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Intensity attacks of *Spodoptera frugiperda* J.E. Smith (Lepidoptera: Noctuidae) on several corn varieties in Kediri, East Java, Indonesia

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Abstract. *Sudihardjo D, Samanhudi, Sholahuddin, Pujiasmanto B, Rahayu M, Setyawati A. 2023. Intensity attacks of* Spodoptera frugiperda *J.E. Smith (Lepidoptera: Noctuidae) on several corn varieties in Kediri, East Java, Indonesia. Biodiversitas 24: 6979-6987.* The presence of *Spodoptera frugiperda* J.E. Smith, 1797 attack on corn is one of the main causes of the decrease in yield. Local, composite, and hybrid corn have different characteristics and will affect intensity attack and foliar damage due to *S. frugiperda* attack. This study aimed to determine the intensity of the attack of several types of local corn, composites, and hybrids against *S. frugiperda*. The research was conducted in the Kediri region, East Java, one of the corn cultivation centers. The study used a completely randomized block design with three replications of 18 varieties of various local, composites, and hybrid corn varieties. Local corn varieties consist of Madura Putih, Kebo Bima, Manik Liu, Lameran-Latim, Seraye-Bali, Madura kuning, and Sumbawa. Composite corn varieties include Bisma, Puput Uri, Srikandi Ungu, and Sukmaraga. Furthermore, the hybrid varieties comprise ADV Jago, Bisi 18, DK 77, NK 6172, P 27, Pertiwi 3, and R7. The results showed the infestation of *S. frugiperda* in all corn varieties peaked at age 42 DAP, with the intensity attack reaching 100%. The lowest intensity attack rate of *S. frugiperda* was obtained by the Sukmaraga composite variety and the NK6172 hybrid variety tends to be more resistant to *S. frugiperda* attacks than composite and local varieties. All corn-tested varieties were attached by *S. frugiperda*, which varied for the percentage of plant damage, severity level, and the time the pest attack first attacked. The clustering groups of each corn variety were based on the intensity attack of *S. frugiperda*, number of larvae, severity level and early infestation founded group resistant, which have less foliar damage due to *S. frugiperda* larvae attacks consisting of 5 varieties: Madura kuning, Madura Putih, Bisma, NK6172, and Srikandi Ungu.

Keywords: Composite corn, hybrid corn, local corn, *Spodoptera frugiperda* attack

INTRODUCTION

Corn is the second strategic food crop commodity after rice and is the second staple food after rice in several regions. Corn is an important crop in the modern agricultural industry, with a production level of more than 40% of grain products worldwide (Ali et al. 2020). Corn is used as food, animal feed, and raw material for the food, cosmetic, ethanol, and textile industries (Jones 2002). National maize productivity reached 54.74 quintals/ha. Based on the level of productivity, Java Island tends to have an average productivity higher than outside Java Island (Anonymous 2021).

One of the factors that cause corn yields to be less than optimal is plant pest attacks, namely pests, diseases, and weeds. *Spodoptera frugiperda* J.E. Smith, 1797 (Fall Armyworm/FAW) is a corn pest that can cause huge losses. Marcos et al. (2023) reported the loss of corn yield is very influential due to *S. frugiperda* larvae eating parts of the developing plant at the vegetative stage and eating the corn grains at the generative stage so that it can directly reduce crop yields. This pest causes significant yield losses if not handled properly. Agboyi et al. (2020) reported that *S. frugiperda* is a polyphagous pest with the characteristic of having a high migration rate every year. The rapid local spread of *S. frugiperda* is mainly due to natural long-distance movement (Ren et al. 2019). Otipa et al. (2017) stated that *S. frugiperda* infestation and damage reduce corn yields and negatively affect national GDP due to reduced market supply. *S. frugiperda* was first reported in West Africa in January 2016 and has spread astonishingly. FAO and CABI (2019) reported that invasions of *S. frugiperda* simultaneously occurred in different countries, such as Africa and Asia. When *S. frugiperda* attacks plants, it causes yield losses ranging from 15% to 73%. For example, annual economic losses in Ghana and Zambia amounted to $177.3 million and $159.3 million, respectively (Day et al. 2017). Harrison et al. (2019) reported that *S. frugiperda* causes crop losses of up to $US13 billion annually across sub-Saharan Africa. This pest also causes approximately one-third of annual maize production losses in Kenya, estimated at approximately 1 million tonnes (Groote et al. 2020).

Besides attacking corn plants, *S. frugiperda* also attacks other plants with at least 82 new host plant species (Montezano et al. 2018). *S. frugiperda* has the characteristics of long-distance migration, polyphagy, strong adaptability, and high fecundity (Wan et al. 2021). FAW populations increase rapidly in warm, humid conditions with moderate rainfall and optimal temperatures

from 11°C to 30°C, with females laying about 1,000 eggs in varying quantities during their lifetime (Assefa and Ayalew 2019). *S. frugiperda* larvae can attack over 80 plant species, including maize, rice, sorghum, millet, sugarcane, vegetables, and cotton. In addition, *S. frugiperda* has 353 host plants from 76 plant families (Montezano et al. 2018).

Various techniques for controlling *S. frugiperda* have been carried out but have not yielded optimal results. Control by technical culture, including early planting and/or early ripe or short-aged varieties, has been carried out. Early harvesting allows maize to avoid the higher density of *S. frugiperda* that develops later in the season (IITA 2016). Each variety of maize has a variety of ages and specific characteristics, both morphologically and physiologically. These age and characteristic differences influence the growing environmental conditions, which will influence the growth of other organisms around them and the response of each variety to *S. frugiperda* attacks. The response and the amount of losses of each variety of maize due to *S. frugiperda* varied greatly. According to Berg and Plessis (2022), methods to manage these pests can be done through cultural practices, such as crop rotation, resistant crop varieties, and biological control methods.

Various management practices and technologies have been developed over the years to control FAW, including host plant resistance, cultural control, biological control, biopesticides, mating disruption and synthetic pesticides (Prasanna et al. 2021). Management practices to control the *S. frugiperda* pest can be done using corn resistance which is very important because it can be used to determine which varieties should be planted by farmers and save costs on pest control. Apart from that, understanding the corn resistance varieties to *S. frugiperda* is also very important because it can be used to develop appropriate control techniques for this pest. Based on the description above, research needs to be carried out regarding the intense attack of *S. frugiperda* on several corn varieties (local, composite, and hybrid varieties), the severity of symptoms of corn damage, and grouping within resistance and susceptibility to S. frugiperda attacks.

MATERIALS AND METHODS

Samples collection and research location

The sample of corn variety was collected from 5 provinces in Indonesia, namely East Java (corn variety: Madura Kuning, Madura Putih, Pertiwi 3, BISI 18, NK6172, R7), Central Java (corn variety: Bisma, P27, ADV Jago, DK77), Bali (corn variety: Seraye-Bali, Manik Liu), Nusa Tenggara Barat (corn variety: Sumbawa, Kebo Bima, Lameran-Latim), and South Sulawesi (corn variety: Pulut Uri, Sukmaraga, Srikandi Ungu). The research was conducted in Tanon Village, Papar District, Kediri Regency, from October 2022 to January 2023, with a latitude of -7.6876560 S, longitude of 112.0843947 E, and an altitude of 67.0 masl.

Research methods

This field experiment used a randomized complete block design and three replications. The land area was 8 rows by 5 meters (28 m^2/plot) for each maize variety. This study relied on an observation method to gather the initial attack, percentage incidents of leave maize damage, severity level, and number of larvae found in *S. frugiperda*. Therefore, grouping each maize variety into resistant or non-resistant was done using cluster analysis with hierarchical techniques in the Minitab version 16 sequential method, agglomerative, hierarchical, and nested clustering (SAHN). Furthermore, the grouping is displayed in the form of a dendrogram.

Foliar damage and plant response due to *S. frugiperda* in corn

A hundred plants distributed diagonally were observed for each maize stage per plot to calculate the percentage intensity attack of *S. frugiperda*. The foliar damage was related to plant age, and *S. frugiperda* larvae prefer infesting the young maize or the vegetative stage (Trisyono et al. 2019). Percentage of intensity attack *S. frugiperda* by using the equation I = (a/b) x 100%, I = Intensity attack, a = number of plant damage by *S. frugiperda*, b = total plant observed. Twenty samples for each diagonal were observed to identify *S. frugiperda* signs that initially emerged on each corn variety, to calculate the number of larvae found in the infected plants, and to characterize the damage by scoring. A scoring system was used to evaluate the amount of foliar damage caused by *S. frugiperda* feeding on each maize variety. The system used a severity level and plant response category from 0 to 9 (Davis and Williams 1992), with 1 representing highly resistant plants and 9 representing highly susceptible plants (Table 1).

RESULTS AND DISCUSSION

The intensity attack of *Spodoptera frugiperda* at the corn vegetative stage

The intensity attack of *S. frugiperda* on several corn varieties at the vegetative stage (7-42 DAP) is presented in Table 2.

Corn damage caused by larvae of *S. frugiperda* appeared; the first symptom was semitransparent patches on the leaves, typical symptoms made by early instar of *S. frugiperda*. The larvae feeding on the whorl or in the growing point resulted in the ragged hole on the leaves, a typical symptom of an old instar of *S. frugiperda*. The intensity attack of S. frugiperda at the experimental site was very high, and it had been observed since the beginning at 14 DAP and continued to increase as the planting age progressed, the trend shown in Figure 1. The intensity attack rate of *S. frugiperda* on hybrid varieties tended to be erratic, but during the critical stage, namely planting age 14-35 DAP, hybrid variety R7 showed the highest level of damage compared to other hybrid varieties. There were no significant differences between one variety and another. The lowest attack rate of *S. frugiperda* was obtained by the Sukmaraga composite variety and the

NK6172 hybrid variety. According to Anyanda et al. (2022), hybrid corn has factors that can inhibit the growth of *S. frugiperda* so that it can reduce fecundity. Overall, hybrid variety NK6172 tends to be more resistant to *S. frugiperda* attacks than composite and local varieties.

Severity level of leaf damage due to *Spodoptera frugiperda*

The severity level was classified using a scale of 0-9 (Davis and William 1992), where highly resistant corn was given a severity level of 0 and 1 and corn that was highly susceptible had a severity level of 8 and 9. The level of corn damage caused by the pest *S. frugiperda* varies depending on the severity of the attack on leaf damage. *S. frugiperda* attacks corn plants by feeding leaves, causing holes in the leaves and visible dirt, such as sawdust. Light attacks are only characterized by caterpillar bites on leaves with small holes measuring <5 mm or leaf attacks of around 10%. The shoots or growing points of the attacked corn plants will be seriously damaged to breaking/cutting or even breaking off in heavy attacks. Variations in the severity level of corn damage due to *S. frugiperda* are presented in Table 3.

Table 1. The severity level of leaf damage due to *Spodoptera frugiperda* in maize

Severity level	Definition of leaf damage	Response
0	No visible leaf damage	Highly resistant
1	Only pin-hole damage	Highly resistant
2	Pin-hole and small circular hole damage on 1-2 older leaves	Resistant
3	Pinholes, small circular lesions and a few small elongated (rectangular shaped) lesions of up to 1.3 cm in length present on whorl and furl leaves (< 5 leaves)	Resistant
4	Several small to mid-sized 1.3 to 2.5 cm in length elongated lesions present on a few whorl and furl leaves (6 - 8 leaves)	Partially resistant
5	Several large elongated lesions greater than 2.5 cm in length present on a few whorl and furl leaves and/or a few small- to mid-sized uni-form to irregular shaped holes (basement mem-brane consumed) eaten from the whorl and/or furl leaves	Partially resistant
6	Several large elongated lesions present on sever-al whorl and furl leaves and/or several large uniforms to irregular shaped holes eaten from furl and whorl leaves.	Susceptible
7	Many elongated lesions of all sizes present on several whorl and furl leaves plus several large uniform to irregular shaped holes eaten from the whorl and furl leaves	Susceptible
8	Many elongated lesions of all sizes present on most whorl and furl leaves plus many mid- to large-sized uniform to irregular shaped holes eaten from the whorl and furl leaves	Highly susceptible
9	Whorl and furl leaves almost totally destroyed and plant dying as a result of extensive foliar damage	Highly susceptible

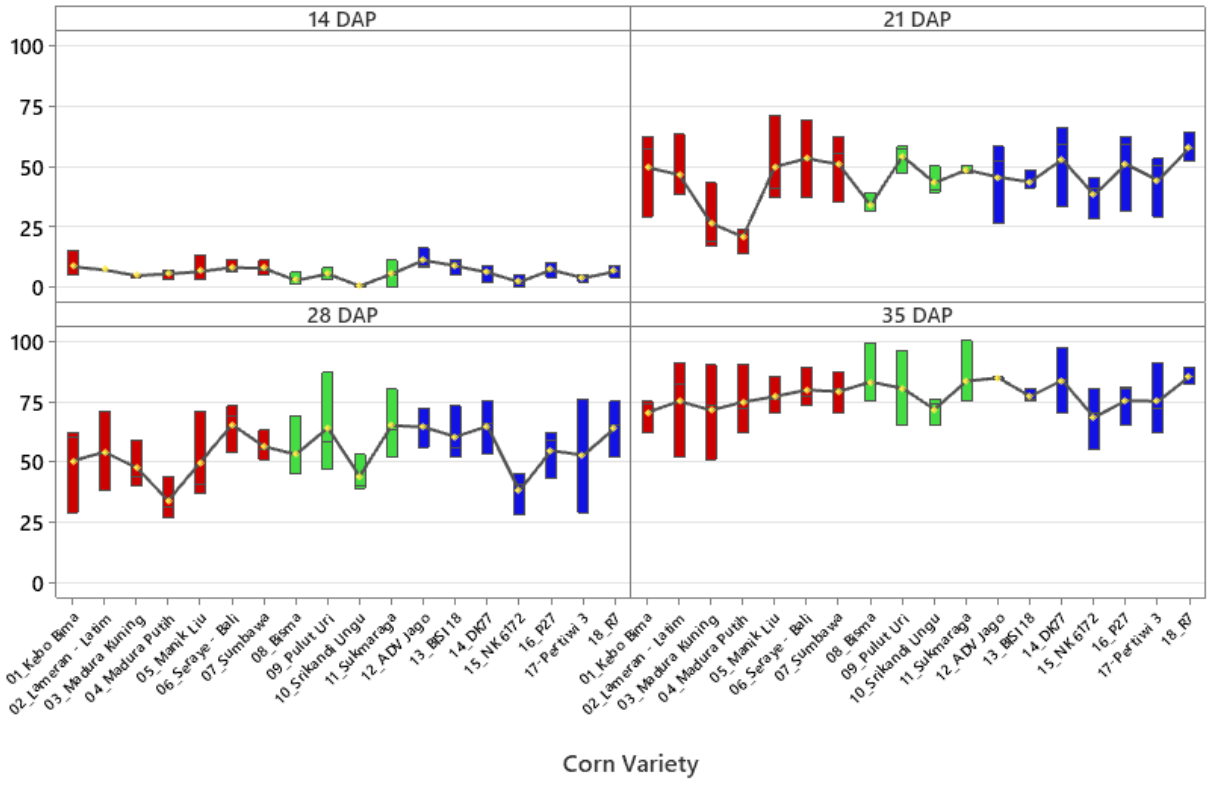

Figure 1. The trend of corn damage percentage by *Spodoptera frugiperda* in the vegetative stage at the age of 14-35 DAP

Table 2. Percentage of intensity attack *Spodoptera frugiperda* on several corn varieties at the vegetative stage (7 - 42 DAP)

Corn variety		Percentage of intensity attack *S. frugiperda*					
		7 DAP	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
Local	Kebo Bima	0.0 a	8.3 ab	49.3 ab	50.3 a	70.3 a	95.7
	Lameran - Latim	0.0 a	7.0 ab	46.3 ab	54.0 a	75.0 a	89.3
	Madura Kuning	0.0 a	4.7 ab	26.3 ab	47.7 a	71.3 a	86.3
	Madura Putih	0.0 a	5.3 ab	20.7 ab	34.0 a	74.7 a	98.7
	Manik Liu	0.0 a	6.3 ab	49.7 ab	49.7 a	77.0 a	97.3
	Seraye - Bali	0.0 a	8.0 ab	53.0 ab	65.3 a	79.7 a	91.7
	Sumbawa	0.0 a	7.7 ab	50.7 ab	56.3 a	79.0 a	97.3
Composite	Bisma	0.0 a	2.7 ab	33.7 ab	53.0 a	83.0 a	99.7
	Pulut Uri	0.0 a	5.3 ab	54.0 b	64.0 a	80.3 a	98.0
	Srikandi Ungu	0.0 a	0.3 b	43.0 ab	44.0 a	71.7 a	96.7
	Sukmaraga	0.0 a	5.3 ab	48.3 ab	65.0 a	83.3 a	100.0
Hybrid	ADV Jago	0.0 a	11.0 a	45.3 ab	64.3 a	84.7 a	99.0
	BISI 18	0.0 a	8.7 ab	43.3 ab	60.3 a	77.0 a	100.0
	DK77	0.0 a	6.0 ab	52.7 ab	64.7 a	83.7 a	95.7
	NK 6172	0.0 a	2.0 ab	38.0 ab	38.0 a	68.3 a	99.3
	P27	0.0 a	7.0 ab	50.7 ab	54.7 a	75.3 a	97.3
	Pertiwi 3	0.0 a	3.7 ab	44.0 ab	52.7 a	75.0 a	100.0
	R7	0.0 a	6.3 ab	57.7 a	64.0 a	85.3 a	99.0

Notes: The average number followed by the same letter and column indicates that it is not significantly different in the 5% LSD test

Table 3. Severity level of leaf damage due to *Spodoptera frugiperda* on several corn varieties at vegetative stage 7-42 DAP

Corn variety		Severity of leaf damage due to *S. frugiperda*					
		7 DAP	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
Local	Kebo Bima	0.0 a	0.7 ab	2.0 a	2.7 ab	3.8 bcde	4.4 abc
	Lameran - Latim	0.0 a	0.7 ab	1.7 a	2.2 bcdef	3.8 bcde	3.8 c
	Madura Kuning	0.0 a	0.5 ab	1.5 a	2.5 abcde	4.5 abcd	4.7 abc
	Madura Putih	0.0 a	0.5 ab	1.8 a	2.5 abcde	4.5 abcd	4.9 ab
	Manik Liu	0.0 a	0.6 ab	2.4 a	2.9 a	5.1 a	5.2 a
	Seraye - Bali	0.0 a	0.8 ab	1.9 a	2.7 abc	4.2 abcde	4.3 abc
	Sumbawa	0.0 a	0.8 ab	2.3 a	2.6 abcde	4.0 bcde	4.1 bc
Composite	Bisma	0.0 a	0.3 ab	1.7 a	2.1 ef	4.2 abcde	4.7 abc
	Pulut Uri	0.0 a	0.5 ab	1.8 a	2.2 cdef	4.3 abcde	4.6 abc
	Srikandi Ungu	0.0 a	0.0 b	1.6 a	1.9 f	2.1 f	2.5 d
	Sukmaraga	0.0 a	0.5 ab	2.2 a	2.5 abcde	3.9 bcde	4.4 abc
Hybrid	ADV Jago	0.0 a	1.1 a	1.8 a	2.5 abcde	4.5 abcd	5.0 a
	BISI 18	0.0 a	0.9 ab	1.7 a	2.6 abcde	4.6 abc	5.2 a
	DK77	0.0 a	0.6 ab	1.9 a	2.1 def	3.6 de	4.0 bc
	NK 6172	0.0 a	0.2 b	1.5 a	2.3 bcdef	3.9 bcde	4.4 abc
	P27	0.0 a	0.7 ab	2.0 a	2.7 abcd	3.7 cde	4.0 bc
	Pertiwi 3	0.0 a	0.4 ab	1.8 a	2.5 abcde	3.4 e	4.3 abc
	R7	0.0 a	0.6 ab	2.0 a	2.7 abcd	4.6 ab	5.0 a

Notes: The average number followed by the same letter and column indicates that it is not significantly different in the 5% LSD test

The severity level of leaf damage caused by *S. frugiperda* showed a low scale variation from 14 DAP and increased with the age of the plant and the damage caused by *S. frugiperda*. The highest scale at 14-42 DAP was found in the local variety Manik Liu, but the highest attack at the end of vegetative was found in the local Sumbawa variety. The composite varieties that produced the highest attacks were the Sukmaraga variety at the beginning of the vegetative period and the Pulut Uri variety at the end. In hybrid varieties, the attack level tends to change and varies weekly. The local Lameran Latim variety obtained the lowest corn severity scale level at the beginning of vegetative, while the local variety Kebo Bima was obtained at the end. In the composite variety, the lowest corn severity level was obtained by the purple Srikandi variety. Overall, the Srikandi Ungu composite variety tends to have a lower attack severity by *S. frugiperda* than the other varieties, as shown in Figure 2. The trend of the severity of corn by *S. frugiperda* in the vegetative stage at the age of 14- 35 DAP on the Davis scale is 0-9.

Number of *Spodoptera frugiperda* larvae

Based on three morphological characteristics, the infesting larvae in the observation sites were determined to be *S. frugiperda:* The inverted Y form in the head capsule, four black spots forming a square in the eighth abdominal segment, and four spots arranged in a trapezoidal pattern in the seventh and ninth abdominal segments. These three traits lined up nicely with the morphological descriptions of the larvae of *S. frugiperda* (Sisodiya et al. 2018).

The study's results found that the number of *S. frugiperda* larvae visually attacked several corn varieties starting 14 days after planting. At the initial observation, it was found that many pale-colored larvae were generally larvae with instars 1-3 (14-21 DAP), and at the final developmental stage of larvae with instars 4-6 (28-42 DAP)

were dark brown with the number of larvae at each observation time shown in Table 4.

Initial attack by Spodoptera frugiperda

There are two categories for maize growth and development stages in corn: vegetative and reproductive. The quantity of the highest leaves with a discernible collar allows for additional categorization of the vegetative growth stage, and tassel starts categorization of the reproductive growth stage (Darby and Lauer 2000). The early infestation time of *S. frugiperda* larvae correlates with suitable host plants at a critical stage in the vegetative stage of each corn variety as the initial attack of *S. frugiperda*. The results of this study indicated that the initial attack of *S. frugiperda* larvae on several corn varieties began at different times, ranging from 8 to 14 days after planting (Table 5).

Table 4. Number of *Spodoptera frugiperda* larvae in several corn varieties at vegetative stage 7-42 DAP

Corn variety		Number of *S. frugiperda* larvae					
		7 DAP	14 DAP	21 DAP	28 DAP	35 DAP	42 DAP
Local	Kebo Bima	0.0 a	6.7 abc	6.7 b	5.7 bcd	5.7 ab	5.3 ab
	Lameran - Latim	0.0 a	10.0 ab	10.0 ab	6.3 bcd	6.0 ab	4.3 abc
	Madura Kuning	0.0 a	6.0 abc	11.0 ab	5.0 bcd	4.7 b	4.7 ab
	Madura Putih	0.0 a	6.7 abc	6.0 b	7.0 bcd	6.0 ab	4.3 abc
	Manik Liu	0.0 a	6.0 abc	16.7 ab	4.7 cd	4.7 b	3.7 bc
	Seraye - Bali	0.0 a	10.3 ab	15.3 ab	5.3 bcd	5.0 ab	4.3 abc
	Sumbawa	0.0 a	8.3 abc	14.3 ab	5.3 bcd	4.3 b	4.7 ab
Composite	Bisma	0.0 a	3.7 bc	12.7 ab	6.0 bcd	5.7 ab	5.3 ab
	Pulut Uri	0.0 a	7.7 abc	19.3 a	8.0 abc	5.0 ab	6.0 a
	Srikandi Ungu	0.0 a	0.3 c	9.3 ab	3.3 d	2.3 c	2.7 c
	Sukmaraga	0.0 a	6.3 abc	16.0 ab	7.0 bcd	5.0 ab	4.3 abc
Hybrid	ADV Jago	0.0 a	12.7 a	13.3 ab	6.3 bcd	4.3 b	4.7 ab
	BISI 18	0.0 a	10.3 ab	10.3 ab	7.7 abc	4.7 b	4.7 ab
	DK77	0.0 a	6.7 abc	13.3 ab	8.7 ab	2.3 c	2.7 c
	NK 6172	0.0 a	3.0 bc	10.3 ab	7.7 abc	4.7 b	3.7 bc
	P27	0.0 a	9.7 ab	10.0 ab	7.3 abc	6.7 a	4.3 abc
	Pertiwi 3	0.0 a	4.7 abc	13.0 ab	7.7 abc	5.0 ab	6.0 a
	R7	0.0 a	7.7 abc	17.7 ab	11.0 a	6.7 a	4.3 abc

Notes: The average number followed by the same letter and column indicates that it is not significantly different in the 5% LSD test

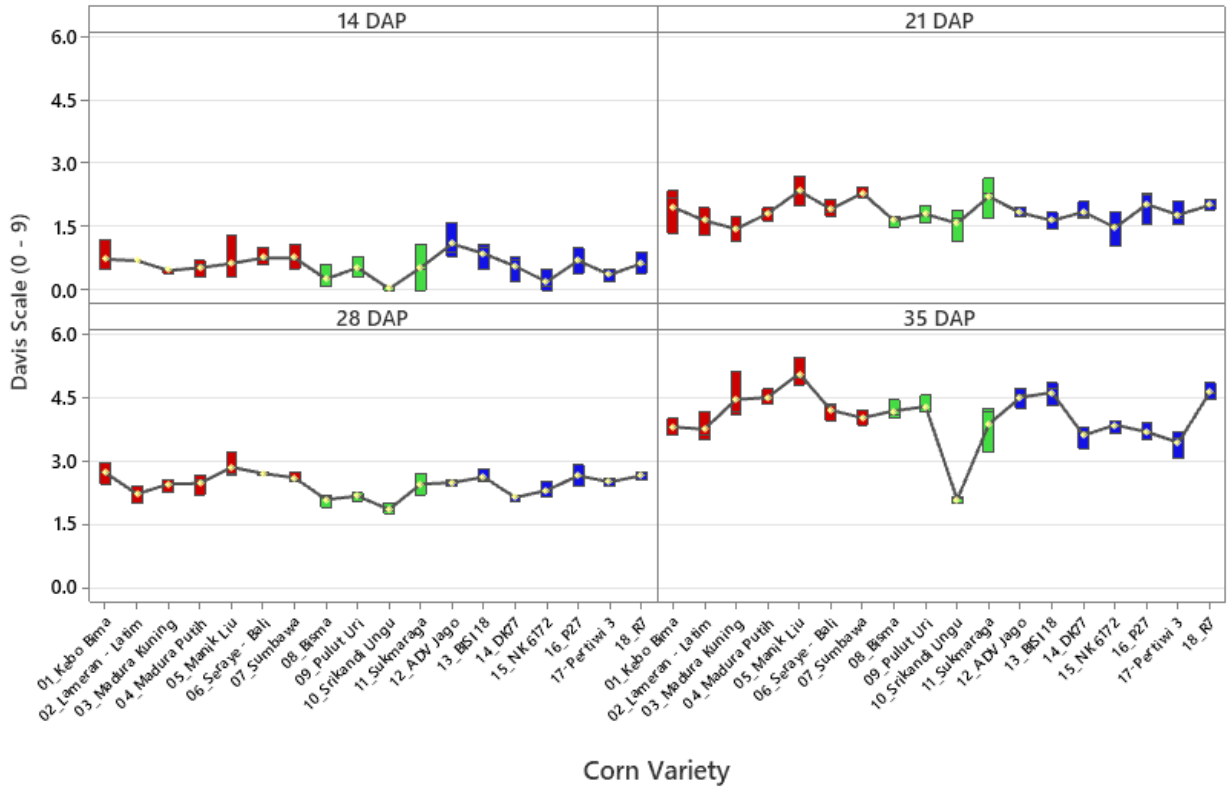

Figure 2. The trend of the severity level of corn damage by *Spodoptera frugiperda* in the vegetative stage at the age of 14-35 DAP on the Davis scale (0-9)

The trend of the initial attack of *S. frugiperda* on several corn varieties is shown in Figure 3. The slowest initial attack of *S. frugiperda* was experienced by the composite variety Srikandi Ungu (14.7 DAP), and the fast attack was experienced by the local variety Seraye-Bali (8.0 DAP). On local varieties, the slowest initial attack was experienced by Seraye-Bali (8.0 DAP), while on hybrid varieties, the longest initial attack was experienced by hybrid variety NK6172 (13.0 DAP). In the composite variety, the fastest initial attack was experienced by the Bisma variety (9.3 DAP), while in the hybrid variety, the fastest initial attack was experienced by DK77 and R7 varieties (8.7 DAP). Bahtiar et al. (2023) reported that composite corn is resistant to environmental conditions, while hybrid corn is very sensitive to biotic and abiotic influences.

Classification of corn varieties' resistance to *Spodoptera frugiperda*

The clustering of each corn variety into resistant or susceptible groups was based on the intensity percentage of *S. frugiperda*, number of larvae, severity level and early infestation. Clustering using cluster analysis with hierarchical techniques and the grouping results are presented in Figure 4.

Table 5. Initial attack of *Spodoptera frugiperda* (DAP) on several corn varieties

Corn variety		Initial attack of *S. frugiperda* (DAP)	
Local	Kebo Bima	9.3	bc
	Lameran - Latim	10.7	abc
	Madura Kuning	8.7	bc
	Madura Putih	9.3	bc
	Manik Liu	9.3	bc
	Seraye - Bali	8.0	c
	Sumbawa	8.7	bc
Composite	Bisma	9.3	bc
	Pulut Uri	10.0	bc
	Srikandi Ungu	14.7	a
	Sukmaraga	11.0	abc
Hybrid	ADV Jago	9.3	bc
	BISI 18	10.7	abc
	DK77	8.7	bc
	NK 6172	13.0	ab
	P27	9.3	bc
	Pertiwi 3	10.7	abc
	R7	8.7	bc

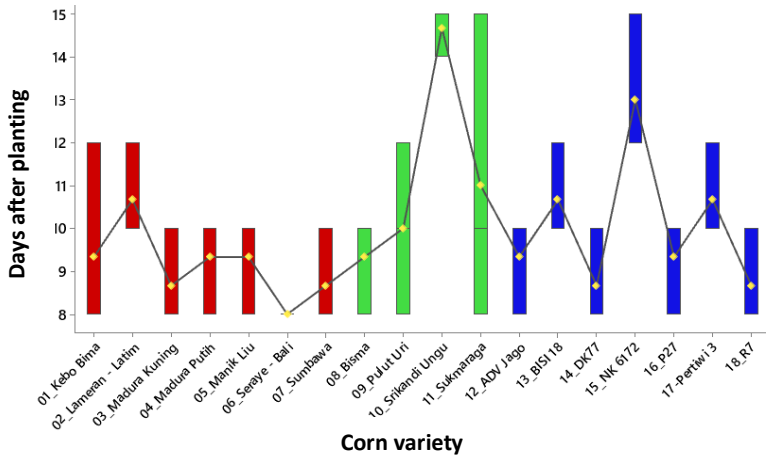

Figure 3. The trend of the initial attack of *Spodoptera frugiperda* on several corn varieties

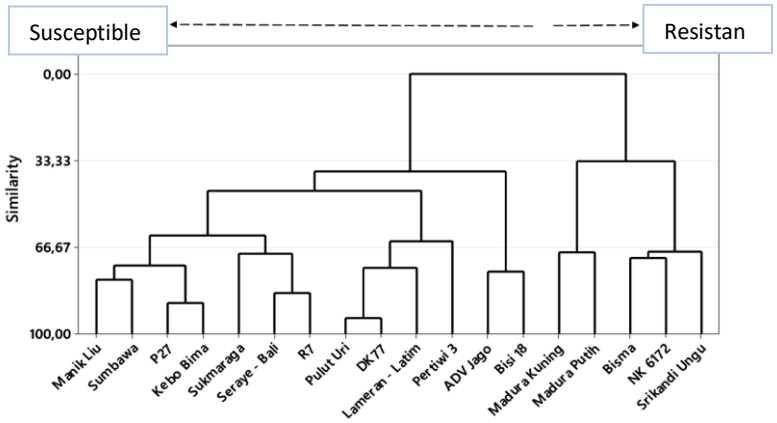

Figure 4. Dendogram of corn variety groupings

Discussion

The infestation of *S. frugiperda* in all corn varieties peaked at age 42 DAP because the intensity reached 100%. In this study, the trend of *S. frugiperda* attacks on several corn varieties can be seen in Figure 1. The percentage of corn damage by *S. frugiperda* in the vegetative stage and the critical phase of corn growth at 14-42 DAP. In addition to planting age, the attack of *S. frugiperda* was also influenced by plant characteristics. *S. frugiperda S. frugiperda* prefers corn with lush leaves rather than with large and hard stems and skin (Deden et al. 2023). *S. frugiperda* infestations can recur extremely quickly, even very soon after plant emergence. All stages of maize plant development are impacted by fall armyworm. However the early growing phase is when the most damage is done (Goergen et al. 2016). *S. frugiperda* larvae feed on leaves throughout the vegetative growth stages, when they migrate to a young corn plant's growth points and devour it. The small caterpillars are nocturnal, feeding fiercely on the leaves at night, but during the day, they hide in the joints between the leaves and the stem and whorl of the maize plant (Gomez et al. 2012)

Different severity levels of corn due to *S. frugiperda* attack were caused by various defense mechanisms of each corn variety. According to Sholihat et al. (2021), differences in the degree of damage to corn can be caused by chemical resistance and plant antibiosis. Several corns produce toxins that can inhibit plant growth, such as oxalate, which can interfere with the growth of pests. Regarding genes, the corn hybrid came from superior plant parents, but even so, the attack rate on hybrid corn was higher than that of *S. frugiperda* on composite varieties; not all hybrid varieties have good resistance to *S. frugiperda*. According to Barrios et al. (2020), hybrid corn tends to have a decrease in yield observed with a greater number of *S. frugiperda* larvae.

The number of larvae found in some corn tends to vary every week. The highest and lowest number of larvae from local varieties and hybrids cannot be determined as the highest and lowest because the development of the larval population changes weekly. In the composite varieties, the highest number of larvae was found in the Pulut Uri variety, while the lowest number of larvae was found in the Srikandi Ungu variety. The Srikandi Ungu composite variety was the least preferred for *S. frugiperda* larvae as a host. In field conditions, *S. frugiperda* has cannibalistic behavior with both actions of attack and defense since individual *S. frugiperda* larvae have a high ability to attack (head touching) and defend (recoiling) themselves (Sokame et al. 2023).

The number of *S. frugiperda* populations that changes every week is suspected because the *S. frugiperda* pest eats other pests or has cannibalism, which causes a decrease in its population in corn plants. Larger larvae often feed on smaller ones, distinguishing them from true armyworms (ICAR 2019). According to Shylesha et al. (2018), one or two larvae are typically present in a whorl, which causes a lot of fecal matter to accumulate and causes distinctive damage symptoms. Older larvae consume the growing primordial shoot, which causes symptoms of a dead heart. A polyphagous pest can easily switch hosts and survive on an alternative crop/plant without the preferred host (Anjorin et al. 2022). Corn approaching the harvest age already has a hard and large stem, which *S. frugiperda* does not prefer.

Damage to corn plants due to the initial attack of *S. frugiperda* larvae in the vegetative phase is usually characterized by symptoms of damage known as window panning; namely, the leaves appear transparent due to loss of the leaf epidermis layer, perforated leaves, and the presence of scraps such as sawdust on the surface, top and bottom of leaves (CABI 2020).

The initial attack of each corn variety begins at different times in the vegetative phase, as shown in Figure 3. However, the initial attack in this study tends to be fast, namely around an average of 9.97 DAP during the corn growth stage in the V3-V4 vegetative phase.

Plants have various mechanisms and reactions to pest attacks. A pest's attack on a crop depends on several factors involving complex interactions between the pest, the crop, and the environment. FAW insect pests can generally evolve to overcome monogenic or oligogenic resistance, depending on the varieties (Huang et al. 2014). The results of this study indicated that the Srikandi Ungu composite variety had a good level of resistance to the initial attack of *S. frugiperda* larvae no later than 14.7 DAP. This is thought to be because the Srikandi Ungu variety contains high anthocyanins. Lackisha et al. (2021) reported that anthocyanins help plants overcome pest attacks because anthocyanins have antiviral, antibacterial, and fungicidal activity. According to West (2016), anthocyanin's function in leaves is largely unknown. It may work with another pigment class called the xanthophylls to protect leaves from excess light, which functions as photoprotection. It also may reduce crop damage from insects and diseases.

Based on Figure 4, The clustering of each corn variety into resistant or susceptible groups was based on the intensity percentage of *S. frugiperda*, number of larvae, severity level and early infestation by using cluster analysis with hierarchical techniques in the Minitab version 16 sequential method, agglomerative, hierarchical, and nested clustering (SAHN). The result was divided into two clusters of similarity of corn varieties, i.e., resistant (plant response category resistant to highly resistant) and susceptible (plant response category susceptible to highly susceptible) to attack by *S. frugiperda*. Cluster one is a group that was susceptible to *S. frugiperda* attacks, consisting of 13 varieties, namely Manik Liu, Sumbawa, P27, Kebo Bima, Sukmaraga, Seraye Bali, R7, Pulut Uri, DK77, Lameran Latim, Pertiwi 3, ADV Jago, and Bisi 18. Cluster two is a group resistant to *S. frugiperda* attacks consisting of 5 varieties: Madura Kuning, Madura Putih, Bisma, NK6172, and Srikandi Ungu.

In conclusion, *Spodoptera frugiperda*, an invasive insect, feeds on corn virtually at all developmental stages. The larvae damaged heavily on young corn at the vegetative stage achieved 90-100% intensity attacks on local, composite, and hybrid corn varieties, and the number of *S. frugiperda* larvae infected plants declined as the plants got older. The severity level of infestation is subject

to insect population and inherent maize plant resistance. *S. frugiperda* negatively impacts directly or indirectly associated with corn yield. Fall armyworm constitutes an important maize pest in Indonesia. This information can assist in developing management practices using corn toward fall armyworm resistance/ tolerance while crop yield is stabilized.

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