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Population of *Lamprosema indicata* and Their Parasitoid in Edamame Soybean Plant

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ABSTRACT

Soybean *Glycine max* L. Merrill has a strategic position in food security. Soybean varieties are various, such as edamame or commonly called vegetable soybean. The important edamame pest is *L. indicata*. This pest has a natural enemy in the form of parasitoids that spread at several altitudes. This study aimed to investigate the *L. indicata* pest population and their parasitoid in edamame soybean plantations at three different altitudes. In this study conducted at three altitudes namely Purwosari (12 masl), Sebanen (814 masl), and Karangbireuh (1295 masl). At each location consist of one plot (1 Ha) and were made into 4 sub-plots exchanging 10 x10m. Also, the yellow pan trap was installed at 8–57 Day After Planting to collect *L. indicata* and parasitoid. The results showed that *L. indicata* was higher in Purwoasri than in other locations. This is due to environmental factors namely temperature. The parasitoid of *L. indicata* was found in all locations, namely Braconidae family (parasitoid of larvae). While the the paarasitoid were collected in yellow pan trap in all locations i.e. Pteromalidae, Diapriidae, Eulophidae, Mymaridae and *Entomacis* sp.

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INTRODUCTION

Soybean *Glycine max* L. Merrill has a strategic position in food security. Soy-based foods is dominated by tempeh, tofu, soy sauce, tauco, and fresh soy. In Indonesia, soybean production is currently only able to meet 35% of the market, while the rest is filled with soybean imports (Hasan *et al.*, 2015). Soybean varieties are various, such as edamame or commonly called vegetable soybean. Edamame is harvested while the seeds are at approximately 80% of maturity, such that it has a green color and a soft texture (Saldivar *et al.*, 2010). One of the pests that attack soybean plants is the leaf roller pest *Laprosema indicata* Fabricius (Lepidoptera: Pyralidae) (Dirgayana *et al.*, 2017). *Lamprosema indicata* is the main leaf-eating pest insect that affects the growth of soybean plants (Xing *et al.,* 2012). *Lamprosema indicata* causes damage to soybean leaves up to 90% (Biswas and Islam, 2012).

The management control that has been done so far only uses chemical control that is using synthetic insecticides. Controls that need to pay attention to environmental aspects and agricultural ecosystems are to implement Integrated Pest Management (IPM), one of which is the use of natural enemies such as parasitoid insects. Parasitoid insects in the soybean planting area that have been found, namely Ichneumonidae and

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Braconidae families (Riyanto *et al.,* 2005). Utilization of natural enemies of *L. indicata* pests is generally still carried out in the lowlands because the lowlands have contours of land that are easily processed, irrigation water management is easier and less likely the soil is affected by erosion. In addition, *L. indicata* pest populations in the lowlands are also high because the ambient temperature supports To produce offspring. In addition to environmental temperature namely air humidity, rainfall, intensity of sunlight, and wind (Camplin, 1978). Environmental temperatures in the lowlands of Indonesia are generally 25–28 ^{0}C. This study aimed to investigate the *L. indicata* pest population and their parasitoid in edamame soybean plantations at three different altitudes.

MATERIALS AND METHODS

Research Locations

This study was conducted in edamame soybean plantations at Purwoasri (12 masl), Sebanen (814 masl), and Karangbireuh Villages (1295 masl), Jember District, East Java. Each research locations were made into 1 plot (1 Ha) and each plot consists of four sub-plots. The sub-plots was determined randomly. Each sub-plot were 10x 10m and each sub-plot was made five transects.

Yellow Pan Trap Installation

Yellow pan trap was installed at 8 until 57 days after planting (DAP) and observed in the afternoon at 03.30 PM. Yellow pan traps were installed in each sub-plot for 24 hours. In each sub-plot four yellow pan traps were placed systematically in each corner of the sub-plot. The insects were filtered using a chiffon cloth and then transferred and kept in the specimen bottle that contains 90% alcohol and glycerin (9:1). Furthermore, the bottle was give coded on each sub-plot to separation of parasitoid and non-parasitoid insects.

Observation of *L. indicata* Larvae.

Lamprosema indicata larvae were counted directly on edamame soybean plants on each transect (imaginary line) consisting of 100 sample plants. The observation of *L. indicata* larvae was carried out when edamame soybean plants at the vegetative growth (8 DAP) with a frequency of observations once a week for eight times observation. Observations were made in the morning at 06.00-10.00 AM.

Collection of the Parasitic *L. indicata*

Lamprosema indicata larvae was collected at vegetative growth (8 DAP) with a frequency of observations once a week for eight times. Sampling of parasitic larvae was carried out by taking larvae directly on each transect consisting of a hundred sample plants. Each sub-plot consists of 500 sample plants. Larvae of *L. indicata* was parasitized by parasitoids had brownish-yellow larvae color. The larvae was already covered by a parasitoid cocoon which was white and attached to a leaf roll. Parasitized larvae was put into a bottle and brought to the laboratory. The larvae were observed until they came out as parasitoids. The parasitoids were obtained then identified under a stereo microscope. Identification of parasitoid based on morphological characteristics, such as wing venation and antennae (Borror *et al.,* 1996).

Data Analysis

The data were analyzed using analysis of variance (F-test) at 5% level. If there are significant differences, then continued testing with LSD at the level of 5%. All the data were analysis by using the Microsoft Excel 2010 program.

RESULTS AND DISCUSSION

Effect of Altitude on *L. indicata* Population

The results showed that altitude was significantly affected to the population of *L. indicata* (Table 1). The population of *L. indicata* in Purwoasri was higher than in Sebanen and Karangbireuh. This shows that the development of the *L. indicata* pest was more suitable in Purwoasri than in Sebanen and Karangbireuh.

Table 1. Population of *L. indicata* based on different altitude locations

Location	Altitude (masl)	Population (Mean ± SD)
Purwoasri	12	11.98 ± 9.37 b
Sebanen	814	1.24 ± 0.81 a
Karangbireuh	1,295	2.23 ± 2.03 a
LSD 5%		2.25

Note: Numbers accompanied by the same letters show no significant difference based on tests LSD 5%; masl: Meters above sea level and SD = Standard Deviation

Differences in *L. indicata* population are thought to differences in temperature at each location. Purwoasri had a 25–26 ℃ temperature, while the Sebanen and Karangbireuh locations had temperature 22–24 ℃. The relationship between *L. indicata* populations is directly proportional to the rise in temperature. Increasing temperature extremes and warming climates generally may extend the season over which these species are active, and could increase abundance (Nyamukondiwa *et al.*, 2013).

Low temperature degree results in high humidity. The humidity in the Purwoasri location is 55–60%, while the Sebanen and Karangbireuh are 75–90%. The high humidity in the Sebanen and Karangbireuh makes *L. indicata* population more difficult to develop so that the population is lower than the Purwoasri. As relative humidity was increased, it found higher percentage of live insects (Papanikolaou *et al.*, 2018).

Population Dynamics of *L. indicata* at Three Altitudes

The population of *L. indicata* in Purwoasri was fluctuated at 15–43 DAP (Figure 1). Population of *L. indicata* at 15 DAP was increased then decreased at 27 DAP due to the application of synthetic pesticides. But at 36 DAP, *L. indicata* population was increase due to edamame plant had entered the generative phase, so it has a lot of leaves as food for pests. *L. indicata* pest attacks plants with the highest attack rate at the age of 30 DAP plants. Because at that time the age of soybean plants bushy leaves and abundant leaf nutrition (Biswas, 2013) .

Populations of *L. indicate* in Sebanen and Karangbireuh tend to be stable (Figure 1), because the application of synthetic pesticides (Methomyl, Imidacloprid, and Cyflutrin), *Beauveria bassiana,* and *Verticillium* sp. at 32–40 DAP. Jauharlina (2006) state that, decrease in *L. indicata* larvae population is related to plant age. The older age of soybean plants, the lower the level of damage because at the age of old plants the water content and leaf nutrition decrease. Fattah *et al.* (2020) report that *L. indicata* pests attack soybean plants from the vegetative phase to the generative phase, which is the age of plants 2–8 weeks after planting because one of these pests has a different resistance when spraying chemical pesticides and bio-insecticides.

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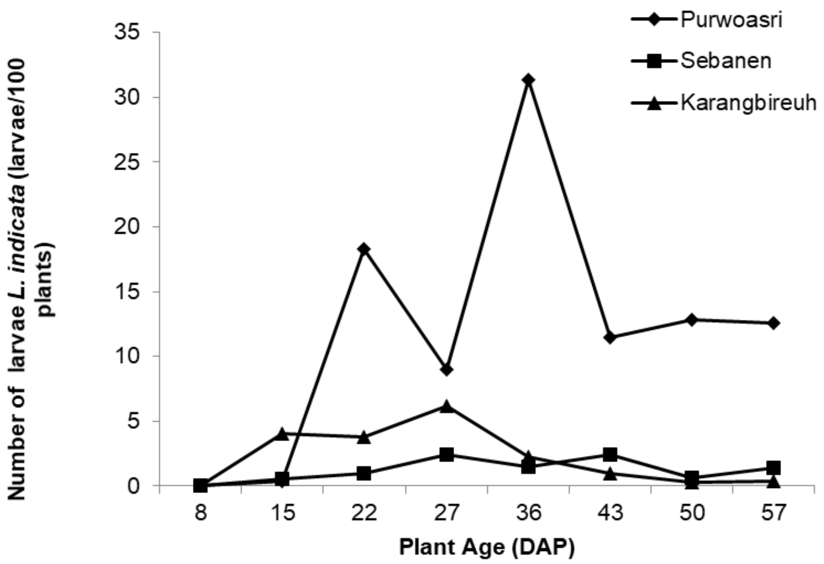

Figure 1. Population of *L. indicata* in Purwoasri, Sebanen and Karangbireuh at 8–57 Days after planting (DAP).

Parasitoid of *L. indicate* Larvae

The parasitoid of *L. indicate* was found in all observation sites was Braconidae family (Figure 3A). The Braconidae parasitoids are clustered and white. Each group ranges from 8–12 pupae. Pupae of parasitoid attached on the body surface of *L. indicata* larvae (Figure 3A). Braconidae parasitoid parasites when the larvae are inside the leaf roll so that the pupa is also attached to the edamame soybean leaf roll. According to Kim *et al.* (2018), The family of Braconidae is larval ectoparasitoid, seen on the outside is white. From observing the characteristics of the parasitoids family, the Braconidae family has two pairs of wings. Three segmented tarsi. Seventeen segmented antennae. His body is slim. Body-color from head to the abdomen is black to the antenna. The ovipositor is not longer than body length (1500.70 µm) (Figure 3B).

Population of Parasitoid in Yellow Pan Traps

The parasitoid was found in yellow pan traps consist of four family and single genus i.e. Pteromalidae, Braconidae, Mymaridae, Eulophidae, Diapriidae and one genus namely *Entomacis* sp. The population of *L. indicata* in Purwoasri is higher than Sebanen and Karangbireuh (Table 1). High of *L. indicata* population followed by the high abundance of parasitoids. Due to abundant food or host resources, so the development of parasitoids increases. Avalos *et al*. (2020) state that the addition of pests resulted in a population of natural enemies in greater numbers. The development of parasitoids depends on pest populations and plant environmental conditions (Sanda and Sunusi, 2016). This is due to most parasitoids are monophagous.

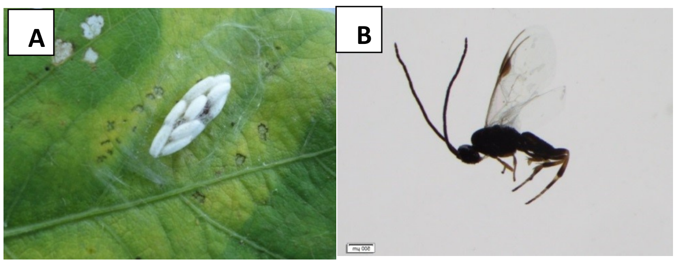

Figure 3. Parasitoid of *L. indicata* (A) Pupae of *L. indicata* (B) Braconidae

Table 2. Parasitoid populations in Purwoasri, Sebanen and Karangbireuh

Research location	**Number of parasitoid (Mean ± SD)**
Purwoasri	36.92 ± 2.11
Sebanen	23.57 ± 0.96
Karangbireuh	35.77 ± 2.40

Note: SD = Standard Deviation

The population of the Braconidae family was highest in all locations (Table 3). While the lowest parasitoid population of the three locations was the Myridae Family. In addition to the family, also found parasitoids from the genus *Entomacis* sp. However, from the parasitoids was found, only the Braconidae family has parasitized *L. indicate* larvae. It is thought that the Braconidae family is most resistant to environmental conditions. In addition, the Braconidae family is monophagous or had specific host. As reported by Shepard and Barrion (1998) that *L. indicata* parasitoids that have been found in Indonesia were the Elasmidae, Chalcididae, Eurytomidae, Bethylidae and Ichneumonidae families. The Braconidae family has a high ability to live and offspring with more number of female than male ratio (Harvey *et al*., 2019). Khalil *et al*. (2016) reported that several types of the Braconidae family were able to laid eggs directly on their host even though they did not received a host for seven 7 consecutive days.

Table 3. Populations of Parasitoid Family Purwoasri, Sebanen and Karangbireuh

Parasitoid family	**Number of parasitoid (Mean± SD)**
Braconidae	28.00 ± 2.04
Pteromalidae	17.32 ± 1.83
Diapriidae	20.54 ± 1.85
Eulophidae	15.90 ± 1.01
Mymaridae	14.19 ± 0.54

Note: SD = Standard Deviation

CONCLUSION

The population of *L. indicata* was higher in Purwoasri (11.98 larvae/100 plants) than Sebanen (1.24 larvae/100 plants) and Karangbireuh (2.23 larvae/100 plants). There are five families and one parasitoid genus found in edamame soybean plantations with different populations. The parasitoid found were Braconidae, Pteromalidae, Diapriidae, Eulophidae, Mymaridae and Entomacis sp. The highest population of parasitoids was Braconidae in all locations. Only Braconidae aligned with *L. indicata* and dominated in three locations (28.00 adults/trap).

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