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Level of *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) Attack on Corn (*Zea mays* L.) Plants at Different Altitudes

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Abstract.
Background. One of the causes of low corn yields is the infestation of fall armyworms. Effective pest control techniques must consider the behavior of this pest. Therefore, it's essential to understand whether altitude influences the level of fallarmyworm infestation.
Aims. This study aims to determine the relationship between altitude and the intensity of attacks and the intensity of damage caused by armyworms.
Methods. The study was conducted at three different altitudes. Each altitude was represented by two villages, resulting in a total of six villages across two different regencies: Kuningan and Cirebon. The research method used was a survey with purposive sampling.
Result. The study's results showed that altitude had a significant negative correlation with attack intensity, but not with damage intensity.
Implementation. Fall armyworm control techniques will differ in different locations, depending on the altitude.

Keywords: attack intensity, corn, elevation, fall armyworm

INTRODUCTION

Corn is the world's most important food crop, alongside wheat and rice. Corn's benefits extend beyond food production to feed, as well as other industrial uses. It is estimated that over 55% of domestic corn is used for feed, 30% for food consumption, and

the remainder for different purposes and seed production. This has led to a continued increase in demand for corn. (Fiqriansyah et al., 2021).

Corn kernels are rich in nutritional content. The nutritional composition of corn kernels is 70% starch, 10% protein, and 5% fat (Tim PIU ICARE BPSIP Jawa Timur, 2024). Meanwhile, dried corn kernels, long considered the primary product of the corn plant, are used as raw material for animal feed and various processed food products. This multipurpose nature has led to a continued increase in demand for corn in Indonesia. In addition to direct consumption, corn is increasingly being used as a primary raw material for the feed and food industries (Fiqriansyah et al., 2021).

One of the causes of declining corn production in Indonesia is the infestation of the fall armyworm (*Spodoptera frugiperda* J.E. Smith). Fall armyworms (FAW) are native to tropical regions from the United States to Argentina. FAW larvae can attack more than 80 plant species, including corn, rice, sorghum, millet, sugarcane, vegetables, and cotton (Nonci et al., 2019). FAW can result in significant yield loss if not treated properly (Azwana, 2021). FAW is an invasive insect that has become a pest of corn crops in Indonesia. This insect originates from America and has spread to various countries. In early 2019, this pest was discovered in corn crops in Sumatra (Nonci et al., 2019).

Maharani et al. (2019) Reported that FAW was found in West Java Province, specifically in Bandung Regency, Garut Regency, and Sumedang Regency. FAW attacks corn plants from the young (vegetative) stage through the flowering (generative) phase. The pest population is relatively high in Sumedang Regency, whereas in Bandung and Garut Regencies, the pest population remains low.

FAW infestation of corn can reduce its economic value, as it attacks corn during both the vegetative and generative growth phases. Young larvae, after hatching, bore into the leaves, consuming the epidermis, and leave a transparent, silvery membrane. Final instar larvae feed on parts of the primordial bud, exhibiting symptoms of shoot death (death heart). Larvae damage shoots, young leaves, and even the growing point of the plant, leading to plant death. Fallworm infestation causes losses for farmers, causing up to 100% damage (Noerfitryani et al., 2023).

This pest causes annual losses to corn crops in African and European countries, ranging from 8.3 to 20.6 million tons, with corresponding economic losses of between US$2.5 billion and US$6.2 billion. In Indonesia, the percentage of damage caused by FAW varies. In Minahasa Regency, the rate ranges from 30% to 70%. (Mamahit et al., 2020), di

Kabupaten Takalar 46,44%- 97,33% (Noerfitryani et al., 2023), in East Kalimantan 13,33%,-93,31% (Widhayasa et al., 2021), and in Tuban Regency, 58%-100% (Megasari & Khoiri, 2021).

Lubis et al. (2020) Explained that the presence and population of FAW insects are likely influenced by altitude. FAW larvae were only found at survey locations at elevations of approximately 700–850 m above sea level (asl), while they were not found at elevations above 850 m asl. However, Mamahit et al. (2020) suggested that there was no significant effect between altitude and pest presence or damage levels.

This study aims to determine whether there are differences in FAW infestation levels at different altitudes. Furthermore, it seeks to investigate whether there is a correlation between environmental conditions, corn cultivation techniques, and FAW infestation levels at different altitudes. The results of this study are essential for determining control techniques to be used at locations with varying altitudes.

LITERATURE REVIEW

Spodoptera frugiperda or FAW is characterized by a dark-colored adult larval head and a pale inverted Y-shaped marking. (Widhayasa et al., 2021). Its life cycle ranges from 32-46 days, with egg stages lasting 2-3 days, larval stages lasting 14-19 days, and pupal stages lasting 9-12 days. (Sari, 2020). FAW can attack corn plants at all stages, from the vegetative to the generative stages, and from leaf tips to cobs. FAW larvae are found on leaf tips, opened leaves, and young cobs. (Pebrianti & Siregar, 2021).

The pest stage that damages corn plants is the larval stage. First-instar larvae initially feed on leaf tissue and leave behind a transparent epidermis layer (Sari, 2020). Second- and third-instar larvae bore holes into the leaves and eat them from the edges inward. FAW larvae are cannibalistic, so that only 1-2 larvae are found on a single corn plant. Second and third-instar larvae possess cannibalistic behavior. Final instar larvae can cause severe damage, often leaving only the leaf veins and stems of corn plants (Nonci et al., 2019). An average population density of 0.2 - 0.8 larvae per plant can reduce yields by 5-20% (Megasari & Khoiri, 2021).

Prasetya et al. (2022) showed that at an altitude of approximately 350 m above sea level, no varieties were found to be most resistant to *S. frugiperda* attacks. The results showed that the highest incidence of *S. frugiperda* attacks varied each time data were collected, so that, from the beginning to the end of the study, almost every variety

experienced both the highest and lowest percentages and intensities of attacks.

Azwana (2021) stated that in the research area, located at an altitude of approximately 12 m above sea level, armyworm attacks began to appear during the vegetative phase, three weeks after planting. Armyworms preferred sweet corn, followed by white corn, hybrid corn, and sorghum. Green beans, tomatoes, and chilies were among the crops that armyworms disliked.

METHODS

The survey was conducted in Babakanmulya and Sidamulya Villages in Jalaksana District, as well as in Dukuhbadag and Bantarpanjang Villages in Cibingbin District, and in Waled and Pabedilan Villages in Pabuaran District. These research locations were chosen because they have extensive corn cultivation areas (corn crop centers). The experimental locations are situated at altitudes ranging from 12 to 720 m above sea level, with an average temperature of 28 °C to 33 °C. The survey was conducted from February to April 2025.

Waled and Pabedila villages are lowland locations, Babakan Mulya and Sidamulya are midland locations, while Dukuhbadag and Bantarpanjang are highland locations (Table 1). At each survey location, one corn plantation location was selected and 15 sample plants were taken from each plantation using the W method. In addition, the cultivation techniques used, pest control methods, land history, surrounding planting conditions, and other factors affecting pest and disease attacks were observed.

Table 1. Elevation of survey location

No.	Regency	District	Village	Elevation (m dpl)
1.	Kuningan	Jalaksana	Babakanmulya	699
2.	Kuningan	Jalaksana	Sidamulya	720
3.	Kuningan	Cibingbin	Dukuhbadag	75
4.	Kuningan	Cibingbin	Bantarpanjang	63
5.	Cirebon	Pabedilan	Waled	12
6.	Cirebon	Pabedilan	Pabedilan	12

The variables observed in this study were attack intensity and damage intensity, which were calculated according to Asfiya et al. (2020). Attack intensity was calculated using the formula:

$$IS = a/b \times 100\%$$

Note:
IS = attack intensity
a = number of sample plants affected

b = number of sample plants observed

The calculation of damage intensity is calculated using the formula:

$$IK = \frac{\sum(n \times v)}{Z \times N} x\ 100\%$$

Note :
IK: damage intensity
n: number of plants/plant parts observed at a particular scale of damage
v: scale of damage from pest attacks
N: total number of plants
Z: highest scale of damage

The damage scale is assessed with a score ranging from 0 (no damage at all) to 9 (the leaf roll is almost destroyed and the plant dies).

To determine the relationship between altitude and other variables, including the level of attack and level of damage, a correlation test was conducted using SPSS version 25.

DISCUSSION

Descriptive Analysisi

Corn cultivation at all survey locations was carried out intensively with thorough soil cultivation, using either hand tractors or hoes. Irrigation was rain-fed, except in Babakan Mulya and Sidamulya villages, which are located in the highlands. Plant spacing varied across locations, with the majority (85%) using a spacing of 80 cm x 20 cm (Figure 1). This is likely due to the fact that the corn planted is a type of sweet corn that is harvested young, resulting in close plant spacing.

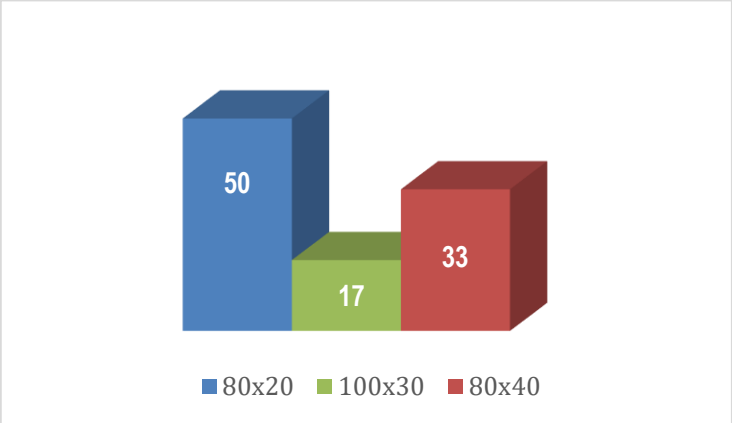

Figure 1. Plant spacing used at the research location

Plant spacing is one of the factors that influences the intensity of FAW attacks, in addition to the types of plants around the corn fields and pest control techniques (S. P. Sari

et al., 2021). Close plant spacing results in a larger plant population, thus providing more food for FAW.

Four cultivars were used at the survey sites: Bonanza, Pioneer P40, Excotis, and Pertiwi. The most commonly used cultivars were Bonanza and Pioneer P40 (Figure 2). At each survey site, farmers may use different cultivars. Cultivar selection is often based on previous corn cultivation experience or the success of other farmers. The results showed differences in FAW preference for different cultivars (Deden et al., 2023). Sweet corn is preferred over white corn and hybrid corn (Azwana, 2021).

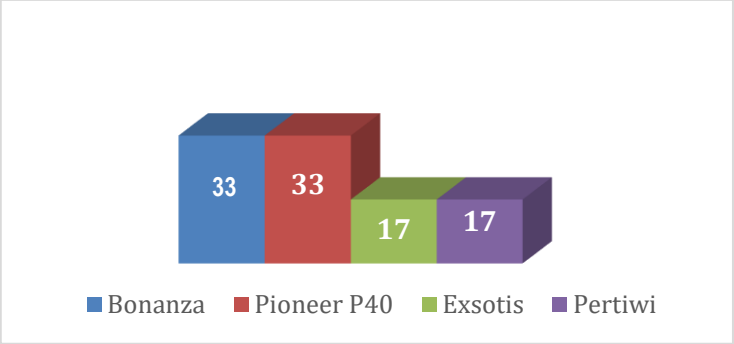

Figure 2. Cultivars used at the survey location

Plant maintenance encompasses watering, fertilizing, weeding, and controlling pests and diseases. In some locations, additional hilling activities are performed. However, the majority (67%) either do not hill or only perform four activities (Figure 3).

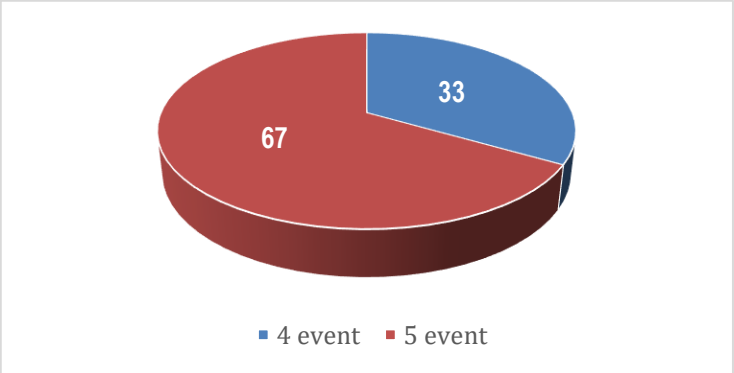

Figure 3. Number of cultivation actions carried out at the survey location

Other plant pests found at the survey sites included downy mildew, rust, and the armyworm *Spodoptera litura*. Most survey sites (50%) were infested with two types of pests, while only 17% were infested with FAW alone (Figure 4). Pest control carried out by farmers at the survey location is through the use of pesticides. The types of insecticides commonly used are Emacel 30 EC, Proclaim 5 SG, and Montaf 400 SL. The most widely used fungicide

is Antracol. Insecticides and fungicides are often used in combination, while insecticides are typically applied in multiple types during a single growing season.

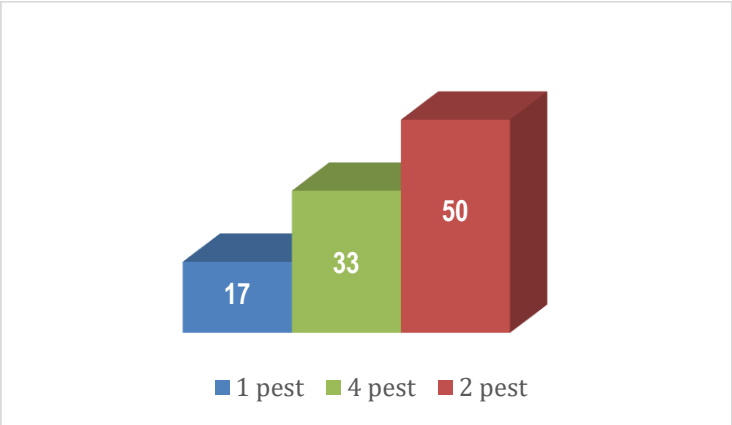

Figure 4. Other types of pests that attack corn plants at the survey location

Figure 5 illustrates the types and quantities of pesticides used. The majority of farmers at the survey location (50%) use two types of pesticides: Montaf (an insecticide) and Antracol (a fungicide). According to Septian et al. (2021), the use of synthetic insecticides is more effective in controlling FAW infestations than other control techniques tested. However, excessive use should be avoided, as they can leave residues in soil and water that can harm non-target organisms (K. K. Sari, 2020).

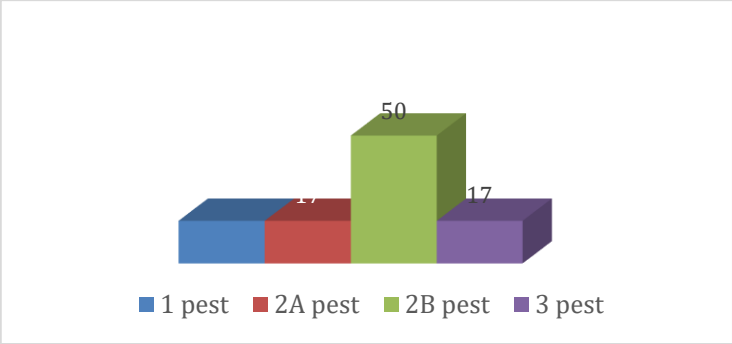

Figure 5. Number and type of pesticides used. 1 pest = one type of pesticide (Emacel 30 EC); 2A pest = two types of pesticides (Montaf and Antracol); 2B = Emacel and Antracol; 3 = three types of pesticides (Montaf, Proclaim, and Antracol).

Correlation Analysis

The results of the correlation analysis showed a significant negative correlation between attack intensity and altitude, but no significant correlation between damage intensity and altitude (Table 2). The intensity of FAW attacks was significantly higher in the lowlands than in the highlands. These results are consistent with Maharani et al. (2019).

Table 2. Correlation coefficient between attack intensity and damage intensity with other observed variables.

Variables	Correlation Coefficient with:	
	Intensity of attack	Intensity of Damage
Elevation	-0.850*	-0.688
Cultivation action	0.050	0.023
Number of other pests	-0.293	0.076
Number of pesticides	-0.809	-0.427
Cultivar	0.866	0.816
Plant Spacing	0.816	0.816

Description: *significantly correlated at the 5% significance level.

Differences in altitude result in variations in average daily temperatures. Temperature changes will impact the life cycle and development of the pest. The optimal temperature for FAW development, from egg to adult, is 26°C-30°C. (Ginting et al., 2024). Highland areas have temperatures lower than the optimal temperature, thus inhibiting the development of FAW.

Symptoms that appear in vegetative phase plants include several elongated lesions on the leaf blades of the plant, some traces of movement, so that some parts of the remaining leaves appear like a membrane (semi-transparent). There are several small to large holes on the tips of the leaves/leaves that roll up with an irregular shape. Almost all plants attacked by larvae have residual feces from FAW larvae in the larval movement marks.

A **B** **C**

Figure 6. Symptoms of *S. frugiperda* attack on corn plants. Elongated lesions with the lower part of the leaf membrane eaten away (A), sawdust-like burrow marks (B). Several large, elongated lesions on several leaf rolls and/or several large holes with uniform to irregular shapes on the rolls and leaf blades (C).

Maintenance did not significantly correlate with attack intensity or damage intensity (Table 2). This means that FAW will attack corn that follows four-stage maintenance (watering, fertilizing, weeding, and pest control) or five-stage maintenance (plus hilling). Good maintenance can provide a clean environment. A clean environment is one way to prevent pest attacks, in addition to crop rotation. (Pebrianti & Siregar, 2021). Plant cultivation techniques can influence the level of pest attacks (Mamahit et al., 2020).

The number and types of other pests attacking corn did not significantly correlate with the intensity of the attack or the extent of damage. The same was true for the number of pesticides used (Table 2). Mamahit et al. (2020) said the extent of damage caused by FAW attacks is largely determined by the control techniques used. In addition to synthetic pesticides, various control techniques have also been studied. The research results showed that the fungus Beauveria bassiana is effective in controlling the fall armyworm *S. litura* (Rosmiati et al., 2018). It seems that this biological agent can also be used to control FAW attacks.

CONCLUSION

The research results showed a significant negative correlation between FAW attack intensity and altitude. FAW tends to attack corn crops in lowlands rather than highlands. There was no significant correlation between damage intensity and altitude. This means that the level of damage from FAW attacks is similar in both lowlands and highlands.

REFERENCE

Asfiya, W., Subagyo, V. N. O., Dharmayanthi, A. B., Fatimah, F., & Rachmatiyah, R. (2020). Intensitas serangan Spodoptera frugiperda J.E. Smith (Lepidoptera: Noctuidae) pada pertanaman jagung di Kabupaten Garut dan Tasikmalaya, Jawa Barat. *Jurnal Entomologi Indonesia*, *17*(3), 163. https://doi.org/10.5994/jei.17.3.163

Azwana, A. (2021). Preferensi Spodoptera Frugiperda J.E. Smith pada berbagai tanaman. *Agrotekma*, *5*(2), 112–121. https://doi.org/10.31289/agr.v5i2.5455

Deden, D., Umiyati, U., & Dukat, D. (2023). Preferensi dan intensitas serangan Spodoptera frugiperda J.E. Smith (Lepidoptera: Noctuidae) pada berbagai varietas jagung manis (Zea mays saccharata). *Jurnal Agrotek Tropika*, *11*(2), 173–179. https://doi.org/10.23960/jat.v11i2.5067

Fiqriansyah, M., Putri, S. A., Syam, R., Rahmadani, A. S., Frianie, T. N., R.L., S. A., N., Y. I. S., Adhayani, A., Fauzan, N., Bachok, N. A., Manggabarani, A. M., & Utami, Y. D. (2021). *Teknologi Budidaya Tanaman Jagung dan Sorgum* (O. Jumadi, M. Junda, M. W. Caronge, Mu'nisa, & N. Iriany, Eds.; 1st ed., Vol. 1). Jurusan Biologi FMIPA UNM.

Ginting, S., Chozin, M., & Sudjatmiko, S. (2024). Infestation of Spodoptera frugiperda on corn in Bengkulu at different elevations. *J. Trop. Plant Pests Dis*, *24*(1), 38–47. https://doi.org/10.23960/j.hptt.12438-47

Lubis, A. A. N., Anwar, R., Soekarno, B. P., Istiaji, B., Sartiami, D., & Herawati, D. (2020). Serangan ulat grayak jagung (Spodoptera frugiperda) pada tanaman jagung di Desa Petir, Kecamatan Daramaga, Kabupaten Bogor dan potensi pengendaliannya menggunakan Metarizhium rileyi. *Jurnal Pusat Inovasi Masyarakat*, *2*(6), 931–939.

Maharani, Y., Kusuma Dewi, V., Tri Puspasari, L., Rizkie, L., Hidayat, Y., & Dono, D. (2019). Cases of fall armyworm Spodoptera frugiperda (Lepidoptera: Nuctuidae) attack on maize in Bandung, Garut, and Sumedang District. *Jurnal Cropsaver*, *2019*(1), 38–46.

Mamahit, J. M. E., Manueke, J., & Pakasi, S. E. (2020). Hama infasif ulat grayak Spodoptera frugiperda (J.E. Smith) pada tanaman jagung di Kabupaten Minahasa. *Posiding Seminar Nasional Lahan Suboptimal Ke-8 Tahun 2020*, 616–624.

Megasari, D., & Khoiri, S. (2021). Tingkat serangan ulat grayak tentara Spodoptera frugiperda J. E. Smith (Lepidoptera: Noctuidae) pada pertanaman jagung di Kabupaten Tuban, Jawa Timur, Indonesia. *Agrovigor: Jurnal Agroekoteknologi*, *14*(1), 1–5. https://doi.org/10.21107/agrovigor.v14i1.9492

Noerfitryani, N., Anwar, A. R., Hamzah, H., Syamsia, S., & Sampara, S. (2023). Intensitas serangan hama ulat grayak Spodoptera frugiperda pada tanaman jagung di Kabupaten Talakar. *Jurnal Galung Tropika*, *12*(1), 45–53. https://doi.org/10.31850/jgt.v12i1.1067

Nonci, N., Kalqutny, S. H., Muis, A., Azrai, M., & Aqil, M. (2019). *Pengenalan Fall Armyworm Spodoptera frugifera J.E. Smith) HamaBaru pada Tanaman Jagung di Indonesia* (1st ed., Vol. 1). Balai Penelitian Tanaman Serealia.

Pebrianti, H. D., & Siregar, H. M. (2021). Serangan ulat grayak jagung Spodoptera frugiperda (Lepidoptera: Noctuidae) pada tanaman jagung di Kabupaten Muaro Jambi, Jambi. *Agrohita*, *6*(1), 31–35. https://doi.org/10.31604/jap.v6i1.3355

Prasetya, G. I., Siregar, A. Z., & Marheni. (2022). Intensitas dan presentase serangan Spodoptera frugiperda J.E. Smith (Lepidoptera: Noctuidae) pada beberapa varietas jagung di Kecamatan Namorambe Kabupaten Deli Serdang. *Cemara*, *19*(1), 77–84.

Rosmiati, A., Hidayat, C., Firmansyah, E., & Setiati, Y. (2018). Potensi Beauveria bassiana sebagai agens hayati Spodoptera litura Fabr. pada tanaman kedelai. *Jurnal Agrikultura*, *29*(1), 43–47.

Sari, K. K. (2020). Viral hama invasif ulat grayak Spodoptera frugiperda ancam panen jagung di kab. Tanah Laut Kalsel. *Proteksi Tanaman Tropika*, *3*(03).

Sari, S. P., Suliansyah, I., Nelly, N., & Hamid, H. (2021). The occurrence of Spodoptera frugiperda attack on maize in West Pasaman District, West Sumatra, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *741*(1). https://doi.org/10.1088/1755-1315/741/1/012020

Septian, R. D., Afifah, L., Surjana, T., Saputro, N. W., & Enri, U. (2021). Identifikasi dan efektivitas berbagai teknik pengendalian hama baru ulat grayak Spodoptera frugiperda J. E. Smith pada tanaman jagung berbasis PHT- Biointensif. *Jurnal Ilmu Pertanian Indonesia*, *26*(4), 521–529. https://doi.org/10.18343/jipi.26.4.521

Tim PIU ICARE BPSIP Jawa Timur. (2024). *Budidaya Jagung dengan Sistem Tanam Zig-Zag*. Badan Standardisasi Instrumen Pertanian, Balai Penerapan Standar Instrumen Penelitian (BPSIP) Jawa Timur.

Widhayasa, B., Prasetyani, E. D., & Gendroyono, H. (2021). Insiden serangan ulat grayak Spodoptera frugiperda (Lepidoptera: Noctuidae) pada tanaman jagung di Kalimantan Timur. *Jurnal Galung Tropika*, *10*(3), 356–363. https://doi.org/10.31850/jgt.v10i3.810