STUDY ON THE USE OF FERTILIZER AND PRUNING TREATMENT FOR IMPROVING COFFEE PRODUCTIVITY IN AGROFORESTRY SYSTEM AT GUNUNG WALAT EDUCATIONAL FOREST

By

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Abstract

Previous studies showed that soil properties in agroforestry sites in Gunung Walat Educatioal Forest were not so fertile and the agroforestry sites vary in terms of vegetation coverage from densely populated stands to moderately dense population. Coffee sp is one of the agroforestry species that was planted under the Agathis loranthifolia trees seven years ago. However, the coffee productivity in the area is still low due to absence of intensive tending leading to difficulties in crop harvesting. The objective of this study was to determine the effectiveness of fertilizer in increasing the growth of coffee after pruning in Gunung Walat Educational Forest. Five different levels of fertilizer mixture (dosages) were used as follows: (1) Control, (2) Urea 100 g + TSP 40 g + KCL 80 g, (3) Urea 150 g + TSP 60 g + KCL 120 g, (4) Urea 200 g + TSP 60 g + KCL 160 g, (5) Urea 250 g + TSP 100 g + KCL 180 g. Research results showed that the use of fertilizer mixture (5) significantly increased sprout growth but no effect on sprout number.

Key words: agroforestry, coffee, pruning, fertilization, sprout

Introduction

Gunung Walat is an educational forest managed by Faculty of Forestry Bogor Agricultural University. Since ten years ago, agroforesty has been developed to maximize land productivity. In addition, Gunung Walat Education Forest is surrounded by villages where majority inhabitants were poor. In line with poverty alleviation program, various plants were selected as main composition of agroforestry. *Coffee robusta* is one of the plant

species that was planted under the *Agahtis loranthifolia* tress seven years ago. The reason for choosing this plant species was due to its tolerance to shade, so they can grow well under the shade and economically important for increasing farmer income.

Previous study showed that soil properties of Agroforestry site in Gunung Walat were not so fertile. Unfortunately, there were no intensive tending that has been done since early planting of coffee and as a consequence, the plant productivities were low. The application of anorganic fertilizer should be attempted in order to increase the productivity of the plants. Coffee productivities were affected not only by site condition but also by crown size as indicated by branch number. For practical purposes, easy harvesting is desirable in which coffee plants are manageable from the grown. The average height of *Coffee robusta* in Gunung Walat is around 5 m after 7 years. It is therefore important to carry out pruning for effective and efficient harvesting.

The objective of this study was to determine the effectiveness of fertilizer application in increasing the growth of coffee after pruning in Gunung Walat Educational Forest (GWEF).

Materials and Methods

Preparation of study site

This study conducted in the area of agroforestry system at GWEF where coffee plants (*Coffea robusta*) were planted 7 years ago under 40 years old *Agathis loranthifolia* stands. The average height of coffee plants was 5 m and Agathis was 25 m. The ground forest floor was mostly dominated by shrubs, grass and ferns.

The forest floors of 0.25 ha were cleared as experimental plot by removing the existing grass and shrubs. Coffee plants (*Coffea robusta*), 5 m height in average, were pruned up to 1 m height (Figure 1). The experimental plot was then divided into 5 (five) blocks, each 500 m^2, containing about 100 individual coffee plants for treatment.

Figure 1 Coffee plants one day after pruning

Experimental design

Random Complete Design was used for this experiment. After pruning, the coffee plants were then fertilized by different levels of fertilizer treatments (dosages) as follows: (1) Control, (2) Urea 100 g + TSP 40 g + KCL 80 g, (3) Urea 150 g + TSP 60 g + KCL 120 g, (4) Urea 200 g + TSP 60 g + KCL 160 g, (5) Urea 250 g + TSP 100 g + KCL 180 g. Sprout/coppice number and height were recorded once a week. For statistical analysis purpose, 30 replicates per treatment were recorded. The data obtained was subjected to Analysis of Variance (ANOVA) and Duncan multiple range test (DMRT).

Figure 2 Coffee plants 12 (twelve) weeks after pruning

Results

Sprout or coppice production and height

The sprout numbers and its height at 12 weeks after pruning were recorded and statistically analyzed. Results of Analysis of Variance in Table 2.1 showed that there were no difference between treatments in terms of sprout numbers but significantly different in term of sprout height.

Table 1 Sprouts production and its height at 12 weeks after pruning

Treatments	N	Average Sprouts numbers	Average Height (cm)	% of increase compared to control	
				Sprouts numbers	Height
Control	30	4.7a*	9.5a*		
Dosage 1	30	5.4a	10.1a	14.8	6.3
Dosage 2	30	4.6a	10.1a	-2	6.3
Dosage 3	30	6.2a	20.8ab	32	118.9
Dosage 4	30	6.2a	29.0abc	32	205.3

Note= *Numbers followed by the same letter are not significantly different

The sprout numbers treated by fertilizer dosages of 3 and 4 was higher than the other dosages, although statistically not different. On the other hand, sprout

height treated by fertilizer dosage 4 was significantly higher than the other treatments.

Sprouts numbers

The weekly increments of sprouts number at 12 weeks observation were shown in Figure 3.

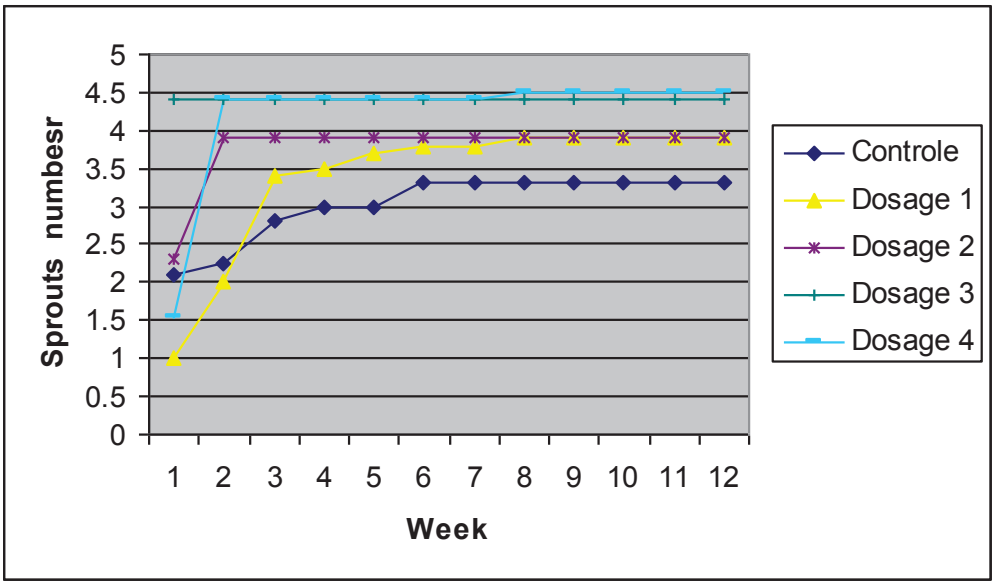

Figure 3 Effects of fertilizers dosages to the sprouts numbers for 12 weeks

Based on analysis of variance, there were no significant differences among fertilizer treatments in terms of sprout number during 12 weeks observations. However, there is no trend that the higher the fertilizer dosage, the more the number of sprouts were produced.

Height increment

The height increments of sprouts for 12 weeks are presented in Figure 4.

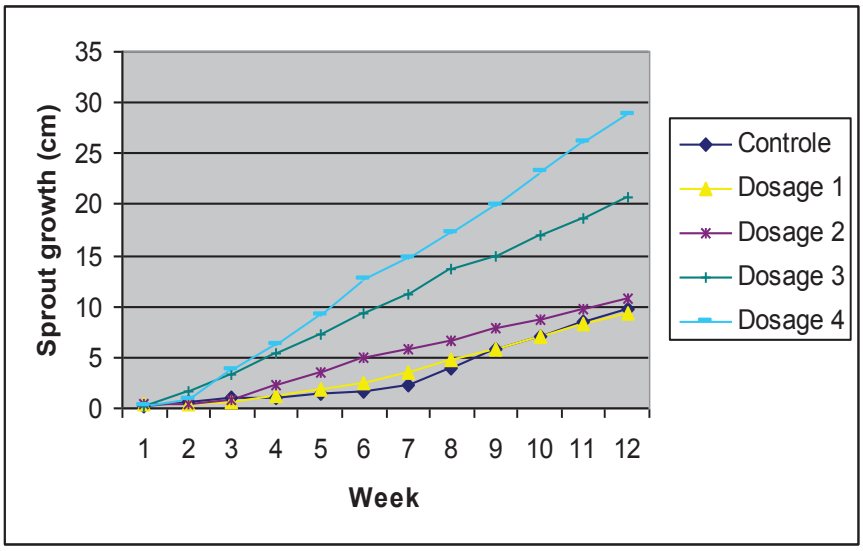

Figure 4 Effects of fertilizer dosages on the growth of sprouts for 12 weeks

Average height at twelve weeks after pruning for control treatment, dosage 1, dosage 2, dosage 3 and dosage 4 were 9.5 cm, 10.1 cm, 10.1 cm, 20.8 cm and 29 cm, respectively. From the third week, treatment with dosages 3 and 4 showed faster sprout height growth than the other dosages. In general, the use of dosages 4 is considered to be the best.

Discussion

Plants require sixteen essential elements and the absence of any one of these will cause failure. Three of the elements, C, H, and O which are the constituent of the structural and primary energy storage compounds, are not usually described as nutrients (Etherington, 1976). The remaining thirteen elements are subdivided into the macronutrients, N,P,K,S,Ca and Mg which are required in comparatively large amounts, and the micronutrients, Cu, Zn, B, Cl, Mo, Mn and Fe which are required in smaller amounts.

Among essential elements N, P and K are required in more large quantity than the other due to not only their physiological function in the plant but also the availability in the soil is limited, therefore, it is important to give fertilizers to the plant. Nitrogen differs in its ubiquitous presence as atmospheric N_2, from which soil-dwelling, or root nodule bacteria and other microorganisms, may fix it as organic N. In this regard, plant which do not have symbiotic with rhizobium they can not fix N_2 from the atmosphere. In this experiment by increasing Nitrogen dosage up to 200 g/plant may increase sprout growth significantly. Physiologically, the

function of Nitrogen in the plant is its presence in the structure of the protein structure and is found in such important molecule as purines, pyrimidines, porphyrins and coenzyme, which are all very important to the cell division and enlargements (Devlin and Witham, 1983). Phosphorus is present in the soil in two general forms, organic and inorganic. According to present-day knowledge, plants do not absorb organic phosphorous. The availability of inorganic P is dependent on the pH of the soil solution. In acid soil, in organic P will be fixed by other element and become not available. The soil pH in this experiment is 5, it may be the reason why there were no significant different among dosage 1 and 2.

The quantity of elements required by the plants is depended on to their old. According to the coffee fertilization standard issued by Ministry of Agriculture of Indonesia (Table 2), Coffee of 5 – 10 years old should be fertilized by Urea, TSP and KCL with the dosages of 300 g, 120 g and 240 g per plant respectively. In this experiment the dosages 4 were lower than the dosages recommended by Ministry of Agriculture, however, it could increase sprouts growth by 205.3 % compared to the control. On the contrary, the dosages 1 and 2 were not significantly different as compared to the control.

Table 2 Recommended fertilizer dosages for Coffee Plant

Ages (Years)	Urea (g)	TSP (g)	KCL (g)
1	2 x 26	2 x 30	2 x 20
2	2 x 50	2 x 10	2 x 40
3	2 x 75	2 x 40	2 x 60
4	2 x 100	2 x 40	2 x 60
5-10	2 x 150	2 x 60	2 x 120
> 10	2 x 300	2 x 80	2 x 160

Source: Indonesian Ministry of Agriculture (1981)

Figure 3 showed that there is no regular pattern in term of initial sprouting; however, there is a tendency that higher dosages of fertilizer might stimulate sprout initiation. One reason to explain these phenomena may be because of higher N absorbed by plant could be used for regulating hormone activity in the plant. The performance of coffees plants can be seen in Figure 2.

Further investigations were needed to know whether the dosages of fertilizer might stimulate initial flowering of the coffee and increase its fruits productivity in the future.

Conclusion

Results of this research draw the following conclusions: (1) the fertilizer dosages significantly increased sprout growth but no sprout numbers, (2) the dosage 1 and 2 were not significantly different as compared to the control, while dosages 3 and 4 were significantly different compared to control and influenced the number of sprout height by 118.9 % and 205, 3 % at 12 weeks after treatments, respectively.

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