Conference Paper

Preliminary Symptom of Teak (*Tectona grandis* Lf.) as Response of Deficiency and Excessive of Macronutrient

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Abstract

Teak (*Tectona grandis* Lf.) is prominent species which has been planted in Indonesia for a long time. Its silviculture technique also has been known well, such as planting system, pruning, and thinning. However, identification of morphology symptom as the response to deficiency and excessive nutrient is still lack. Observing morphology symptom is the easiest, cheapest, and fastest method to identify nutrient necessary for teak. This research aims to identify preliminary morphology symptom of teak at various levels concentration of Calcium (Ca), Magnesium (Mg), and Sulfur (S). This research was conducted in greenhouse, Intensive Silviculture Laboratory, Faculty of Forestry, Universitas Gadjah Mada started from June to September 2016. The experimental design was completely randomized design with eight treatments with tree replications as follows: control (without nutrient), complete (macronutrient 100 %), Ca1 (Calcium 0 %), Ca2 (Calcium 200 %), Mg1 (Magnesium 0 %), Mg2 (Magnesium 200 %), S1 (Sulfur 0 %), S2 (Sulfur 200 %). The preliminary symptom observed on leaves after teak stump treated for three months. The result showed that omission and addition of macronutrient resulting specific morphology symptom especially leaves.

Keywords: Calcium, Magnesium, Morphology symptom, Sulfur

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1. Introduction

Teak (*Tectona grandis* Lf.) has been planted in Indonesia, especially in Java Island for a long time since second century [1]. It does not only produce strong but also durable wood [2]. However, in the overseas timber market, worldwide production of teak which only about 3 000 000 $m^3 \cdot yr^{-1}$ is low compared with its demand [3]. The high price of teak wood leads forest community to plant it in their land [4]. It is also potential to develop in another area in Indonesia [5].

As a commercial species, optimization of its growth will be very profitable. Silviculture technique of teak has been known well, such as planting system, pruning, and thinning but information about nutritional requirement is still lack. Thus, defining the appropriate management of fertilization based on nutrient demands of this plant is difficult. The growth of plant can be optimum if adequate concentrations of essential nutrients to plant can be presented. Nutritional deficiency in plants is characterized by lower element concentration in substrate or when the chemical element is present in unavailable form for plant absorption [6] whereas nutritional excessive is identified by higher element concentration in substrate, most like occurs as a result of over application of fertilizer [7]. The symptom is manifested when nutritional deficiency and excessive are severe [6].

There are some methods to define the nutrient requirement of plant such; soil analysis, plant tissue analysis, and plant morphology symptom identification. Soil and plant tissue analysis are high cost and only can do by an analyst. Different from two ways previously, plant morphology symptom identification is easy and cheap way to guide for deficiency and excessive of macronutrient. It allows making quick decision on correct nutrient requirement and consequent action of fertilization [8]. In field, determination morphology symptom promoted by deficiency or excessive of nutrients is difficult because many factors influence plant growth. Hence, controlled research in a greenhouse using nutritive solution is necessary.

In this way, the aim of this study was to identify preliminary morphology symptom of teak at various levels concentration of Calcium (Ca), Magnesium (Mg), and Sulfur (S). Those nutrients were needed by plant in large number.

2. Methods

This research was conducted in greenhouse, Intensive Silviculture Laboratory, Faculty of Forestry, Universitas Gadjah Mada, Yogyakarta, Indonesia. Material of experiment was the teak seedlings which were produced from shoot cutting propagation. Six months old seedling was formed be stump before planted on silica sand (8 to 30) mesh. Stump form was made by cut shoot and root of seeding then left the stem. Length of stump which was used in this study is about 17 em. Teak stump was established for three months, from June to September 2016.

This experiment using completely randomized design with three replications including eigth treatments, namely: complete (macronutrients and micronutrients) refer to Viégas et al. [9] which is applied on teak by Silva [3], and individual omission and addition of each nutrient, Ca1 (zero level of calcium), Ca2 (double concentration of calcium), Mg1

(zero level of magnesium), Mg2 (double concentration of magnesium), S1 (zero level of sulfur), S2 (double concentration of sulfur), and control (zero level of both macronutrients and micronutrients, watering by aquadest).

The stumps were transplanted to 19 cm in diameter and 20 cm of height polybags, with a perforated base in order to facilitate the disposal and replacement of the nutrient solution being used in the experiment. For acclimatization stump watering by aquadest every day for 5 d, before treatments were initiated. Stump watering by treatment solution every day. A month after treatment some shoots sprouted up from each stump. The observation focus on one shoot thus singling was done to left the best shoot. All parameters were observed 2 mo after treatments were initiated.

Parameter observed in this research were amount of leaf, diameter and length of shoot, length of Internode, size of leaf and morphology symptom of teak. Diameter that was measured 1.5 cm from base of shoot. Length of shoot was measure from base of shoot to base of the youngest petiole. Size of leaf determines by average of multiplication of length and wide of leaf. Leaf length was measured from base to tip, while wide was measured from widest part of leaf. Based on size of leaf which was measured in this experiment, leaf size divided into some categories which is shown at Table 1. Morphology symptoms, especially on leaf were characterized, described and photographed

TABLE 1: Categories of size leaf based on multiplication of length and wide of leaf.

Size (mm^2)	Categories
1 to 85	Narrow
86 to 170	Medium
171 to 255	Wide

3. Result and Discussion

The omission of macronutrient and micronutrient (control) affected growth of shoot teak when compared to another treatments (Table 2). The parameters growth value of control is lowest. Although, complete treatment was treated with complete solution but did not show the best result. Its diameter and length of shoot are lower than omission and addition treatments. The number of its leaves also less than them. Complete treatment cannot result in the optimum leaf size. It is may indicate that the complete solution in this research is not proper for teak stump. Consequently, the symptom which observed in this research are various. According to the functional requirement of nutrient and characteristic of redistributed between organs, the symptom of calcium and sulfur deficiency should be showed in younger leaves but in this experiment, the symptom showed in

both younger and older. Magnesium deficiency should appear in older leaves, but in this observation not only in older but also in younger.

Table 2: Effect of nutrient on growth parameters of teak.

Treatments	Amount of Leaves	Diameter of Shoot (mm)	Length of Shoot (cm)	Length of Internode (cm)	Size of leaf ($1 \cdot mm^2$)	Leaf Size Categories
Control	11	6.06	1.38	0.25	18	Narrow
Complete	13	8.75	5.00	0.86	68	Narrow
Ca1	17	14.90	12.47	1.37	217	Wide
Ca2	17	13.92	10.50	1.11	188	Wide
Mg1	18	15.23	12.45	1.18	254	Wide
Mg2	14	10.50	7.00	0.86	142	Medium
S1	16	15.38	14.75	1.41	222	Wide
S2	18	16.55	15.43	1.91	185	Wide

3.1. Morphology symptom promoted by omission and addition calcium

The symptom of Ca deficiency resulting in the appearance of interveinal chlorosis of younger leaves, the irregular margin of younger and older leaves, also necrotic in the edge of younger leaves. Calcium is required for membrane integrity and function. It is cannot be exported to deficient tissues since calcium is not transportable in the phloem [10]. Deficiency symptom of Ca in *Ananas comosus* (L.) Merr., initially the new leaves have developed light green color in the center of the blade and in the edge of the leaves [6]. While in *Swietenia macrophylla* King identified by deformation of younger leaves that had bent to their ventral surface [8]. The symptom of Ca excessive characterized by younger leaves that had bent to their ventral surface, uniform chlorosis of older leaves, irregular edge of younger leaves, and interveinal purplish of younger leaves.

3.2. Morphology symptom promoted by omission and addition of magnesium

A deficiency of magnesium showing uniform and interveinal chlorosis of older leaves, leaf necrosis which started from it margin, and interveinal chlorosis of younger leaves. Others experiment showed that symptom of magnesium deficiency of teak resulting chlorosis interveinal in secondary ribs, while remaining was green, in older leaves [3]. Magnesium deficient taro has leaf blade with yellowing between the veins, particularly in older leaves [11]. A major function of magnesium is as co-ordinated metal in chlorophyll.

This nutrient is exported from old leaves [10]. An excessive of magnesium characterized irregular edge of younger leaves, the form of youngest leaves is curly, and interveinal chlorosis which process progressed the necrosis occurred.

3.3. Morphology symptom promoted by omission and addition of sulfur

The symptom of sulfur deficiency resulting uniform chlorosis of older leaves. Sulfur is essential for the formation of protein containing the amino acids, cysteine, and methionine. It is poorly phloem mobile [10]. Sulfur deficiency in *A. comosus* identified by the occurrence of a light brown color in the center of the leaf blade and by the appearance of a light green color along the banks of the upper leaves [6]. While in eucalypts the interveinal area of expanding leaves turn pale green. With time, the leaves become uniformly yellow and symptom spread from expanding to fully expanded leaves [10]. The omission of sulphur of *S. macrophylla* showed light green color in young leaves [8]. On the other hand, younger leaves of teak showed lighter green color. An excessive of sulfur affected older leaver cup upward. It also can determined by uneven leaf of younger leaves, interveinal tissue was not form.

4. Conclusion

The result showed that omission and addition of macronutrient resulting specific morphology symptom especially leaves.

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