



Short Note

Occurrence of Heavy Infestation by the Fall Armyworm *Spodoptera frugiperda*, a New Alien Invasive Pest, in Corn in Lampung Indonesia

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ABSTRACT

The fall armyworm *Spodoptera frugiperda* has spread and damaged corn in many African and a few Asian Countries recently. A recent outbreak (2019) of *Spodoptera* species in corn producing areas in the Island of Sumatra was suspected to be a new invasive species. Field observations were made on May 16, 2019 in the District of East and Central Lampung to identify the attacking *Spodoptera* species, and to observe and determine the damages. Based on the morphological characteristics, the “Y” inverted shape on the head capsule and the patterns of black spots on the abdominal segments (square and trapezoidal forms), the species was confirmed as *S. frugiperda*. The larvae heavily damaged the early stage of corn (approximately 2-week old) with 100% plants infested and each plant was occupied by a medium or large larva; while older corn received less damage. Larvae fed on the leaves causing defoliation before feeding on the growing point. Different damage symptoms due to *S. frugiperda* were compared to those of the Asian corn borer, *Ostrinia furnacalis*, and further discussion was made to determine the potential consequences of this new threat to the corn production in Indonesia.

Keywords: corn, Indonesia, outbreak, *Spodoptera frugiperda*, the fall armyworm

INTRODUCTION

The fall armyworm, *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae), is a major pest of corn and a polyphagous insect pest attacking >80 crops. *S. frugiperda*, a native to tropical and subtropical regions in the Americas, has been reported to infest corn and causing significant losses in the African Countries since the first detected in January 2016. Furthermore, this insect has spread to other countries, India and Yemen in 2018 (Georgen *et al.*, 2016; FAO, 2018; CABI, 2019). Recently, this species has been found in Thailand (S. Samanwong, February 6, 2019, personal communication). The fast dispersion of this insect may be attributed to high adaptability to the new environment, moth's strong flier, and international trade (Johnson, 1987; CABI, 2019). Considering these factors and the geographic proximity to the newly infected countries, the risks of spreading to Indonesia and causing some economic losses for corn farmers are real.

In the early May, a newspaper Tribun-Medan (May 1, 2019) reported that thousand hectares of

corn in the District of Karo, the Province of North Sumatra were infested heavily by a new species of armyworm (suspected as *S. frugiperda*) because they were different from the common *Spodoptera* species damaging the corn (*S. litura*) which is most entomologists and agricultural officers are familiar with. The similar corn damage was also observed in the District of East Lampung, the Province of Lampung. Proper identification of species causing the problem is the key to the success in managing the new invasive species. Therefore, field observations were conducted in the two Districts in the Province of Lampung (East and Central Lampung) to identify and confirm whether or not the new invasive species infesting corn was *S. frugiperda* and to describe and determine the damages.

MATERIALS AND METHODS

Locations

The sites for field observation were selected purposively on May 15, 2019 at the two corn fields reported to be infected by *Spodoptera* larvae,

suspected as *S. frugiperda*. The first site was in the Village of Margosari (S 5°11'33.6588" E 105°21'38.6028"), the County of Metro Kidang, the District of East Lampung, and the second site was in Village of Sidokerto, the County of Bumi Ratu Luban, and the District of Central Lampung.

Corn Plantations

In Margosari, there were several fields of corn with two different ages. The first field was about 0.5 ha with ca 2-week old, and the adjacent field was older corn (ca 9-week old) (>0.5 ha). Similarly, there were two different ages of corn in Metro Kidang with ca >3 ha of corn fields. The first field was ca 5-week old corn (ca 1 ha) planted adjacent to the slightly older corn (ca 2 ha of 7-week old). Therefore, four corn stages were sampled during the observations.

Observations

Thirty plants distributed diagonally were observed for each corn stage (2-, 5-, 7-, and 9-week old). For each diagonal, corn was sampled with an interval of two steps to have 15 samples for each diagonal. The observations were carried out to identify the larvae attacking the plants based on their morphological characteristics, to calculate the number of larvae found in the infected plants, to determine the percentage of infected plants, and to characterize the damage symptoms. Samples of larvae were collected from Margosari. Identification was conducted in the fields and in the Laboratory of Plant Quarantine in Lampung. After observing

the larval morphological characteristics in the laboratory, the larvae were given to the Quarantine Office in Lampung since this insect was considered as a quarantine pest.

RESULTS AND DISCUSSION

Larvae

The infesting larvae in the sites of observation were identified as *S. frugiperda* based on the three morphological characters: the inverted "Y" shape in the head capsule (Figure 1A), a four black spot forming a square in the 8th abdominal segment (Figure 1B), and a trapezoidal pattern of four spots in the 1–7th and the 9th abdominal segments (Figure 1C). These three characteristics well fitted with the morphological descriptions of *S. frugiperda* larvae (King & Saunders, 1984; EPPO, 2015; Ganiger *et al.*, 2018; Sisodiya *et al.*, 2018). The result from molecular identification of the larvae was in agreement with that based on the morphological identification, and the molecular data together with the analysis of their relatedness to the populations of *S. frugiperda* from other countries are being prepared for a publication (Suputa *et al.*, May 22, 2019, personal communication).

In all infected plants, we found one larva per plant. The collected larvae had different colors showing polymorphism (Figure 2). Interestingly, larvae were dominated by the late instars and we did not find any other stages of this insect during the field observation. These may indicate that the generations of this insect in the sites of observation

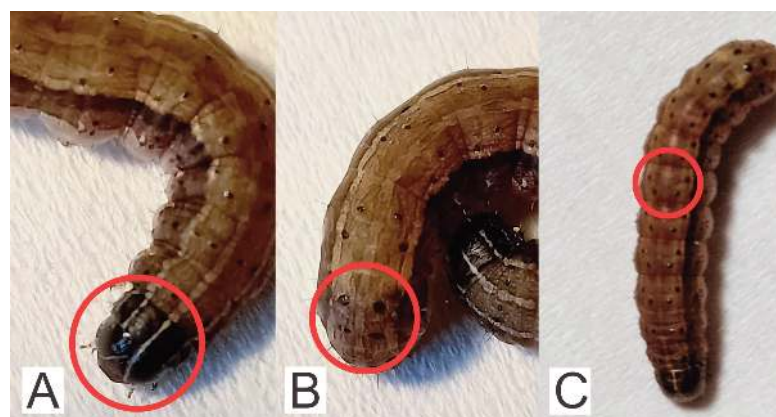


Figure 1. Morphological characteristics of the fall armyworm *Spodoptera frugiperda* collected from corn in Margosari, the District of East Lampung, the Province of Lampung Indonesia on May 15, 2019; (A) the inverted "Y" shape on the head capsule; (B) four black spots on the 8th abdominal segment forming a square pattern; and (C) four black spots on the remaining abdominal segments forming a trapezoidal pattern



Figure 2. Larval polymorphism in the fall armyworm *Spodoptera frugiperda* collected from corn in Margosari, the District of East Lampung, the Province of Lampung Indonesia on May 15, 2019; (A) dark brown color of the larva; (B) yellowish green color of the larva

were still distinctive from one to other generation or no overlapping generations. This may be related to the early invasive stages of a new species. However, there is no data available indicating the exact time of this insect landed in the Province of Lampung or Indonesia in general. Based on the information gathered from the farmers, this season was the first time they encountered problem causing by this insect. *S. frugiperda* has overlapping generations once they are established (Fuxa, 1989; Sousa *et al.*, 2016). Therefore, it is predicted that similar life stages will be disappearing over the generations with consequences that larvae of *S. frugiperda* will most likely be present all the time once the hosts exist. This condition should be taken into account for managing this invasive species.

Plant Damage

We observed four different leaf damaged symptoms due to *S. frugiperda* larvae. The first symptom was semitransparent patches on the leaves (Figure 3A) as a typical symptom made by the early instars of *Spodoptera* species. The larvae feeding on the whorl resulted in the ragged holes on the leaves (Figure 3B). Most larvae were found in the growing point and protected by the faeces. They caused the lodging of the growing point (Figure 3C) which might eventually result in no new leaves. In older plants, the larvae fed on the young male flowers causing the damage on the tip of the flower (Figure 3D).

Damages on corn leaves due to *S. frugiperda* were distinctive from those of *Ostrinia furnacalis*, the Asian corn borer. The window-like symptom was typical for *S. frugiperda* (Figure 3A) and other *Spodoptera* species. Larvae of both species could feed on whorls which result in parallel holes (Figure 3B and 3E). Holes due to *O. furnacalis* (Figure 3E) were smaller than those by *S. frugiperda* (Figure 3B) because only the early larval stage of *O. furnacalis* feeds on the whorl before the larvae bore into the stem. On the other hand, *S. frugiperda* preferred feeding on the vegetative stage particularly on leaves, whorl, and the growing point (Figure 3A–C). Leaves damaged by *S. frugiperda* were often easily identified by the presence of faeces which is not common for *O. furnacalis*. Larval feeding on the growing point of the plants caused different damages. *S. frugiperda* tend to feed on the early stage of corn and continued feeding on the growing point causing massive damage (Figure 3C), whereas *O. furnacalis*

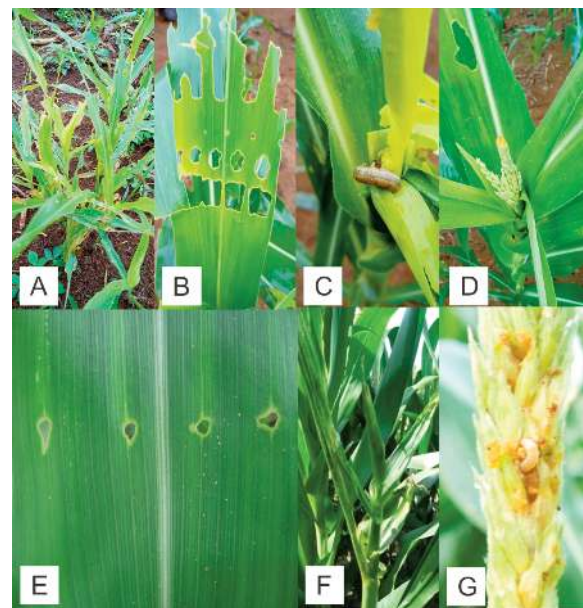


Figure 3. Different damages due to larvae of the fall armyworm *Spodoptera frugiperda* observed from corn in Margosari, the District of East Lampung, the Province of Lampung Indonesia on May 15, 2019; (A) semitransparent patches on the leaves; (B) ragged holes on the leaves; (C) damage on the growing point of the plant; and (D) damage on the tip of the flower. Damages due to larvae of the Asian corn borer *Ostrinia furnacalis*: (E) typical parallel small holes; (F) the male flower was not formed; and (G) a larva feeding the male flower internally.

was occasionally found attacking at the growing point at the later stage of corn which could cause the male flower not formed (Figure 3F). This later damage was commonly found in East Java in 2014, and the local farmers called this symptom as “bundel” meaning no growing tip. Furthermore, the male flowers may also be attacked by both *S. frugiperda* (Figure 3D) and *O. furnacalis* (Figure 3G). The differences in the feeding behavior and the size of the larvae of these two species resulted in distinguishable damages based on the presence of faeces for *S. frugiperda* and the size of holes where *O. furnacalis* has smaller holes on the tassels. Although we have not found *S. frugiperda* feeding on the ear during the field observations, a few references have indicated that this species could also damage the ear similarly to the corn earworm (*Helicoverpa armigera*) (King & Saunders, 1984; Capinera, 2017) as well as *O. furnacalis* (Y. A. Trisyono, personal field observation).

The damage was related to the plant age, and *S. frugiperda* larvae tend to prefer infesting the young corn. In Margosari, 100% plants (2-week old) were infected by *S. frugiperda*. On the other hand, we did not find any damage in the 9-week old plants planting adjacent to the 2-week field. In addition to the thirty samples, an observation was made on many other plants at the first field and all of these plants were also damaged. In the village of Sidokerto, the two corn fields observed had slightly different in their ages (5- and 7-week old). Thirty percent of the 5-week old corn was damaged by *S. frugiperda*, while the other field (7-week old) received less damage (10%). High infected plants (100%) occurred in Margosari (East Lampung) showed the potency of *S. frugiperda* in damaging the corn, particularly during the early stage of corn (2-week old). This suggests that oviposition might have happened when the plants were less than one-week old after germination. Infestation at the growing tip may cause a total loss because new leaves will not emerge and replanting may be needed with the possibility of being infected again from the following generations of *S. frugiperda*.

Considering the damages that we have seen in the fields, *S. frugiperda* is more likely to become more damaging to corn than three other lepidopteran species known commonly attacking corn in Indonesia, such as *O. furnacalis*, *H. armigera*, and *S. litura*. If the damage due to *S. frugiperda* did not cause the plant mortality, a significant yield reduction (28% per

plant) could still occur when the plants were infested during the first to second week after germination (Evans & Stansly, 1990). A decrease in yield reduction is expected when the plants get older. Consequently, the economic injury level (EIL) values increased from 14% infestation at the two-week-old to 50% infestation at the six-week-old plants (Evans & Stansly, 1990). The values of EIL are dynamic and they can be different from country to country because of the variations in the values of the parameters used to calculate the EIL. Regardless of the necessary adjustment for each situation, this report and other previous publications suggest that the early stage of corn is the sensitive stage for *S. frugiperda*. Therefore, an efficient and effective tool for monitoring should be in place to support the decisions in timing, selecting, and implementing the effective control measures. Furthermore, efforts to reduce and contain the population in the infected areas in Sumatra must be taken to lower minimize the economic losses in the infected areas and to delay the spread to other corn producing areas in Indonesia.

CONCLUSION

The *Spodoptera* species infesting corn in the Province of Lampung in May 2019 was confirmed as *S. frugiperda* based on their morphological characteristics. The larvae damaged heavily on young corn (100%), and the number of infected plants declined as the plants get older. The potential economic losses due to *S. frugiperda* were likely to be higher than that of the other existing lepidopteran species.

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