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Research Article

Physiological Characteristics of Soybean Leaves with and without Shading at Palm Oil Plantation, West Papua

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Abstract

The objective of this research was to identify the validity of physiological characteristics of the three species of soybean with and without the shading of the Palm Palm Foundation. The research was carried out in the palm oil plantation area of PT. Medcopapua Hijau Selaras, Prafi District, West Papua, June 2014 August. This study used a Randomized Complete Design with the right replication environment environment conditions (shade and with shade). These conditions are soybean variants, consisting of Detam1, Demas1 andDena 1.Leaf samples were collected at heven weeks after planting. Conditions without shade increase chlorophyll bby 0.1334mg / g compared to shaded. The Dena 1 variety has highest chlorophyll a, b and chlorophyllyl total (1.1039.0.5587 and 1.6627 mg / g). Allsoybean varietal variety of different differences of anthocyaninor carotene leaves.

Keywords: Chlorophyll A, Chlorophyll B, Anthocyanin, Carotene

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Introduction

Increased soybean production can be done by expanding planting areas and increasing productivity. Utilization of areas under oil palm shade is an alternative to expanding soybean cultivation. In this way, oil palm plantations contribute to supporting national food security (PPKS, 2007). This system has a very big chance to be applied in West Papua. The area of oil palm plantations in West Papua is around 57398 Ha (owned by PTPN) where13157 Ha are owned by smallholder (BPS, 2012). Data shows that soybean harvested area in West Papua in the period 2009 - 2011 was 1150, 571 and 375 ha with an average productivity of 1.05 tons/ha.

The main limiting factor for planting in the shade is the low intensity of sunlight (Mathew et al. 2000; Bellaloui et al. 2012; Abdel-Wahab). According to Asadi et al. (1997) oil palm plantations of 2-3 years TBM cause shading of 33-50%, while 20% shade is classified as inappropriate for soybeans (Adisarwanto et al. 2000).

This condition will lead to the changes in morphology and physiology as a strategy for dealing with stress. Chairudin et al. (2015) and Muhuria et al. (2006) reported that shade conditions caused an increase in chlorophyll aand chlorophyll b, but reduced the ratio ofchlorophyll a/b. In addition, Soverda (2011) added shade to soybeans to increase the carotenoid content.

Agronomic actions aim to increase the productivity of soybeans in the shade. The ability of soybeans to photosynthesize in these conditions is an adaptation mechanism so that information about leaf physiology character needs to be known for evaluation of tolerant varieties. This study was aimed was aimed to identify several leaf physiological physiological characteristics haracteristics and the growth of eight three soybean varieties at three different spacing under oil palm shade.

Materials and Methods

The research were carried out in the oil palm plantation area of PT. Medcopapua Hijau Selaras, Prafi District, West Papua from June to August 2018. Samples were planted in oil palm plantation aisles using the Randomized Block Design method with three replications on two environmental factors (shade and without shade). The second factor is soybean varieties, consisting of Detam 1, Demas 1 and Dena 1. Analysis of leaf chlorophyll, anthocyanin and carotene are carried out in the Postharvest Laboratory, Department of Agronomy and Horticulture, Bogor Agriculture Institute, Bogor.

Previously, oil palm aisles were cleared and soil samples were taken for initial analysis. Then, making a plot (2 m x 4 m) and enclosing the research site. Provision of manure (10 tons/hectare) is carried out one week before planting while fertilization is followed (Ponska) at three weeks after planting (WAP). Each hole is filled with two soybean seeds per hole and at one WAP, soybeans are given a buffer because of etiolation. Leaves for analysis of chlorophyll, anthocyanin, and carotene were carried out at seven WAP.

Data analysis was performed using variance analysis with 95% confidence level and continued with Tukey test. Processing data using Minitab 16 statistical programs.

Results and Discussion

Analysis of variance showed no interaction between environmental conditions and soybean varieties against the content of chlorophyll a, chlorophyll b, ratio of chlorophyll a /b, total of

chlorophyll, anthocyanin and carotene leaves. The single factor of the variety was very significant in affecting the content of leaf chlorophylla (Figure 1).

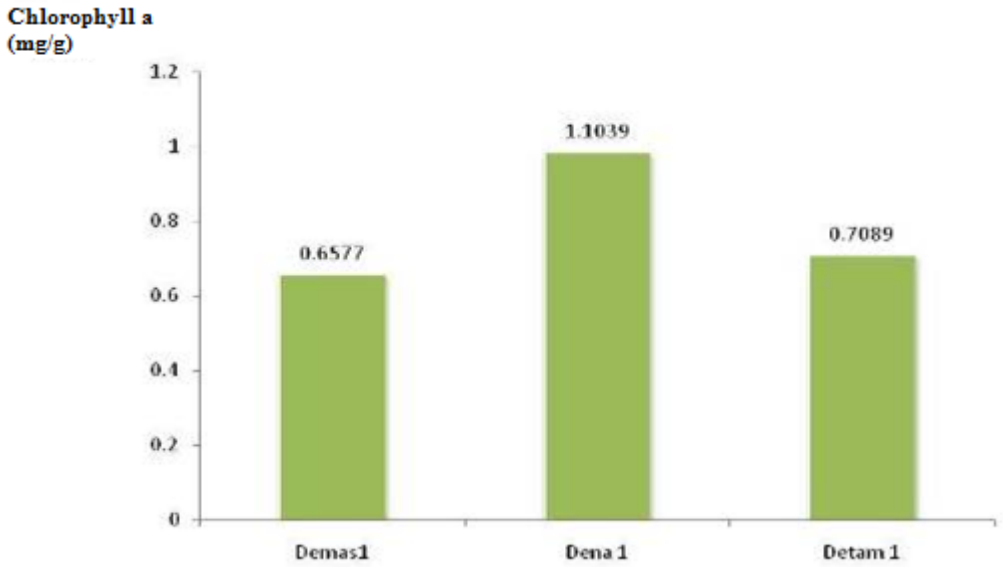

Figure 1. Chlorophyll-a content of each soybean variety

The Tukey tests showed that Dena 1 variety had the highest chlorophyll a content (1.1039 mg/g), significantly different from Detam 1 and Demas 1 (0.7089 and 0.6577 mg/g). There is no difference between chlorophyll a content in shade and without shade conditions. Thisisallegedlydue to the light intensity in shaded conditions that allows the leaves to photosynthesize so that chlorophyll b does not increase. The results of this study support the report of Darma et al. (2012) which suggested that the use of 50% shade did not affect the chlorophyll a and b levels of soybean leaves, however the real response was indicated by soybean varieties.

The light intensity of the shade conditions during the study was 7550 lux, while individual soybean leaves would be fulfilled at an intensity of 23680 lux. The light intensity of 7550 lux is classified as 40% shaded by paranet shade (400-15000 lux) (Pradnyawan et al. 2005). According to Salisbury and Ross (1995), 1000-40000 lux is classified as high light intensity.

Dena 1 is a soybean variety which is shade tolerant with higher chlorophyll a and b content than Demas 1 and Detam 1 (when shaded and not shaded). Although this study shows there is no interaction between the two conditions, each variety showed different response under different conditions (Figure 2).

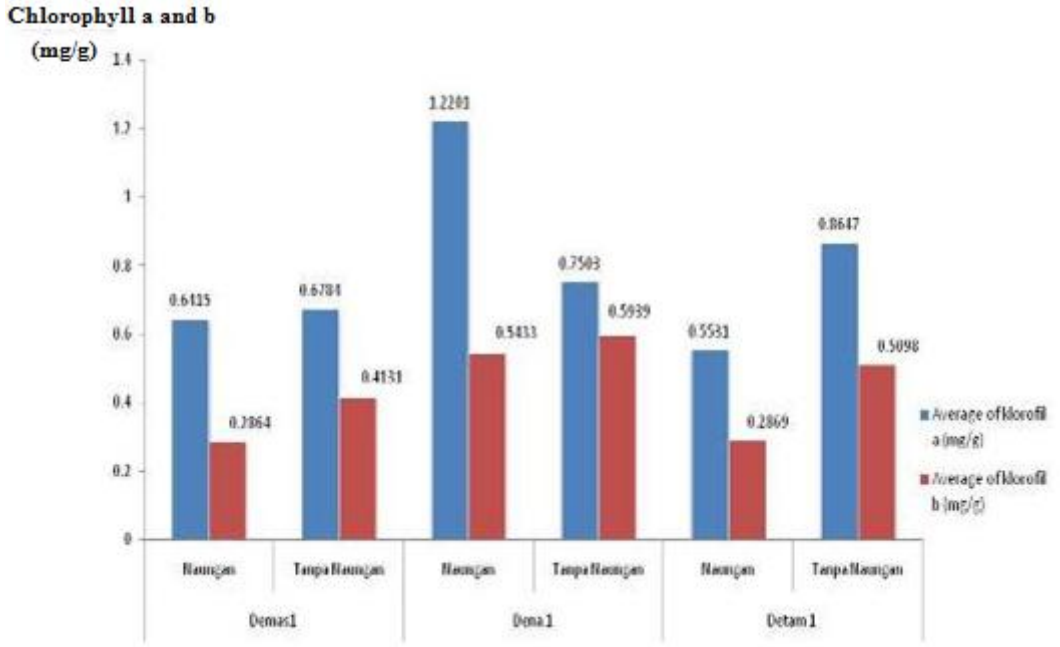

Figure 2. Chlorophyll a and b content for each soybean variety in shade and without shade conditions

In figure 2, Dena 1relatively has a higher chlorophyll a content compared to Demas 1 and Detam 1 in different conditions (Shade: 1.2207 mg/g; Without shade: 0.9855 mg/g). Palm oil shadeon Dena 1 increasedthe chlorophyll a content by 0.2352 mg/g. Chairudin et al. (2015) reported six soybean varieties that grew in shaded conditionshas increased amount of chlorophyll a and chlorophyll b. Pradnyawan et al. (2005) reported the similar results, where 70% shade conditions could produce the higher chlorophyll a leaf content (4.126%) than without shade (3.393%). The same result were also obtained by Salisbury and Ross (1995) where the amount of chlorophyll that is more in the shade serves to maximize light absorption. This condition is thought to be the reason for the high chlorophyll a and b of these varieties in terms of the influence of a single variety factor.

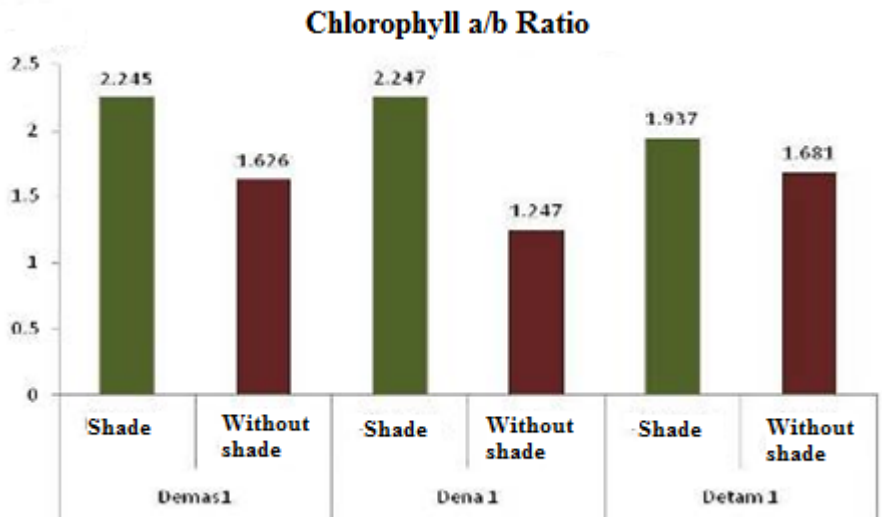

Figure 3. Chlorophyll a/b ratio for each soybean variety in shade and without shade conditions

The difference content of chlorophyll a and b for each variety is also thought to be influenced by the ability of these varieties in the synthesis of chlorophyll. This statement was supported by Ai and Banyo (2011) where the plant pigments development is influenced by plant genetic factors, such as differences in gene expression that received.

The Tukey tests showed that shade conditions caused the higher chlorophyll a/b ratio (2.1432) than without shade (1.5178) in soybean leaves (Figure 3) and this result confirms that there is no increase in chlorophyll b due to oil palm shade. Allegedly due to an increase of chlorophyll a compared to chlorophyll b and causing a higher ratio of chlorophyll a/b

The results of Tukey tests showed that the conditions without shade caused the soybean leaves to have higher carotene (0.5008 mg/g) compared to shade (0.3762 mg/g) (Figure 4). Carotene is a flavonoid compound that can increase due to the influence of light (Salisbury and Ross, 1995). This pigment can be found in chloroplast with chlorophyll or as a chromoplast (Mlodzinska, 2009). In addition, Kurniawan et al. (2010) also suggested that the ability of carotene synthesis is influenced by genetic differences.

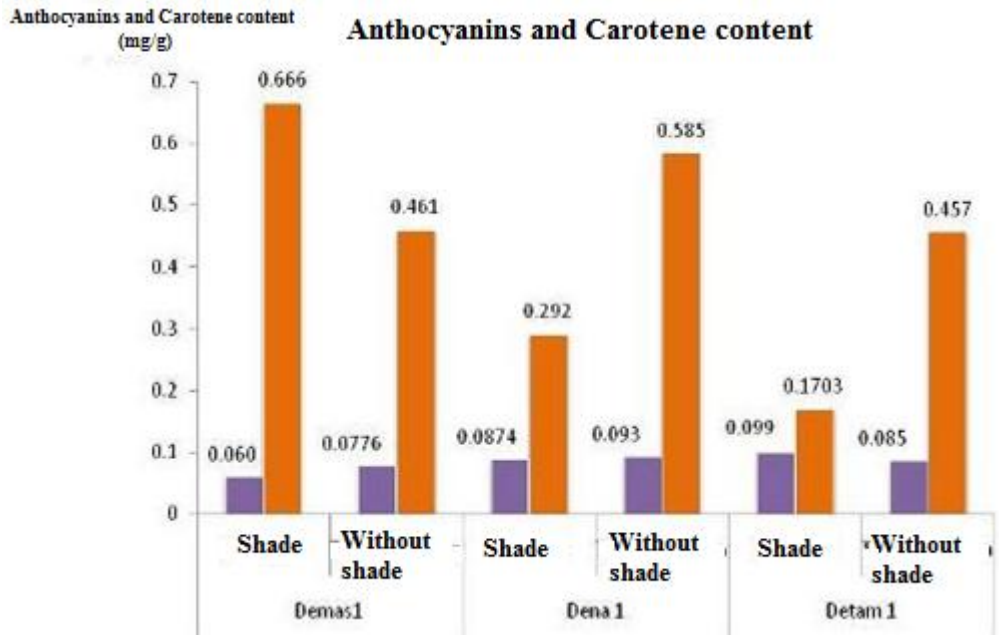

Figure 4. The Anthocyanins and Carotene content of each soybean variety in shade and without shade conditions

Meanwhile, the environmental factors, varieties and their interactions do not affect to the content of soybeans anthocyanin pigment (Figure 4). This response may occur because anthocyanin synthesis activities are inhibited by the synthesis of chlorophyll (Dodd et al.1998). The stability of non-enzymatic anthocyanins is also influenced by pH, temperature, and light (Salisbury and Ross, 1995).

Conclusions

Shade and without shade conditions did not caused any changes in chlorophyll a, chlorophyll b, ratio of chlorophyll a/b, carotene, and anthocyanin content of soybean leaves. Dena 1 has the highest contains of chlorophyll a, chlorophyll b, and ratio of chlorophyll a/b. Conditions without shade produce higher carotene content than shade. Shade and without shade conditions did not caused any changes in chlorophyll a, chlorophyll b, ratio of chlorophyll a/b, carotene, and anthocyanin content of soybean leaves. Dena 1 has the highest contains of

chlorophyll a, chlorophyll b, and ratio of chlorophyll a/b.Conditions without shade produce higher carotene content than shade.

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