The role of planting media and mulch in the growth of *Leptopus antigenon* as a beneficial plant on oil palm plantation

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Abstract. Oil palm is one of the important plantation crops in Indonesia. Oil palm is also a potential source of foreign exchange. In sustainable oil palm plantation management, pest and disease control are factors affecting FFB yield. A fireworm is a pest for oil palms. Biological control of fireworm in oil palm plantations is conducted by planting *Antigonon leptopus*, which produces nectar for parasitoid hosts and the caterpillars' predators. The growth and development of oil palm trees are affected by planting medium and maintenance. This study aims to obtain the best media and mulching composition for growing *A. leptopus*. The study uses a completely randomized design (CRD). The planting media treatment consists of various ratios of soil, sand, and manure (T0, T1, T2, T3 and T4). The mulch treatment consists of mulching (M0) and without mulching (M1). The parameters observed included length of tendrils, number of leaflets, total dry weight, root dry weight, shoot ratio, number of flowers, and flowering plants. The results showed that planting media did not affect seed germination and viability. The ratio of planting media (2:1:1) combined with mulching gave the best vegetative growth and number of flowers for *A. leptosus*.

1. Introduction
Oil Palm is one of the plantation crops that have an important role for Indonesia as the main commodity to export, increasing Indonesian income. These commodities are also a potential source of foreign exchange because they can occupy the plantation sector's top order of production. Oil Palm is one of the immigrant plants from West Africa whose cultivation has grown very rapidly in Indonesia and is still the main source of foreign exchange from the agricultural sector. Lands that are agronomically suitable for the use of land for oil palm have positively impacted the development and improvement of people’s lives [1].

Oil palm cultivation requires significant handling, both from soil cultivation, soil nutrient content, and weed control. Several factors, including soil fertility, climate, superior seeds, and pests and diseases, are determined by good plant growth. Even though environmental factors have been met, oil palm plants will not grow optimally if pests and diseases still attack them. This requires continuous and integrated pest control. Pest and disease control is useful to prevent an explosion of pest and disease populations as early as possible. One of the pests that can attack oil palm plants is the fire caterpillar. Oil palm leaf-eating caterpillars can generally be found at all plant ages. The fire caterpillar has caused many persistent problems with long time exploitation.

Technical, chemical and biological controls can carry out pest control. Chemical control is carried out if a pest attack has passed the economic threshold, while for biological pest control, it can be done by planting a beneficial plant such as Turnera subulata, *Casia cobanensis*, *Antigonon leptopus*. 
Antigonon leptopus can be used as a caterpillar control because it has the liquid or nectar needed by pest control agents as parasitoid hosts and predators for palm leaf-eating caterpillars or as alternative prey hosts for palm leaf-eating caterpillars [2][3][4]. The Sycanus beetle, as one of the caterpillar predators, has the following mechanism, after the beetle sucks honey from the Antigonon flower, the female beetle, which will lay eggs, puts her eggs into the body of the caterpillar. When the Sycanus larvae hatch, they will eat the fire caterpillar's body fluids, causing the caterpillars to die.

The plant growth is influenced by the conditions of the planting medium and the environment. There are many media alternatives to use, provided that it is easy to get, the price is cheap, and it can hold water. Planting media that are often used are a mixture of soil, sand, and manure.

Based on these problems, this study aims to obtain the best media composition and mulching for the growth and flowering of the Antigonon leptopus.

2. Methods
The research was conducted for seven months in November 2019 - May 2020 at the Cikabayan Educational Garden, IPB University. The tools used in the research were a 100 cm ruler, sprayer, bucket, pot tray, stakes, tape, labels, markers, scissors, polybags, hoes, 0.5 cm x 0.5 cm sieve, analytical scales. Meanwhile, the materials used were the seeds of Antigonon leptopus, water, soil, sand, manure, and corn mulch.

The planting media used in this research were soils, river sand, and manure. Soil and sand are filtered first to separate large particles using a 0.5 x 0.5 cm sieve. Then each one is composited according to the treatment. Corn mulch is obtained from dry corn husks and leaves, then coarsely chopped and put into polybags according to treatment.

The experimental design used in the study was factorial Completely Randomized Design (CRD). This study used 1 type of mulch and one control (M0, M1) and four kinds of growing media and one control (T0, T1, T2, T3, T4). The number of treatments tried was 5 x 2 = 10 treatments, each treatment was repeated three times, and each treatment contained three units. The number of experimental units used is 10 x 3 x 3 = 90 experimental units. The study design consisted of 2 treatment factors, which were described as follows:

The first factor is the difference in planting media which consists of 5 levels, namely: TO = Soil, T1 = Soil + Sand + Manure with 2:1:1 ratio (v/v/v), T2 = Soil + Sand + Manure with 1:1:1 ratio (v/v/v), T3 = Soil + Sand with 1:1 ratio (v/v), T4 = Soil + Manure with 1:1 ratio (v/v).

The second factor is the provision of mulch, which consists of 2 levels: M0:Control and M1: Plants With Corn Mulch. The experiment model was:

\[ Y_{ijk} = \mu + \alpha_i + \delta_{ik} + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk} \]  

Notes:
- \( i = 1,2 \)
- \( j = 1,2,3 \)
- \( k = 1,2,3, ..., 5 \)
- \( Y_{ijk} \) = The value of observations on the differences in the types of planting media at stage i, giving mulch to level j, and repetitions k.
- \( \alpha_i \) = The influence of the growing media factor
- \( \beta_j \) = The influence of the factors dedicating mulch to j
- \( \delta_{ik} \) = The influence of the random component of the main plot which spreads normally
- \( (\alpha\beta)_{ij} \) = The influence of the interaction component of the planting media factor and the factors of mulching
- \( \epsilon_{ijk} \) = The random influence of a normally scattered subplot

Criteria for analysis of variance, if:
- \( P\text{-value}>\alpha \) (0.05), the treatment has no significant effect on the parameters tested.
- \( P\text{-value}<\alpha \) (0.05), the treatment has a significant effect on the parameters tested.

If the variances give real results, then the Duncan test is carried out at an error level of 5% to determine the difference between treatments.
3. Measurement and observation
Parameters observed and measured were seed germination (%), growth in tendrils length (cm), increase in the number of leaflets (number of strands), root dry weight (grams), crown dry weight (grams), root length (cm), ratio root shoots, percentage of interest (%), and number of flowers.

3.1. Seed germination (%)
It was done by counting and observing the number of seeds germinated and the total seeds germinated every day for seven days

\[
\text{Germination} = \frac{\sum \text{germinated seeds} \times 100}{\sum \text{seeds}} \quad (2)
\]

3.2. Viability (%)
It was carried out at the end of the observation (6 weeks after planting). This percentage is obtained from the number of plants Antigonon sp. living per number of Antigonon sp. planted with the following calculations:

\[
\text{Viability} = \frac{\sum \text{Growth } A.\text{leptopus}}{\sum A.\text{leptopus planted}} \times 100 \quad (3)
\]

3.3. Tendrils long (cm)
It was measured by marking the plant stems about 1 cm from the soil surface.

4. Results and discussion

4.1. The Percentage of seed germination and viability of Antigonon leptopus
The germination percentage of Antigonon leptopus seeds was 71.42% from the calculation results (Table 1).

| Species            | Number of seeds plants | Number of seeds germination | % seeds germination |
|--------------------|------------------------|-----------------------------|---------------------|
| Antigonon leptopus | 196 seeds              | 140 seeds                   | 71.42%              |

The survival rate of Antigonon leptopus was carried out at 18 weeks after planting. A.leptopus plants have a viability percentage of 100%.

4.2. The response of different planting media and addition of mulch to the length of the tendril of Antigonon leptopus
Antigonon leptopus is a type of plant that grows vines, so the tendrils' length is an indicator that is easily observed to determine the growth response to treatment. Based on the results of statistical tests, a single treatment of media differences significantly affected the length of the tendrils. Single treatment T1 with soil composition: sand: manure 2: 1: 1 ratio was the best treatment based on the results of further tests with an average value of 93.073 cm and gave an increase in control of 258.03%.

According to Setiadi [5], the length of a plant is influenced by light intensity and wind speed. This is following the statement of Sitompul and Guritno [6] that plants that experience a lack of light will usually grow taller than plants that get enough light. Based on the research conditions in the field, the light intensity that enters is not evenly distributed because the research location is between two greenhouses so that this can affect the height of the plants planted; besides that the wind that blows there is quite large because when the research is entering the rainy season.
4.3. Responses to differences in planting media and addition of mulch to the leaves number

The combination treatment between the planting medium and the addition of mulch gave a significantly different effect on the number of leaves parameters. The Duncan test results on the combination treatment between planting media and adding mulch can be seen in Table 2.

Table 2. The combination treatment of planting media and addition of mulch to the average number of leaves of *A. leptopus* plants

| Treatment of the combination of growing media and adding mulch | Mean     | Improvement to control (%) |
|---------------------------------------------------------------|----------|----------------------------|
| T1M1                                                          | 33.223aa | 227.867                    |
| T4M0                                                          | 32.177baba | 220.693                |
| T1M0                                                          | 28.263bac | 193.845                    |
| T2M0                                                          | 27.913bac | 191/443                    |
| T2M1                                                          | 26.863bc  | 184.245                    |
| T4M1                                                          | 26.463bc  | 181.502                    |
| T3M1                                                          | 25.973cc  | 178.141                    |
| T3M0                                                          | 22.800cc  | 156.379                    |
| T0M1                                                          | 14.580d   | 0                           |

Different letters indicate significantly different on the DMRT 5% test

Table 2 showed that the combination treatment of different growing media with the addition of mulch gives the best response compared to other combinations. This treatment increased 227.867% from the control with an average value of leaves number of 33,223. The number of leaves in plants showed the influence of a plant's metabolic process that can occur well because carbon absorption and the process of producing energy through photosynthesis can occur [7]. The greener color can indicate an increase in nutrient absorption, especially phosphorus and other nutrients [8]. The interaction between planting media and mulch is one of the factors that causes plants to grow optimally. According to Samiati et al. [9], giving mulch has a good effect on plants because mulch can eliminate soil temperature fluctuations and increase soil water retention capacity so that it supported early plant growth. Trisnaningsih et al. [10] was stated that changes in temperature from cold or unstable heat affect the ability of photosynthesis, translocation, respiration, and transpiration; if the temperature is too cold or too high, growth will slow down or stop altogether.

4.4. The response of different planting media and addition of mulch to the total dry weight of *Antigonon leptopus*

Table 3. The combination treatment of different planting media and the addition of mulch to the total dry weight of *A. leptopus* plants

| Growing media + mulch addition | Mean     | Improvement to control (%) |
|--------------------------------|----------|----------------------------|
| T1M1                           | 13.901a  | 337.158                    |
| T1M0                           | 12.15b   | 294.688                    |
| T2M0                           | 9.323cc  | 226.122                    |
| T2M1                           | 8.407dc  | 203.905                    |
| T3M1                           | 8.313dc  | 201.625                    |
| T4M0                           | 8.280dc  | 200.825                    |
| T3M0                           | 7.387de  | 179.166                    |
| T4M1                           | 6.530e   | 158.380                    |
| T0M1                           | 4.620f   | 112.054                    |
| T0M0                           | 4.123f   | 0                           |

Different letters indicate significantly different on the DMRT 5% test
The indicator commonly used to determine whether a seed's growth is good or not is the total dry weight [11]. The combination treatment of planting media with the addition of mulch had a significant effect on the total dry weight of *A. leptopus* plants. The total dry weight value is obtained from the shoot dry weight and root dry weight values (Table 3).

Table 5 showed that soil media's combination treatment: sand: manure (2: 1: 1 v/v) and the addition of mulch is the treatment that gives the best response to the parameters of total plant dry weight. This treatment increased 297.99% to the control with an average of 13.03 grams for the single treatment of planting media, while the combination treatment of planting media and addition of mulch gave an increase of 294.69% to the control with an average value of 12.15 grams. The total dry weight value of a plant showed that the greater the total dry weight value obtained, each part of the plant's ability to develop and carry out its respective roles.

4.5. The response of different planting media to root dry

The single treatment of different planting media had a significant effect on the root dry weight parameter. Based on the results of Duncan's continued test, it was shown that the single treatment of differences in the composition of the planting medium with the T1 type (soil: sand: manure 2: 1: 1 v/v) was the treatment that gave the best response to the dry weight parameter of the plant roots by giving an increase in control of 193.98% with an average value of 4.19 grams. The greater the value of the roots’ dry weight, was indicating that root growth and development can run well. The roots function was as a provider of nutrients and water needed in plant metabolism [6]. The weight of a root can also be affected by the texture of the media. The compact texture of the media can inhibit root growth.

4.6. Response to differences in planting media and giving mulch to root top

Based on the results of statistical tests, a single treatment of planting media, the addition of mulch and combination treatment gave significantly different effects on shoot and root ratio parameters (Table 4).

| Media differentiation + addition of mulch | Mean    | Improvement to control (%) |
|------------------------------------------|---------|-----------------------------|
| T1M1                                     | 2.14a   | 310.14                      |
| T1M0                                     | 1.63b   | 236.23                      |
| T2M0                                     | 1.21cc  | 175.36                      |
| T2M1                                     | 1.15cc  | 166.67                      |
| T4M1                                     | 1.13cc  | 163.77                      |
| T4M0                                     | 1.13cc  | 163.77                      |
| T0M1                                     | 1.00dc  | 144.93                      |
| T3M1                                     | 0.93dce | 134.78                      |
| T3M0                                     | 0.83de  | 120.29                      |
| T0M0                                     | 0.69e   | 0                           |

Table 6 showed the combination treatment of differences in T1 growing media (soil: sand: manure 2: 1: 1 v/v) with the addition of M1 mulch is the treatment that gives the best response to the shoot root ratio parameter by giving an increase in control of 310.14% with an average value of 2.14.

The shoot -root ratio can show the comparison between the water and mineral capacity of the transpiration process and the photosynthetic area of the plant, so the shoot root ratio can describe the resistance of seedlings when planted in the field [12]. A balanced root shoot ratio value is needed by the seeds so that the absorption of water and nutrients by the roots translocated to the shoot is balanced with a sufficient photosynthesis area to carry out transpiration and produce carbohydrates needed for root growth. The shoot ratio values produced in this study ranged from 0.69-2. These results indicated that the plant roots were developed better than the shoots. This was in line with the opinion of Sitompul and Guritno [6], which was stated that the low root pack ratio was found in plants that lack water and
nutrients so that plants try to form more roots to increase water and nutrient uptake. This can also be influenced by the size of the polybag used in the study, which is too small so that the root growth is not balanced with the growth of the plant shoots and many roots come out of the polybag.

4.7. The response of planting media to the percentage of flowering plant and the number of flowers per plant

Table 3 shows that the planting medium has a significant effect on the percentage of flowers and the number of flowers. T1 treatment with soil composition: sand: manure (2: 1: 1 v/v) showed the highest average value compared to other treatments. The composition ratio of 2: 1: 1 is a good ratio for planting media because the media will not become solid due to the presence of sand and manure that can hold water. According to Lingga [13], the P element in manure is well absorbed by the media for plant supply needs. Plants need phosphorus content to help form flowers and fruit. Imam [14] stated that plants’ phosphorus nutrients are very important, namely stimulating root growth and functioning as raw material to form protein, helping assimilation and respiration and accelerating flowering and ripening of seeds. The more the number of flowers, the higher the plant will absorb nutrients.

| Treatments | % flowering plants | Number of flowers per plant |
|------------|-------------------|-----------------------------|
| T-0 M0     | 85.6              | 8.1 b                       |
| T-0 M1     | 85.4              | 8.2 b                       |
| T-1M0      | 100.0             | 13.2 a                      |
| T-1M1      | 100.0             | 13.6 a                      |
| T-2 M0     | 100.0             | 11.1ab                      |
| T-2 M1     | 100.0             | 11.3 ab                     |
| T-3 M0     | 100.0             | 11.3 ab                     |
| T-3 M1     | 100.0             | 10.5 ab                     |
| T-4 M0     | 90.8              | 10.2 ab                     |
| T-4 M1     | 90.5              | 10.3 ab                     |

5. Conclusions

The planting media and mulch did not significantly affect the germination and seeds viability of A. leptosus plants. The planting media of soil, sand, and manure comparison (2: 1: 1) within mulch (T1M1) gave the best vegetative growth (Length of plant tendrils and number of leaves) and some flower per plant.

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References

[1] Setiadi Y. 2017. *Humic Substance Complex*. Bogor (ID): IPB
[2] Sitompul SM, Guritno B. 1995. *Analisa Pertumbuhan Tanaman*. Yogyakarta(ID): Gajah Mada University Press
[3] Fageria, *et al*. 2006. Growth, yield and yield components of lowland rice as influenced by ammonium sulfate and urea fertilization. *Journal of Plant Nutrition*.34: 371-386
[4] Rahmawati, E. 2017. Pengaruh fosfat terhadape efektivitas fulvic acid pada pertumbuhan
Centrosema pubescens (Benth) [skripsi]. Bogor (ID): Institut Pertanian Bogor

[5] Samiati, A., Bahrun, dan LO Safuan. 2012. Pengaruh takaran mulsa terhadap pertumbuhan dan produksi sawi (Brassica juncea L.). J. Agronomi. 1(2): 121-125

[6] Trisnaningsih, U., N. Handayani dan D. Budirokhman. 2015. Pengaruh bobot mulsa jerami padi terhadap pertumbuhan dan hasil tanaman kacang hijau (Vigna radiata L.) kultivar kutilang. J. Agroswagati. 1(3): 274-277

[7] Permatasari I, Kusmana C. 2011. Respon pertumbuhan semai tancang (Bruguiera gymorrhiza (L) Lamk) terhadap tingkat penggenangan di kawasan mangrove jalan Tol Sedyatmo, Jakarta Utara. Jurnal Silvikultur Tropika. 2(3): 181-186

[8] Uyun, YS. 2006. Penggunaan cendawan mikoriza arbuscular (CMA) yang meningkatkan pertumbuhan semai Jati (Tectona grandis Lin) pada limbah media jamur tiram (Pleurotus sp.) [skripsi]. Bogor (ID): Institut Pertanian Bogor

[9] Lingga, P. 2006. Hidroponik Bercocok Tanam Tanpa Tanah. Edisi Revisi. Jakarta (ID): Penebar Swadaya

[10] Imam, MA. Pengaruh jumlah benih perlubang dan interval pemberian pupuk NPK terhadap pertumbuhan dan produksi tanaman kedelai (Glicine max (L.) Merrill. J. Saintis. 8(1): 1-18