. It is understandable that cytokinins and gibberellin role a lot in cell elongation and enlargement, especially in the stem [16].

4. Conclusions
In general, the application of GR can reduce plant length and number of leaves. The highest stomatal density was obtained in the application of coconut water while the lowest as shown in the application of coconut water and bamboo shoots. The highest chlorophyll a, chlorophyll b, and total chlorophyll are found without GR application and application of a mixture of coconut water, shallot, bamboo shoots, and banana weevils. The lowest content of chlorophylls are found in the application of coconut water and bamboo shoots. To achieve the further objectives of this study, it is necessary to analyze the total leaf area and saponin content.

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