The occurrence of *Spodoptera frugiperda* attack on maize in West Pasaman District, West Sumatra, Indonesia

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Abstract. Maize [*Zea mays*] is the third most important cereal crop in Asian countries after rice and wheat. In Indonesia, maize is the second food crop after rice. One of the main problems in corn cultivation is pests. *Spodoptera frugiperda* [Lepidoptera: Noctuidae] is the major pest of maize and polyphagous insect pest attacking more than 80 crops. This study aims to determine the occurrence of heavy by the *S. frugiperda* in West Pasaman District, West Sumatra. The research method used in this study was a survey or sampling. The results showed that there was a severe attack of a new invasive pest, *S. frugiperda* on maize crops in West Pasaman. The attack rate of *S. frugiperda* in West Pasaman District was classified as high, reaching 100.00% at the age of 40 days after planting. Maize was severely damaged in the early stages phase vegetative of maize [approximately 40 days after planting], with 100% of maize infested and each plant was occupied by one until two medium or large larvae. Its means, the vegetative phase is a phase that is vulnerable to the *S. frugiperda* attack of maize. The high intensity of *S. frugiperda* attacks is also caused by several factors, like variety, spacing, types of plants around maize fields, and when farmers used pest and disease control techniques. Even a severe attack can cause the maize to fail to grow. This new invasive pest can threaten maize production in Indonesia. Therefore, further research is needed regarding this new invasive pest, *S. frugiperda*.

Keywords: Fall armyworm, growing point [shoots], new invasive pest, vulnerable phase, west Pasaman District

1. Introduction

Maize [*Zea mays* L.] is the third most important cereal crop in Asian countries. In Indonesia, maize is the second food crop after rice. One of the maize production centers in West Pasaman [1]. *Spodoptera frugiperda* J.E. Smith is the major pest of maize and polyphagous insect pest attacking more than 80 crops. *S. frugiperda*, a native pest to tropical and subtropical regions in America and has been reported to infest maize and causing significant losses in African countries since the first detection in January 2016. Furthermore, this insect has spread to other countries, India and Yemen in 2018 [10; 8; 3]. In Indonesia, *S. frugiperda* is an invasive new pest on maize. At the beginning of 2019, this pest was found in maize plants in the Sumatra area [13].
Recently in early July, Sari et al. have been reported in the newspaper Khazanah-Kota Padang [July 3, 2019], that maize in several districts in West Sumatra Province was attacked by *S. frugiperda*. Based on the survey results of Sari et al. [18] since the beginning of 2019, this pest has attack corn plants in West Pasaman, Pariaman, Solok, and Padang Pariaman District. This attack of *S. frugiperda* is greatly feared by farmers today because the damage caused by this pest is very high. Even if control measures are not taken immediately, they can reduce production yields. This species has been also found in Bandung [14], Lampung [22], and Bengkulu [15]. But scientific reports on the existence of *S. frugiperda* pest in West Sumatra are still limited. Therefore, research about new invasive pests on maize in West Sumatra is urgently needed. The intensity of attacks and the occurrence of large populations of new invasive pests are urgently needed to prevent the explosion of new invasive pests.

2. **Material and methods**

This experiment has been carried out in two sub-districts of maize production centers in West Pasaman District, and at the Bioecology Laboratory, Faculty of Agriculture, Andalas University, Indonesia. This study was conducted from October 2019 to March 2020. The two sub-districts of maize production centers in West Pasaman are Luhak Nan Duo and Kinali. The material used in this research was 96% alcohol. Meanwhile, tools that were used included microscope, microcentrifuge tube, plastic kreb, dropper pipette, petri dish, container box, insect tweezers, cap, field shoes, label paper, digital camera Sony HX-300, tissue, face shield, mask, and other tools.

The method used in this research is sampling. In this experiment, the location of the research sample was 1 ha. Sampling was carried out four times, namely at the age of 20, 40, 60, and 80 days after planting. The sampling represents 2 growth phases of the maize plant, namely the vegetative and generative phases.

The sample collection of *S. frugiperda* was done by direct observation of all plant samples. The method used in this study was random or sampling. We did as much as 4 times in every location [20, 40, 60, and 80 days after planting (DAP)]. It is taking the larvae using tweezers. The sample obtained was put into a 1.5 ml microcentrifuge tube which already contained 96% alcohol. Then the microcentrifuge tube was labeled. Then samples were taken to Insect Bioecology laboratory, Faculty of Agriculture, Andalas University to identified. Identification of *S. frugiperda* that attacks maize in West Pasaman, West Sumatra carried out by observing the character of the morphology of the larvae and imago under the light microscope. The identification process refers to [17], [11], [2], [7], [4], [16], [6], [19], and [13].

The level of attack of an invasive new pest, *S. frugiperda* was analyzed using Microsoft Excel and a description of the specific symptoms. Data processing aims to determine and obtain the attack intensity of *S. frugiperda* in the West Pasaman District.

3. **Results and Discussion**

The results showed that there was a severe attack of *Spodoptera frugiperda* on maize in West Pasaman. The attack rate of *S. frugiperda* in West Pasaman District was classified as high, reaching 100.00% in the vegetative phase of maize [Figure 1].
Figure 1. The attack rate of *S. frugiperda* [FAW] on maize in West Pasaman, Indonesia.

In Figure 1, it can be seen that maize was severely damaged at the age of 40 days after planting [DAP], with 100% of maize infested, and each plant was occupied by medium or large larvae. Based on the plant growth phase, the age of 40 days after planting is the vegetative phase. It means that the vegetative phase has been the growth phase most susceptible to FAW. The identification of FAW in all locations was based on the character of morphological larvae. Three characteristics are also set as a description of the morphology of larvae [12; 7; 21]. *S. frugiperda* attacked shoots of maize [Figure 2].

Figure 2. The specific symptoms of *S. frugiperda* in West Pasaman. Larvae on shoots of maize [a], Their feces like sawdust [b].

In Figure 2, it can be seen that the specific symptom of FAW has been known that the larvae feed on the shoots of maize, and leaving their feces like sawdust. Even a severe attack can cause the maize to fail to grow. FAW is very voracious and larvae can eat the shoots of maize until they run out, so if control efforts too late, the risk of crop failure can occur when the attack rate is high. The results of this study are the same as those stated by [3], that FAW attacked plant growth points which can fails shoot formation. The losses incurred due to FAW in African and European countries are between 8.3 and 20.6 million tons per year [9].

Based on the growth phase of maize, so FAW can attack all the development phases [vegetative and generative phase]. However, the highest attack rate of FAW occurred in the vegetative phase, namely 72.50% until 100.00% [Figure 3].
Figure 3. The intensity of attacks of *S. frugiperda* in the vegetative phase of maize, in West Pasaman, West Sumatra, Indonesia.

In Figure 3 it can be seen that the vegetative phase is a phase that is vulnerable to FAW attack. According to [20], there are only one or two larvae per plant on maize in Southern India. However, in this study, the average number of FAW larvae found in West Pasaman was average two to three per plant. When the attack intensity of FAW is classified as heavy, the signs of damage that occurred in the vegetative phase can be seen visible in the field. The leaves on the shoots were seen to be damaged and disjointed was due to being eaten by larvae. Besides, the high intensity attacks also provide an opportunity to find the egg of FAW imago in the field [Figure 4].

Figure 4. The occurrence of heavy attacks from FAW in West Pasaman [a], Eggs of *S. frugiperda* was founded on maize [b]. [Photo: Silvia Permata Sari]

In addition to the maize growth phase, the high intensity of attacks from FAW in the vegetative phase in West Pasaman is thought to be due to several factors [Table 1].
Table 1. Other factors affecting the intensity of attacks from FAW in West Pasaman, West Sumatra, Indonesia

| Other Factors                                           | Luhak Nan Duo Sub-district | Kinali Sub-district |
|---------------------------------------------------------|----------------------------|--------------------|
| Altitude                                                | 36 mdpl                    | 28 mdpl            |
| Variety of maize                                        | Pioneer 32                 | Pioneer 32         |
| Spacing of maize                                        | 75 x 20 cm                 | 75 x 25 cm         |
| Founded or not of *S. frugiperda*                       | Founded                    | Founded            |
| The part of the plant that is attacked                  | Shoots                     | Shoots             |
| The average number of larvae founded per plant          | Two-three larvae per plant | Two larvae per     |
| Types of plants around the maize field                  | NK 212 varieties, oil palm | NK 212 varieties, oil palm |

In Table 1, it can be seen that West Pasaman is classified as lowland [<400 meters above sea level], where the altitude ranges from 28 - 36 meters above sea level. The condition of the landscape close to sea level allows the spread of FAW which is very likely to occur from one region to another. Pioneer 32 varieties have an upright leaf structure when the shoots are fully open so that it will attract more FAW imago. The types of plants around the fields also affect the percentage attack, meaning that the availability of food occurs throughout its life and at the same time as an alternative host plant. [18] reported that maize in West Pasaman was attacked by FAW since the beginning of 2019. The high intensity of *S. frugiperda* attacks during the vegetative period does not always make the attack intensity high during the generative period with ranges from 0.00 - 14.17% [Figure 5].

![The Intensity of Attacks of *S. frugiperda* in Generative Phase of Maize in West Pasaman, West Sumatra, Indonesia](image-url)

**Figure 5.** The intensity of attacks of *S. frugiperda* on generative phase, in West Pasaman, West Sumatra, Indonesia.
In Figure 5, it can be seen that the attack intensity of FAW decreases with the increasing age of maize. At the age of 60 days after planting, maize has a morphological structure of leaves and stems that are harder and stronger. Besides, farmers in West Pasaman intensively carry out several chemical control techniques on the generative phase, so FAW was no longer found. [20] reported the existence of FAW and natural enemies on maize in Southern India. Mechanisms of plant resistance to FAW attacks have also been developed [5]. Furthermore, [9], imago of FAW is a strong flier and has a high cruising range. At the beginning of May 2019, the mass media Tribun-Medan [1 May 2019] reported that thousands of hectares of land of maize in Karo, North Sumatra, is believed to have been infested by FAW. The same damage was also reported in the Lampung district of the east, Lampung [22]. [14], said that FAW has been attacked on maize in West Java. Moreover, [15] said that FAW has also attacked maize in Bengkulu.

4. Conclusions

As for the conclusion was a severe attack of S. frugiperda on maize crops in West Pasaman District, West Sumatra Province, Indonesia. The vegetative phase is a phase that is vulnerable to S. frugiperda attack. Even a severe attack can cause the maize to fail to grow. The high intensity also influenced by variety, spacing, types of plants around the maize fields, and pest and disease control techniques used by farmers.

Acknowledgment

The author are grateful to Andalas University, which has funded this research [RDP cluster], Profesor Irfan Suliansyah, Profesor Novri Nelly, and Dr, Hasmiandy Hamid as my supervisor in PhD Program di Andalas University. And I said to thanks all my research team who helped carry out this research, both in the field and in the laboratory, what's more this research was carried out during the Covid-19 Pandemic.

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