bryanti_2023_IOP_Conf._Ser.__Earth_Environ._Sci._1255_012011.pdf

by master 3

Submission date: 31-Jan-2024 02:37PM (UTC+0700)
Submission ID: 2245235086
File name: bryanti_2023_IOP_Conf._Ser.__Earth_Environ._Sci._1255_012011.pdf (1.06M)
Word count: 3163
Character count: 16934

Damage Caused by *Spodoptera frugiperda* J.E Smith on Corn in Climate Zones in South Sulawesi, Indonesia

To cite this article: A Vebryanti *et al* 2023 *IOP Conf. Ser.: Earth Environ. Sci.* **1255** 012011

Damage Caused by *Spodoptera frugiperda* J.E Smith on Corn in Climate Zones in South Sulawesi, Indonesia

A Vebryanti[1], I D Daud[2], N E Dungga[3]

[1]*Master's Degree Program, Agrotechnology, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, Indonesia*
[2]*Departement of Plant Pest and Diseases, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, Indonesia*
[3]*Departement of Agronomy, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, Indonesia*

Email: andivebryanti@gmail.com

Abstract. Corn, as one of the main commodities in South Sulawesi, cannot be separated from pests such as *Spodoptera frugiperda*. J.E Smith. *S. frugiperda* is a new invasive pest in Indonesia and has been reported to spread throughout the provinces, including South Sulawesi. However, information on *S. frugiperda* damage in South Sulawesi was still limited. The purpose of this research is to determine how *S. frugiperda* affects corn plants in South Sulawesi's potential agricultural climate zones, specifically the west, east, and transitional sectors. Surveys from October to December 2022 were carried out in three regencies representing each climate zone in South Sulawesi. The scouting method was used to conduct field observations on 50 plant samples at each location. Use a visual rating scale of 1 (no damage) to 5 (severe plant stunting and funnel damage) to determine the severity. The intensity of attack during the observation recorded the highest rate of attack in the transitional sector The highest attack rate was in the transitional sector (Luwu), with a total damage category and attack intensity of 48.7%, while the lowest was in the eastern sector (Wajo), with an attack intensity of 32.80%. The highest larval density was in the transitional sector (Luwu), with an average range of 0.04-0.52 larva/plant, while the lowest was in the western sector (Takalar), with an average range of 0.04-0.06 larva/plant. The infested corn plants in the all-climate zone in South Sulawesi showed various typical damages caused by *S. frugiperda*.

Keywords: attack intensity, corn, larvae population, *Spodoptera frugiperda,*

1. Introduction

South Sulawesi plays a role in Indonesia's corn production. The climate potential in South Sulawesi for agricultural development, such as corn, is very supportive, and the development areas are grouped into three sections based on the relative similarity of the climatic zones, namely the West, East, and Transitional Sectors. The western area is impacted by westerly breezes, and the eastern area is affected by easterly breezes, which are firmly connected with the blustery and dry seasons [1].

Corn, as one of the main commodities in South Sulawesi, cannot be separated from pests such as *Spopdoptera frugiperda*. J.E. Smith. *S. frugiperda* is a new invasive pest that comes from America [2], [3], and was detected in Indonesia in early 2019 in West Pasaman District,

West Sumatra [4]. It quickly spread to other provinces, including South Sumatra [5], Lampung [6], West Java [7], Bengkulu [8], Bali [9], East Nusa Tenggara [10], and South Sulawesi [5].

The food crops belonging to the Graminae family, including corn, rice, wheat, sorghum, and sugarcane, serve as its main hosts. *S. frugiperda* is polyphagous [11]. Imago is a long-range flier with a high cruising range; therefore, *S. frugiperda* can migrate to other growing regions where primary hosts are available [12]. *S. frugiperda* also damaged the corn plant throughout its life cycle, from the vegetative to the generative phases. Mild larvae attacks can damage the surface of the leaf skin so that it appears transparent, whereas in heavy attacks there is frost around the corn [13].

The *S. frugiperda* population's existence and growth must be monitored because they can result in significant yield losses. Several studies have shown that *S. frugiperda* attacks in Indonesia are very high, where the intensity of damage has reached 26.50% to 70% in Lampung [14], 58,31% to 78,75% in East Java [15], 85% to 100% in East Nusa Tenggara [13], and 47.84% in Bali [9]. However, the information on *S. frugiperda* damage in corn production centers in South Sulawesi was still limited. The purpose of this research is to determine how *S. frugiperda* affects corn plants in South Sulawesi's potential agricultural climate zones, specifically the west, east, and transitional sectors.

2. Material and methods

2.1. Study Area

This observation was carried out in three regencies, which represent each climate zone in South Sulawesi, and the sub-districts within each of those regencies were chosen based on where the main corn-producing centers are, namely Takalar (4015'10.27" S 1200 0'47.10" E) from the west sector, Wajo (4015'10.27" S 1200 0'47.10" E) from the east sector, and Luwu (3016'10.21" S 1200 16'23.38"E) from the transitional sector (Figure 1) from October to December 2022.

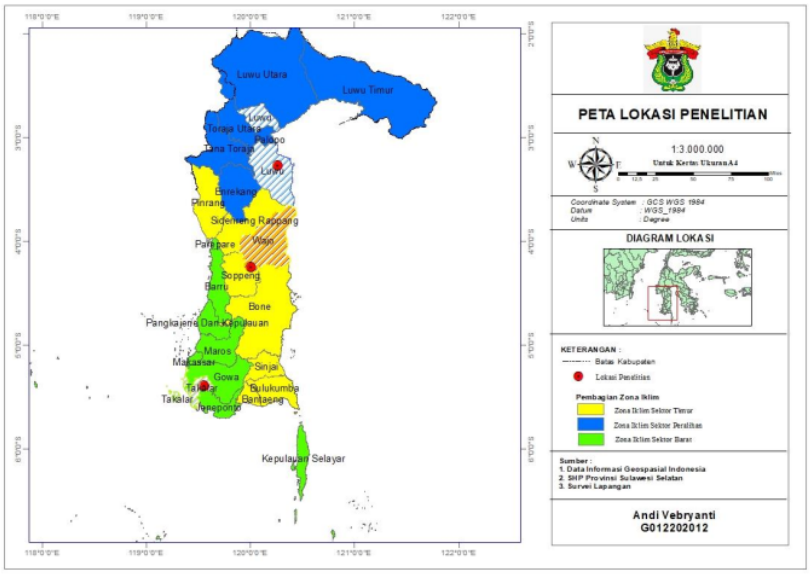

Figure 1. Map of the observation location

2.2. Damage due to S. frugiperda

The scouting method involves direct observation of plants to identify them. Because the survey area is large enough to cover all of the land, this scouting method was used. The corn fields were scouted using a ‘‘W” pattern approach, and the total sample observed was 50 plants (10 consecutive plants at five different spots along the ‘‘W” transect) [16]. The collected data was carried out every week for each observable location until the corn was six weeks old.

Using a rating scale for grading damage severity on whorl-stage plants, the percentage of severity was determined by the severity of pinholes, shot-holes, lesions, tattering, and dead hearts. [14]. Attack intensity and level of leaf damage were determined by examining damage or attack symptoms caused by *S. frugiperda* in the same maize plant sample evaluated by [17] based on the leaf damage scale in Table 1.

Tabel 1. A visual rating scale to assess leaf damage [17]

Scale	Damage (%)	Symptoms
1	0	No damage
2	1-10	Little damage, <5 mm diameter or only destruction of leaf cuticles
3	11-25	Medium damage, chewable areas >5 mm, funnel leaves intact
4	26-50	Heavy damage, chewing areas >1 cm, the funnel less severe
5	>50	Total damage, plant stunting and funnel damaged severely

The scores and scales were calculated using the formula :

$$K = \frac{\sum_{i=1}^{k} vi \times ni}{N \times Z} \times 100\%$$

Details: K = level of damage;
vi = pest attack scale;
ni = number of sample plants;
N = total number of sample plants;
Z = scale of highest pest attack.

The total larval populations were counted directly by carefully observing the same sample of corn plants attack intensity. Larval populations were observed in the early stages. From 6:00 to 9:00 in the morning, the larvae hid in the midribs of corn leaves.

2.3. Data Analysis

The average percentage of pest infestation is displayed graphically. Data on larval population density were also presented graphically.

3. Result and discussion

3.1. Population and damage caused by Spodoptera frugiperda in corn

Our observations show that the intensity of attacks during six weeks of observation at three different locations indicated moderate to severe attack symptom categories ranging from 20.8% to 65.2% (Figure 2). Analysis showed that *S. frugiperda* infestation on corn began 1 week after

planting (WAP) with a 'moderate' attack intensity (20.8% to 23.2%) per plant. There were differences in the level of damage between the three observable locations where the lowest level of damage occurred in Wajo and the highest level of damage occurred in Luwu. The highest attack intensity in Takalar was found on corn plants four weeks after planting (55.2%). While the highest intensity in Wajo was found in corn plants aged six weeks after planting (41.6%), In Luwu, the highest corn planting intensity was five weeks after planting (65.2%). Those results show that *S. frugiperda* larvae are highly damaging and may lower corn yields in the field.

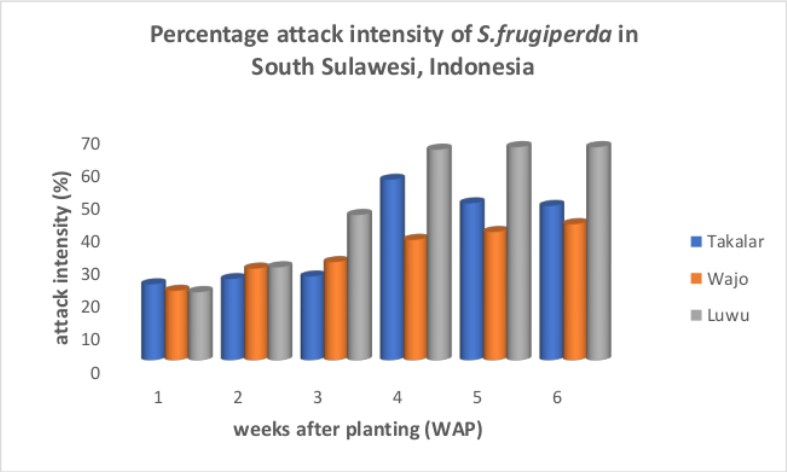

Figure 2. Precentage attack intensity of *S.frugiperda* in South Sulawesi, Indonesia

The intensity of the attack continued to increase, with an attack rate of >50% on corn plants aged 4, 5, and 6 weeks after planting. According to the [9] research, the severity of the larval attack reached its peak when corn was four weeks old, and attacks continued to decline at the age of eight weeks. The highest attack intensity at four weeks after planting is also suspected because the *S. frugiperda* pest has reached the 5th instar larval stage (adult larvae), where the caterpillars have started to have a slightly brown to light green color, so they need more food [18].

The three observation sites planted had different varieties of corn: Takalar had BISI 18 varieties, Wajo had Pertiwi 5 varieties, and Luwu had ADV 777 varieties. Therefore, differences in varieties affect the level of attack of *S. frugiperda*. The data support the research [19] that corn varieties have different levels of preference. ADV 777 Ruby (Luwu) is more susceptible to attack by *S. frugiperda* than corn varieties Bisi 18 in Takalar and Pertiwi 5 in Wajo. Based on varietal resistance research conducted by [20] on observing *S. frugiperda* attacks at plant ages around five weeks, or the fast growth phase. It was found that Pertiwi 5 and Bisi 18 varieties had tolerance or resistance to *S. frugiperda* attacks compared to other varieties, namely P 36, NK Super, NK 7328, Exotic, and Local. Based on the attack criteria, the Pertiwi 5 and BISI 18 varieties were classified as varieties that were somewhat susceptible to a *S. frugiperda* attack.

Direct field observations found that the shape and size of *S. frugiperda* larvae were extremely varied. The larvae are typically located in leaf buds (Figure 3a), where they damage the plant's

developing point and consume the inside of the plant by storing food scraps near the corn leaves, where they leave behind frass that resembles sawdust (Figure 3b). Larvae feed on the leaves, causing the leaf surface of the corn plant to become transparent (Figure 3c), causing the growth of the corn plant to be stunted because of the point becoming infected. S. frugiperda exhibits the same damage features, according to [8] and [21].

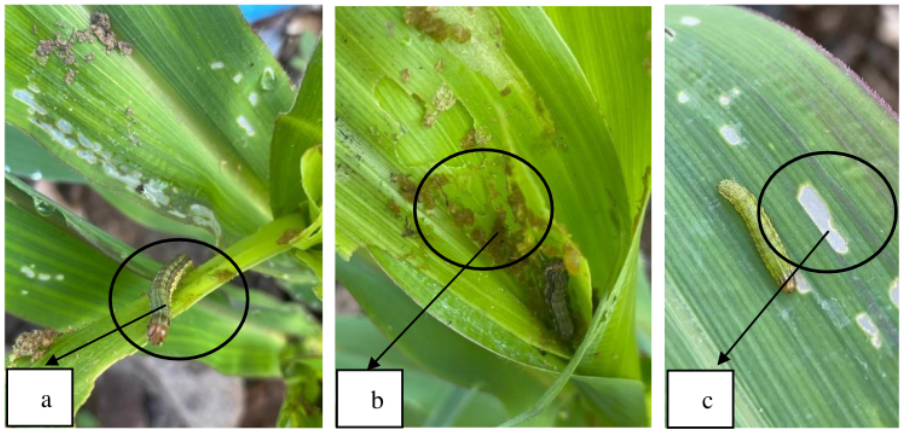

Figure 3. (a) larvae in leaf buds, (b) larvae food scraps, (c) leave corn become transparant

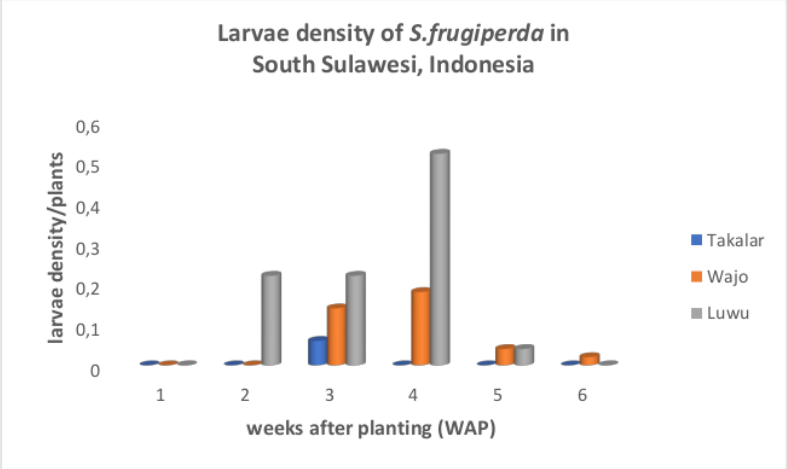

Figure 4. Larvae density of *S. frugiperda* in South Sulawesi, Indonesia

Population larvae of *S. frugiperda* were found two weeks after planting in Luwu and three weeks after planting in the Takalar and Wajo, which are described in Figure 4. The transitional sector (Luwu) had the highest larval density, with an average range of 0.04 to 0.52 larvae per 50 plants, and the land observation was dry soil that was originally planted with cocoa. Corn planting is not carried out simultaneously where there is corn planting land around the observation area that is 1 month older than the corn observation field. This causes the large number of larvae found compared to the other two observable locations. This concurs with [4],

which claimed that late crops planted in comparison to nearby plantations had a higher possibility of being visited by female moths to lay their eggs.

The lowest larval density was in the western sector (Takalar), with an average range of 0.04-0.06 larvae per 50 plants. The observable area was a large dry land area above the hills, and the farmers in the area did not do simultaneous planting, which caused the ages of the corn plants to differ. The number of *S. frugiperda* larvae that attack corn plants has reportedly decreased in recent seasons, according to local farmers. It has been supported by data from the Center for Food Crops and Horticulture Protection of South Sulawesi, which presents information for the general time period of 2022 (January–October). The area of corn affected by *S. frugiperda* in Takalar is 3.95 ha. Control efforts have been successful so that there is a very significant decrease in the area of the corn affected at the beginning of emergence from this pest attack, which is an area of 170.55 ha (2019).

The difference in the number of larvae found may be due to the number of larvae observed in each plant. The results showed that the number of larvae in the plantings was around 1-3 larvae. According to [19], the smaller the larval stage, the greater the number of larvae found in the plantations, and conversely, the larger the larval stage, the smaller or more likely it is to be solitary or in one plant. This hypothesis is further confirmed by [18], which demonstrates that the population of the corn pest *S. frugiperda* is dominated by one or two crop larvae because the larger larvae are cannibals. According to [22], cannibalistic behavior happens at the larval stage when larger larvae eat smaller larvae.

Another factor that causes differences in attack intensity and the population is the climate, which includes temperature, rainfall, and humidity. According to the study, Takalar had an average temperature of 29.41°C and a humidity of 78.39%, Wajo had an average temperature of 30.69°C and a humidity of 82.46%, and Luwu had an average temperature of 27.06°C and a humidity of 86.82%. The high larval population and intense attack activity in Luwu are impacted by the local temperature, which is ideal for the development of *S. frugiperda* larvae. This research [18] supports the finding that the optimum temperature for the development of Spodoptera frugiperda larvae is 28°C (development can occur at a temperature between 11°C and 30°C for a period of time). The ideal conditions for the growth of S. frugiperda, according to [23] are between 24°C and 33°C with 60% to 90% humidity.

Conclusion

The survey results in South Sulawesi found that *S. frugiperda* affected maize plants in the climate zone, especially in the western, eastern, and transitional sectors, with various typical damages caused by *S. frugiperda*. The highest attack rate was in the transitional sector (Luwu), with a total damage category and attack intensity of 48.7%, while the lowest was in the eastern sector (Wajo), with an attack intensity of 32.80%. The highest larval density was in the transitional sector (Luwu), with an average range of 0.04-0.52 larva/plant, while the lowest was in the western sector (Takalar), with an average range of 0.04-0.06 larva/plant.

5. Acknowledment

The authors would like to thank the Indonesia Education Endowment Fund - LPDP for funding this research.

Reference

[1] Herniwati and Kadir S 2009 *Prosiding Seminar Nasional Serealia*
[2] Nagoshi R. N. *et al* 2017 *PLoS One*, **2** 1

[3] Otim M. H. *et al* 2018 *PLoS One* **13** 1
[4] Nonci N, Kalgutny S.H, Mirsam H, Muis A, Azrai M, and Aqil M 2019 *Pengenalan Fall Armyworm* (Maros: Balai Penelitian Tanaman Serealia)
[5] Hutasoit R. T, Kalqutny S. H., and Widiarta I. N 2020 *Biodiversitas* **21** 3576
[6] Trisyono Y. A, Suputa S, Aryuwandari V. E. F, Hartaman M, and Jumari J 2019 *J. Perlindungan Tanam. Indones* **23** 156
[7] Maharani Y, Dewi V. K, Puspasari L. T, Rizkie, Hidayat Y, and Dono D 2019 *Crop. - J. Plant Prot* **2** 38
[8] Ginting S, Zarkani A, Wibowo R. H, and Sipriyadi 2021 *Serangga* **26** 110
[9] Supartha I. W, Susila I. W,. Sunari A. A. A. A. S, Mahaputra I. G. F, Yudha I. K. W, and Wiradana P. A 2021 *Biodiversitas* **22** 3378
[10] Pu'u Y. M, and Mutiara C 2021 *J. Entomol. Indones* **18** 153
[11] Goergen G, Kumar P. L, Sankung S. B, Togola A, and Tamo M 2016 *PLoS One* **11** 1
[12] Jaramillo B. C. I, Barragan Quijano E, and Monje Andrade B 2019 *Rev. Fac. Nac. Agron. Medellin* **72** 8953
[13] Mukkun L, Kleden Y. L, and Simamora A. V 2021 *Int. J. Trop. Drylands* **5** 20
[14] Lestari P *et al* 2020 *Biodiversitas* **21** 1670
[15] Kalqutny S. H, Nonci N, and Muis A 2021 *IOP Conf. Ser. Earth Environ. Sci* **911**
[16] Prasanna, B.M., Huesing, J.E., Eddy, R. and Peschke, V.M 2018 *Fall Armyworm in Africa: A Guide for Integrated Pest Management* (Mexico. CIMMYT. USAID)
[17] Kuate A. F*et al* 2019 *PLoS One* **14** 1
[18] FAO and CABI 2019 *Community-Based Fall Armyworm, Monitoring, Early Warning and Management* (Amerika : CC BY-NC-SA 3.0 IGO)
[19] Novita D, Supeno B, and Haryanto H 2021 *Pros. Saintek* **3** 225
[20] Timotiwu P. B, Agustiansyah, Setiawan W. A, and Sudarsono H, 2021 *Professorship Research* University of Lampung
[21] Sartiami D, Dadang, Harahap I. S, Kusumah Y. M, and Anwar R 2020 *IOP Conf. Ser. Earth Environ. Sci* **468**
[22] Nadrawati Z. A, Ginting Br.S 2019 *Thesis* University of Bengkulu
[23] Du Plessis H, Schlemmer M. L, and Van den Berg J 2020 *Insects* **11**

bryanti_2023_IOP_Conf._Ser.__Earth_Environ._Sci._1255_012...

ORIGINALITY REPORT

8%	%	8%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	I W Supartha, I W Susila, K A Yuliadhi, E S M Haloho, I K W Yudha, I W E K Utama, P A Wiradana. "Monitoring of damage and distribution of invasive fall armyworm, Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae) on maize crop in Karo, North Sumatera, Indonesia", IOP Conference Series: Earth and Environmental Science, 2022 Publication	3%
2	B Widhayasa, E S Darma, H Gendroyono, E D Prasetyani. "Detection of the fall armyworm Spodoptera frugiperda and its damage symptoms to maize in East Kalimantan, Indonesia", IOP Conference Series: Earth and Environmental Science, 2022 Publication	1%
3	Apollin Fotso Kuate, Rachid Hanna, Armand R. P. Doumtsop Fotio, Albert Fomumbod Abang et al. "Spodoptera frugiperda Smith (Lepidoptera: Noctuidae) in Cameroon: Case study on its distribution, damage, pesticide	1%

use, genetic differentiation and host plants", PLOS ONE, 2019
Publication

---

4 S Herlinda, M E Sinaga, F Ihsan, F Fawwazi et al. "Outbreaks of a new invasive pest, the fall armyworm (Spodoptera frugiperda) in South Sumatra, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 — 1 %
Publication

---

5 Siti Herlinda, Radix Suharjo, Melati Elbi Sinaga, Fairuz Fawwazi, Suwandi Suwandi. "First report of occurrence of corn and rice strains of fall armyworm, Spodoptera frugiperda in South Sumatra, Indonesia and its damage in maize", Journal of the Saudi Society of Agricultural Sciences, 2021 — 1 %
Publication

---

6 S Tarigan, N Maryana, N Mubin. "Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae): Attacks and their natural enemies on corn plantations in Munte Village, Munte Sub-district, Karo District, North Sumatera.", IOP Conference Series: Earth and Environmental Science, 2023 — 1 %
Publication

---

7 Muliadi, S Sjam, S Thamrin. "The role of combination insectary plants and botanical pesticides in increasing arthropod — <1 %

populations of natural enemies and suppressing populations of s. frugiperda in corn", IOP Conference Series: Earth and Environmental Science, 2023
Publication

8 S Herlinda, I M P Simbolon, Hasbi, S Suwandi, Suparman. "Host Plant Species Of The New Invasive Pest, Fall Armyworm (Spodoptera Frugiperda) In South Sumatra", IOP Conference Series: Earth and Environmental Science, 2022 <1%
Publication

9 W Asfiya, V N O Subagyo, Y Maharani, Fatimah, A Ruswandi, A Winara, M Diana, Y H Nur, Y Indrajaya. "Maize farmers' responses to Spodoptera frugiperda in Indonesia and management practices: a case study in West Java", IOP Conference Series: Earth and Environmental Science, 2022 <1%
Publication

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		