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New Report of Distribution of Entomopathogenic Fungi *Aschersonia* sp. Infected Whitefly in Bali

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ABSTRAK

Laporan Baru tentang Distribusi Jamur Entomopatogenik *Aschersonia* sp. yang Menginfeksi Kutu Putih di Bali. Penelitian tentang distribusi jamur entomopatogenik *Aschersonia* sp. dilakukan untuk mengetahui persebaran *Aschersonia* yang menginfeksi kutu putih di seluruh Bali. Penelitian tersebut dilakukan di Kabupaten Gianyar, Bangli dan Buleleng pada centra perkebunan jeruk dimulai tahun 2014 sampai tahun 2018. *Aschersonia* pertama kali ditemukan pada tahun 2014 di Desa Sekaan Kintamani Bangli dan Desa Kerta Payangan Kabupaten Gianyar, dan pada tahun 2018 ditemukan di Desa Gobleg Sukasada Kabupaten Buleleng. Distribusi jamur tersebut ditemukan di dataran tinggi dan tidak ditemukan di dataran rendah. Hal ini sangat terkait dengan keadaan iklim terutama kelembaban dan suhu. Jamur Aschersonia sangat baik tumbuh pada suhu 20°C yang berada pada dataran tinggi.

Kata kunci: jamur entomopatogenik, kutu putih, dataran tinggi

INTRODUCTION

At the beginning of 2014 in Bangli Regency, which is a citrus-producing center in Bali, it was found a species of fungi that has characteristics similar to *Aschersonia*. The discovery of this fungi was also encountered in a number of very large and quite wide spread until the area of Gianyar Regency. Almost all fungi were found on the attached on the down side of the citrus leaf. *Aschersonia* is an entomopathogenic fungi or an insect pathogen that is can be the controlling agent especially for the whitefly and scale insect pest. This fungi can infect whitefly in both nymph and imago stadia. This fungi infection in whitefly also have a really unique typical symptoms. This fungi can be found infecting whitefly in the tropics and subtropics with a diverse range of species (Meekes *et al.,* 2002).

One of importance species of *Aschersonia* is *Aschersonia aleyrodis.*

Aschersonia aleyrodis itself is a species of *Aschersonia* that has been widely studied and reported for its ability to suppress some species of whiteflies (Gao *et al.*, 1985; Fransen *et al.*, 1987; Faria and Wraight, 2001; Meekes *et al.*, 2002; Qiu *et al.*, 2003), and has been developed commercially in the Netherlands (Evans and Hywel-Jones, 1990) and the former Soviet Union (Faria and Wraight, 2007). In addition the species of *Aschersonia* above, that has potential as a biocontrol agent against whitefly pests have registered or under development (Fransen, 1990; Charnley and Collins, 2007). The new information about the species of *Aschersonia* in Bali was reported as an *Aschersonia placenta* by Sudiarta *et al.* (2019). However the information only identification, the information of *Aschersonia* in Indonesia is very limited, therefore the more research is needed. One of the basic research is started from recognition of *Aschersonia* in the field including its distribution in Bali. Base on the information, the research about distribution and development of entomopathogenic fungi *Aschersonia* sp. of whitefly in Bali was conducted.

MATERIAL AND METHOD

Place and Time of Research

This researchhas been conducted in several locations in Gianyar, Buleleng, and Bangli Regency that recognized as citrus production center and Plant Pathology Laboratory, Faculty of Agriculture, Udayana University. The time of research was started from 2014 until 2018.

Recognition of Symptom of *Aschersonia*

The shape and color of the stroma can be directly observed in the field and is usually located down side of the leaves where the host lived. The leaves of the plant then plucked and put in a plastic bag and tightly closed so that the sample lasts a long time.

Distribution and Field Analyze of *Aschersonia* in Bali

The methods to determine the distribution of *Aschersonia* was carried out in several areas in Bali by searching for symptom that appeared in the field accompanied by recorded and analyze the conditions of the environment where *Aschersonia* discovered. Data about the host of *Aschersonia*, the plant where the *Aschersonia* found, climates, and other data that related to the *Aschersonia*.

Sampling of fresh sample of *Aschersonia* for the laboratory analyze conducted in different locations in Bali. Samples taken were plant leaves containing whitefly that have infected by *Aschersonia*. Samples were put into plastic bag and labeled with place and date of sampling.

Climate Data Information

The climate data was collected from each location of distribution of insect pathogen, the data include altitude, temperature, and humidity.

RESULT AND DISCUSSION

Recognition of Entomopathogenic Fungi *Aschersonia* sp.

Along with field observations, sampling activities were also carried out. Sampling was the first step of identification in this study. Sampling was carried out in conjunction with a field survey to find locations where there was the attack of pathogenic fungi *Aschersonia*. The search for the existence of *Aschersonia* was carried out in several locations in Tabanan, Gianyar, Buleleng, and Bangli Regency that recognized as citrus production center.

After successfully found the location of *Aschersonia*, the next step is to collect the strands of the leaves plants contained *Aschersonia*.

Figure 1. *Aschersonia* which has been found on the leaves of citrus plants in several locations in Gianyar, Buleleng, and Bangli Regency

Aschersonia found in the village of Jehem has a large population. *Aschersonia* which was collected at this location was only found in citrus plants. Although various types of plants are found around citrus plants, no *Aschersonia* symptoms are found. This is closely related to the host of *Aschersonia* that only lives and associated with citrus plants. Surprisingly, *Aschersonia* was discovered accidentally in Pancasari village. *Aschersonia* attack symptoms have never been reported before in mulberry plants. This makes *Aschersonia* become something interesting to study further. The results of this study can also provide more insight into the existence of *Aschersonia* in Bali particularly.

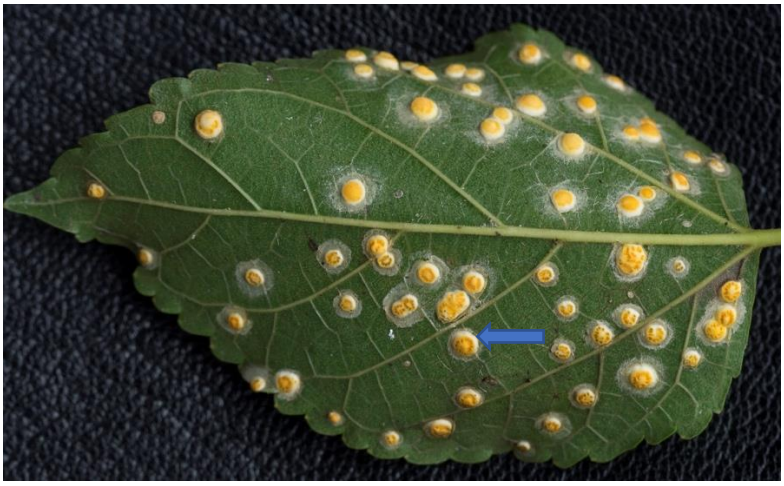

Figure 2. *Aschersonia* which has been found on the leaves of mulberry plants in the area of Pancasari village.

Distribution and Field Analyze of *Aschersonia* in Bali

Aschersonia is an entomopathogenic fungi that infects whitefly. This fungi lives and develops in environmental conditions that can support the development and distribution of these fungi. So that not all regions, especially in Bali, can become suitable habitat for *Aschersonia*. The data on how the *Aschersonia* distribution map in various regions in Bali is important in studying this fungi.

Aschersonia was first reported in Bali in 2014 in the Kintamani area and until now there is still the presence of *Aschersonia* in that place. *Aschersonia* then began to be reported in other areas after that. The following is data on *Aschersonia* distribution in several regions in Bali.

Table 1. Distribution of *Aschersonia* in Several Location in Bali with the Information of Insect Species that Infected by *Aschersonia* (Host Insect) and the Plant Species Where the *Aschersonia* Was Found (Host Plant)

Location	2014		2015		2016		2017		2018	
	Host Insect	Host Plant	Host Insect	Host Plant	Host Insect	Host Plant	Host Insect	Host Plant	Host Insect	Host Plant
Kerta (Gianyar)	whitefly	citrus	whitefly	citrus	whitefly	citrus	whitefly	citrus	whitefly	Citrus and bay leaf
Jehem (Bangli)	-	-	-	-	whitefly	citrus	whitefly	citrus	whitefly	citrus
Sekaan (Bangli)	whitefly	citrus	whitefly	citrus	whitefly	citrus	whitefly	citrus	whitefly	citrus
Gobleg (Buleleng)	-	-	-	-	-	-	-	-	whitefly	citrus
Pancasari (Buleleng)	-	-	-	-	-	-	whitefly	mulberry	whitefly	mulberry

Kerta located at an altitude of 600-925 meters above sea level. Kerta has a tropical climate with significant rainfall. Even in the driest month there is a lot of rain. This climate is considered to be Af according to the Köppen-Geiger climate classification. The average relative humidity is more than 80%. The average annual temperature is 21.0°C in Kerta. November is the warmest month of the year. The temperature in November averages 21.5° C. July is the coldest month, with temperatures averaging 19.9°C. Throughout the year, the temperature varies around 1.6°C. Kerta has 2769 mm of precipitation that falls annually. The driest month is September, with 83 mm of rain. Most precipitation falls in December, averaging 441 mm. There is a difference in 358 mm of precipitation between the driest month and the wettest month (Anonym 2018; Suamba *et. al.* 2014).

Jehem located at an altitude of 500-1000 meters above sea level. Jehem has a tropical climate with high rainfall, even in the driest month. The climate here is classified as Af based on the Köppen-Geiger system. The average relative humidity is more than 80%. The average annual temperature is 23.8°C in Jehem. Precipitation here averages 2040 mm. The driest month is August with the lowest precipitation of 63 mm and the highest precipitation occurs in February, with an average of 335 mm. The precipitation varies 272 mm between the driest month and the wettest month. With an average of 24.4°C,

November is the warmest month. The lowest temperature in the year is July, when it is around 22.7°C. The variation in temperatures throughout the year is 1.7°C (Anonym, 2018; BPS, 2017).

Sekaan located at an altitude of > 1000 meters above sea level. Sekaan's climate is classified as tropical. Most months are characterized by significant rainfall. A short dry season has a small impact. This climate is considered to be Am according to the Köppen-Geiger climate classification. The average relative humidity is more than 80%. The average annual temperature in Sekaan is 19.8°C. At an average temperature of 20.3°C, January is the hottest month of the year. The lowest temperature in the year is July, when it is around 18.9°C. The variation in temperatures throughout the year is 1.4°C. Precipitation that falls annually 2627 mm. The driest month is September, with 55 mm of rain. The greatest amount of precipitation occurs in January, with an average of 465 mm. Between the driest and wettest months, the difference in precipitation is 410 mm (Anonym, 2018; BPS, 2017).

Gobleg located at an altitude of 1200 meters above sea level. The climate here is tropical. Most months of the year, there is significant rainfall in Gobleg. There is only a short dry season. This location is classified as Am based on Köppen and Geiger. The average relative humidity is more than 80%. The average annual temperature is 22.5°C in Gobleg. January is the warmest month of the year. The temperature in January averages 23.0° C. The average temperatures vary during the year by 1.7°C. The rainfall here averages 2392 mm. The driest month is September, with 38 mm of rain. Most of the precipitation here falls in February, averaging 410 mm. There is a difference in 372 mm of precipitation between the driest month and the wettest month (Anonym, 2018; BPS, 2017).

Pancasari located at an altitude of 1200 meters above sea level. The climate here is classified as Cwb based on the Köppen-Geiger system. The average relative humidity is more than 80%. The average annual temperature is 18.7°C in Pancasari. At an average temperature of 19.1°C, January is the hottest month of the year. July has the lowest average temperature in a year. This is 17.8°C. During the year, the average temperatures vary by 1.3°C. Within a year, the average rainfall is 2315 mm. The driest month is September, with 20 mm of rain. With an average of 500 mm, the most precipitation falls in January. Between the driest and wettest months, the difference in precipitation is 480 mm (Anonym, 2018; BPS, 2017).

The emergence of *Aschersonia* attacks found in some of these areas is strongly influenced by 3 important factors, namely the presence of *Aschersonia* inoculum, the presence of *Aschersonia* hosts which is whitefly, and of course environmental factors. These three factors influence each other and it will be difficult to *Aschersonia* to infecting and causing symptom in the field if one or more of these factors are not appropriate.

Climatic conditions from both sampling sites have relatively low temperature conditions with high rainfall and humidity. Climate factors such as temperature and humidity are the most influential for the development and spread of fungi (Meeks, 2001). High moisture is a condition that is very supportive and in accordance with life needs of *Aschersonia* which requires high humidity to reach optimal development. *Aschersonia* actually has tolerance on low humidity up to 50%, but in this condition *Aschersonia* will not grow and develop properly (Fransen, 1987).

Environmental humidity plays an important role in development *Aschersonia*. But other weather factors that have an influence on development of *Aschersonia* is temperature. *Aschersonia* like other entomopathogenic fungi is able to grow and develop in the temperature range 15-30^{o}C (Osborne, 1990). This high range of temperatures make *Aschersonia* can live in climatic conditions in accordance with temperature conditions in Jehem village and Pancasari village. Temperature range between 15-30^{o}C is also in accordance with the tropical climate in other regions of Bali and even in Indonesia. Hall (1981) and Fransen (1987) reported for optimal development of *Aschersonia aleyrodis* in artificial media the temperature needed is around 25^{o}C. This temperature is the optimal temperature for the development of *Aschersonia*.

Rain has an important role in the spread of *Aschersonia*. Raindrops can help *Aschersonia* to spread conidia from one place to another or even to insects (Meeks *et al.*, 2002). Rain is also able to help provide the water needed by the *Aschersonia* conidia to germinate. Therefore rain can be said to be a determining factor for the development and spread of *Aschersonia*.

The abundant of *Aschersonia* was found in high land area in Bali around 1000 m above sea level (asl). The high land area is related with the climate condition, humidity, temperature for growth of the fungi. Humidity and temperature in high land area is suitable for *Aschersonia* growth to infected the insect host (Mishra, *et al*. 2015; Jaworski and Hilszczański, 2013). In low land area the host

insect were found, however the climate condition is not suitable for *Aschersonia* growth.

CONCLUSION

Aschersonia was first reported in Bali in 2014 in the Sekaan Kintamani area (Bangli Regency) and Kerta Payangan, (Gianyar Regency), and in 2018 was distributed in Gobleg Sukasada (Buleleng Regancy) in citrus production area. Surprisingly, in 2018 the *Aschersonia* also was first reported found in Pancasari Sukasada (Buleleng regency) in mulberry plant.

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