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## AGRO-EKOSISTEM: MANAJEMEN PEMANFAATAN SUMBER DAYA ALAM SECARA BIJAKSANA

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## SEMINAR NASIONAL

## Fakultas Teknologi Informasi dan Sains Universitas Hindu Indonesia 2019

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## Daftar Isi

# Application of vegetative mulch in vanilla plantation is crucial for mitigating the impact of drought during dry season

# (Pemberian mulsa dari bahan tanaman pada perkebunan panili sangat penting untuk mitigasi dampak kekeringan pada musim kemarau)

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***Abstrak***

*Indonesia adalah Negara tropis yang memiliki 2 musim yaitu musim hujan dan musim kemarau. Produksi dan pertumbuhan tanaman yang memiliki perakaran dangkal dan dibudidayakan pada lahan tadah hujan sangat tergantung pada musim ini. Tanaman ini tumbuh sangat baik pada musim hujan karena air tersedia dalam jumlah yang mencukupi, tetapi sangat sulit tumbuh pada musim kemarau karena kekeringan dimulai dari permukaan lahan. Oleh karena itu, agar pertumbuhan dan produksi tanaman ini berkelanjutan, maka mitigasi dampak musim kemarau melalui pemberian mulsa dipandang sangat penting. Akan tetapi di Indonesia, teknik mitigasi melalui pemberian mulsa ini, tidak banyak diperhatikan terutama untuk perkebunan panili. Oleh karena itu dilakukan percobaan untuk menguji pengaruh pemberian mulsa terhadap pertumbuhan* *panili. Stek panili 2 buku ditumbuhkan dalam pot yang berisi media tanam berupa top soil dan diberi mulsa potongan rumput, paku, keladi, daun kering dan sabut kelapa. Percobaan ini menemukan bahwa pada musim hujan, pemberian mulsa daun kering dan rumput mempercepat pertumbuhan stek panili, tetapi pemberian mulsa paku dan keladi menghambat pertumbuhan. Pada musim kering, pemberian mulsa potongan rumput dapat meningkatkan pertumbuhan stek panili dan memperbaiki kelembaban tanah. Disimpulkan bahwa potongan rumput, daun kering dan sabut kelapa merupakan bahan tanaman yang cukup aman untuk mulsa tanaman panili.*

***Kata kunci**: Stek, kekeringan, pertumbuhan, mulsa, panili.*

***Abstract***

*Indonesia is a tropical country, generally known to have 2 climatic conditions wet and dry season. Shallow rooted crop in rain fed plantation is highly dependent on this climatic conditions. These plants grow well during wet season because sufficient water is available to support growth, but hardly grow during dry seasons because drought is commenced from soil surface. So, in order to sustain growth and production of this shallow rooted plants, mitigation of the impact of drought by addition of vegetative mulch is viewed very crucial. However, since this mitigation has received little attention, experiments were then conducted to examine the effect of mulching on growth of vanilla. Vanilla cutting were grown in pots containing top soil growth medium and mulched with grass, fern, taro clipping, dry leaf and coconut husk. This experiments found that during wet season, addition of dry leaf and grass clipping enhanced the growth of vanilla cutting, but addition of fern and taro clipping inhibited growth. Under condition of dry seasons, addition of grass clipping was found increased soil moisture and increased growth of the vanilla cuttings. These experiments concluded that addition of grass clipping, dry leaf and coconut husk is safe plant materials for mulching vanilla plants.*

***Key words**; Cutting, drought, growth, mulch, vanilla.*

## Introduction

Fresh water is vital for plant growth and reproduction, socio-economic and maintenance of a healthy ecosystem (FAO 2017). Since food for human being is depended on the photosynthetic activity in the plants, it is very easy to understand that under condition of drought, food security might be threaten. So, in order to increase food security, continuous water supply for plant growth is required. Naturally, this fresh water supply is depended on earth water cycle which commenced on evaporation of water from water reservoir such as the sea and ocean, movement of cloud into high land until rain fall to occur in the mountain (Pagano and Sorooshian 2002). The amount of water evaporate from the sea surface is depended on air temperature and wind flow (Balasubramanian and Nagaraju 2015). Therefore under condition of lower temperature, less water is evaporated and less water available from the rain fall. Otherwise, under condition of higher air temperature, more water evaporated from the sea surface and more water is supplied from the rain fall into the plantations. In Indonesia these two weather condition has been well known as dry season and wet seasons. The question is that how to sustain fresh water supply during dry seasons for plant growth and reproduction.

Assuming that the lower water resistant the faster the water to flow, the flow of water runoff on the landscape is much faster than the flow of grown water. This slow rate of water flow make more water available during dry season. Therefore, in order to increase fresh water for plants growth during dry season, more rain water should entering the slow flow of grown water. One portion of this grown water is then taken up by trees via root system before transpired into the atmosphere (Taiz and Zieger 2002). For the plants, water release via transpiration is a payoff for $CO_2$ uptake. Depending on the area of forested land, the amount of water transpired into atmosphere could make an important contribution for rain cloud which then cycled back into the soil as a rain fall. This imply that rain water will be sustained longer in a place when more water undergoing local water cycle. The other portion of grown water could then flow in a slow rate into the river or as a spring which then become a very important water resources for agriculture, human health and ecosystem. Since the infiltration of water into grown water depend on soil porosity, soil organic material which enhance soil porosity is becoming crucial. In natural vegetation, soil organic material is reported very high, accounted for about 47.5 ton/hectare (Chhabra 2003). However, the organic material decreased when this natural forest then converted into plantation (Villarino 2017). So, in order to sustain crop production, continuous addition of vegetative material is required to maintain organic material in the soil (Adiputra 2018).

Soil organic carbon has been acknowledged as key for sustainable crop production because it lengthen soil moisture, make more nutrient available for plant and sustain a healthy soil. Accordingly, under condition of prolonged dry season, high soil organic carbon plantation could lengthen the growth of shallow rooted plants. Since the soil organic carbon is dynamic, it could decrease after oxidation or mineralization (Chan 2008), continuous addition of organic material is very important to sustain soil organic carbon in the plantation. For example, Nishigaki et al. (2017) reported that addition of *Impirata cylindrica* as vegetative mulch could decreased soil loss although water runoff is relatively similar which imply that addition of vegetative mulch could sustain soil fertility. In other report, Luna et al. (2017) concluded that mulches and amendment could reduce water runoff and increased soil porosity which implying that addition of this mulch increase water sustainability. Even though, for crop production, application of plants material should be selective since mulch material could contain compound that toxic to shallow rooted plants (Chalker-Scott 2007). Toxic compound such as allelochemical could be released by mulch material during it decomposition. This present study investigated weed plant material that can be viewed as safe material for mulching vanilla plants.

**Materials and methods.**

**Experiment 1**

Two nodes vanilla cutting were transplanted into 1 litre pot containing 0.5 litre top soil. The pots were then divided into 5 groups and each group was consisted of 8 pots. The first, second, third, fourth group were mulched with grass, fern, taro and dry leaf, respectively and the fifth group were not mulched as control cuttings. After the addition of mulch, the pot were then mounted in a shaded green house. This first experiment were performed during rain seasons. The growth of this cutting were monitored every weeks.

**Experiment 2**

Procedure applied in experiment 2 is similar to experiment 1 except that dry leaf were replaced by coconut husk and was conducted during dry season. In this experiment, soil pH and soil moisture were also monitored and total phenolic compound in the plant materials was examined.

**Results**

**Environmental condition during experiment 1 and 2.**

Experiment 1 was conducted during wet season, in the period of 9 Des 2018 – 21 April 2019. During this period, average daily high to low air temperature was 31±0.8 to 25.3±1.2 °C and daily precipitation was 6.9±14.3 mm. Experiment 2 was conducted during dry season in the period of 8 June 2019 – 25 August 2019. High-Low temperature and precipitation in the period during expt 2 was 28±0.4 to 23.8±1.2 °C and precipitation was 0.4±3.2 mm (Fig.1, 2).

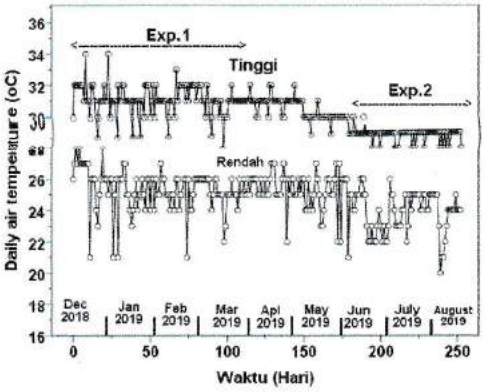


Fig. 1. Daily air temperature in wongaya Gede during expt 1 and 2

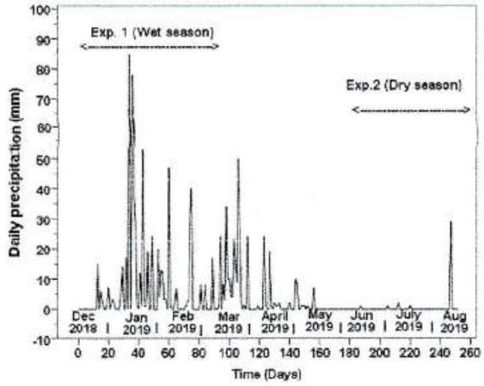


Fig. 2. Daily precipitation in Wongaya Gede during expt. 1 and 2.

## The growth of vanilla cutting under condition of wet season

Under condition of wet season, vanilla was firstly found to produce new root system in cuttings added grass clipping, dry-leaf mulch and in control cuttings at day 14 after transplantation. Cutting added fern clipping and taro clipping was firstly found to produce new root system at day 21 and day 28 after transplantation. At day 35, when all control cutting has produced new root system, the number of cutting added mulch was showing 62.5, 37.5, 50 and 75% for cutting added grass, fern, taro clipping and dry leaf mulch. In the ensuing period, when the number of cutting added grass and fern clipping increased growth into 75%, the number of cutting added taro clipping was increased into 62.5% (Fig. 3).

Bud burst was firstly observed at day 28 after transplantation in cutting added grass, fern, dry leaf and control. Cutting added taro clipping was firstly found to show bud burst at day 70 after transplantation. At day 56, when all control cutting has shown bud bust, cutting added grass, fern and dry leaf was shown 50, 37.5 and 50% growth (Fig. 4).

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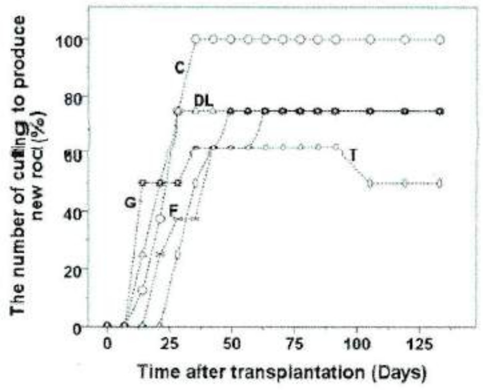


Fig. 3 The number of cutting showing production of new root under condition of wet season

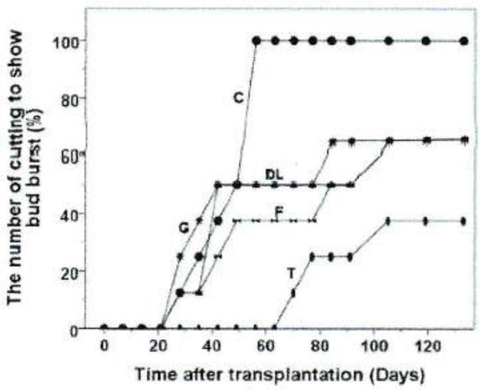


Fig 4. The number of cutting showing bud burst under condition of wet season

**The growth of vanilla cutting under condition of dry seasons**

Under condition of dry season, vanilla was firstly found to produce new root system at day 22 after transplantation. This growth was observed in cutting added grass clipping, coconut husk and control cuttings. The number of cutting showed new root growth was 12.5, 25 and 37.5% for grass, coco husk and control, respectively. Cutting added fern and taro clipping was firstly found to produce new root system at day 28 after transplantation, accounted for 12.5 and 25% for fern and taro, respectively (Fig. 5). At day 43, all cutting added coconut husk has produced new root system. In the same day, cutting added grass, fern, taro and control showed 75, 50, 62.5 and 75% growth, respectively.

Production of new stem was found very slow during the dry season, especially cutting added coconut husk and control cutting. These two group of cutting has not been found to show bud burst until day 78 after transplantation. Cutting added grass and taro clippings however, has shown bud burst before the production of root system. In cutting added grass clipping, bud burst was firstly found at day 14, although root system were firstly observed to emerge at day 22. Similarly, cutting added taro clipping was found to show bud burst at day 22 although this cutting was firstly to show root emergence at day 28. Cutting added fern clipping was found to show bud burst at day 59 after transplantation. At the end of observation at day 78, the number of cutting added grass clipping, fern and taro showed growth was 37.5, 12.5 and 12.5%, respectively.

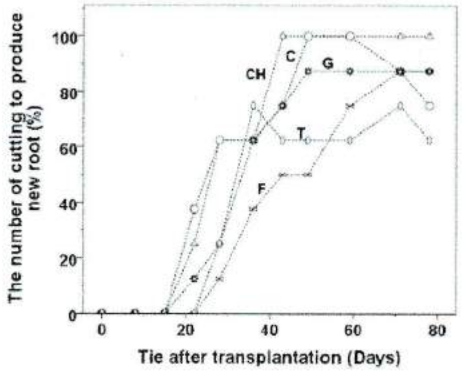


Fig. 5. The number of cutting to produce new root under condition of dry seasons

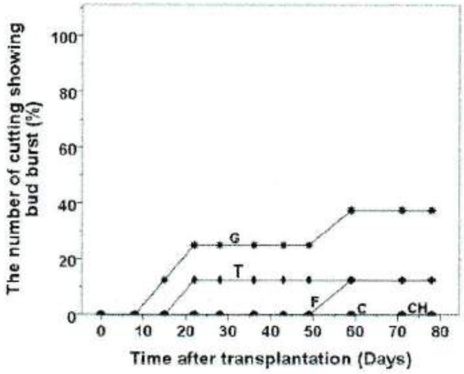


Fig. 6. The number of cutting showing bud burst under condition of dry seasons

**Discussions**

Production of new stem was more sensitive to the changes of temperature and precipitation rather than production of new root system. Under condition of temperature 31-25°C and daily precipitation was 6.9 mm, cutting without mulch was commenced to produce root system at day 14 and bud burst at day 28. This cutting has attained 100% root growth at day 35 and 100% bud burst at day 59. However under condition of dry season where average daily temperature was 28-23°C and precipitation was 0.4 mm, root

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emergence was commenced at day 22 and attained 100% at day 49. Bud burst in this control was not observed until day 78 after transplantation. Thus, dry season slightly delay production of root system for ca 14 days but totally repressed production of new stem. This clearly indicated that under a harsh environmental conditions, plants enhanced root growth with the expense of shoot growth.

In variably, addition of vegetative mulch was found improve environmental condition. For example, under condition of dry season, cutting added coconut husk was found to attained 100% root growth at day 43 and continuously growing. Control cutting however, although attained 100% root growth at day 49, some of this new root did not continue their growth (Fig.5). Addition of fresh grass clipping was very impressive. Under condition of wet season, addition of grass clipping was not found to inhibit initial growth of whether root system or new stem (Fig. 3 and 4). Under condition of dry season, addition of grass clipping also did not inhibit initial growth of root system Fig.5). Importantly, when control cutting and cutting added coconut husk unable to initiate the growth of new stem, cutting added grass clipping showed production of new stem. At the end of observation at day 78, the number of grass added cutting to produce new stem was 37.5% (Fig. 6). This strongly indicated that grass clipping did not only improve environmental condition but also provided nutrient that enable the cutting to produce new stem. Unlike coconut husk and grass clipping, addition of fern and taro clipping was not found to substantially support the growth of vanilla cuttings. This mulches was found delay initial growth of root system during wet season and dry season, delay bud burst during wet season and only slightly improve bud burst under condition of dry seasons (Fig. 3, 4, 5, 6). It is speculated that fern and taro clipping release allelochemical during it decomposition.

**Conclusion**

For vanilla grown in rain fed farm land, prolonged dry season is a harsh environment condition. In order to sustain growth, mitigation of the impact of dry season is very crucial. One cheap method than can be applied is addition of coconut husk or grass clipping. Where grass clipping can be locally collected after weeding, coconut husk commonly viewed as by product in coconut plantation. Both of these plant material is relatively cheap and support the growth of vanilla plant safely.

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