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Composition, sex ratio, and population density of *Silba adipata* McAlpine (Diptera: Lonchaeidae) and *Bactrocera dorsalis* Complex (Diptera: Tephritidae) in white chili *(Capsicum frutescens* L.) in Bali Province, Indonesia

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ABSTRACT

This study aims to determine the composition, sex ratio, and population density of the pest, *Silba adipata* and *Bactrocera dorsalis* in White Chili *(Capsicum frutescens* L.*)* in Bali. This research was conducted from March 2020 to July 2020. Samples were taken from 9 districts and cities in Bali Province, namely Jembrana, Tabanan, Buleleng, Badung, Denpasar City, Gianyar, Bangli, Klungkung and Karangasem. Sampling was done by purposive method, namely 100-150 chilies attacked by *S. adipata* and *B. dorsalis* on white chili plants. Our results indicate that the presence of *S. adipata* is more dominant in six districts compared to *B. dorsalis*, which only dominates in three districts in Bali. In general, the composition of *S. adipata* was 62.32% / 3,827 adults, while *B. dorsalis* was only 37.68% / 941 adults. The sex ratio of *S. adipata* and *B. dorsalis* was 1:2. The population density of *S. adipata* was higher than that of *B. dorsalis*. The population density of *S. adipata* averaged 1.05 insects/adult fruit, while *B. dorsalis* was 0.35 insects/adult fruit. This result is an important report and requires prevention efforts for these two pests in supporting the productivity of white chilies in Bali Province.

Key words : *Silba adipata, Bactrocera dorsalis, Crop Productivity, Pest monitoring*

Introduction

White chili *(Capsicum frutescens* L.*)* is one of the horticultural commodities that many consumers need in Indonesia because it is one of the most important fruit vegetables cultivated commercially in tropical

countries and has high economic value besides that the fruit has a combination of color, taste, and complete nutritional value (Olatunji and Afolayan. 2018). The centers of white chili in Indonesia are spread in various provinces such as East Java, West Java, Central Java, West Nusa Tenggara, Bali, Aceh, and North Sumatra. The report states that the production of white chili in Indonesia from 2006 to 2015 fluctuated, namely in 2006 amounting to 449.08 thousand tons, however in 2007 there was a decrease to 444.76 thousand tons, and in 2009 there was an increase again reaching up to 591.36 million tons. Then in 2010, it decreased to 521.7 thousand tons and then continued to increase until 2015 to 869.95 thousand tons (BPS 2017). One of the factors that cause fluctuations and decreases in white chili production is caused by plant pests (Karmawati *et al.,* 2020).

Pest disturbances are an obstacle that is often faced in increasing the production of chili plants. There are several types of important pests that are a problem in white chili cultivation in Indonesia, including fruit flies (*Bactrocera dorsalis* Complex). Research from Vargas *et al.* (2015) states that *B. dorsalis* Complex of the genus Bactrocera is one of the fruit fly species native to the tropics which is economically important fruit flies. The *B. dorsalis* pest attacks fruit commodities with soft and thin skins which are commonly found in tropical regions such as Indonesia. Thus, economically the *B. dorsalis* is very detrimental to the agricultural sector in Indonesia.

Apart from pests from the genus Bactrocera, there are also other types of flies first reported by Merta (2019), namely *S. adipata* which attacks cayenne pepper plantations, especially in Bali. The symptoms are similar to those of *B. dorsalis* so it is difficult for farmers to tell the difference. The distribution of *B. dorsalis* and *S. adipata* can be directly influenced by natural factors such as host plants, altitude above sea level, temperature, and humidity. However, until now the main target in controlling efforts is still directed at *B. dorsalis* and there have not been many further studies on *S. adipata in* Bali Province.

Therefore, the aim of this study was to determine the composition, sex ratio, and population density between two important pests, *Silba adipata* and *Bactrocera dorsalis* Complex which attacked white chili plantations in Bali Province *(Capsicum frutescens* L.*)*. Our results are expected to provide initial information about these two pests, so that they can provide solutions especially for farmers, policy makers, and agricultural academics.

Materials and Methods

Study area

This research includes two stages, namely field, and laboratory-scale research. Field research was carried out in all districts/cities in Bali Province. Laboratory research was carried out at the Laboratory of Plant Disease Pest Integrated Management, Faculty of Agriculture, Udayana University. This research was conducted from March to July 2020.

Sampling and observation methods

Sampling was carried out by survey at the white chili pepper plantations in Bali, which was carried out every 2 times a week. This research was conducted purposively by taking 100-150 chilies that were suspected of being attacked by *S. adipata* and *B. dorsalis* Complex in white cayenne pepper cultivation. All fruit that is symptomatic is picked and then accommodated in a transparent plastic bag volume of 1 kg then taken to the laboratory for maintenance. Furthermore, the chilies are put into a plastic cup with a height of 10.5 cm and a diameter of 8 cm which has been filled with sand as much as ± 20 g, each glass is filled with one chili and covered with gauze, tied with a rubber band and labeled (location, date, sampling, and altitude) (Figure 1). Observations were made every day until the appearance of *S. adipata* and *B. dorsalis* Complex adult. The flies that have appeared are then identified, counted, and sex ratio.

Identification

Adult insects that come out of the culture are then identified to determine the type. Identification of *S. adipata* was carried out by observing morphological characters such as color, antennae, eyes, piston (MacGowan, 2005; MacGowan and Rauf, 2019). Based on the morphological characters, it is then matched on the online Lonchaeidae web (http://lonchaeidae.myspecies.info/).

Identification of *B. dorsalis* Complex was carried out by observing morphological characters such as scutum color, facial spots, wing venation, leg color, color, and pattern on the abdomen. Based on the morphological character, it is then matched with the

identification key compiled by AQIS (2008) and CABI (2007).

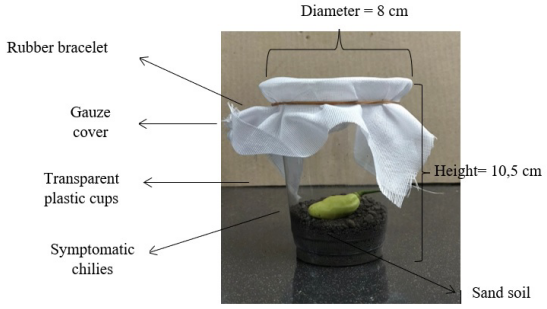

Fig. 1. Symptomatic white chili rearing method in this study. (Source: Personal Documentation)

Observation variable

Population composition of pest

The adult insect population was calculated by observing the adults that appeared on the rearing results. The following is the formula for calculating the composition of the population according to Odum (1994) :

$$Pi = \frac{ni}{N} \; x \; 100\%$$

Note:
Pi: population composition
ni: number of kind I
N: total number

Population density

The population density is calculated per fruit using the Diana *et al.* (2012) as follows:

$$KP = \Sigma \frac{ni}{N}$$

Note :
KP: Population Density (individual),
ni: The number of the 1th type,
N: The number of chilies observed

Data analysis

Population composition data, sex ratio, and population density of *S. adipata* and *B. dorsalis* Complex obtained from the research results were analyzed according to the formula for each parameter. The data is presented in tabular form, diagrams which are operated using Ms. Excel 2019 (Microsoft, USA) and Figures.

Results and Discussion

Composition

Composition is the composition and number of individuals in a community. The composition is obtained from the percentage of the number of each species divided by the total number of species found in the observation location. Composition observations were carried out in each Regency / City in the Province of Bali. The results of the research population composition of *S. adipata* and *B. dorsalis* Complex are presented in Figure 2.

Based on Figure 2, it can be seen that the population composition of *S. adipata* is higher in Tabanan, Buleleng, Badung, Denpasar, Bangli, and Klungkung Districts while the *B. dorsalis* Complex population tends to be higher in Jembrana, Gianyar and Karangasem Districts. Overall, the average population composition of *S. adipata* and *B. dorsalis* Complex in Bali, namely *S. adipata* was 62.32%, while *B. dorsalis* Complex was 37.68%.

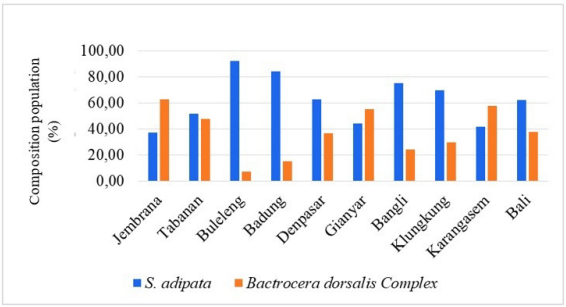

Fig. 2. Population composition (%) of *S. adipata* and *B. dorsalis* Complex in white chili plantations in each district / city and the average in Bali Province.

We assume that the population composition of *S. adipata* and *B. dorsalis* Complex in an area is strongly influenced by several factors, one of which is the host plant. The pest, *B. dorsalis* Complex is a species of fruit fly that is found in an area as the main pest on fruit plants which are polypagus with a large host range and are available throughout the year (Ginting 2009). Furthermore, according to CABI (2007) the host range of *B. dorsalis* Complex includes papaya, guava, water guava, sweet orange, tomato, star fruit, rambutan, jackfruit, mango, chili, eggplant, passion fruit, etc. Meanwhile, *S. adipata* has the main hosts, namely edible fig *(Ficus carica* L.*)* and white chili. This indicates that *S. adipata* has fewer host plants than *B. dorsalis* Complex in this

study. When viewed at each research location, around the chili plants, there are guava, tomato, eggplant, orange plants where these plants are the host plants of *B. dorsalis* Complex. So we assume that the factors that cause the population of *S. adipata* is higher than *B. dorsalis* Complex because *S. adipata* is more focused on attacking chili plants than *B. dorsalis* Complex attacks many other host plants so that the composition of *B. dorsalis* Complex in white chilli is lower compared to *S. adipata*.

Sex ratio

Sex ratio is the ratio of the number of male and female species in the population. The results of the research on the sex ratios of *S. adipata* and *B. dorsalis* Complex are shown in Table 1 below.

Based on Table 1, the sex ratio of *S. adipata* and *B. dorsalis* Complex is 1:2. Overall, it was found that the female sex was higher than the male sex. The higher the number of female adult, the population will increase, this is thought to be the more eggs laid by adult females on the attacked fruit because there are enough nutrients that are able to support the successful mating of each species *S. adipata* and *B. dorsalis* Complex. In theory, female flies need large amounts of protein because they are needed for the development of reproductive organs and the formation of fertile eggs (Sun and Spradling, 2013). Furthermore, Prabhu *et al.* (2008) in their report stated that male Tephritidae flies that consume protein have a higher mating success than males who do not consume protein. This was also conveyed by Smykal and Raikhel (2015) who stated that protein is a substance that is needed in the process of egg formation.

Population density

Observation of pest population density was seen

Table 1. Sex ratio of *S. adipata* and *B. dorsalis* Complex attacking white chili plants in each cities/regency in Bali.

Cities/regency	Types of species	N	Spesies (individu)		Sex ratio
			Males	Females	
Jembrana	*S. adipata*	13	4	9	1:2
	B. dorsalis Complex	22	11	11	1:1
Tabanan	*S. adipata*	509	218	291	1:2
	B. dorsalis Complex	111	53	58	1:1
Buleleng	*S. adipata*	322	109	213	1:2
	B. dorsalis Complex	12	4	8	1:2
Badung	*S. adipata*	1314	585	729	1:2
	B. dorsalis Complex	240	113	127	1:2
Denpasar	*S. adipata*	29	14	15	1:1
	B. dorsalis Complex	17	3	14	1:2
Gianyar	*S. adipata*	611	243	368	1:2
	B. dorsalis Complex	241	108	133	1:2
Bangli	*S. adipata*	916	331	585	1:2
	B. dorsalis Complex	241	91	156	1:2
Klungkung	*S. adipata*	90	34	56	1:2
	B. dorsalis Complex	41	19	22	1:2
Karangasem	*S. adipata*	23	7	16	1:2
	B. dorsalis Complex	32	12	20	1:2
Mean	*S. adipata*	425.22	171.67	253.56	1:2
	B. dorsalis Complex	107	46	61	1:2

Table 2. population density of *S. adipata* and *B. dorsalis* Complex on white chili plantations in Bali Province

Species of pest	Number of individuals per fruit*									´KP(ind/ fruit)	Mean
	1	2	3	4	5	6	7	8	9		
S. adipata	0.17	0.91	1.30	2.84	0.45	0.80	2.12	0.57	0.26	9.42	1.05
B. dorsalis	0.28	0.22	0.11	0.52	0.26	0.51	0.64	0.25	0.36	3.15	0.35

Note : Regency* 1: Jembrana, 2: Tabanan, 3: Buleleng, 4: Badung, 5: Denpasar, 6: Gianyar, 7: Bangli, 8: Klungkung, 9: Karangasem.

from the number of adults that came out on maintenance. The population density in each district / city is shown in Table 2.

Based on Table 2, our research results indicate that there are two types of pest species that attack white chili in the field in Bali Province. The average population density of *S. adipata* was 1.05 individuals / fruit, while *B. dorsalis* Complex had an average population density of 0.35 individuals / fruit. The low population density of *B. dorsalis* Complex can be caused because most farmers still apply control techniques that tend to be environmentally friendly, namely by installing *methyl eugenol* traps that can attract and suppress *B. dorsalis* Complex populations in the field. *Methyl eugenol* is a compound that attracts insects, especially for male fruit flies (Tan and Nishida, 2012). If the population of male fruit flies can be suppressed, the reproduction of female fruit flies will decrease so that it can reduce the population of fruit flies on chili plants. Whereas, *S. adipata* is a new pest whose existence is not yet known by farmers so that no further control has been carried out. Because of this, it is still necessary to do an in-depth study of the new pest of *Silba adipata*, for example through integrated pest control that is environmentally friendly. This can help farmers in the field to carry out an early warning system for this type of pest.

Conclusion

Our results conclude that the population composition is dominated by the pest *Silba adipata* compared to *B. dorsalis* Complex. The sex ratio of *S. adipata* and *B. dorsalis* Complex is 1: 2. Likewise, the population density of *S. adipata* was higher than that of *B. dorsalis* Complex. These results confirm that the new pest of *S. adipata* is not widely known by chili farmers in Bali Province, so further research is still needed regarding this new pest control effort by optimizing the application of vegetable pesticides, natural enemies, and more environmentally friendly adhesive / attractant traps.

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