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EFFECTIVENESS OF ARABICA COFFEE PLANT PRUNING TECHNIQUES (Arabica *Coffea*)

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ABSTRACT

Effectiveness of Arabica Coffee Plant Pruning Technique (Coffea arabica) The purpose of this study was to determine the effectiveness of Arabica coffee plant pruning techniques (Coffea arabik). This study was conducted from April to June 2025 in Aeksabaon Village, Marancar District, South Tapanuli Regency, North Sumatra Province. The altitude is ± 75 meters above sea level. The study used the Non-Factorial Randomized Block Design (RAK) method with treatment factors. N1 = Form Pruning, N2 = Production Pruning, N3 = Rejuvenation Pruning. The research parameters include; wet fruit production per sample (g), wet fruit production per plot (g), dry fruit production per sample (g), dry fruit production per plot (g), dry bean production per sample (g), dry bean production per plot (g), weight of 100 dry beans (g). The results of the study showed that the effectiveness of pruning had a significant effect on the production of fresh fruit per sample (g), production of wet fruit per plot (g), production of dry fruit per sample (g), production of dry fruit per plot (g), production of dry seeds per sample (g), production of dry seeds per plot (g), and weight of 100 dry seeds (g).

Keyword : arabica; effectiveness; coffee; pruning; technique

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1. INTRODUCTION

Coffee plants are found in Africa. After the discovery of the coffee plant, this plant began to be cultivated and spread throughout the world. History records that coffee was first invented by Ethiopians about 3000 years ago. At that time there was a goat herder who was bringing his cattle to the field. While tending his cattle, he saw his pet goat eating a berry-like seed on the tree and then the goat remained awake and hyperactive even after sunset. Then the shepherd tried to process and eat the seeds. He felt refreshed again, in the past, people didn't pounded coffee and then brewed it. At first, coffee was only dried and then brewed, only after 500 years of discovery, a tool to crush coffee beans appeared. At that time, coffee processing was also still very simple (Gayatri, 2019)

In 1920, small companies in Indonesia began to grow coffee as the main commodity. Plantations in Java were nationalized on independence day and revitalized with new varieties of arabica coffee in the 1950s. This variety is adopted by small companies through the government or various community development programs. Now more than 90% of Indonesia's Arabica coffee is developed by small companies mainly in the North Sumatra area, with 1 hectare of land or less. The annual production of arabica is about 75,000 tons and 90% is exported. Arabica coffee that reaches other countries mostly falls into the special market segment (Ariani, Marahadi, Doni, 2020)

We must encourage coffee demand from the upstream side, such as improving productivity. The expansion of the area is now very limited, with intensification, improved cultivation patterns. North Sumatra itself has coffee production center areas that are quite widely spread across various regions, including: Simalungun, Karo, Dairi, Mandailing Natal, North Tapanuli, Pakpak Bharat, Humbang Hasundutan, Toba, Samosir and Sidikalang (North Sumatra Plantation Office, 2022)

Pruning is carried out to facilitate maintenance, form or stimulate the growth of productive new branches and facilitate the regulation of incoming light and facilitate the process of pest and disease control. Pruning will result in a smaller number of branches and a more regular arrangement of the leaf position so that the intensity of sunlight penetrating to the leaf surface is better not too hot or not too humid. Too high light intensity will cause water deficiency due to low humidity so that the moisture content of plants and soil is reduced. Water shortage conditions will cause the rate of photosynthesis to be inhibited because the stomata guard cells cannot close. Too low light intensity will result in plants not being able to photosynthesize because stomata cells are always closed (Mulyono, *et al*., 2016).

2. LITERATURE REVIEW

Coffee Plant Botany

a. Root

Coffee plants are a type of plant with two pieces (dicots) and have taproots. Coffee roots have a single root that grows perpendicular to a depth of 45 cm. Coffee roots are said to be not deep because more than 90% of the weight of the roots is in a soil layer of 0-30 cm (Hidayatullah, 2020)

b. Trunk

The stems and branches of the stems that grow from the seeds are called tree trunks. The trunk of a tree has segments that are clearly visible when the plant is young. Each segment grows a pair of opposite leaves, then two types of branches grow, namely orthotrop branches (branches that grow perpendicular or vertical) and can replace the position of the stem if the stem is broken or cut) and plagiotropic branches (branches or branches that grow sideways or horizontally) (Mariani, 2014).

c. Leaf

The shape of the coffee leaves is oval, the ends are slightly tapered. The leaves grow on stems, branches, and twigs arranged side by side. The arrangement of leaves alternates and grows on horizontal branches and branches. Mature leaves are dark green, while young leaves are bronze Coffee leaves will become wide, thin and mushy if the light intensity is too little. Thus, the leaves can be used to control shade settings (Saragih, 2020)

d. Fruit

The fruit of the coffee plant consists of pulp and seeds. The pulp consists of three layers, namely the outer shell (exocarp) which is the outer layer of the coffee fruit. When ripe, the flesh of the fruit contains lentils and sugar compounds that taste sweet. The meat layer (mesocarp) at the time of maturation of the pectolytic enzyme breaks down the pectic chain, producing an insoluble hydrogel rich in sugars and pectin. The parchment layer (endocarp) is a layer formed from three to seven layers of sclerenchyma cells. (Coffee and Cocoa Research Center, 2014).

e. Seed

Coffee beans consist of silver skin, endosperm, and embryos. The size of coffee beans varies with an average length of 10 mm and a width of 6 mm. The silver skin, called the perisperm or spermoderm, is the outermost layer that encloses the seeds. Silver skins are formed from the nucleus, or the middle part of the ovule. The endosperm is the main reserve tissue of the seed. The chemical compounds found in the endosperm can be grouped as soluble and insoluble in water. Water-soluble compounds are caffeine, trigonelline, nicotinic acid (niacin), 18 chlorenic acid, mono-, di-and oligosaccharides, some proteins and carboxylic acids. Components that are insoluble in water are cellulose, polysaccharides, lignin, and hemicellulose (Coffee and Cocoa Research Center, 2014).

f. Flower

Coffee plants have compound flowers in the shape of a kisoma with an umbrella of mostly 3-5 flowers so that they form a pseudo-arrangement that has many flowers. Each sapling has a pointed concoction leaf about 55 mm long (Coffee and Cocoa Research Center, 2014)

Requirements for Growing Coffee Plants.

a. Climate
   Coffea is a shrub that can grow well in the tropics (15º N -12º LS) in lowlands with an altitude of up to 800 above sea level and grows optimally at temperatures between 22 – 30 ºC. The coffee plant will begin to flower at the age of between 1 to 2 years and cross-pollinate with the help of wind or insects (Depari, 2017).
b. Soil
   Arabica coffee can live in rather sour soil. i.e. pH 5.5-6.5. and liberika is a type of coffee found in Indonesia. Coffee that is widely cultivated in Indonesia in Indonesia is arabica and robusta (Pratama, 2018)
c. Coffee Pruning Techniques
   Pruning generally aims to keep the tree in a low state so as to make it easier to maintain the plant, form new productive branches, minimize pest and disease attacks. Maintenance pruning is usually carried out on old branches that are no longer productive, generally branches that have borne fruit 2-3 times with the aim of spurring the growth of more productive branches (Thamrin, 2014).

3. RESEARCH METHOD

This study used a Non-Factorial Group Random Design (RAK) with treatment factors. N1 = Shape Trimming, N2 = Production Trimming, N3 = Rejuvenation Trimming

4. RESULTS AND DISCUSSION

A. Result

1. Wet Fruit Production per Sample (g)

Data on the results of weighing wet fruit production per sample due to the effectiveness of arabica coffee plant pruning techniques are presented in Table 1.

The results of the analysis of various fingerprints showed that the effectiveness of the arabica coffee plant pruning technique had a real effect on the production of wet fruit per sample (g).

The effectiveness of arabica coffee plant pruning techniques on wet fruit production per sample (g) after statistical tests using the Duncant distance test can be seen in Table 1.

Table 1. Average Data of Wet Fruit Production per Sample (g) of Arabica Coffee Plants

Treatment	Wet Fruit Production per Sample (g)	Notation
Trimming		
N1 = Shape Trimming	13.14	Bb
N2 = Production Cuts	16.70	Aa
N3 = Rejuvenated Pruning	13.23	Aa

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 1 can be explained that the effectiveness of the pruning technique has a very significant influence on the production of wet fruits per sample, where the heaviest wet fruit production per sample (g) is found in the N2 treatment = production pruning which weighs 16.70 grams, which is not real from the N3 treatment = rejuvenated pruning which weighs 13.23 grams, but it is very noticeable in the treatment N1 = shape trimming which weighs 13.14 grams.

More details on the effectiveness of arabica coffee plant pruning techniques on wet fruit production per sample (g) can be seen in Figure 1.

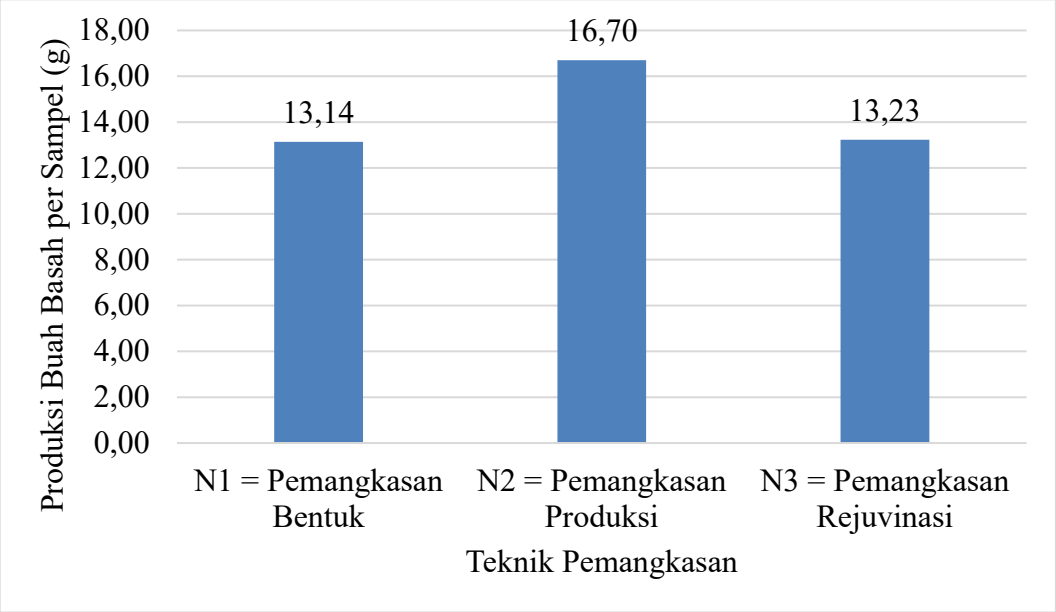

Figure 1. Stem Graph of the Relationship of Arabica Coffee Plant Pruning Techniques to Wet Fruit Production per Sample (g)

Figure 1 can be explained that the heaviest wet fruit production per sample was found in the N2 treatment = production trimming which weighed 16.70 grams, then followed by the N3 treatment = rejuvenation trimming which weighed 13.23 grams, and the N1 treatment = shape trimming which weighed 13.14 grams.

2. Wet Fruit Production per Plot (g)

Data on the results of weighing wet fruit production per plot due to the effectiveness of arabica coffee plant pruning techniques are presented in Table 2.

The results of the analysis of the variety of fingerprints showed that the effectiveness of the arabica coffee plant pruning technique had a real effect on the production of wet fruits per plot (g).

The effectiveness of arabica coffee plant pruning techniques on wet fruit production per plot (g) after statistical tests using the Duncant distance test can be seen in Table 2.

Table 2. Average Data of Wet Fruit Production per Plot (g) of Arabica Coffee Plants

Treatment	Wet Fruit Production per Plot (g)	Notation
Trimming		
N1 = Shape Trimming	23.67	Ba
N2 = Production Cuts	31.33	Aa
N3 = Rejuvenated Pruning	23.78	Ba

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 2 can be explained that the effectiveness of pruning techniques has an influence on wet fruit production per plot (g), where the heaviest wet fruit production per plot is found in the N2 treatment = production pruning which weighs 31.33 grams, which is significantly different from the N3 treatment = rejuvenated pruning which weighs 23.78 grams, and the N1 treatment = shape pruning which weighs 23.67 grams.

More details on the effectiveness of arabica coffee plant pruning techniques on wet fruit production per plot (g) can be seen in Figure 2.

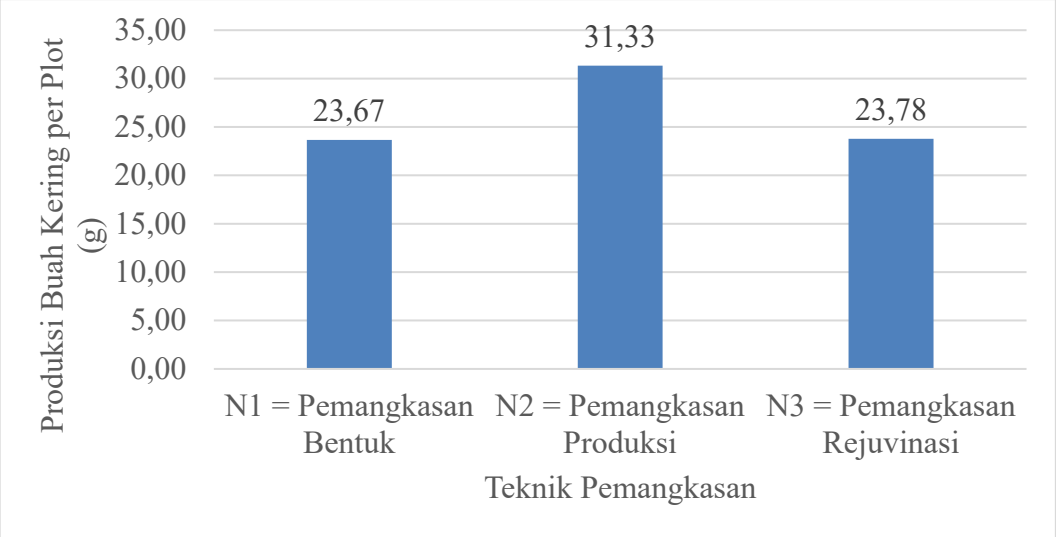

Figure 2. Stem Graph of the Relationship of Arabica Coffee Plant Pruning Techniques to Wet Fruit Production per Plot (g)

Figure 2 can be explained that the heaviest wet fruit production per plot was found in the N2 treatment = production trimming which weighed 31.33 grams, then followed by the N3 treatment = rejuvenation pruning which weighed 23.78 grams, and the N1 treatment = shape trimming which weighed 23.67 grams.

3. Dried Fruit Production per Sample (g)

Data on the results of weighing dried fruit production per sample due to the effectiveness of arabica coffee plant pruning techniques are presented in Table 3.

The results of the variety-based fingerprint analysis showed that the effectiveness of the Arabica coffee plant pruning technique had a real influence on the production of dried fruits per sample (g).

The effectiveness of arabica coffee plant pruning techniques on dry fruit production per sample (g) after statistical tests using the Duncant distance test can be seen in Table 3.

Table 3. Average Dried Fruit Production Data per Sample (g)

Treatment	Dried Fruit Production per Sample (g)	Notation
Trimming		
N1 = Shape Trimming	11.07	Ba
N2 = Production Cuts	13.56	Aa
N3 = Rejuvenated Pruning	12.27	Aba

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 3 can be explained that the effectiveness of the pruning technique has a real effect on the production of dried fruit per sample, where the heaviest dry fruit production per sample is found in the treatment N2 = production pruning which weighs 13.56 grams, which is not real from the treatment N3 = rejuvenated pruning which weighs 12.27 grams, and is significantly different from the N1 treatment = shape pruning which weighs 11.07 grams.

More details on the effectiveness of Arabica coffee plant pruning techniques on dried fruit production per sample (g) can be seen in Figure 3.

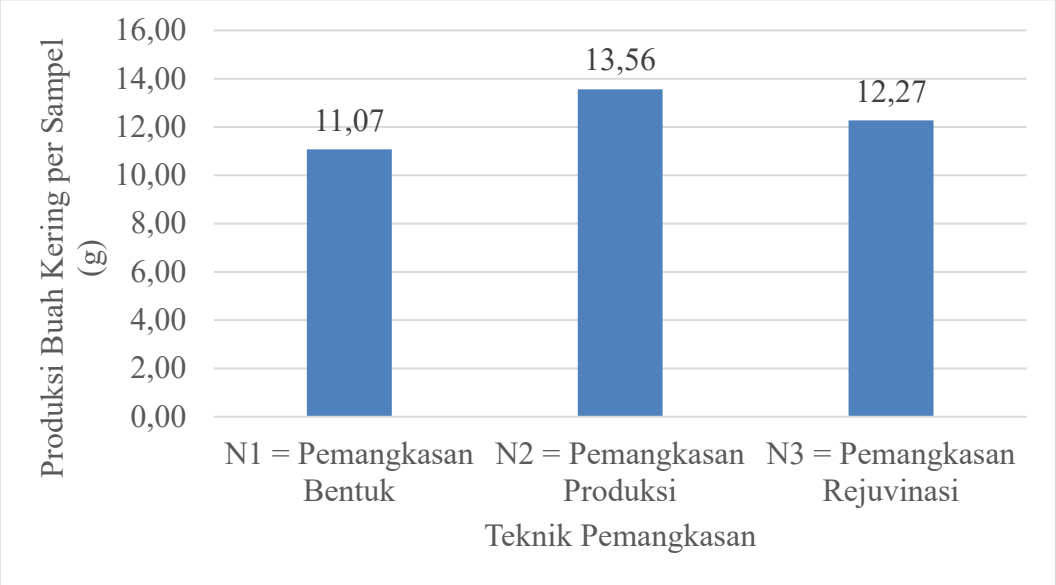

Figure 3. Stem Graph of the Relationship of Arabica Coffee Plant Pruning Techniques to Dried Fruit Production per Sample (g)

Figure 3 can be explained that the heaviest dried fruit production per sample was found in the N2 treatment = production trimming which weighed 13.56 grams, then followed by the N3 treatment = rejuvenation trimming which weighed 12.27 grams, and the N1 treatment = shape trimming which weighed 11.07 grams.

4. Dried Fruit Production per Plot (g)

Data on the results of weighing dried fruit production per plot due to the effectiveness of Arabica coffee plant pruning techniques are presented in Table 4.

The results of the analysis of the variety of fingerprints showed that the effectiveness of the Arabica coffee plant pruning technique had a real influence on the production of dried fruits per plot (g).

The effectiveness of arabica coffee plant pruning techniques on the production of dried fruits per plot (g) after statistical tests using the Duncant distance test can be seen in Table 4.

Table 4. Average Dry Fruit Production Data per Plot (g)

Treatment	Dried Fruit Production per Plot (g)	Notation
Trimming		
N1 = Shape Trimming	20.90	Ba
N2 = Production Cuts	25.41	Aa
N3 = Rejuvenated Pruning	21.06	Ba

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 4 can be explained that the effectiveness of pruning techniques has a real effect on the production of dried fruits per plot (g), where the heaviest dry fruit production per plot is found in the N2 treatment = production pruning which weighs 25.41 grams, which is significantly different from the treatment N3 = rejuvenated pruning which weighs 21.06 grams, and the N1 treatment = shape pruning which weighs 20.90 grams.

More details on the effectiveness of arabica coffee plant pruning techniques on dried fruit production per plot (g) can be seen in Figure 4.

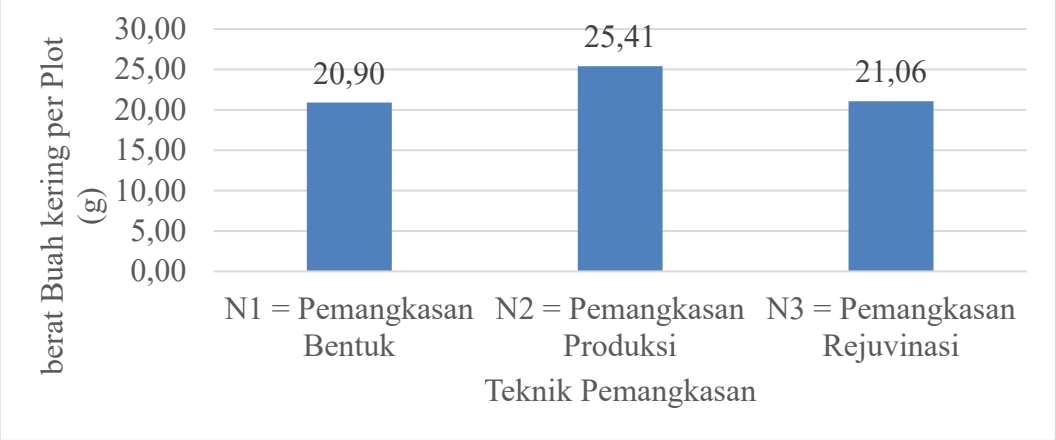

Figure 4. Stem Graph of the Relationship of Arabica Coffee Plant Pruning Techniques to Dried Fruit Production per Plot (g)

Figure 4 can be explained that the heaviest dry fruit production per plot was found in the N2 treatment = production trimming weighing 25.41 grams, followed by the N3 treatment = rejuvenation trimming weighing 21.06 grams, and the N1 treatment = shape trimming weighing 20.90 grams.

5. Dry Seed Production per Sample (g)

Data on the results of weighing dry bean production per sample due to the effectiveness of arabica coffee plant pruning techniques are presented in Table 5.

The results of the analysis of various fingerprints showed that the effectiveness of the arabica coffee plant pruning technique had a real effect on the production of dried beans per sample (g).

The effectiveness of arabica coffee plant pruning techniques on the production of dried beans per sample (g) after statistical tests using the Duncant distance test can be seen in Table 5.

Table 5. Average Dry Seed Production Data per Sample (g)

Treatment	Dry Seed Production per Sample (g)	Notation
Trimming		
N1 = Shape Trimming	10.59	Ba
N2 = Production Cuts	13.31	Aa
N3 = Rejuvenated Pruning	11.60	Aba

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 5 can be explained that the effectiveness of the pruning technique has a real effect on the production of dried seeds per sample (g), where the heaviest dry seed weight production per sample is found in the N2 treatment = production pruning which weighs 13.31 grams, which is not real from the N3 treatment = rejuvenated pruning which weighs 11.60 grams, but is significantly different from the N1 treatment = shape pruning which weighs 10.59 grams.

More details on the effectiveness of Arabica coffee plant pruning techniques on dry bean production per sample (g) can be seen in Figure 5.

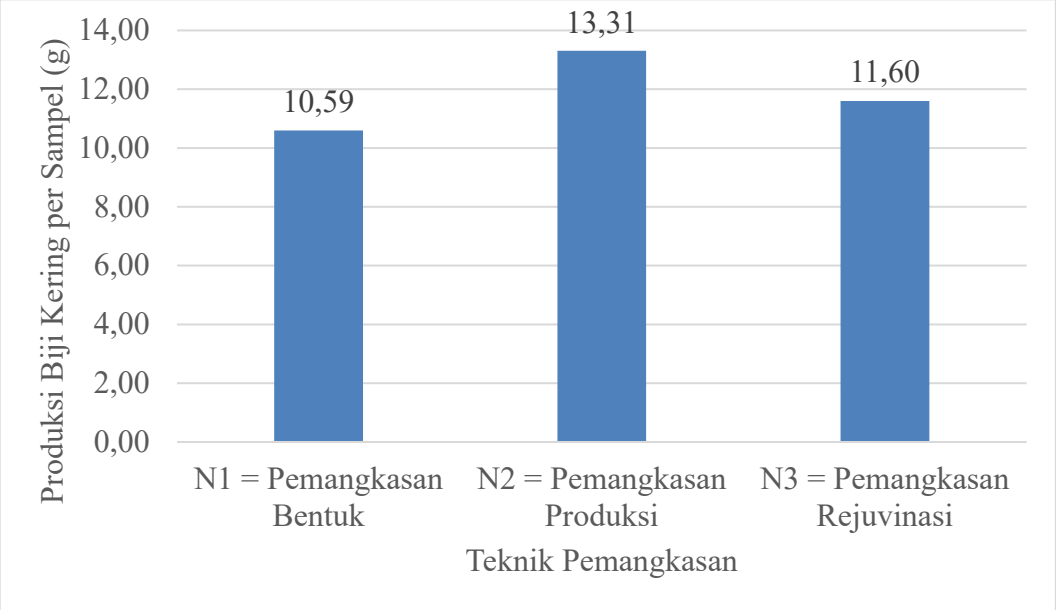

Figure 5. Stem Graph of the Relationship of Arabica Coffee Plant Pruning Techniques to Dry Bean Production per Sample (g)

Figure 5 can be explained that the heaviest dry seed production per sample was found in the N2 treatment = production trimming weighing 13.31 grams, followed by the N3 treatment = rejuvenation trimming weighing 11.60 grams, and the N1 treatment = shape trimming weighing 10.59 grams.

6. Dry Seed Production per Plot (g)

Data on the results of weighing dry bean production per plot due to the effectiveness of arabica coffee plant pruning techniques are presented in Table 6.

The results of the analysis of various fingerprints showed that the effectiveness of the arabica coffee plant pruning technique had a real influence on the production of dried beans per plot (g).

The effectiveness of the arabica coffee plant pruning technique on the production of dry beans per plot (g) after a statistical test using the Duncant distance test can be seen in Table 6.

Table 6. Average Dry Seed Production Data per Plot (g)

Treatment	Dry Seed Production per Plot (g)	Notation
Trimming		
N1 = Shape Trimming	18.37	Ba
N2 = Production Cuts	24.18	Aa
N3 = Rejuvenated Pruning	19.55	Ba

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 6 can be explained that the effectiveness of pruning techniques has a real effect on the production of dry seeds per plot (g), where the heaviest dry seed production per plot is found in the treatment technique N2 = production pruning which weighs 24.18 grams, which is significantly different from the treatment technique N3 = rejuvenation pruning which weighs 19.55 grams, and the N1 treatment technique = shape pruning which weighs 18.37 grams.

More details on the effectiveness of arabica coffee plant pruning techniques on dry bean production per plot (g) can be seen in Figure 6.

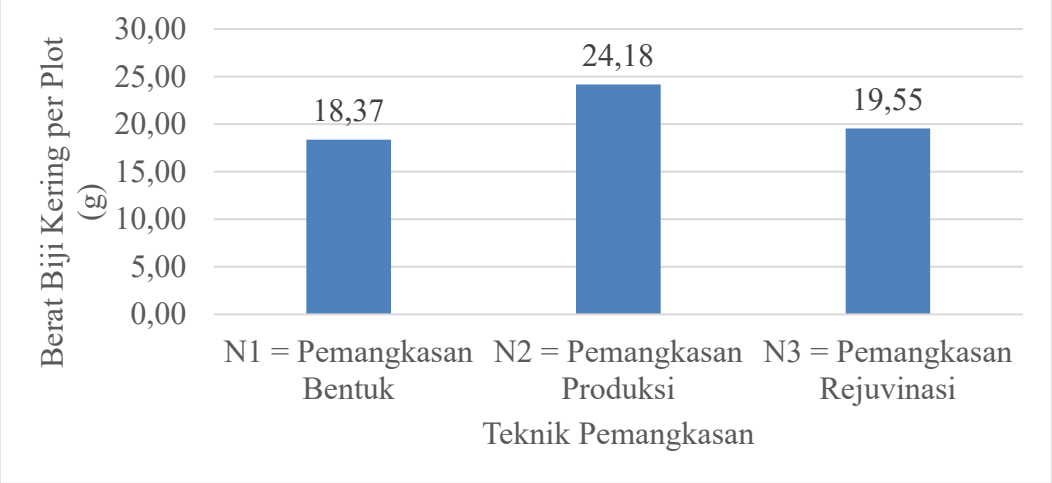

Figure 6. Stem Graph of the Relationship of Arabica Coffee Plant Pruning Techniques to Dry Bean Production per Plot (g)

Figure 6 can be explained that the heaviest dry seed production per plot is found in the N2 treatment = production trimming which weighs 24.18 grams, then followed by the N3 treatment = rejuvenation trimming which weighs 19.55 grams, and the N1 treatment = shape trimming which weighs 18.37 grams.

7. Weight 100 Seeds (g)

The data from weighing the weight of 100 beans due to the effectiveness of arbika coffee plant pruning techniques is presented in Table 7.

The results of the analysis of various fingerprints showed that the effectiveness of the Arabica coffee plant pruning technique had a real effect on the weight of 100 beans (g).

The effectiveness of the arabica coffee plant pruning technique on the weight of 100 beans (g) after a statistical test using the Duncant distance test can be seen in Table 7.

Table 7. Average Weight Data 100 Pieces (g)

Treatment	Weight 100 Seeds (g)	Notation
Trimming		
N1 = Shape Trimming	16.98	Ba
N2 = Production Cuts	18.12	Aa
N3 = Rejuvenated Pruning	17.29	Aba

Remarks: Numbers in the same column followed by different letters mean that they are significantly different at the level of 5% (lowercase) and very real differences at the level of 1% (uppercase)

Table 7 can be explained that the effectiveness of the pruning technique has a real effect on the weight of 100 seeds (g), where the weight of the heaviest 100 seeds is found in the N2 treatment = production pruning which weighs 18.12 grams, which is not real from the N3 treatment = rejuvenated pruning which weighs 17.29 grams, but it is significantly different from the N1 treatment = shape pruning which weighs 16.98 grams.

More details on the effectiveness of the arabica coffee plant pruning technique on the weight of 100 seeds (g) can be seen in Figure 7.

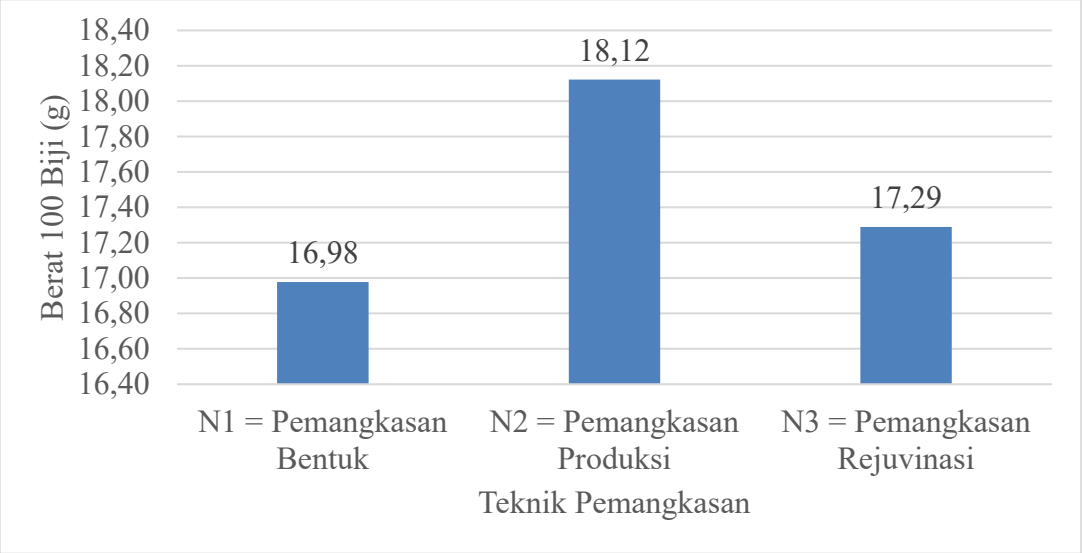

Figure 7. Stem Chart of the Relationship of Arabica Coffee Plant Pruning Technique to the Weight of 100 Seeds (g)

Figure 7 can be explained that the heaviest dry seed production per plot is found in the N2 = production trimming which weighs 18.12 grams, followed by the N3 treatment = rejuvenation trimming which weighs 17.29 grams, and the N1 treatment = shape trimming which weighs 16.98 grams.

B. Discussion

Effectiveness of Arabica Coffee Plant Pruning Techniques

The results of the study after being statistically analyzed showed that the effectiveness of the arabica coffee plant pruning technique had a real effect on the production of wet fruit per sample (g), the production of wet fruit per plot (g), the production of dried fruit per sample (g), the production of dried seeds per sample (g), the production of dried beans per plot (g), the weight of 100 dried seeds (g).

The effectiveness of arabica coffee plant pruning techniques has a real influence on wet fruit production per sample (g). This is suspected because the purpose of cutting production is to stimulate the number of coffee fruits themselves. As stated by Yulianto and Fitriani, (2018). That pruning is one of the important cultivation techniques in coffee production, especially Arabica coffee.

The effect of the effectiveness of arabica coffee pruning techniques on the production of wet fruits per plot (g), this is expected to increase the number of coffee plants observed as production so as to produce heavy production per plot. Siregar, *et. Al,* (2020). The more plants observed, the more production will also increase.

The research conducted on the effectiveness of Arabica coffee plant pruning techniques has an effect on the production of dried fruits per sample (g). When wet fruit is sun-dried, the water on the skin will evaporate into the air, so that the dry weight is equal to the wet weight. Harahap, *et.al*, (2020), stated that the result of dry weight is the same as the wet weight.

The results of the study show that the effectiveness of the arabica coffee plant pruning technique has an influence on the production of dried fruits per plot. The effect of Arabica coffee plant pruning techniques is because each pruning technique gives different results, Siregar, *et. Al,* (2020). There are 3 types of pruning techniques on coffee plants that give different results.

The research showed that the effectiveness of Arabica coffee plant pruning techniques has an effect on the production of dried beans per sample (g) and the production of dried beans per plot (g). The coffee production used is the beans, so a good bean is a bean that is uniformly shiny, clean and heavy. Siswanto Y. and Nadia O. Simamora (2025), production cutting techniques produce good and heavy production.

The effect of the effectiveness of the Arabica coffee plant pruning technique affects the weight of 100 beans (g). If the weight of all production has an effect, then the weight of 100 seeds also has an effect. Harahap, *et.al*, (2020), stated that the weight of 100 seeds depends on the weight of the dry seed production.

5. CONCLUSION AND SUGGESTIONS

Conclusion

The effectiveness of arabica coffee plant pruning techniques has a real effect on wet fruit production per sample (g), wet fruit production per plot (g), dried fruit production per sample (g), dried fruit production per plot (g), dry seed production per sample (g), dry seed production per plot (g), weight of 100 dried seeds (g).

Suggestion

To produce high production of arabica coffee plants, it is recommended to cut production.

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