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DIVERSITY OF *Vanda tricolor* Lindl. (ORCHIDACEAE) FLOWER-VISITING INSECTS IN THE TURGO HILL OF MOUNT MERAPI NATIONAL PARK, YOGYAKARTA, INDONESIA

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ABSTRACT

Vanda tricolor is an orchid species native to the Mount Merapi National Park, Yogyakarta, Indonesia. The study of interaction flower-visiting insect is important to support in situ conservation program. The purpose of this research wasto study the diversity of *Vanda tricolor* Lind. flower-visiting insects and their roles in The Turgo Hill of Mount Merapi National Park. Flower-visiting insect was captured in the morning (08.00-10.00 AM), daytime (00.00-02.00 PM) and afternoon (04.00-06.00 PM). Data were taken four times in November 2011 during the flowering season. Insect samples were preserved by dried and wet phase. Sample identification was done in the Entomology Laboratory, Faculty of Biology, Universitas Gadjah Mada. The results indicated that *Vanda tricolor* flowers were visited by insects from three orders, six families, and eleven species in the morning; four orders, six families, and nine species in the daytime; and two orders, three families, and five species in the afternoon with various role. In this research, we also observed pollination activity potential by *Xylocopa latipes* (Hymenoptera: Apidae). There were 14 *V. tricolor* flower-visiting insects from four orders and nine families. There were no significant differences between the insect diversity of the morning and daytime, while in the afternoon there was a decline in the diversity of the insects.

Key words: *Vanda tricolor,* flower-visiting insects, Turgo Hill of Mount Merapi National Park

INTRODUCTION

Mount Merapi National Park is one of the in situ conservation sites with a highland topography and a humid forest. Susantyo (2011) reported plant biodiversity from this place and *Vanda tricolor* was recorded in Mount Merapi National Park as a native orchid species. *V. tricolor* belongs to Orchidaceae, tribe Vandeae (Carlsward *et al*., 2006), which has a pleasant fragrant and a red-purple-brown attractive colour (Cullen, 1992). The distributions of *V.tricolor* in Indonesia were reported in West Java, Central Java (including Yogyakarta), East Java, and Central Sulawesi (Gardiner, 2007). This orchid is well known as native in Java and Bali; one of its natural habitat is Kaliurang, Mount Merapi, Yogyakarta. The cultivation and ecological distribution of *V. tricolor* has been reviewed as a high-valued orchid (Semiarti *et al*., 2009). However, the rate of self-pollination and cultivation in its native habitat is still low. Pollination in many orchids has been reportedly held by insects (Banziger *et al.,* 2005). We observed the insect visitation if could lead to outcrossing of *V. tricolor* and the role of each visiting-insect.

MATERIALS AND METHODS

Observation

Observations of the diversity of *V. tricolor* flower-visiting insects were done in three periods: in the morning (08:00 AM to 10:00 AM), daytime (00:00 PM to 02:00 PM), and afternoon (04:00 PM to 06:00 PM), four times during flowering season (November – December). Insects were captured using sweepnet for flying insects and small brush for small insect, and collected for identification purposes. Air temperature and humidity were measured to represent the environmental conditions.

Preservation and Identification

Collected adult insects were preserved in a dry and wet phase. Dried preservation was done by inserting the dried specimens in an oven at a temperature of 37^{o}C for seven days, while the eggs, larvae, nymph or pupa were preserved by wet preservation in 70% ethanol. Morphological identification was done according to Borror *et al.*, (1992).

RESULT AND DISCUSSION

Our results show that there were differences in the diversity of *V. tricolor* flower-visiting insects in the morning, daytime and afternoon, as is shown in the Table 1, and the environmental conditions in the Table 2.

Table 1. Diversity of *V. tricolor* Lindl. flower-visiting insect in The Turgo Hill of Mount Merapi National Park, Yogyakarta, Indonesia

No.	Species Name	Family	Time		
			Morning (08.00AM-10.00AM)	Daytime (00.00PM-02.00PM)	Afternoon (04.00PM-06.00PM)
Order Diptera					
1.	Dt1	Calliphoridae	√		
2.	*Allograpta obliqua* Say.	Syrphidae	√		
3.	*Musca domestica* L.	Muscidae	√	√	√
Order Coleoptera					
1.	Col1	Curculionidae	√	√	
2.	Col2	Scarabaeidae		√	
Order Hymenoptera					
1.	*Myrmicaria* sp.	Formicidae	√	√	√
2.	*Paratrechina* sp.	Formicidae	√		
3.	*Rotastruma* sp.	Formicidae	√		
4.	Hy1	Formicidae (Ponerinae)	√	√	
5.	*Lepisiota* sp.	Formicidae	√	√	√
6.	*Vespa velutina*, Lepeletier	Vespidae (Vespinae)	√		√
7.	*Camponotus* sp.	Formicidae	√	√	√
8.	*Xylocopa latipes*, Drury.	Apidae		√	
Order Lepidoptera					
1.	*Amata* sp.	Arctiidae (Syntominae)		√	

Table 2. Environmental conditions of The Turgo Hill Turgo Hill of Mount Merapi National Park, Yogyakarta, Indonesia

	Morning (08.00AM-10.00AM)	Daytime (00.00PM-02.00PM)	Afternoon (04.00PM-06.00PM)
Air Temperature (°C)	27.75±0.66	27.53±1.42	24.89±2.74
Air Humidity (%)	71.33±6.66	74.29±6.05	83.3±11.3

According to the observations, there were no significant differences in the diversity between the morning and daytime, while in the afternoon there was a decline in the diversity of the visitors. This could be due to diurnal insect activity, which begins to feed in the morning until late afternoon with the highest activity during the day, especially in bright conditions (Khairiah *et al*., 2012). Insects have different purposes in visiting flowers, such as foraging (Kimball, 2009). Insect-visitors were captured during field observation. Calliphoridae Family (encoded Dipt1) was reportedly a common pollinator, because of their ability to respond to flower colors and nectars. Calliporids can discriminate yellow and blue; yellow color is preferred, except at decaying odour supervenes, brown-purple is preferred. Calliporids were used to pollinate flowers with small size (Jewiss-Gaines *et al*., 2012). *Allograpta obliqua* usually visits flower for nectar and considered to be an important pollinator for some plants (Weems, 2011). *Musca domestica* is considered a potential pollinator for mango plant (Sung *et al*., 2006). Our observations showed that there were two types of insects from Coleoptera Order: Curculionidae Family (encoded Col1) and Scarabaeidae Family (encoded Col2). Generally, Curculionidae Family lays eggs by making a hole in the stem, leaves, pseudobulbs, and flowers. Furthermore, Curculionidae Family also feeds on the outside of its host. Probably, Col1 acts as insect pests. These insects are diurnal (Prena, 2008). The presence in this study of interest *V. tricolor* found in the morning and daytime. The second insect in Coleoptera Order was Scarabaeidae Family (encoded Col2) that are destructive insects and plant eaters. Some others are dung-feeders or scavengers (Borror *et al*., 1992). Scarabaeidae that visited *V. tricolor*'s flower in this study is probably the scavenger that was interested in the smell of decayed *V. tricolor'*s flower. According to Swezey (1945), Scarabaeidae is not included in the list of insects associated with orchids.

In this study, we found six species of ants (Hymenoptera: Formicidae) that visited the *V. Tricolor'*s flower. They are *Myrmicaria* sp., *Paratrechina* sp., *Rotastruma* sp., *Lepisiota* sp., *Camponotus* sp., and Hy1 (see Table 3.). Hy1 is the code we provided to the ants of the Ponerinae Subfamily that we could not identify its species' name. These six ants species probably do not have a pollinator role in the *V. tricolor'*s flower, because *V. tricolor*'s flower does not have a part which is similar with female ants, so the pollination by pseudocopulating male ants is impossible (Peakall, 1989), and the sizes of ants found in this study were much smaller than those of the anther cap of *V. tricolor'*s flower, so the possibility of ants can inadvertently open the anther cap during the move is very small (Toro *et al*., 2012). The role of these six ants species are possibly only as the consumers of nectar or a visitor who were feeding on *V. tricolor*'s flower.

Vespa velutina is known as a predator of social wasp and bees. It is one of the most adept hornets at catching honeybees on the wing with the highest predation levels in the morning and afternoon. It is related to the daily rhythm of honeybees flight (Chauzat & Maryin,

2009). This may be the reason of *V. velutina* presence as *V. tricolor* flower-visiting insect. *Xylocopa latipes* was reported as pollinator of *Papilionanthe teres* (Roxb.). Several orchids from different genera like *Phalaenopsis* Ridl., *Vanda* Jones ex R. Br., *Eupholia* R. Br., and *Aerides odorata* Lour. Also reported pollinated by *Xylocopa* (Carr, 1928; Dressler, 1990; Van der Cingel, 2001; Kocyan *et al*., 2008; Peter, 2009). Flora species that are pollinated by a carpenter bee have common characteristics, like large with strong heavy tissue of flower and sexual part (gynostemium in orchid) must in contact with the dorsal part of the bee (Van der Pijl, 1954). Moreover, a report from Africa and India suggests that the bee from genus *Xylocopa* has a tendency to pollinate flower with a bright yellow or bright pink color (Peter, 2009; Raju and Rao, 2006).

Amata sp. is member of Arctiidae, a large family of moth. In Kalimantan, there were around 30 species of *Amata*, distributed from lowland until mountain region (Holloway, 1988). Jakubska *et al.* (2005) reported *Amata* sp. as flower-visiting insect in orchid plant *Epipactis helleborine* (L.) Crantz.; however, the role of the insect is still undetermined.

The flower of *V. tricolor* has a thick, cylindric, 1-2 m long stem. Leaves 45 x 5 cm, oblong. Inflorescences erect, 8-15 flowers. Flowers 6-7.5 cm in diameter, fragrant, waxy, short column. Sepals and petals broadly ovate, claw-like base, wavy, yellow spotted with dark pink-purple-dark brown, white base. Labellum trilobed, midlobe broadly oblong, waisted at the middle, basal part boarder than apical, violet-red with purple stripes, short spur (Cullen, 1992; Semiarti *et al*., 2009). The scent perceivable from 1 m away when many inflorescences bloom together (Lestari, 2010). Purple stripes on the labellum probably can be one of the attractant for insect-pollinator. Moreover, at the basal part of the column, we found a clear, waxy gel and two yellow spots. Two yellow spots probably had attracts *X. latipes* to came into the spur, while the waxy gels on the basal of the column probably attract many insect to came into the spur. The waxy gels could contain sugar exudate, as reported by Jeffrey *et al*. (1970). Ants are attracted to orchids due to the presence of sugar containing exudates. The waxy gel could be the only reward offered by *V. tricolor*'s flowers. A matching size of insect and flower would increase the possibility of pollination. Fit size flower-insect reported in *Epipogium roseum* pollination (Zhou *et al*., 2012). In our research, *X. latipes* has a fit size to *V. tricolor*. The pollen has a great advantage to stick at the thorax (Fig 1.). Presented as two compact mass, yellow, pollen has a sticky viscidium disc. When *X. latipes* tries to exit from the spur, the column has a contact with the dorsal part of *X. latipes*. Then the outer surface of viscidium disc sticks to the thorax. The movement of *X. latipes* coincidentally pulls the anther cap and pollen is removed (Fig 2.)

Diversity fluctuations were influenced by the environmental conditions, including air temperature and humidity. Based on the observations, temperature and humidity affected the diversity of insects-visitors. The diversities of insect visitors in the morning and daytime were quite similar when the temperature and humidity levels were equal, then decreased in the afternoon with a decreasing temperature and increasing humidity. Insect is a poikilothermic organism whose body temperature is affected by the environmental temperature (Borror *et al*., 1992).

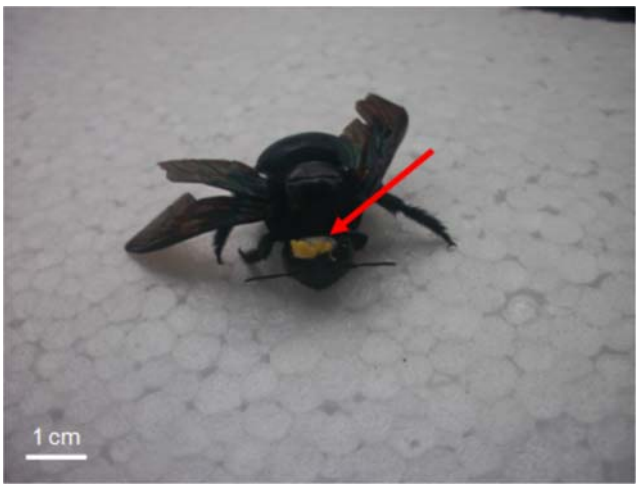

Figure 1. *Xylocopa latipes*, pollinator potential of *V. tricolor* with gynostemium on the thorax

Figure 2. *X. latipes* entering the flower of *V. tricolor*

CONCLUSION

There were 14 species of *V. tricolor* flower-visiting insects from four orders and nine families. There were no significant differences in the diversity between the morning and daytime, while in the afternoon there was a decline in the diversity of the visit. While the most potential pollinator was showed by *Xylocopa latipes*, further work is needed to test the percentage of pollen removal to resolve the mechanism of *X. latipes* attracted to *V. tricolor*.

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