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Spodoptera frugiperda J.E SMITH ATTACK ON NON-MAIZE CROPS IN BANTUL REGENCY

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ABSTRACT

Spodoptera frugiperda is a polyphagous insect that has a main host of corn plants and attacks corn plants in the vegetative to generative phase. Besides corn, *S. frugiperda* has been reported to have other alternative host plants. The purpose of this study was to analyze the type of *S. frugiperda* attack most often found on alternative host plants and analyze the types of plants other than corn that are most often used as alternative hosts by *S. frugiperda* in Bantul Regency. This research was conducted in Bantul Regency in January-April 2023. Samples were taken from two villages from each sub-district in Bantul Regency. The research was conducted using survey method to determine the village as the research location and purposive method for sampling the alternative host plants. Samples taken were plants around corn fields with symptoms of *S. frugiperda* attack in the form of perforated leaves or traces of feces from feeding activities or *S. frugiperda* egg packages. The results of this study showed that 29 plant species from 13 families were attacked by *S. frugiperda* in Bantul Regency. The most common type of *S. frugiperda* attack was bite marks (60%). The most commonly attacked plant species came from the Poaceae family, namely elephant grass (*Pennisetum purpureum*). The conclusion of this study is that *S. frugiperda* has attacked plants other than corn in 17 sub-districts in Bantul Regency.

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1. Introduction

Spodoptera frugiperda J.E. Smith or commonly referred to as armyworm is a polyphagous insect and has a main host in the form of corn plants (Subiono, 2019; Canico et al., 2021). *Spodoptera frugiperda* attacks corn plants in the vegetative to generative phase (Novita et al., 2021), and can attack the cob when the larvae population is high (DPKP DIY, 2020). This pest attacks the growing point of the plant so that it can cause the failure of shoot or young leaf formation (Maharani et al., 2019), and even cause plant death (CABI, 2021).

The larval phase of *S. frugiperda* has a high feeding ability (Harahap, 2019) and is usually on young, curled leaves (MOA, 2019). Leaves attacked by *S. frugiperda* are characterized by perforated leaves due to *S. frugiperda* bite marks (Nonci et al., 2019), dirt marks in the form of sawdust-like flakes (Pannuti et al., 2016), and egg packages (Apriani et al., 2021). The attack of *S. frugiperda* larvae can cause 54% damage to the leaves (Baudron et al., 2019) and cause a decrease in corn production. The loss of corn yield due to *S. frugiperda* infestation in Bantul Regency reached 5-20% (DPKP DIY, 2019). According to research by Faturohman (2020) and (Nurkomar et al., 2021) *S. frugiperda* has been reported to attack Bantul Regency.

Spodoptera frugiperda has host plants other than corn (alternative hosts) consisting of 76 families and 353 plant species (Casmuz et al., 2017; Motezano et al., 2018). Other host plants of *S. frugiperda* come from higher plants including soybean (Arifin, 2021), cabbage (Subiono, 2019), cassava (Canico et al., 2021), cotton (Motenzano et al., 2018), sorghum (CABI, 2021), and vegetable and bean crops (Canico et al., 2021). These alternative hosts are used by *S. frugiperda* to find sources of nutrients (Sopialena, 2017), food (Sodiq, 2009) and shelter from its natural enemies (Septariani et al., 2019).

Spodoptera frugiperda was first discovered in Indonesia in West Pasaman Regency, West Sumatra (Nonci et al., 2019). Until now, *S. frugiperda* has spread in various regions in Indonesia, such as West Java (Maharani et al., 2019), Lampung (Trisyono et al., 2019), Aceh, Riau, Jambi (Pebrianti and Siregar, 2021), Gunungkidul (Dyati, 2022), and Bantul and Sleman (Nurkomar et al., 2021; Afriandini, 2022). Research on alternative hosts of *S. frugiperda* has been conducted in Sleman Regency by Afriandini (2022) with the results of finding 11 families of alternative host plants and in Gunungkidul Regency by Dyati (2022) who found 10 families of alternative host plants of *S. frugiperda*. However, research on the types of attacks on higher plants other than corn by *S. frugiperda* in Bantul Regency has never been conducted. So, the purpose of this research is to analyze the types of attacks most often found on alternative host plants of *S. frugiperda* in Bantul Regency and analyze the types of plants other than corn that are most often used as alternative hosts by *S. frugiperda* in Bantul Regency. This research is important to anticipate the attack of *S. frugiperda* on higher plants other than corn in Bantul Regency and as an initial database of alternative host plants of *S. frugiperda* in Bantul Regency.

2. Methods

Methods that used in this research were:

Determination of sampling location

This research was conducted from January to June 2023 around corn fields in 17 sub-districts in Bantul regency. The sampling locations were determined using survey and purposive methods. The survey method was used to select two villages in each sub-district. The purposive method was used to determine corn fields that fit the criteria in each selected village. The sampling criteria in this study were samples taken around corn fields that were 2-6 weeks old.

Abiotic measurements and sampling

Abiotic measurements at the sampling location were taken three times, namely at the beginning of coming to the location, midway and at the end of sampling at each location (Afriandini, 2022). Abiotic parameters measured in this study include light intensity, temperature and air humidity. In addition, coordinate point taking was also carried out using the Essential GPS application.

Sampling was done by visiting the location of the area around the corn field directly. Samples taken are plants other than corn that are around the corn field with a radius of 3-5 meters. The plants taken are high level plants that have symptoms of *S. frugiperda* attack. Symptoms of attack caused by *S. frugiperda* were characterized by perforated leaves due to *S. frugiperda* bite marks (Nonci et al., 2019) or there are traces of excrement from feeding activities in the form of sawdust-like flakes (Pannuti et al., 2016), or the discovery of *S. frugiperda* egg packages (Apriani et al., 2021).

Sample identification

The alternative host plants obtained were then identified using the PlantNet application. Plants that have been identified are then confirmed using a reference book by equating the characteristics of the plants found with those in the book. The reference books used are plant identification books from Naidu (2012) and Sastrapradja and Johar (1981). Identification was carried out at the Ecology and Systematics Research Laboratory, Ahmad Dahlan University, Yogyakarta.

Frequency calculation

This frequency calculation is used to calculate the types (species) of alternative hosts in the form of higher plants that are most often attacked by *S. frugiperda* in Bantul Regency. The calculation of frequency and relative frequency is modified from the frequency formula according to Utami and Putra (2020). The frequency calculation used is:

$$\textbf{F species x (Fx)} = \frac{\textbf{Σ district where species was found}}{\textbf{Σ Total district}}$$

$$\textbf{F relative (Fr)} = \frac{\textbf{Fx}}{\textbf{Σ Total F all district}} \times \textbf{100\%}$$

Data analysis

The data analysis used in this study was quantitative descriptive analysis. Descriptive analysis was used to describe the types of attacks most often found by *S. frugiperda* on alternative host plants found during the study. Quantitative descriptive analysis is also used to explain the types of plants that are most often used as alternative hosts for *S. frugiperda* and the calculation of frequency and relative frequency.

3. Results and Discussion

3.1 Types of infestation of *S. frugiperda* most commonly found on crops other than maize in Bantul District

The types of infestation found in this study consisted of bite marks, egg packages and feces marks. Each type of plant was found to have a different type of infestation. The most common type of infestation was bite marks (60%) and the least common was feces (6%) (Fig. 1).

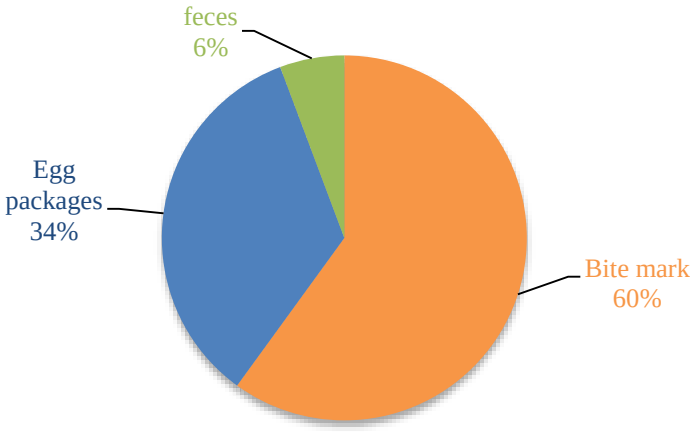

Fig 1. Types of *S. frugiperda* infestation identified on crops other than maize in Bantul Regency

The many types of attacks in the form of bite marks of *S. frugiperda* larvae found in this study are due to the activity of larvae that first taste the plants that will be used as hosts. This is in accordance with the statement from Sodiq (2009) that in choosing a host plant, insects will go through three processes, one of which is gustatory. In choosing a suitable host, insects will also perform host recognition using their sensory organs (Sodiq, 2009). If it has found the right host, then the host will be accepted (host acceptance) by sensing whether or not there are secondary metabolites that are harmful to larval growth. If there are compounds that are harmful to larval growth, the larvae will only taste them and leave the plant (Sodiq, 2009).

Secondary metabolite compounds that are toxic to *S. frugiperda* larvae are flavonoids, tannins, saponins, and alkaloids. Flavonoid compounds are toxic because they can interfere with the respiratory and digestive systems in larvae, resulting in slow death (Kurniawan et al., 2021). Tannin compounds are toxic to insects because tannins can bind to proteins needed for larval growth and reduce larval appetite by blocking enzyme activity in digestion (Lantiunga, 2022). Saponin compounds can make the larvae turn yellow, shrink, and the physiological changes of the larvae become soft (Muta'ali, 2015; Waluyo et al., 2022). This alkaloid group compound can attack heart activity and can reduce appetite, causing death in insects (Kurniawan et al., 2021). The results of research by Trisyono et al. (2019) also reported that *S. frugiperda* larvae will leave plants that have

secondary metabolite compounds that are toxic to *S. frugiperda* larvae after trying (tasting) the plants. So that this activity can cause the plant to become hollow (Fig. 2).

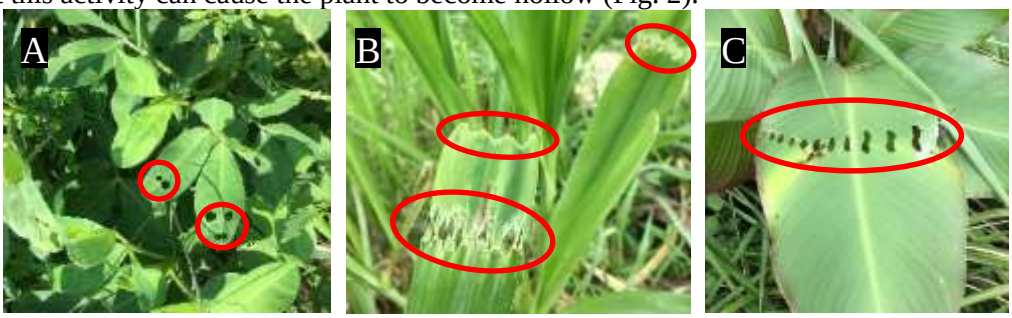

Fig 2. Bite marks of *S. frugiperda* larvae on crops other than maize in the Bantul Regency (A. Groundnut; B. Elephant grass and C. Betel flower) (Personal documentation, 2023).

The next attack symptom observed was the presence of egg packages (Fig. 3). According to Sodiq (2019), insects not only use the host plant as a shelter and source of nutrients but also as a place to lay eggs or breed. The presence of egg packages is because volatile compounds found in plants can attract female moths to lay their eggs. Volatile compounds have volatile properties, so insects easily recognize and are used as signals by insects to find food and places to lay their eggs (Masriany, et al., 2020). This is in accordance with the statement of Rwomushana (2019) that volatile compounds produced by plants will attract female moths to lay their eggs. Female S. frugiperda moths will respond to volatile compounds E)-b-farnesene, (Z)-3-hexenyl acetate, (E)-β-ocimene, b-linalool, indole, and TMTT (Zevallos et al., 2016).

Fig 3. *Spodoptera frugiperda* egg packages on crops other than maize in the Bantul Regency (A. Cabbage; B. Cassava and C. Reeds) (Personal documentation, 2023).

The least common symptom of *S. frugiperda* attack in this study was feces. Plant damage due to feces is usually characterized by the presence of coarse powder that resembles sawdust (Firmansyah and Ramadhan, 2021). Fecal scars on the host can mainly be found on the shoots of the host when the leaf buds have not fully opened (Siahaan and Mullo, 2021). According to Rusisah (2021), *S. frugiperda* attacks in the vegetative phase are characterized by the presence of sawdust-shaped excrement marks. The feces from larval feeding activities are on the surface of the leaves in the form of sawdust (Fig 4). This is in accordance with the statement of Lamsal et al. (2020) that excrement marks due to the feeding activity of *S. frugiperda* larvae are found on the surface and petioles.

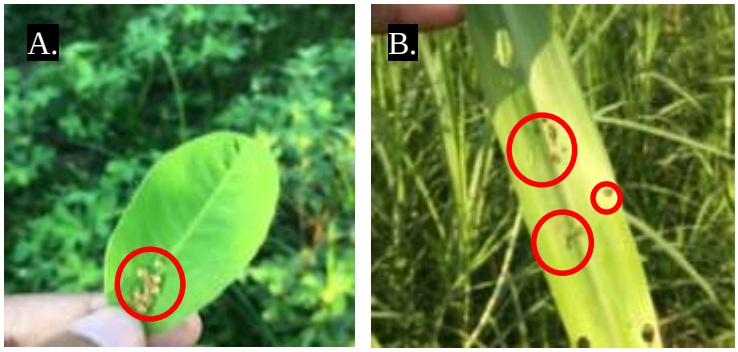

Fig 4. *Spodoptera frugiperda* feces marks on crops other than maize in the Bantul Regency (A. Groundnut and B. Elephant grass) (Personal documentation, 2023).

3.2 Alternative host plant species of *S. frugiperda* most commonly found in Bantul Regency

Research conducted in 17 sub-districts in Bantul regency found 29 plant species from 13 families infested by *S. frugiperda*. The most common plant species found to be alternative host plants are *P. purpureum, A. hyspogaea, I. aquatica* and *O. sativa*. The relative frequency value of *P. purpureum* had the highest value (13.10%), *A. hypogaea* (10.71%), *I. aquatica* (9.52%) and *O. sativa* (9.52%) (Table 1).

Table 1. Jenis- jenis tanaman inang alternatif *S. frugiperda* yang ditemukan di Kabupaten Bantul

Family	Species	Σ	F	Fr (%)
Convolvulaceae	*Ipomoea cordatatriloba*	7	0,41	8,33
	Ipomoea aquatica	8	0,47	9,52
	Ipomoea batatas	2	0,12	2,38
Euphorbiaceae	*Phyllanthus tenellus*	1	0,06	1,19
	Manihot esculenta	6	0,35	7,14
	Euphorbia heterophylla	1	0,06	1,19
Poaceae	*Cymbopogon nardus*	1	0,06	1,19
	Pennisetum purpureum	11	0,65	13,10
	Oryza sativa	8	0,47	9,52
	Imperata cylindrica	6	0,35	7,14
	Cynodon dactylon	1	0,06	1,19
	Sorghum halepense	1	0,06	1,19
Fabaceae	*Vigna sinensis*	1	0,06	1,19
	Arachis hypogaea	9	0,53	10,71
	Neonotonia wightii	1	0,06	1,19
	Crotaralia incana	1	0,06	1,19
Acanthaceae	*Asystasia gangetica*	2	0,12	2,38
	Ruellia tuberosa	1	0,06	1,19
Solanaceae	*Physalis angulata*	4	0,24	4,76
	Capsicum frutescens	2	0,12	2,38
	Solanum melongena	1	0,06	1,19
Asteraceae	*Eclipta prostrata*	2	0,12	2,38
Capparaceae	*Cleome rutidosperma*	1	0,06	1,19
Brassicaceae	*Sinapis alba*	1	0,06	1,19
	Brassica oleracea	1	0,06	1,19
Malvaceae	*Malvastrum coromandelianum*	1	0,06	1,19
Cannaceae	*Canna indica*	1	0,06	1,19
Musaceae	*Musa paradisiaca*	1	0,06	1,19
Amaranthaceae	*Amaranthus spinosus*	1	0,06	1,19
	Total		4,94	100

Note: Σ= number of plant species found at the sampling site; F= frequency; Fr= relative frequency.

Pennisetum purpureum was found in 11 sampling locations, with a relative frequency value of 13.10%. This is because the nutritional content and morphology of elephant grass leaves are similar to the main host, causing elephant grass to be used as an alternative host plant by *S. frugiperda* in this study. According to Bernays (2001), visual responses are used by female moths to lay their eggs, so elephant grass attracts the attention of female moths to lay their eggs because of morphological similarities with the main host. In addition, elephant grass has also been used as a pest trap plant, one of which is *S. frugiperda* (Nonci et al., 2019).

Plants other than elephant grass that are often used by *S. frugiperda* as alternative hosts were *A. hypogaea* (groundnut). Groundnut was found in 9 sampling locations, with a relative frequency value of 10.71%. Morphological similarities between peanut leaves and corn leaves make *S. frugiperda* interested in making peanuts as an alternative host, namely the presence of fine hairs on

the leaf surface (Mulyani, 2006; Sauvion et al., 2017). Furthermore, kale (*I. aquatica*) and rice (*O. sativa*) are often used as alternative hosts by *S. frugiperda*. Each plant was found in 8 different sampling locations with a relative frequency value of 9.52%.

Ipomoea aquatica has been found as an alternative host in the study of Montezano et al. (2018) in America and Herlinda et al. (2022) in South Sumatra. Abiotic factors at the location where kale was found are suitable for kale growth because it has an average temperature of 28ºC and 90% humidity, so kale can be found in 8 sampling locations. Furthermore, rice plants (*O. sativa*) were often used as alternative hosts. *Oryza sativa* (rice) has been found as an alternative host in the research of Montezano et al. (2018) in America, Canico et al. (2021) in Mozambique and Afriandini (2022) and Dyati (2022) in Yogyakarta Special Region.

Table 2. Mean air temperature, air humidity, and light intensity at sampling sites in Bantul Regency

District	Abiotic factors		
	Air temperture (ºC)	Air humidity (%)	Light intensty (lux)
Banguntapan	27.27	86	1237
Pleret	30.27	84.95	4649
Piyungan	36.05	67.66	6344.5
Sewon	31.28	65	43213.16
Jetis	31.63	75.85	45504.98
Imogiri	34.67	56.65	104771.65
Srandakan	28.10	88.80	13468.15
Sanden	34.71	61.31	52575
Kretek	36	51.50	134680
Pundong	27.83	95.85	6368.16
Bambanglipuro	28.07	95	19562.50
Sedayu	22.04	98.65	11660.50
Pajangan	28.61	99	34001.67
Pandak	25.59	93.66	27644.16
Bantul	32.52	90.16	76183.33
Kasihan	25.16	84.08	46901.67
Dlingo	27.58	79.67	28449.67

According to Plessis et al (2020) the optimum temperature for the development of *S. frugiperda* larvae from egg to imago ranges from 26-32ºC, the higher the temperature will affect the speed of development of *S. frugiperda* larvae. Temperature also affects the female imago of *S. frugiperda* to lay their eggs. This is in accordance with the average temperature at the sampling sites in Bantul Regency, which is 30ºC, allowing for the development of *S. frugiperda* (Table 2). Other abiotic factors that affect the distribution of *S. frugiperda* are air humidity and light intensity. According to Jiang et al (2021), the optimum air humidity for *S. frugiperda* development ranges from 60-90%. Light intensity also affects the abundance of *S. frugiperda*, the average light intensity measured in Bantul Regency is 39038.67 lux. Based on the measurement results, the average light intensity is not suitable for the development of *S. frugiperda*. *Spodoptera frugiperda* is active at night to fly and lay its eggs (Sari, 2021). The value of light intensity at night ranges from 0.001 - 0.2 lux (Simanjuntak et al., 2022). Based on this study, the growth of *S. frugiperda* was not appropriate because the research was conducted in the morning before noon so that the measured light intensity was high.

4. Conclusion

Research on the types of *S. frugiperda* infestation on crops other than corn in Bantul Regency found bite marks, egg packages and dung marks. The most common type of infestation was bite

marks at 60%. The type of plant other than corn that is most often used by *S. frugiperda* in Bantul Regency was *Pennisetum purpureum* that has been found in 11 sampling locations with a relative frequency value of 13.10%.

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