



Distribution and biology *Spodoptera frugiperda* on corn crops (*Zea mays* L.)

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Key words: Biology, Pest, Corn, Distribution, *Spodoptera frugiperda*.

<http://dx.doi.org/10.12692/ijb/19.6.86-93>

Article published on December 18, 2021

Abstract

Spodoptera frugiperda is a new insect pest that originated in the Americas and has spread to various countries including Indonesia. This pest attacks the growing point of corn crops resulting in the failure of the formation of young shoots/leaves of the plant. Loss of results due to insect attacks can reach 80%, can even cause puso if not controlled. Larvae of *S. frugiperda* have high feeding ability and are polyphagous. Larvae enter the part of the plant on the sidelines between the leaves and stems and actively feed in the same location, so if the population is still small, it will be difficult to detect. Imago is also a strong aviator and has a high cruising power. One to plan control is to study the distribution of insect pests and their biology in the Tanah Laut regency of South Kalimantan province. This research aims to study the distribution and biology of *S. frugiperda* in Tanah Laut Regency of South Kalimantan Province. At 11 observation sites from three subdistricts (Tambang Ulang, Pelaihari, and Panyipatan) in Tanah Laut Regency, on cornfields in all these locations have been found *S. frugiperda* with an average number of egg stadia 0.36 groups of eggs, larvae 27.18 tails, pupa 0.09 tails and imago found during observation 0.27 tails with the percentage of this pest attack in corn farming in three subdistricts in Tanah Laut Regency (Pelaihari, Panyipatan, and Tambang Ulang) of 45.86%. Of the two observed corn varieties (feed and sweet), the percentage of attacks on feed corn ranged from 22.22 - 66.67%, while sweet corn ranged from 52.38 to 63.64%. The average phases of eggs, larvae, pupae and imago are 2 each; 19.5; 9.8; and 3.4 days.

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Introduction

In increasing food production, the Indonesian government has made a special effort program and corn crops (*Zea mays* L.) including one of the commodities that are expected to increase, known as the Special Effort of Corn and Soybean Rice (UPSUS PAJALE) (Ministry of Agriculture, 2019). In addition to rice crops, corn crops are a strategic commodity in meeting food needs in Indonesia as raw materials for oil and flour production. In addition to corn as a foodstuff, corn can also be used as animal feed.

South Kalimantan is the second-largest producer of corn after West Kalimantan. Of the thirteen regencies/cities in South Kalimantan, residents/farmers who do not grow corn only in the city of Banjarmasin. As the main center in Kalimantan is Tanah Laut Regency which has been developed covering an area of 82,481.5 hectares with a production of 402,860 tons (South Kalimantan Food and Horticulture Plant Office, 2018).

As is the case with planting crops in general, in growing corn, plants cannot be separated from the problem of plant disrupting organisms that were known to reduce production both in quantity and quality. Lately, the serious problem facing farmers in the cultivation of corn crops is the attack of the pest *Spodoptera frugiperda*.

S. frugiperda is a new pest insect on corn crops in Indonesia. This insect originated in America and has spread widely in various countries (Ministry of Agriculture, 2019). This pest attacks the growing point of the plant, failing the formation of young shoots/leaves of the plant. Loss of results due to insect attacks can reach 80%, can even cause puso (crop failure) if not controlled. Larvae of *S. frugiperda* have high feeding ability and are polyphagous. Larvae enter the part of the plant on the sidelines between the leaves and stems and actively eat there so that if the population is still small, it will be difficult to detect. The imago is also a strong aviator and has a high cruising range (FAO and CABI, 2019). This pest is capable of causing up to 100%

damage (Bagariang *et al.*, 2020; Megasari & Khoiri, 2021). The main host of *S. frugiperda* in the food crops of the Graminae family, such as corn, rice, wheat, sorghum, and sugarcane, so that the existence and development of the population need to be wary. *S. frugiperda* is also a dangerous invasive pest because its life cycle is short and includes difficult to control (FAO and CABI, 2019). Currently, the spread of *S. frugiperda* in the area of South Kalimantan, especially Tanah Laut Regency has not been widely reported, but from reports of farmers and officers in the field, this pest has been found in several corn farming locations. Therefore, new pest monitoring and research measures are very important to prevent the occurrence of pest explosions in an area and determine their control strategies.

To determine this pest control strategy, it is necessary to study its distribution and eco-biology. Based on existing problems regarding the damage caused by *S. frugiperda* to corn crops, research is needed to study the distribution and biology of *S. frugiperda*.

This research is a strengthening of the Basic Research of the ULM Research Development Master Plan in the framework of Food Security for the period 2020-2024 (Institute for Research and Community Service, 2020). This research aims to find out the Distribution and Biology of *S. frugiperda* pests in corn crops.

Materials and methods

This research experiment was conducted at the Entomology Laboratory of the Department of Pests and Plant Diseases, Faculty of Agriculture, Lambung Mangkurat Banjarbaru University, and three districts of corn crop cultivation in Tanah Laut Regency, Tambang Ulang sub-district, Pelaihari Subdistrict and Panyipatan (Fig. 1). The study was conducted from March 2021 - October 2021.

This research was conducted using a survey method (*purposive sampling*) to farmers in Tanah Laut Regency. To find out the distribution of *S. frugiperda*, observations were made at 11 corn plantation locations with an area of at least 0.5 ha by observing

the abundance of individuals in 60 sample plants from each location. In addition to observing its abundance is also carried out the collection of *larvae* of *S. frugiperda*, which will be propagated to study bioecology (life cycle). The things that will be

observed are the time (days) of development of each egg stage, larva, pupa and imago in the laboratory. Observational data will be tabulated and analyzed descriptively.

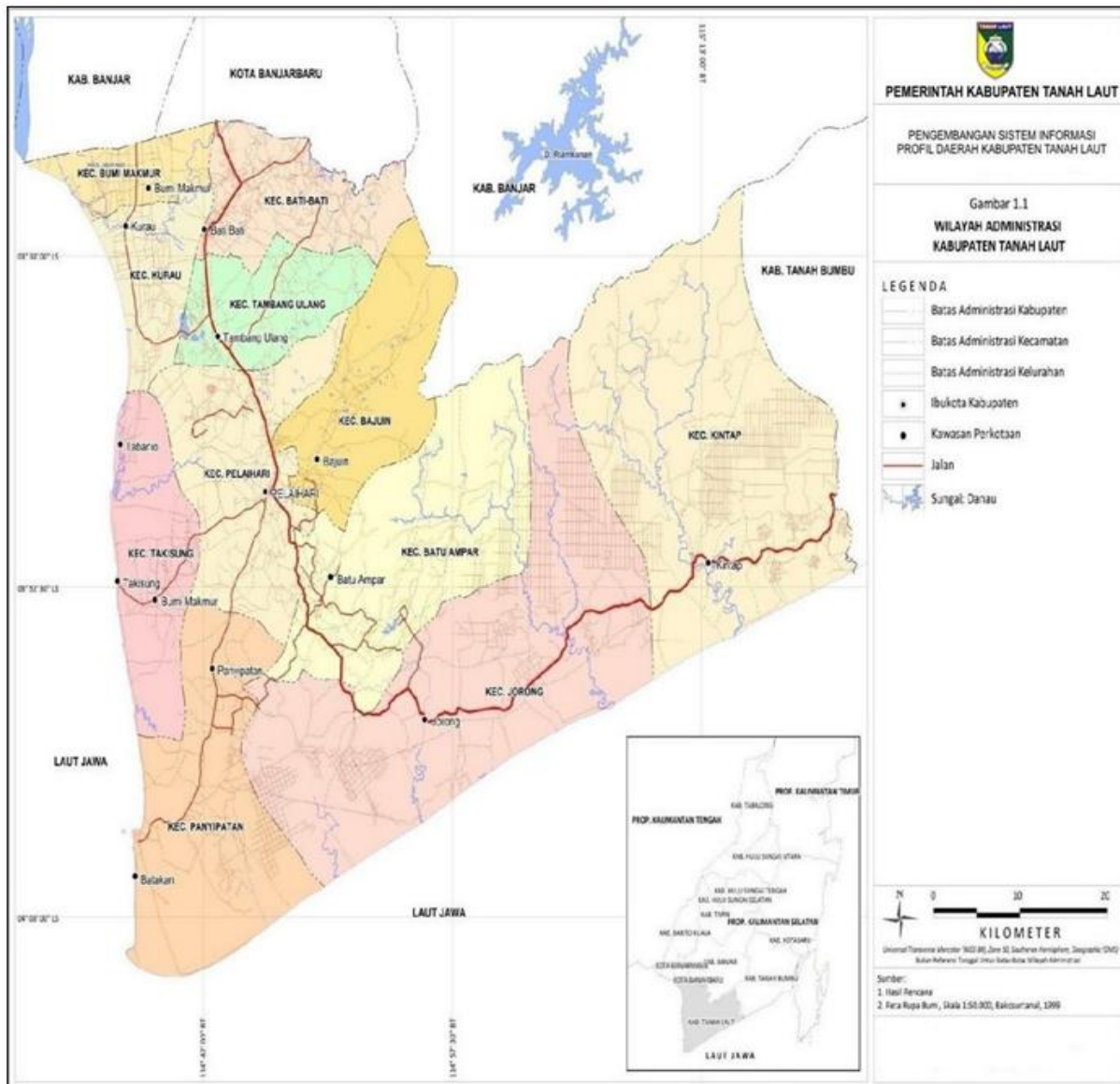


Fig. 1. Map of the Administrative Area of Tanah Laut Regency of South Kalimantan Province (Source: Bakosurtanal Earth Map, 1999 in The Government of Tanah Laut Regency).

Research preparation

Location survey

Before the research was surveyed to determine the location, the selected location was a corn plantation that is at least 0.5 ha. The selected location is corn farming in three sub-districts in Tanah Laut Regency, Tambang ulang, Pelahari, and Panyipatan spread across 11 villages.

Propagation of insects *Spodoptera frugiperda*

The propagation of *S. frugiperda* pests is carried out before biological research is carried out. Larvae of *S. frugiperda* obtained from agricultural land are put into a container of jars that have been modified so that the larvae can grow properly by giving corn leaves until the larvae enter the larval phase of instar 6 (12-15 days). After the larva changes stadia to pupa

marked by reduced movement activity and feeding activity, then the larva is transferred back to the modified jar by adding wood powder at the base of the jar, this phase has a time range (7 days) before becoming imago. When the pupa has turned into an imago then the next stage is to move the imago to a jar that has been modified by installing opaque paper around the inside of the jar.

The purpose of adding the paper is as a place to lay eggs by the imago itself, which has a time range of about (5-6 days) by providing food in the form of honey liquid (Kasten,1978).

Eggs from imago that are still attached to the opaque paper are then moved by cutting some parts of the paper and then transferring them to other jars that have been prepared food in the form of lettuce leaves that aim if the egg hatches then the main source of feed of the larvae is the lettuce leaves. To avoid cannibalism, newly hatched larvae on unhatched eggs will be moved. This propagation is done to obtain the number of worm pests as many as 150 tails for use in the implementation of research which in each experimental unit invested 10 larvae.

Observation

Distribution

The specified distributions are spatial (space) and vertical distributions. To obtain spatial distribution, observations are made on the land path at each location. 11 observation locations have been determined in three sub-districts in Tanah Laut Regency that have been selected, Tambang Ulang, Pelaihari, and Panyipatan. In The Tambang ulang sub-district with research locations Bingkulu Village, Pelaihari sub-district in Ambungan Village, Sarang Halang Village (two locations), Tampang Village (two locations), Telaga Village, Sumber Mulya Village; Panyipatan sub-district in Bumi Asih Village, Batu Tungku Village, and Sukaramah Village Observations were carried out four times, on April 2021, April 21, May 04, and June 01, 2021. To determine the vertical distribution is done by observing the individual abundance of *S. frugiperda* and its damage to the

corn crop. Observations based on the path diagonally of corn farming by determining the sample crop every five steps against 60 plants at each location, bringing the total to 660 plants.

The magnitude of the damage is determined by the formula:

$$P = \frac{A}{B} \times 100\%$$

P: percentage of attacks.

A: The number of plants affected.

B: The total number of plants observed.

Biology

The biological aspect that will be observed is the time (day) length of each stadia development of metamorphosis, namely from egg stadia, larvae, pupae to imago on a laboratory scale.

Results and discussion

Distribution of *Spodoptera frugiperda*

Observations in the field to find out the distribution of *S. frugiperda* are not following with the plan with an observation period of once a week due to the enactment of restrictions on community activities during the pandemic, namely the enactment of Restrictions on Community Activities (PPKM) by the government. Observations of the distribution of *S. frugiperda* were made three times at 11 observation sites as mentioned above.

The results of observations have obtained data that at all observation sites have been found insect pest *S. frugiperda* on average from the egg stage, as many as 0.36 packages (egg groups), larvae as many as 27.18 pupae as many as 0.09, and imago as many as 0.27 (Table 1) with attacks varying between 25% - 76% (Table 2).

S. frugiperda in the field was found to attack all stage growth corn crops (vegetative and generative) both feed corn and sweet corn, but the damage to sweet corn is heavier than corn feed. This is in accordance with the statements and results of the study of Maharani *et al.* (2019), Prasanna *et al.* (2018), Pebrianti and Siregar (2021).

Table 1. *Spodoptera frugiperda* in egg stadia, larvae, pupae and imago found at 11 observation sites.

No.	Location	Eggs (package)	Larvae	Pupae	Imago
1.	Bingkulu Village Sub-district Tambang Ulang	0	30	0	0
2.	Ambungan Village Sub-district Pelaihari	0	10	0	3
3.	Sarang Halang Village (I) Sub-district Pelaihari	0	22	1	0
4.	Sarang Halang Village (II) Sub-district Pelaihari	0	29	0	0
5.	Tampang Village (I) Sub-district Pelaihari	0	11	0	1
6.	Telaga Village Sub-district Pelaihari	4	26	0	0
7.	Sumber Mulya Village Sub-district Pelaihari	0	29	0	0
8.	Tampang Village (II) Sub-district Pelaihari	0	29	0	1
9.	Bumi Asih Village Sub-district Panyipatan	0	42	0	0
10.	Batu Tungku Village Sub-district Panyipatan	0	29	0	0
11.	Sukaramah Village Sub-district Panyipatan	0	42	0	1
	Sum	4	299	1	3
	Average	0,36	27,18	0,09	0,27

Table 2. Percentage of *Spodoptera frugiperda* attacks on corn plantations in three sub-districts in Tanah Laut Regency.

No.	Location	Type (variety)	Age of the plant	Attack (%)
1.	Bingkulu Village Sub-district Tambang Ulang	Feed corn (NK 212)	±20	22,22
2.	Ambungan Village Sub-district Pelaihari	Feed corn (NK Sumo)	±30	64,44
3.	Sarang Halang Village (I) Sub-district Pelaihari	Feed corn (Bisi 18)	±50	66,67
4.	Sarang Halang Village (II) Sub-district Pelaihari	Feed corn (Bisi 18)	±40	61,11
5.	Tampang Village (I) Sub-district Pelaihari	Feed corn (NK 212)	±60	36,36
6.	Telaga Village Sub-district Pelaihari	Feed corn (BC 18)	±60	32,50
7.	Sumber Mulya Village Sub-district Pelaihari	Feed corn (NK 212)	±14	25,00
8.	Tampang Village (II) Sub-district Pelaihari	Feed corn (RK 45 and Pioneer)	±40	36,25
9.	Bumi Asih Village Sub-district Panyipatan	Sweet corn (Exotic Pertiwi)	±40	52,38
10.	Batu Tungku Village Sub-district Panyipatan	Feed corn (NK 212)	±60	43,94
11.	Sukaramah Village Sub-district. Panyipatan	Sweet corn (Exotic Pertiwi)	±14	63,64
	Average			45,86

The highest level of damage is found in the vegetative phase (Trisyono *et al.*, 2019). Larvae can damage almost all parts of the plant, even causing the failure

of the formation of young shoots or leaves of the plant (Maharani *et al.*, 2019).

Table 3. Age (day) stage eggs to stadia imago *Spodoptera frugiperda*.

Repetition	Stage										
	Egg	Instars 1	Instars 2	Instars 3	Instars 4	Instars 5	Instars 6	Prepupa	Pupa	Imago	Total
I	2	4	5	4	2	2	2	2	10	5	39
II	2	4	5	4	2	2	2	2	10	7	41
III	2	4	5	4	2	2	2	2	11	6	41
IV	2	4	5	4	2	2	2	2	9	6	39
V	2	4	4	4	3	3	3	2	9	9	43
VI	2	4	4	4	3	3	3	2	9	13	47
VII	2	4	4	4	3	3	3	2	12	12	49
VIII	2	4	4	4	3	2	2	2	12	7	43
IX	2	4	4	4	3	2	2	2	8	6	38
X	2	4	4	4	3	3	3	2	8	8	41
Average	2	4	4.4	4	2.6	2.4	2.4	2	9.8	7.9	42.1
SD	0	0	0.49	0	0.49	0.49	0.49	0	1.4	2.55	3.36

Biology Spodoptera frugiperda

Biological observations of *S. frugiperda* include observations from the egg phase to the imago phase

in units of time of day. The average phases of eggs, larvae (instars, pupae, and imago are 2 each; 19.5; 9.8, and 3.4 days (Table 3).

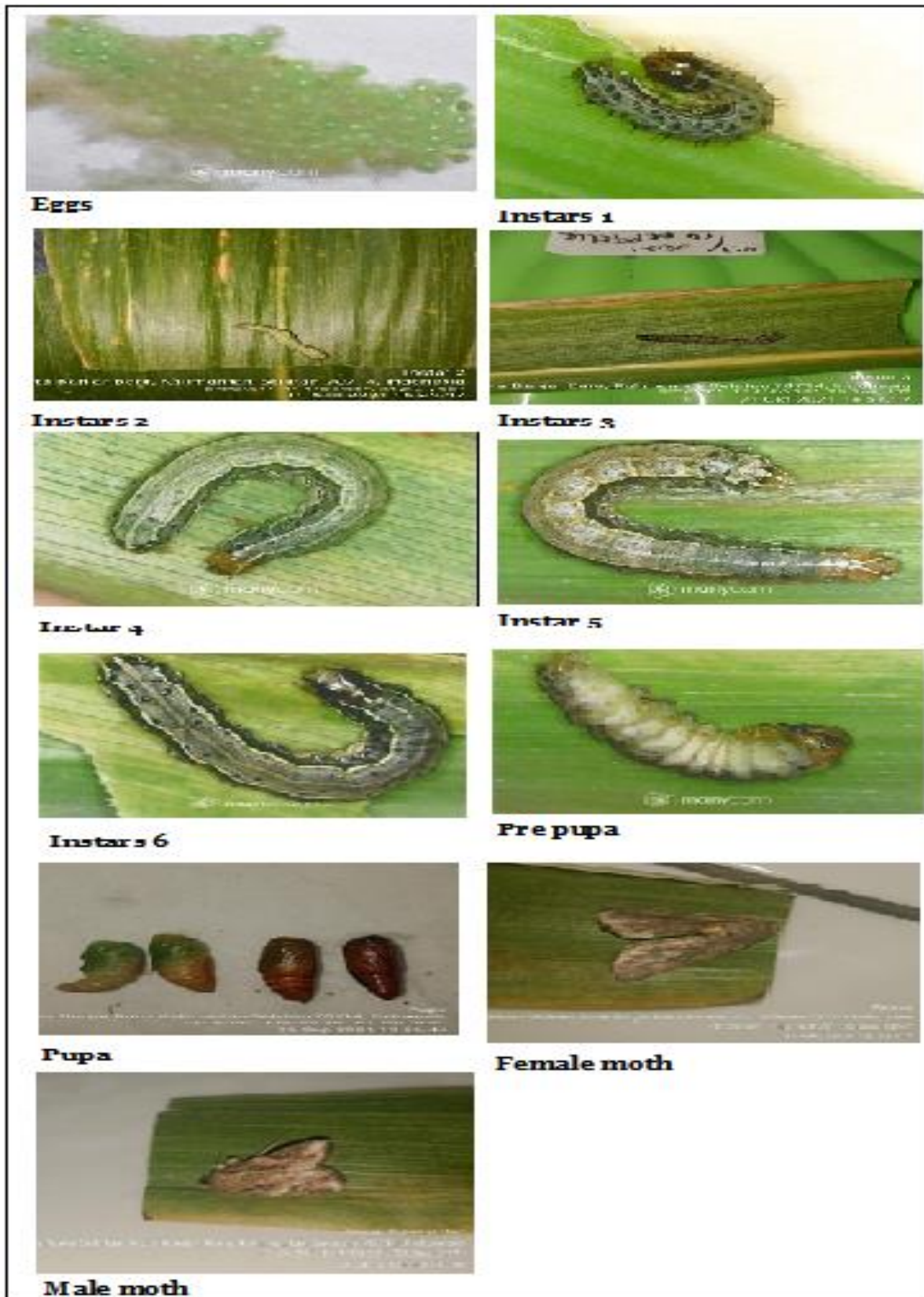


Fig. 2. Development of *Spodoptera frugiperda* from laboratory observations.

Based on its life cycle ranging from 32-46 days with egg stadia 2-3 days, larvae 14-19 days and pupae 9-12 days according to Nonci *et al.* (2019), larvae instar 1 *caterpillar frugiperda* reportedly can eat leaf tissue to cause a transparent epidermal layer.

In the later stages, instar larvae 2-3 are even able to make a hole in the leaves and eat the leaves from the edges to the back. When *the caterpillar frugiperda* has reached the final instar larva, this pest can eat parts of the leaves and stems to leave only the bones. The characteristic of *frugiperda* caterpillars is that the head of this caterpillar is dark in color and there is a light-colored inverted Y shape on the front of the head.

The morphology of each stadia is as in the following figure (Fig. 2); the difference *between Spodoptera frugiperda* and other grayworms is the level of gluttony in eating plants. *Frugiperda* caterpillars have a gluttony rate of eating plants up to 10 times compared to local species. During this time for local species, many eat at night only, while during the day sleep and hide, while *caterpillar frugiperda* always eat corn plants throughout the day and night do not stop, until the plant runs out and when the food is exhausted it is cannibal, namely eating fellow.

There is an interesting thing found in the field that pest attacks the extent of damage will be worse if the land is far from the coastal area.

Conclusion

S. frugiperda corn pests have spread throughout the research site, namely in The Re-Mining Subdistrict, Pelaihari Subdistrict and Panyipatan Subdistrict. In The Re Mine District with research locations namely Bingkulu Village, Pelaihari Subdistrict in Ambungan Village, Sarang Halang Village (two locations), Tampang Village (two locations), Telaga Village, Sumber Mulya Village; Panyipatan Subdistrict in Bumi Asih Village, Batu Furnace Village and Sukaramah Village. The average phases of eggs, larvae, pupae and imago are 2 each; 19.5; 9.8, and 3.4 days.

Acknowledgment

This research was financed by DIPA Lambung Mangkurat University fiscal year 2021. Number: SP DIPA – 023.17.2.6777518/2021 dated November 23, 2020. in accordance with the Decree of the Rector of Lambung Mangkurat University Number: 697/UN8/PG/2021 dated March 22, 2021.

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