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Physiological Process of *Acacia mangium* Willd. Plant of Six Months Old Attacked by Black Spots Disease in PT Itci Hutani Manunggal Terunen

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Abstract *- The purposes of this study were to determine symptoms and signs of black spot disease on mangium plants of 6 months old, frequency of the attacks and their effects on physiological processes of affected phyllode (amount of chlorophyll, transpiration, evaporation and water potential of phyllode). Fieldwork was conducted in the research plots measuring 25 m x 25 m) in mangium plantation. Observed plants were 6 months old amounted to 104 plants at a spacing of 3 m x 2 m, the seedlings were originated from Riau Islands. Plants were observed in the census in research plots .The results showed that the black spot disease was caused by a fungus Meliola brisbanensis with symptoms of black spots on phyllode, where the spots occured more on the upper surface than the lower surface. Other than phyllode, young part of the stem was also attacked. Attacked phyllode changed in color from green to yellow (chlorotic). Frequency of attacks on plot of 6 months old was 62.5%. The amount of chlorophyll in phyllode attacked by black spot fungus was 40.8 Spad. Transpiration velocity had the value of 1284.26 gr/dm²/second, evaporation rate of 0.00019 gcm²/minute. Water potential of phyllode at 08:00 to 10:00 a.m was 18 bars, at 12:00 a.m to 14:00 p.m 21.2 bars and at 4:00 p.m. to 6:00 p.m. was 9 bars. Environmental factors that influence the physiological process of black spot fungus were soil pH, irradiation intensity, water content of soil and were influenced by factors inside of the black spot disease itself.*

Keywords *— Physiological process, black spot, Acacia mangium, ITCI;*

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I. INTRODUCTION

Acacia mangium Willd. (mangium) belongs to species of legumes that grows fast, does not require a high growth requirements, the plant is able to grow on poor soils and infertile as grassland, logged-over forest, rocky land, eroded soil, soil with low pH and adaptable to local environment (Retnowati, 1988). However, survival rate of mangium usually decreases with increasing age of the plant, this is due to, among others: (i) decrease in plant resistance to extremes environmental as well as the application of silvicultural techniques and the habitat that are not appropriate, (ii) competition with other vegetation, (iii) the possibility of pathogen attack.

Based on the results of research on wood and bark of mangium which included basic characteristics and technology of product processing proves that this species of wood can be used for various purposes of use. Mangium wood has high economic value because it is a good material for veneer and interesting furniture such as cabinets, doors and window frames as well as good for the fuel. Mangium plants of seven and eight years old produce wood that can be made for good particle board (Nair, 2001).

All plant pathogens adversely affect the growth and development of their host. Pathogen attack can change the control system in the form of hormones, increase of respiration speed, inhibition of chlorophyll formation or shortage of chloroplasts in the leaves. Thus the photosynthetic capacity is reduced when compared to healthy leaves, although initially slightly higher than the healthy leaves (Agrios, 1996). On plant disease which the pathogen infects leaves, transpiration (evaporation) is

usually increased. This is due to the destruction of at least part of the leaf cuticle protection, increased permeability of leaf cells and stomata dis-function. After a severe attack of pathogens then transpiration decreases. All living plant cells require adequate water and the amount of organic and balanced inorganic nutrients for survival and passage of physiological functions. Many plant pathogens with one or more patterns disrupt the translocations of water and nutrient in plants. Some pathogens disrupt the integrity or function of the roots, causing reduction of water absorption.

This research was conducted at PT ITCI Hutani Manunggal Terunen. While reported by the company, that there had occurred the attack of plant pathogen on mangium plantation, which the kind of pathogen was not known. Intensity of their attacks was as much as 15%, although there had been intensive efforts to control since the beginning of plantation up to the age of 5 years.

The purposes of this study were to determine: i) Symptoms of black spot disease at the age of 6 months of mangium plants. ii) The frequency of attacks. iii) Effect of black spot fungus attacks on the plant physiological processes (amount of chlorophyll, transpiration, evaporation and water potential of phyllode).

This study is expected to be a reference for planting mangium, researchers and other parties concerned as well as to material of information about the presence of black spot disease and is expected to be a material of consideration in the efficiency of disease control efforts.

II. Materials and Methods

1. Field Research

Research plot and number of plants.

Research plot measured 25 m x 25 m (625 m^2). Number of the whole plants of *mangium* were 104 plants of 6 months old with the spacing of plant 3 m x 2 m, the seeds were originated from Riau. On each plant in the sample plot was observed the symptoms of disease, signs of disease and physiological processes of affected phyllode. Trees that had been observed were marked with red rapia rope tied to the tree in order to avoid repeated observations and given the red tape for numbering the markers on the trees that had been observed. Observations of the attack were carried out just once.

Symptoms of black spot disease.

Symptoms of black spot disease were determined by looking at the symptoms at each plant mainly the phyllodes and then noted whether there was any plant disease.

Physiological process of plant.

The data recorded in the field were to take attacked phyllodes of mangium to measure the amount of chlorophyll, the speed of evaporation and transpiration and water potential. Sampling of mangium phyllodes were conducted by systematic random on affected plants. Testing was repeated 3 times and then the value of the test results were averaged.

Number of chlorophyl of phyllodes.

Chlorophyll content was measured with a Minolta SPAD Chlorophyl Meter.

Transpiration.

Transpiration velocity was measured by using the method of cobalt paper.

Evaporation

a. Calculate the area phyllodes of mangium. The formula to calculate the area is as follows:
Wide of phyllode = (weight of cutted paper picture of phyllode x wide of paper) / weight of paper
b. Calculating the speed of evaporation. Evaporation = time / surface area (Pratama dkk., 2009).

Water potensial of phyllode.

Phyllode water potential was measured with a Pressure Chamber Type PMS -1002.

Environmental factors.

Data of environmental factors recorded in the field were air temperature and humidity, precipitation, altitude and soil content.

2. Research in the Laboratory

For identification of symptoms of black spot disease (fungus) was conducted by looking at the following preparations: preparations were observed with a microscope at a magnification of 10 x 40. If the result was clear, then photographed with a microscope photo micro grapic or if it was not clear then made a sketch of the fungi. Identification of fungal species was done by using the identification keys in the literature by Lilly and Barnett (1951), Old *et al.* (2000).

Data Analysis

Frequency of pathogen attack.

To determine the frequency (F) of attack on a plantation stand, it was used a formula according to James (1974) as follows: F = (number of infected plants / total number of plants observed) x 100%

Physiological process of plant

Transpiration velocity on the infected phyllode was calculated by the formula: G = 3600 / T, where G = transpiration velocity (µgr/cm^2/detik). T = time needed for changing color of cobalt paper.

Evaporation velocity was calculated by the formula:
Evaporation = time of measurement / surface area of phyllode sample

Water potential of phyllode was measured using Presure Chamber Type STD -1002. Measurements were made with a measurement time period, i.e morning (8:00 to 10:00), (10:00 to 12:00) and afternoon (16:00 to 18:00 o'clock).

To evaluate the effect of melt temperature on the injection molding of PP T30S, experiments were performed at melt temperatures of 155.8, 158.4, 162.3, 170.1, 178.1 and 186.2 °C (in practice, the controlled variable is the barrel temperature with the setting values of 180, 185, 190, 200, 210 and 220 °C). Meanwhile, all other factors (as shown in Table 1) remained unchanged.

During the process of injection molding, melt pressures and temperatures were measured.

In the similar method, each factor was analyzed by varying its set value and keeping the other ones at the default value. All possible values of each factor are shown in Table 1, and the ones in brackets are the default. Because the driving motor of the test apparatus is the type of speed control, in this study the holding pressure of the traditional processing parameter was replaced by the moving speed of the plunger during the packing phase, namely packing speed.

III. Results and Discussion

Symptoms, Sign and Frequency of Attack

Black spot disease or black mildew disease was a disease with symptoms of black spots on phyllodes which more occured on the upper surface than the lower. Other than phyllode, the young stem of the tree was also attacked. Infected phyllode changed in color from green to yellow (chlorotic). Symptoms of such diseases caused by fungi *Meliola brisbanensis* (family Meliolaceae, orders Meliolales). Symptoms of fungal attack by *M. brisbanensis* presented in Figure 1.

Fig. 1 Phyllode and stem of mangium infected by *Meliola brisbanensis*

Meliola brisbanensis had been reported to occur also in *A. auriculiformis* and *A. mangium* in Queensland (Old *et al*., 1997) and *A. dealbata* in Malaysia (Singh, 1980). Gading (1988) in Old *et al*., (1997) reported as *M. adenanphererae* Cit.& Hansf. Insect legs might become the main means of spread of this disease.

Among 104 plants observed, the plant at the age of 6 months which were affected as many as 65 plants (62.5%). The high frequency of this disease was caused by higher air humidity in the age of 6 months plantation (88%), where this condition was very suitable for the development of the fungus *M. brisbanensis*. Mochida *et al*. (1987) and Koesmaryono (1993) stated that the relatively high air humidity throughout the year is a potential condition for the emergence of pests and plant diseases, especially the condition of air humidity around the plant.

Physiological Process of Plant

Amount of chlorophyl.

The low content of chlorophyll in the affected phyllode by black spot disease in the plot of 6 months old likely due to very acidic soil pH (4.4) and the availability of very low water content. The pigment of chlorophyll degradation can occur in low pH and high temperature. This was the cause of pheophytinization process, that was the Mg_2 ion release process. The amount of chlorophyll in the phyllode atacked by black spot disease was 40.8 Spad. Water shortage affected all aspects of plant growth which included physiological processes, biochemistry, anatomy and morphology.

One of the physiological response of plants to water shortage is a decline in leaf chlorophyll concentrations that can be caused by the formation of chlorophyll inhibited, decreased of ribulose-1,5-bisphosphate carboxylase oxygenase (rubisco) enzyme and inhibition of absorption of nutrients, especially nitrogen and magnesium, which plays an important role in the synthesis of chlorophyll.

Transpiration rate.

Phyllode transpiration rate attacked by the black spot disease was 1284.26 gr/dm^2/second, this figure was very high when compared with healthy phyllode (421.89 gr/dm^2/second). This was likely due to moderately light intensity (48%) in plot of 6 months old, thus affecting the stomata to open widely which can further increase the velocity of transpiration.

On the plant disease which the pathogen infects leaves, transpiration (evaporation) is usually increased. This is due to the destruction of parts that provide protection against the leaf that is cuticle, increased permeability of leaf cells and disfunction of stomata.

Rate of evaporation.

Based on calculations, the rate of evaporation on the affected phyllode attacked by black spot was 0.00019 gr/cm^2/minute. It was also due to the intensity of radiation in the plot of 6 months old was 48% can increase the rate of evaporation. When compared with healthy phyllode evaporation rate (0.00019 gr/cm^2/ minute), then the effect of environmeltal factors seemed to be less influential, but the activity of the fungus *M. brisbanensis* which can increase the evaporation rate. Furthermore it could affect a wide open of stomata which could further increase the rate of transpiration. According to Fitter and Hay (1992), high intensity of light would increase the air temperature and lower relative humidity, so that the increase would affect the rate of evaporation that could increase of the transpiration of plants.

Water potential of phyllode.

Based on the measurement results, the water potential of phyllode of mangium infected by black spot disease at 8:00 to 10:00 a.m. at the age of 6 months was 18.00 bars. At 12.00-14.00 p.m was 21.20 bars and at 16.00-18.00 p.m was 9 bars. This means that phyllode infected by black spot disease with a value of 9 bar had light stress at 16:00 to 18:00, while in the morning and afternoon had severe stress. With light to severe stress conditions, it could cease the growth of leaf cells (Fitter and Hay, 1992). This happened because of the availability of ground water at 6 months old mangium plant was low and also high intensity of irradiation.

IV. CONCLUSIONS

Black spot disease or dark mildew disease is a disease with symptoms of black spots on phyllodes which is more occured on the upper surface than the lower. Besides phyllode, the young stem was also attacked. Black spot disease caused by the fungus *Meliola brisbanensis*. Frequency of black spot disease was 62.5%. The amount of chlorophyll in phyllode attacked by the black spot disease was 40.8 Spad. Transpiration rate of infected phyllode was 1284.26 gr/dm^2/second. Evaporation rate was 0.00019 µgr/cm^2/minute. Water potential of infected phyllode at 08:00 to 10:00 a.m in the plot of 6 months old was 18 bars, at 12:00 to 14:00 was 21.2 bars, while at 16:00 to 18:00 was 9 bars.

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