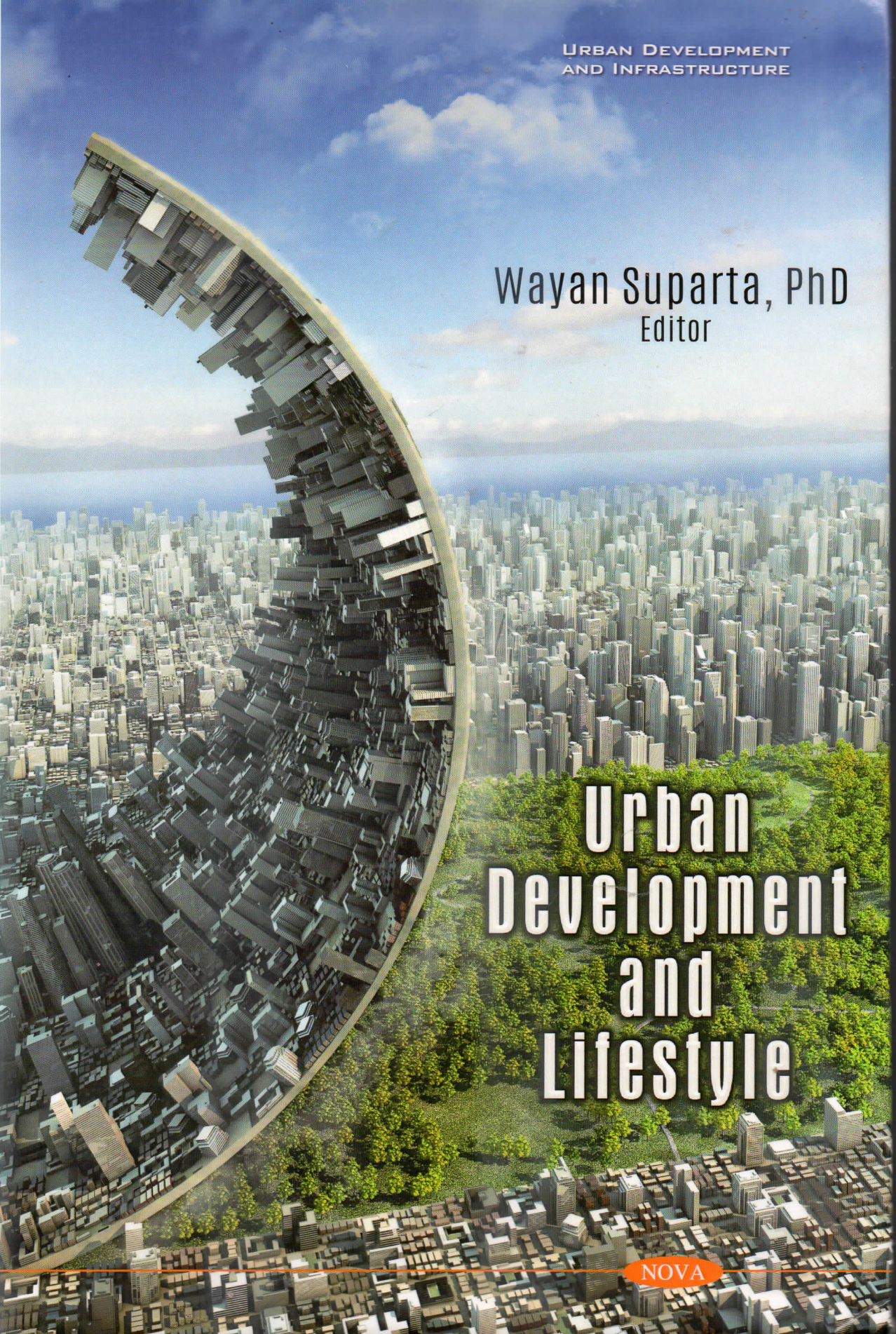
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Chapter 24

THE EFFECT OF STEM CUTTING TYPE AND PLASTIC-COVERED ON BOUGAINVILLEA GROWTH IN GREEN OPEN SPACE

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ABSTRACT

The research aims to determine the effect of stem cutting type and plastic-covered on bougainvillea growth in the green open space. Data were obtained from the experimental garden of the Agriculture Faculty, UPN "Veteran" Yogyakarta, between October to December 2019, using a Completely Randomized Design with the factorial arrangement. Furthermore, the stem cutting type consisting of the terminal, middle, and basal, was considered the first factor, while the use plastic-covered on cutting consisting of without and with covering was considered the second. The result showed there is no interaction between the stem cutting type and the plastic-covered in the growth of bougainvillea stem cutting. The basal stem cutting produced better result on the number of days to sprout (14,50 days), length of the longest shoot (9,67cm), root number (6,42), length of the longest root (9,83cm) than the middle and terminal cutting. While the cutting with plastic-covered produced the best result within the number of days to sprout (13,22 days), shoot number (7,33), length of the longest shoot (8,69cm), root number (5,83) and length of the longest root (9,00cm).

Keywords: bougainvillea, cutting type, plastic-covered

INTRODUCTION

Green open space is needed in cities due to the population increase of people relocating to urban areas. Therefore, it is important to conduct layout and planning for proper utilization

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of lands with the maintained environmental balance. One of the most important areas that are important in regional planning is the green open space. Rachmansyah [1] stated that green open space can provide oxygen and absorb carbon dioxide and other air pollutants. The plants in 1 ha of green space require 900kg of CO2 to conduct photosynthesis for 12h, and at the same time, they will produce 600kg O2. According to Paramita & Suparta [2], stated that without green open space, the microclimate in the city village could be affected. Not available green open space as a source of oxygen causes the air exchange less good and less perfect.

According to Law Number 26 of 2007 concerning Spatial Planning, Green Open Space is an elongated area, lane, or cluster that is used to grow natural and artificial plants. It is dominated by vegetation such as trees, bushes, grasses, and many ornamental flower plants such as the colorful bougainvillea, which grows best in full sun. This plant needs high light intensity for good flowering and does best at 10 to 2500 feet above ground level by Kobayashi [3].

According to Nurhikmah [4], Bougainvillea leaves have the ability to absorb timbale metal emitted from the vehicle in response to the exposure time and also used as bio-accumulator of timbale metal in the air. This is in accordance with the research conducted by Nitesh [5], which stated that this plant has the ability to absorb and deposit dust consistently, during the dry season. Therefore, they are recommended as a city garden element because they are tolerant of pollutants. Furthermore, it also acts as a stabilizer and environmental preserver of pollution due to various human activities.

Bougainvillea belongs to the *Nyctaginaceae* family, and it is propagated by cuttings, layering, as well as budding. Macdonald [6] stated that the vegetative propagation by stem cuttings has the ability to produce a large number of young plants from a single parent plant. Therefore, it is a useful technique in the conservation of endangered plants and the rapid propagation of new cultivars. Several factors tend to affect the rooting potential of stem cuttings, which include species, specific cultivar needs, the source, position, type of cutting, juvenility and condition of the stock plant, leaf removal, etiolation, girdling, and cutting by Hartmann [7].

According to Rochiman & Harjadi [8], the cuttings' growth is influenced by internal factors, which include the material type, age, plant growth regulator, and carbohydrate content. The varying types of cutting material cause variations in rooted ability. Amri [9] stated that the basal cutting has a better root than the terminal and middle cutting on *Dalbergia melanoxylon*, due to plant nutrient content such as carbohydrates, proteins, lipids, nitrogen, enzymes, hormones, and rooting cofactor. Furthermore, Lesmana [10] stated that the basal cutting produces the best respond on root number, root length, and root dry weight.

The external factors are the growing media environment, humidity, temperature, light, and implementation. According to Hartmann [7], higher temperature and relative humidity tend to stimulate root growth. Furthermore, covered is conducted by manipulating the microenvironment, using plastic, which stabilizes temperature and relative humidity. While Yusmaini & Suharsi [11] stated that cutting with plastic-covered produced the best result on shoot length of *Stevia rebaudiana* Bertoni M. This is in line with research which stated that cutting with covered produced the best result on leaf area *of Mussaenda frondosa.* The objective of this study, therefore, is to assess the effect of stem cuttings type and plastic-covered on the growth of Bougainvillea plants under shading net, ultimately to make an efficient, rapid, cheap, and simple protocol for its propagation.

METHODS

This research was conducted in the experimental garden, Faculty of Agriculture, UPN "Veteran" Yogyakarta on latitude -7.740311 and longitude 110.441003, altitude 191m above the sea level, between October and December 2019. The maximum and minimum mean daily temperatures of the area ranged between 26,5°C and 31,6°C, while its monthly maximum and minimum relative humidity was 92% and 68%, respectively. In this experiment, the *Bougainvillea spectabilis* stem cuttings consisted of three different material in the terminal, middle, and basal, of 20 cm in length were obtained from healthy parent stock early in the morning (to ensure the plant is fully turgid) with a sharp thin-bladed pocket knife. Furthermore, smooth and slanting cuts were administered at the stalk and lower ends below the node, respectively, and prepared by removing the entire leaf. The process of *bougainvillea* cutting treatment is illustrated in Figure 1.

A Completely Randomized Design involving the application of two factors, including (1) stem cuttings types, which consists of terminal, middle, and basal. (2) plastic-covered, including planting of stem cutting in polybag without plastic-covered and planting of stem cutting in plastic glass with plastic-covered, were utilized.

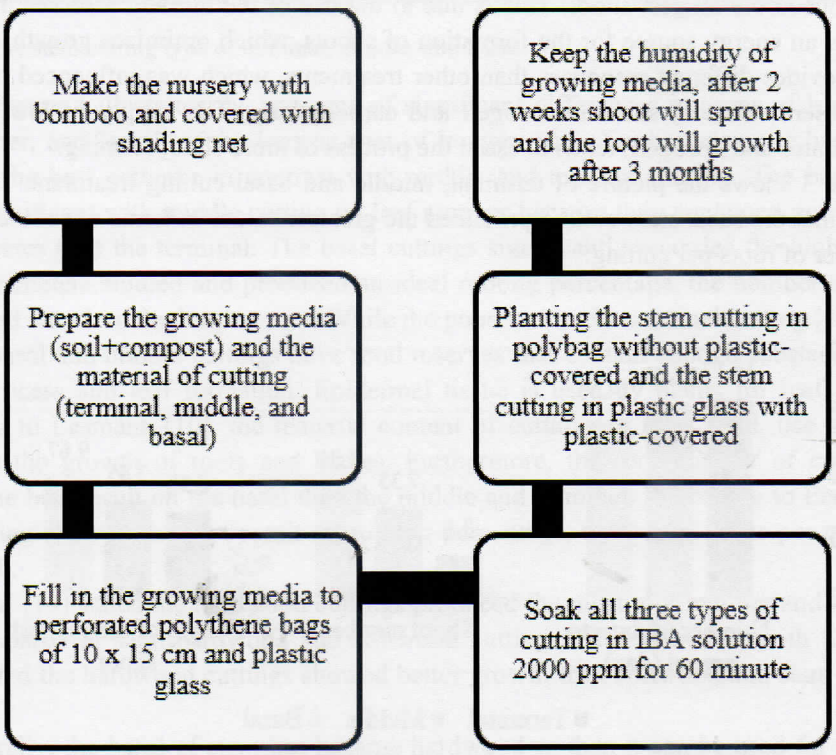

Figure 1. Process of *bougainvillea* cutting treatment.

Different parameters of *Bougainvillea* cuttings were evaluated 90 days after planting in the rooting medium. The parameters were the number of days to sprout, shoot number, length of the longest shoot (cm), leaf number, length of longest root (cm), and root number.

Furthermore, the observed data were analyzed using the Analysis of Varian (ANOVA) at a significance level of 5%, and if there were a significant effect continued by and DMRT (Duncan Multiple Range Test), at 5% significant levels.

RESULT AND DISCUSSION

The analysis of variance revealed a significant effect of stem cuttings types and using plastic-covered on planting of stem cutting. There was no interaction between stem cutting types and using plastic-covered in bougainvillea growth. Figure 2 shows significant differences in number of days to sprout, shoot number, and length of the longest shoot. The basal cutting comparably provided the faster in terms of the number of days to sprout as it is generally considered to contain higher amounts of reserved carbohydrates than middle and terminal cutting.

Furthermore, carbohydrates were used by cutting material for faster sprouting. This is in line Hidayanto [12], which stated carbohydrate content that is in the cutting material is main factor within shoot primodial growth.

The middle and basal cutting produce better shoot number than the terminal, whereas basal produced the longest shoot. This is due to the use of the nutrient reserves in the stem cuttings as an energy source for the formation of shoots, which optimizes growth. The basal cutting provides different responses than other treatments, which was influenced by varying nutrient reserve content such us nitrogen and carbohydrate. The supply of low C/N ratio (carbohydrates and nitrogen) tends to assist the process of more shoot forming.

Figure 3 shows the picture of terminal, middle and basal cutting treatment. The results indicated that the basal stem cutting produced the greatest values in terms of root length (cm) and number of roots per cutting.

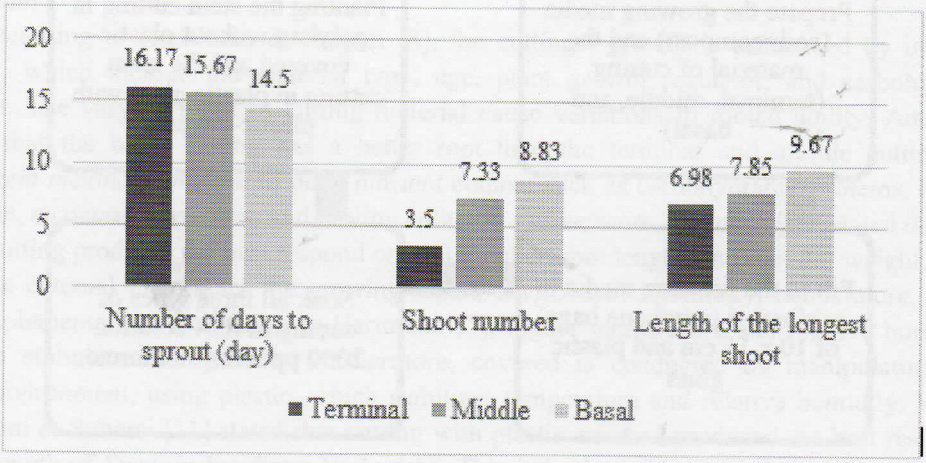

Figure 2. Graph of number of days to sprout, shoot number and length of the longest shoot of *bougainvillea* as influenced by stem cutting type.

Figure 3. The stem cutting type of terminal, middle, and basal.

The Figure 4 illustrates the presence of significant differences in terms of leaf number, root number, and length of the longest root of bougenvillea. Furthermore, the basal cutting exhibited the best outcome in contrast with middle and terminal cutting. The basal cutting was no significant with middle cutting on leaf number because they contained more reserved carbohydrates than the terminal. The basal cuttings significantly recorded the highest values for all parameters studied and produced an ideal rooting percentage, the number of root per cutting, and length of the longest root. While the poorest was the terminal cutting [13].

The basal and middle cuttings have food reserves that contain enough substances for the growth process and leaf formation. Epidermal tissue is used by plants for leaf formation. According to Lesmana [10], the material content of cuttings in most food, use nitrogen to determine the growth of roots and leaves. Furthermore, the root number of cutting stem showed the best result on the basal than the middle and terminal. According to Eed [13], the basal cutting showed the best result on rooting percentage, number of roots per cutting and root length.

Kumar [14] stated the hardwood cuttings produced the most root number and the longest roots compared to semi-hardwood and softwood cuttings. This is in line with Singh [15], which stated the hardwood cuttings showed better growth than softwood and semi hardwood cuttings.

Generally, the basal of stem has became hardwood so then it can be used for vegetative propagation. Overall, the basal cuttings have higher food reserves compared to middle and terminal cutting, and they are also related due to the presence of meristem tissue in the stem, which allows air changes and food substances available to the stem. The carbohydrate content and nitrogen are depended on growth and amount of nitrogen, respectively [16].

The basal cutting produced the best result in accordance with the length of the longest root compared to the middle and terminal, due to its high carbohydrate content. This is in line

with the research conducted by Supriyanto & Prakasa [17], which stated that the ability to form roots in the plant is influenced by its carbohydrate content as well as the hormonal balance in the cutting material.

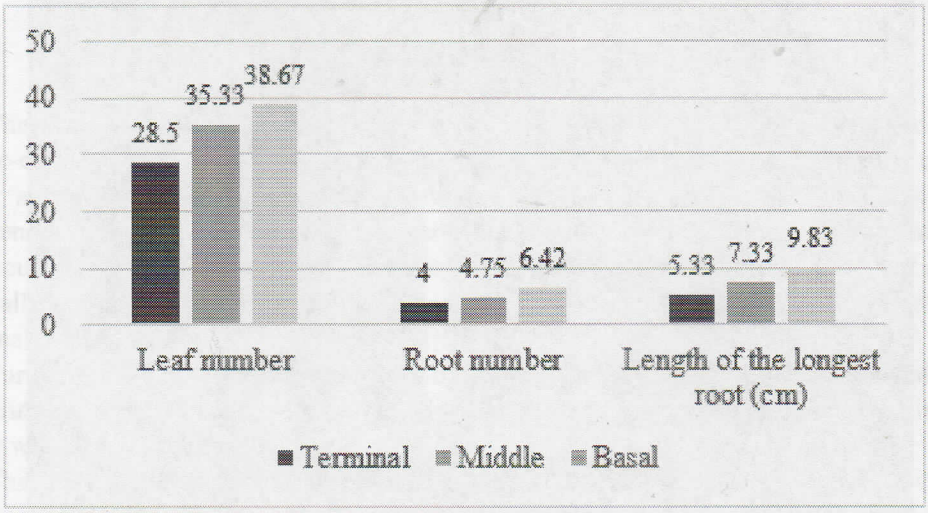

Figure 4. Graph of leaf number, root number and length of the longest root of *bougainvillea* as influenced by stem cutting type.

Figure 5 illustrates that cutting with plastic-covered was faster to sprout than without plastic-covered. The stem cutting with plastic-covered produced the best result on the number of days to sprout compared to others. The cutting with plastic-covered is carried out as a way to manipulate microenvironment, while cutting without plastic-covered, can't adapt under direct sunlight. According to Hartmann [7], the higher the temperature and relative humidity, the greater the stimulated sprouts.

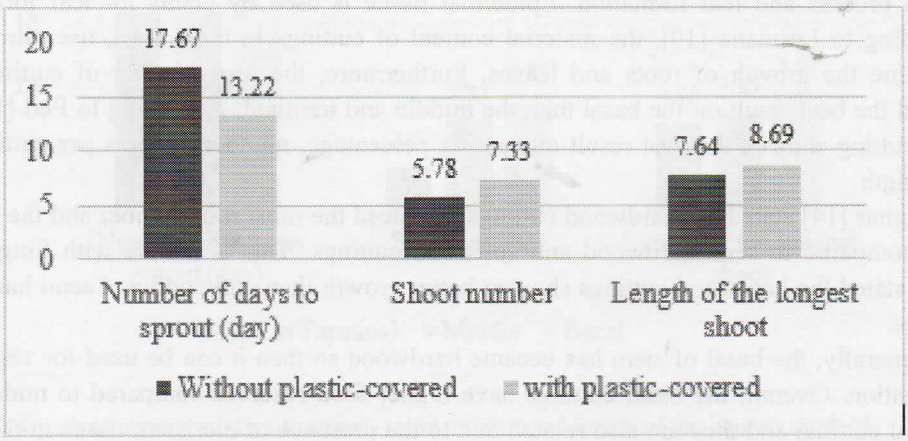

Figure 5. Graph of number of days to sprout, shoot number and length of the longest shoot of *bougainvillea* as influenced by plastic-covered.

The stem cutting with plastic-covered produces the best shoot number and longest shoot. It also provides ideal conditions for cuttings to grow and provide a higher chance of survival. According to Yusmaini & Suharsi [11], cutting with plastic-covered produces the best average length of the longest shoot than cutting without plastic-covered. Covering with plastic has been able to create optimum condition for cutting. The average temperature in this research is 26°C with 90% humidity, whereas without plastic is 28°C with 66 - 70% humidity.

Figure 6 illustrates that the use of plastic-covered provided no significant effect on leaf number, however, after 3 weeks, it is opened, and the leaf has the ability to grow optimally. Ultimately, leaves have the ability to photosynthesis so that it will increase the number. The cutting with plastic-covered produced the best result on root number and length of longest root which is a way used to maintain relative humidity during propagation, which is needed in the 2-3 weeks, with higher relative humidity (80 - 90%). Furthermore, Pierik [18] stated that plastic-covered tend to increase the relative humidity of the air to achieve an ideal state, and it is conducive for cuttings to keep growing and not dry.

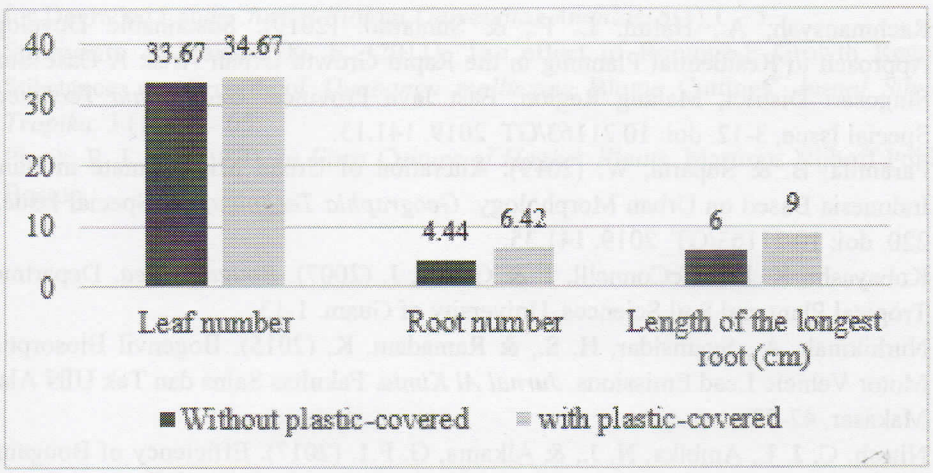

Figure 6. Graph of leaf number, root number and length of the longest root of *bougainvillea* as influenced by plastic-covered.

According to Rochiman & Harjadi [8], the optimal temperature for root formation in plant types is 26°C, with a humidity of 80 - 90%. This research was supported by Hartmann [7], which stated that 15 - 26°C temperatures is ideal for the formation of shoots and roots in cuttings. Root formation in cuttings involves the process of cell differentiation in areas bordering the cuttings surface, subsequently cells become meristematic. The cells divide and extend through the cortex and epidermis, thereafter it becomes to primordial roots. In these conditions, more root can be produced on cuttings with plastic-covered.

CONCLUSION

Based on the results and discussion, the following conclusion was made, there is no interaction between the stem cutting types and using plastic-covered in growth of

bougainvillea stem cuttings. The basal stem cutting produced better result on all parameters than the middle and terminal cutting. The cutting with plastic-covered produced the best result on the number of days to sprout, shoot numbers, length of the longest shoot, root numbers and length.of the longest root

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