First Report: *Spodoptera Picta* Guerin-Meneville, Armyworm on Swamp Lily (*Crinum x powellii ‘Album’) in Bogor, Indonesia

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**INTRODUCTION**

Armyworm attacks are commonly found attacking various types of plants, such as food crops, horticulture, and plantations. The year 2019 was stirred up by the arrival of a new pest in Indonesia, namely the corn armyworm fall armyworm (*Spodoptera frugiperda*) (Sartiami et al., 2019). The *S. frugiperda* pest spreads very quickly due to the behavior of its imago, which can fly hundreds of kilometers (Rauf, 2019). Armyworm species that are commonly found in Indonesia are *S. litura*, *S. exigua*, *S. littoralis*, *S. exceptiona*, and *S. mauritia* (Kalshoven, 1981; Tompunu et al., 2014; Paparang et al., 2016; Larasati, 2020; Dirgayana & Marsadi 2023). However, this armyworm species has never been known to attack ornamental plants like daffodils. In general, several ornamental plants have not been studied much because the economic value of ornamental plants still needs to be improved in Indonesia. Home ornamental plants are not the primary commodity and priority. Even though ornamental plants can also be shelters or alternative plants for pest breeding.

White crinum or swamp lily (*Crinum x powellii ‘Album’*) is a cross between the lily species *C. bulbispermum* and *C. moorei*. Lilies are one of the Amaryllidaceae family's families, commonly found as house decorating plants. White lily is a robust bulbous perennial with umbels of large, trumpet-shaped, pure white flowers with a length of 10 cm, and is an annual flower type. The leaves are elongated like a sword with a sheath at the base. Plant height is around 90-120 cm (Gardenia.net). Lilies are also commonly referred to as wonderfully fragrant because of the fragrant aroma they emit.

**ABSTRACT**

Armyworms are very common and can attack all types of plants. Attacking ornamental plants such as flowers is no exception. This study aimed to determine the types of fall armyworms that attacked lilies in a Bogor, West Java house. It turned out to be a prominent symptom of the attack: the leaves became bald, attacked from the leaves to the base of the stem, and the dirt and the previous attack became wet. Armyworm larvae are dark grey, with eye-catching yellow stripes in the late larval stage. The larvae and adults were identified as a group of armyworms of *Spodoptera picta* (Lepidoptera: Noctuidae). They are common in Australia, and they attack lilies. Characteristics of the larvae were dark grey with a longitudinal black line, a striking yellow line that runs along the middle of the dorsal, and a Y shape in the head. The female of *S. picta* lays eggs in groups ranging from 50 to 218 eggs per egg group with an egg size of 1 mm. Lili armyworm larvae have five stages with larval sizes of 2, 5, 15, 28, and 46 mm, respectively. Meanwhile, the size of the pupa and imago of *S. picta* was 23 and 20 mm, respectively. The management of *S. picta* armyworms must not be done to cause significant damage and losses to ornamental flower crops.

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Research on pests and diseases that attack lilies has yet to be done much. There are no known reports of severe pest attacks on lilies in Indonesia. However, in several countries, such as Africa, Australia, and America, it is reported that lilies are often attacked by drill caterpillars (*Brithys pancratii*) (Lepidoptera: Noctuidae), snails, and slugs (Archer, 2004). Several diseases have also been reported, namely from virus and fungal groups. However, the research has yet to be scientifically published. Therefore, this study aimed to report the findings of leaf-eating caterpillars (defoliators) that attack lilies in Bogor.

**METHODS**

**Insect Sampling and Rearing**

Insects were obtained using a purposive sampling by taking them directly from the attack site (Sugiyono, 2010). The sampling location records its location coordinates with the Garmin 64S GPS. The insect samples obtained were then reared in the laboratory rearing room with lily leaf feed for the larval phase, while adult insects were fed with 10% honey solution absorbed on cotton in the rearing box. Besides that, the imago rearing box is also given a lily leaf as a place for imago to lay their eggs. Larvae were reared in rearing boxes measuring 37 cm long, 27 cm wide, and 15 cm high.

Meanwhile, the adults were kept in rearing boxes that were 50 cm x 50 cm x 50 cm in length, width, and height. Parameters observed were eggs, larvae, pupae, and adults, as well as the length of life of each growth phase. Observations were made daily to determine each developmental phase’s growth by looking at the exuvia from the head capsule. Moultling is checked based on the presence of the head capsule and exuvia.

**Identification of Insect Sample**

The insects found were identified using an identification keys book for the family, genus, and species levels using the *Insect Australia I and II* book, also *Book Moths of Borneo* part 12.

**Data Analysis**

Observational and morphometric data from each developmental phase (egg, larva, pupa, and imago) were tabulated, and the mean and standard deviation were calculated using Microsoft Excel 2016.

**RESULTS AND DISCUSSION**

**Attack Symptoms of Armyworm**

Lilies are plants that are commonly found as ornamental plants in residential areas. The field results include discovering Lepidoptera larvae that eat up lily leaves at the Housing of IPB Alam Sinarsari (6°34’50.5”S 106°43’57.6” E). The lily is eaten from the top of the leaf to the base of the leaf. The larvae also eat the base of the stem and burrow into the base of the stem, causing the lily plant to collapse.

**Characteristics of *Spodoptera picta***

The results of the identification of the larvae and imago found that these insects belonged to the armyworm group of the Noctuidae family. Characteristics of the larvae found, namely the late instar larvae are dark grey with a longitudinal black line, a striking yellow line that runs along the middle of the dorsal, and a Y shape in the head (Figure 2). On the larvae’s mesothorax and rear abdominal vertebrae, there is a black patch similar to the cotton armyworm species *S. litura* larvae.
Figure 2. Morphological characteristics of *Spodoptera picta* collected from Bogor, Indonesia

Imago lays eggs on the underside of leaves. Eggs are covered with scales similar to eggs in other *Spodoptera* genera (Figure 3a). The first and second instar larvae are yellowish green, then brown in the third and fourth instar larvae, and turn darker and quite large in the fifth instar larvae (Figure 3d-f). The number of eggs laid by imago *S. picta* was 50-218 in one egg group. In addition, the third instar larvae also found a pattern, like a ring on the neck. Pupae are reddish-brown, usually found on the ground near attacked plants. Meanwhile, the reddish-brown imago with a 'batik' pattern (Figure 3d) is similar to the *S. litura* species but has a larger size.

The average body length of *S. picta* larvae in instar 1 was 2 mm, instar 2 was 5 mm, instar 3 was 15 mm, instar 4 was 28 mm, and instar 5 was 46 mm. Meanwhile, the pupa and imago sizes of *S. picta* were 23 mm and 20 mm in length, respectively (Table 1).
The life cycle of S. picta ranges from 57-73 days. Eggs of S. picta take 3-4 days to hatch. Larvae have five instar stages of development. The duration of larval development in each instar ranges from 4-10 days (Table 1). The development time of S. picta larvae is influenced by the nutritional content of the feed eaten by the larvae. According to Megasari et al. (2022), feeding inappropriately to larvae causes slower growth. The final instar begins to stop eating and move around a little until it finally enters the prepupal phase. The pupae phase of S. picta ranges from 12-14 days. Meanwhile, the life span of S. picta imago ranged from 12-14 days (Table 1).

Table 1. Morphometric and time development of Spodoptera picta from Bogor, Indonesia

<table>
<thead>
<tr>
<th>Life stages</th>
<th>Range ± mean (mm)</th>
<th>Development (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg</td>
<td>1 ± 0.2</td>
<td>4-5</td>
</tr>
<tr>
<td>Larvae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1\textsuperscript{st} instar</td>
<td>2 ± 0.5</td>
<td>7-8</td>
</tr>
<tr>
<td>2\textsuperscript{nd} instar</td>
<td>5 ± 0.9</td>
<td>6-8</td>
</tr>
<tr>
<td>3\textsuperscript{rd} instar</td>
<td>15 ± 3.6</td>
<td>8-10</td>
</tr>
<tr>
<td>4\textsuperscript{th} instar</td>
<td>28 ± 4.2</td>
<td>4-8</td>
</tr>
<tr>
<td>5\textsuperscript{th} instar</td>
<td>46 ± 4.7</td>
<td>4-6</td>
</tr>
<tr>
<td>Pupae</td>
<td>23 ± 0.8</td>
<td>12-14</td>
</tr>
<tr>
<td>Imago</td>
<td>20 ± 1.4</td>
<td>12-14</td>
</tr>
</tbody>
</table>

Common pests that attack lilies are known only from the snail and slug group. However, pests from the armyworm group have been reported to attack in Australia, South Africa, Europe, Japan, and America. In these countries, lily borers were known from the species Brithys crini and B. pancrati (Lepidoptera: Noctuidae) (Kalshoven, 1981; Archer, 2004; Herbison-Evans, Crossley, 2018). It turned out that the caterpillars of this species had different morphological characteristics from those found in the field. However, the armyworm that attacks daffodils (Crinum pedunculatum) in Australia has the same morphological characteristics, both in its larval and imago stages, namely from the species Spodoptera picta (Lepidoptera: Noctuidae).

According to Herbison-Evans and Crossley (2017), S. picta armyworm has been found on the islands of Sulawesi and Kalimantan. However, this armyworm species has never been described after being studied in several kinds of literature, such as in the book “The Pest of Crops in Indonesia” by Kalshoven (1981). The book only describes the attack on the lily by the caterpillar B. crini. In addition, the book “Moth of Borneo” states that this species has been found in the Borneo area, not in the Kalimantan region, but in the Kuching region, Malaysia, and the coastal area of Brunei.
Spodoptera picta, often called the lily caterpillar from Asia, is a pest of considerable concern among ornamental plant lovers. The distribution of S. picta is limited to the continents of Asia and Australia, so S. picta is often said to live in the tropical Indo-Australian climate (Lit et al., 2014). In Indonesia, S. picta attacks were reported in 2016-2019 in several areas, namely in Sumedang Regency (West Java), Poso Regency (Central Sulawesi), and Badung Regency (Bali) (GBIF 2021). However, there were no further reports regarding the symptoms and damage caused. The S. picta moth has a very close kinship with S. litura. The phylogeny tree of the Genus Spodoptera (Pogue, 2002) showed S. picta and S. litura came from the same sister group, whereas the Fall Armyworm caterpillar S. frugiperda is quite distinctly related (Figure 4).

The size of the larvae and pupae of S. picta in Indonesia is larger than that of S. picta in Singapore (Ang et al., 2010). The last instar larva of S. picta has a length of 46 mm, and this larva has a more extended size when compared to S. litura and S. frugiperda. Likewise, the size of the pupa and imago S. picta have a length of 23 and 20 mm, respectively. Overall, the size of the larvae, pupae, and imago of S. picta was larger when compared to S. litura and S. frugiperda (Table 2, Fig. 4). The three Spodoptera imago in Figure 4 have similar patterns, but S. picta imago is pink. In contrast, S. litura and S. frugiperda imago tend to be brown.

<table>
<thead>
<tr>
<th>Stadium</th>
<th>S. picta</th>
<th>S. picta</th>
<th>S. litura</th>
<th>S. frugiperda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last instar</td>
<td>46 ± 4.7</td>
<td>46</td>
<td>33.80 ± 0.10</td>
<td>35.00 ± 0.15</td>
</tr>
<tr>
<td>Pupa</td>
<td>23 ± 0.8</td>
<td>20</td>
<td>17.92 ± 0.15</td>
<td>14.14 ± 0.31</td>
</tr>
<tr>
<td>Imago</td>
<td>20 ± 1.4</td>
<td>23</td>
<td>16.20 ± 0.10</td>
<td>16.30 ± 0.39</td>
</tr>
</tbody>
</table>

Table 2. Comparison of Genus Spodoptera at larva, pupa, and imago (in mm)

The early instar larvae will attack the young leaves and erode the leaf lamina, and then the larger larvae (3-5) will attack the leaf sheaths and even attack the basal plant growth points and lily bulbs, which can cause plant death (Lit et al., 2014). Plants that are hosts for S. picta are plants from the Amaryllidaceae family, such as Crinum asiaticum, Crinum pendunculatum, and Clivia mimiata (Ang et al., 2010), Clivia miniata Regel, Hippeastrum sp., Hymenocallis littoralis (L. f. ex Salisb.) Salisb (Lit et al. 2014). Damage caused by S. picta to lilies can reach 100%. The lily plants cause the symptoms until the plants collapse. The damage caused by the lily armyworm attack of S. picta was more severe than that of the armyworm S. litura and S. frugiperda (Marwoto & Suharsono, 2008; Lubis et al., 2020). Although the attack caused by S. picta is very high, attention to the existence of this moth is not the primary part. The plants attacked by S. picta are not included in the types of food or horticultural crops that are a primary concern in developing countries, such as Indonesia.

The management of S. picta armyworms needs to be done so as not to cause major damage and losses to ornamental flower crops, especially those from the Amaryllidaceae family. Biological control can be carried out using Nucleopolyhedrovirus (NPV) from the same genus, otherwise known as a cross-infection mechanism. The results of Hila and Caoili’s research (2020) stated that the NPV found in S. picta larvae could infect S. litura with an effectiveness of 46.67%. This makes it possible that NPV derived from S. picta larvae can also be used to control S. picta. If the attack is severe, control can be carried out using pesticides with the recommended dosage.

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CONCLUSIONS

The larvae that attack the lilies in Bogor are a group of armyworms in the Noctuidae family. It is known that the armyworm has not been described in Kalshoven's book but has been cited in the Moth of Borneo book. The armyworm is known to be a caterpillar of Spodoptera picta, commonly found attacking lilies in Australia.

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