Effect of the Combination of Some Fertilizers on Chlorophyll Content of *Gemor* (*Nothaphoebe coriacea*), Indonesia

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ABSTRACT— ***Our study aimed to determine the influence of various fertilizer combinations on chlorophyll content of gemor (Nothaphoebe coriacea). The study was conducted in the laboratory and nursery, Banjarbaru forestry research institute, South Kalimantan, Indonesia in January-March 2014. The study used a completely randomised design with one factorial as fertilizer treatment. Fertilization treatments included s no fertilizer (control) (T1); Urea (T2), Urea + SP-36 (T3); Urea + SP-36 + KCL (T4); and Urea + SP-36 + KCl + Dolomite (T5). Chlorophyll content was measured refering to spectometry method. Data were analyzed using Duncan Multiple Range Test (DMRT). The results showed that only T3 groups of treatment had significant effect on chlorophyll a, chlorophyll b, and total chlorophyll of gemor. The conclusion of this experiment is that using combination of urea + SP-36 together have improved the chlorophyll a, b, and total chlorophyll content of gemor. Therefore, on-farm trials must be achieved to confirm results before authorising their popularisation in peasants via the multilocation and multiannual trials.***

Keywords— Chlorophyll, Chlorphyll Content, Fertilization, *Nothaphoebe coriacea*.

1. INTRODUCTION

Gemor is a vernacular or trade name of *gemor*-bark-producing tree species (or *gemor* tree), which belongs to genus Nothaphoebe of the family of Lauraceae. The species has been commonly identified as belonging to the genus Alseodaphne in the same family [1]. Locally they are called as *gemor*, menuk (Kutai, Dayak Tunjung) or tempuloh (Dayak Bahau), which cover *Nothaphoebe coriacea* and *Nothaphoebe umbelliflora*. According to Sosef et al., *Nothaphoebe coriacea* occurs in Peninsular Malaysia, Singapore and Indonesia (Sumatra and Kalimantan); while *Nothaphoebe umbelliflora* occurs in Indo-China, Thailand, Peninsular Malaysia, Singapore, Indonesia (Sumatra, Java, Kalimantan) and Papua New Guinea. In Indonesia, the two species are found naturally in swampy forests of Sumatra and Kalimantan [2].

Gemor is one type of trees that has a high economical value in the world market trading. This is caused by the high demand against the bark gemor both for local and international community such as Taiwan, Singapore, and Japan [3]. The bark of *gemor* is used as the main raw material for mosquito repellent manufacture, incense for rituals and raw materials for glue. Such a high demand for *gemor* are not followed by the replanting or cultivation programme [4].

During this time, the production of bark gemor is dependent on natural forests and is rarely cultivated by society, triggering the diminishing of its potential. Panjaitan *et al*. [4] suggest that the potential *gemor* in the native range is quite low. For example, in the district Katingan, Central Kalimantan seedling regeneration was found only 66 stems/ha, saplings 21 stems/ha, the level of the pole 15 stems/ha and tree level 0.3 stems/ ha. To support the availability of gemor, cultivation development efforts continue to be made both acting on genotype and environment. The action on genotype consists in breeding of genetic seedlings quality, while the one on environment concerns the adding of fertilizers [4].

Fertilizers are sources of plant nutrient that can be added to soil to maintain its natural fertility [5]. For optimum plant growth, nutrients must be available in sufficient and balanced quantities for plants. Mineral nutrients are inorganic elements that have essential and specific functions in plant metabolism which results in normal plant growth and crop production. These mineral nutrients are nitrogen (N), phosphorus (P), and potassium (K). It is well known that these mineral nutrients have great effects in plant growth and development [6].

In a study on nutrient absorption by crop plant and its relation to chlorophyll content, the results clearly indicated that green coloration of plant organs displaying chlorophyll is related to the amount of nutrients absorbed by the plant from the soil. Roy and Singh [7] also reported similar results in barley with vermi-compost applications. They also observed that application of organic manure resulted in higher leaf chlorophyll content than inorganic fertilizer. The greater chlorophyll content in leaves are important because photosynthetic activity and crop yield can increase with increased chlorophyll content of leaves [8].

Nonetheless, little work has been done on the combined effects of N, P, K on chlorophyll content of *gemor*. The acknowledge of the best combination of fertilizers used could improve the chlorophyll content of gemor leaves, and thus the yielding. Therefore, the objective of this study was to determine the effects of different combinations of N, P and K fertilizer on chlorophyll content of *gemor.*

2. MATERIAL AND METHODS

The present study was carried out at the laboratory and nursery, Banjarbaru Forestry Research Institute (BFRI), South Kalimantan, Indonesia. This experiment was conducted during Januray-March 2014. The average of minimum temperature varies from 18-21^{0}C and maximum varies from 30-33^{0}C. The seedlings of *Nothaphoebe coriacea* were used for this study. Fertilizers used for seedling were urea ($CO(NH_2)_2$), super phosphate (SP-36), potassium chloride (KCL), and dolomite ($CaMg(CO_3)_2$).

2.1 Experimental Design

Hundred seedlings of Gemor, with 6 months of age ~~and~~ with average of height of ~~are~~ 18.3 cm, diameter of 0.3 cm, and 6 fragments of leaves were used. Seedlings used in this study germinated from seeds and weaned in a polybag container using a mixture of peat and husk media (1:1).

A factorial in a completely randomised design was used. There were 5 treatments in the experiment and each treatment was prepared in quadruplicate. The treatments were as follows; (1) T1: as a control group without fertilizer; (2) T2: urea; (3) T3= urea+SP-36; (4) urea+SP-36+KCl; (5) T5 urea+SP-36+KCl+dolomite.

Treatment with fertilizers was carried out accroding to Yuwati *et al* [9] design. Each of seedling received 36.8 mg fertilizer per plant for each type of fertilizer twice a week for three months. *Gemor* seedlings are placed in areas that were given paranet with an intensity of 50%. Maintenance was done by watering seedlings every day in the morning and afternoon. The cleaning of the weeds that grow among the seedlings was done in the polybag. All these experimental procedures were carried out ~~in~~ for 3 months.

2.2 Total Chlorophyll Content Estimation

Total chlorophyll content was estimated according to the spectometry methods. The 100 mg fresh leaf was crushed in 20 ml of 80% acetone and the extract centrifuged for 10 min at 1000 rpm. Absorbance of the supernatant was recorded at 663nm and 645nm. They were read using a spectrophotometer. Chlorophyll content (expressed as mg/g^{-1} of each sample) was estimated according to [10] formula as follows:

Chlorophyll a (mg/g^{-1}) = 12.7 (A663) – 2.69 (A645) x VW

Chlorophyll b (mg/g^{-1}) = 22.9 (A645) – 4.86 (A663) x VW

Total Chlorophyll t (mg/g^{-1}) = [20.2 (A645) – 8.02 (A663) xVW]/1000

Where A = absorbance at the given wavelength, W = weight of fresh leaf sample, V = final volume of chlorophyll solution.

2.3 Statistical Analysis

All collected data were statistically processed by analysis of variance (ANOVA) using the SPSS software package version 16.0 for windows. Treatment means were compared using Duncan's Multiple Range Test (DMRT) at 5% level.

3. RESULTS

Regarding the effect of 5 applied treatments, 3 significantly different sets were evidenced. The first one, represented by treatment T1, was characterised by weak chlorophyll-a content in leaves. The second one, consisting of T2, T4 and T5 treatments, was marked by fair chlorophyll-a content in leaves. The third one, comprising treatment T3, differed from 2 previous by high chlorophyll-a content in leaves. Dispersion of measured values around each mean varied from 13.397 to 15.492 (Figure 1)

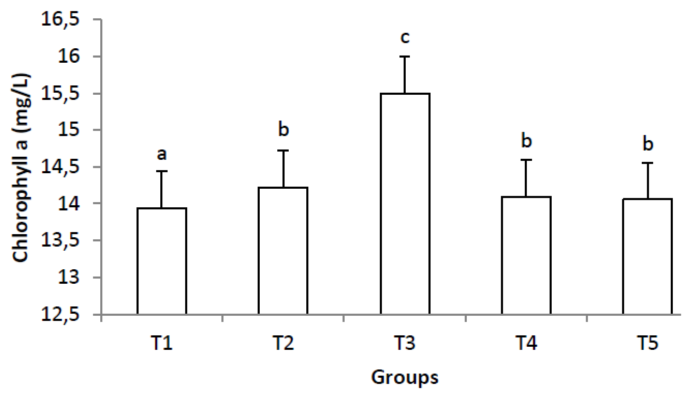

Figure 1: Means classification of chlorophyll-a content of leaves as a function of 5 tested treatments. Histogrammes surmounted by different letters are significantly different according to DMRT test at 0.05 level.

For the chlorophyll-b content, the first one, represented by treatment T1, was characterised by weak chlorophyll-b content in leaves. The second one, consisting of T2, T4 and T5 treatments, was marked by fair chlorophyll-b content in leaves. The third one, comprising treatment T3, differed from 2 previous by high chlorophyll-b content in leaves. Dispersion of measured values around each mean varied from 25.367 to 28.006 (Figure 2)

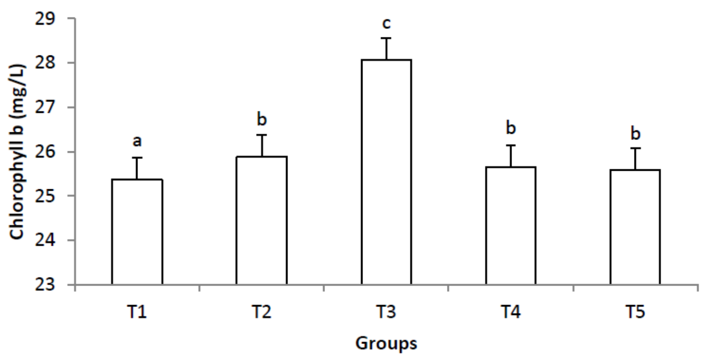

Figure 2: Means classification of chlorophyll-b content of leaves as a function of 5 tested treatments. Histogrammes surmounted by different letters are significantly different according to DMRT test at 0.05 threshold.

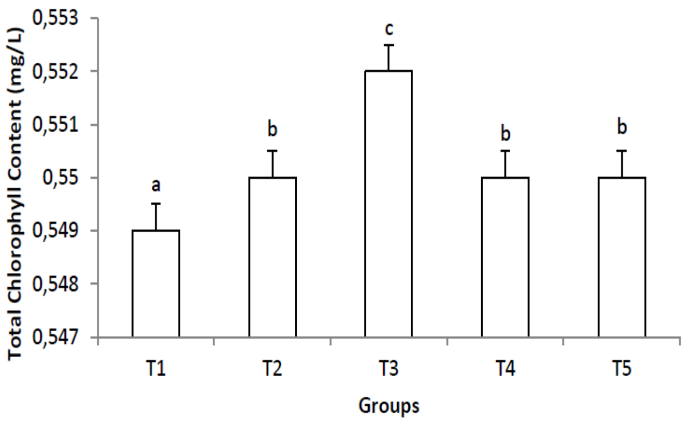

Figure 3: Means classification of total chlorophyll content of leaves as a function of 5 tested treatments. Histogrammes surmounted by different letters are significantly different according to DMRT test at 0.05 probability.

For the total chlorophyll content, the first one, represented by treatment T1, was characterised by weak total chlorophyll content in leaves. The second one, consisting of T2, T4 and T5 treatments, was marked by fair total chlorophyll content in leaves. The third one, comprising treatment T3, differed from 2 previous by high total chlorophyll content in leaves. Dispersion of measured values around each mean varied from 0.550 to 0.549 (Figure 3)

DMRT showed that all groups of treatments T2-T5 have significant total chlorophyll content in comparison with control ($p<0,05$). DMRT also showed that T3 have significant total chlorophyll content in comparison with all groups of treatments ($p<0,05$).

4. DISCUSSION

The fertilizers added to soil provides macronutrients and micronutrients, which are assimilated by plants and utilized for various metabolic activities to synthesize chlorophyll, required for their normal growth and developments [8]. In this present investigation, it was planned to study the effect of the combination of 4 organic and mineral fertilizers on chlorophyll content of *gemor*. Results show that chlorophyll a, b, and total content increased in treated groups compared to the control one. The plants treated with Urea + SP-36 showed maximum content as compared to control and other treatments. The present investigation indicated that *gemor* respond better with respect to chlorophyll content with combination treatment of Urea + SP-36 compared to another treatment with another combination.

Results of this study indicated that nitrogen (N) and phosphate (P) expressed the most influence on the chlorophyll content of *gemor*. N is of vital importance for plant growth due to being a part of amino acid, protein, enzymes and chlorophyll molecule [5]. N is required by plants in comparatively larger amounts than other elements. The presence of N in excess promotes development of the above ground organs with abundant dark green (high chlorophyll) tissues of soft consistency [11].

The result of this study also found in several previous study. It was observed that the application of N increased the chlorophyll content in leaves of the Aloe vera plants [12]. Verma *et al*. [13] recorded that the N content in the third leaf, chlorophyl a content increased with increasing nitrogen rate. Generally, the highest levels of chlorophyll 'a' and 'b' were obtained in the highest level of N [12].

Besides N, the results of this study also indicated that P affect the chlorophyll content of *gemor*. P is one of the most essential elements for plant growth after N. P plays a significant role in several physiological and biochemical plant activities like photosynthesis, transformation of sugar to starch, and transporting of the genetic traits [14]. P is important component which stimulates the photosynthesis and enters into the composition of rich energy compounds and strengthens roots of the plant. This leads finally to increase of the habit growth and chlorophyll content of the leaves [15]. These experimental results must be tested in on-farm trials before authorizing their popularization in peasants through the mulicolation and multi-year research trials.

5. CONCLUSION

From afore mentioned data, we conclude that the combination between urea and SP-36 showed significant enhancement for chlorophyll a, chlorophyll b and total chlorophyll content of *gemor* seedlings. These results must be tested in on-farm trials.

6. ACKNOWLEDGEMENT

Authors are thankful to Head of Ministry of Forestry, Forestry Research and Development Agency, and all staf of Banjarbaru Forestry Research Institute, Indonesia for supporting this research project.

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