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Insect Pest Diversity on Maize Farming at UPT Tanjung Selamat, Deli Serdang Regency: A Case Study

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ABSTRACT

UPT Tanjung Selamat located in North Sumatra is one of significant corn farming areas in North Sumatra which currently faces disturbance from insects. This study investigates insect pest diversity in corn fields at two growth stages, 25 and 60 days after planting (DAP), within the UPT Tanjung Selamat area of Deli Serdang Regency. Yellow sticky traps were installed in designated sites as approaches to collect and identify insect pest community in the area. Our results showed that at 25 DAP, three pest species were identified, while at 60 DAP, seven species were recorded, showcasing higher diversity at the latter stage. The insect pest with the highest population density at both growth stages of maize is Cicadulina bipunctata, with 48.12 ind/m² at 60 DAP and 36.67 ind/m² at 25 DAP. The total insect pest density peaked at 60 DAP (61.44 individuals/m²) and reached its lowest at 30 DAP (49.38 individuals/m²). Similarly, the diversity index was highest at 60 DAP (1.283), contrasting with the lowest value at 25 DAP (0.652). The evenness index mirrored these trends, peaking at 60 DAP (0.659) and reaching its lowest at 25 DAP (0.593). The Sorensen similarity index indicated a 60% similarity between the two periods, reflecting relatively similar insect pest compositions. These findings highlight the dynamic nature of insect pest populations in maize fields at different growth stages, emphasizing the need for age-specific management strategies. This study contributes valuable insights for optimizing pest control measures and promoting sustainable corn production practices.

Keyword: Cicadulina bipunctata, Ecology, Maize, North Sumatra, Pest, Zea mays.

ABSTRAK

UPT Tanjung Selamat yang berlokasi di Sumatera Utara merupakan salah satu kawasan pertanian jagung penting di Sumatera Utara yang saat ini menghadapi gangguan dari serangan serangga. Penelitian ini mengkaji keanekaragaman serangga hama pada lahan jagung pada dua stadia pertumbuhan yaitu umur 25 dan 60 hari setelah tanam (HST), di wilayah UPT Tanjung Selamat Kabupaten Deli Serdang. Perangkap lengket berwarna kuning dipasang di lokasi yang telah ditentukan sebagai pendekatan untuk mengumpulkan dan mengidentifikasi komunitas serangga hama di area tersebut. Hasil kami menunjukkan bahwa pada 25 HST, tiga spesies hama teridentifikasi, sedangkan pada 60 HST, tercatat tujuh spesies, yang menunjukkan keanekaragaman yang lebih tinggi pada tahap terakhir. Serangga hama dengan kepadatan populasi tertinggi pada kedua stadia pertumbuhan jagung adalah Cicadulina bipunctata sebesar 48,12 ind/m² pada 60 HST dan 36,67 ind/m² pada 25 HST. Kepadatan total serangga hama mencapai puncaknya pada 60 HST (61,44 individu/m²) dan mencapai titik terendah pada 30 HST (49,38 individu/m²). Demikian pula dengan indeks keanekaragaman tertinggi pada 60 HST (1,283), berbeda dengan nilai terendah pada 25 HST (0,652). Indeks pemerataan mencerminkan tren ini, mencapai puncaknya pada 60 DAP (0,659) dan mencapai titik terendah pada 25 DAP (0,593). Indeks kesamaan Sorensen menunjukkan kesamaan sebesar 60% antara kedua periode, yang mencerminkan komposisi serangga hama yang relatif sama. Temuan ini menyoroti sifat dinamis populasi serangga hama di lahan jagung pada berbagai tahap pertumbuhan, dan menekankan perlunya strategi pengelolaan yang spesifik berdasarkan umur. Studi

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ini memberikan kontribusi wawasan berharga untuk mengoptimalkan tindakan pengendalian hama dan mempromosikan praktik produksi jagung berkelanjutan.
Keyword: *Cicadulina bipunctata*, Ekologi, Jagung, Sumatera Utara, Hama, *Zea mays*.

1. Introduction

Maize (Zea mays L.), an agriculturally significant cereal, emerges as a highly promising and versatile crop, making important contributions across various nutritional and industrial domains [1]. This cereal species is distinguished by its capacity to serve as a primary source of vital components such as carbohydrates, plant-based protein, essential fatty acids, isoflavones, and an array of essential minerals including calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), phosphorus (P), and iron (Fe) [2–5]. Beyond its pivotal role as a staple in human diets, corn exhibits versatility in its applications, finding utility in diverse sectors. Notably, it contributes to the formulation of livestock feed [6], acts as a fundamental raw material in industrial processes, and serves as a key ingredient in the production of various consumables, including beverages, syrups, coffee, paper, oil, and paint [7]. The multifaceted role of corn in both nutritional and industrial contexts highlights its paramount importance in agricultural landscapes and global economies.

Maize face disruptions during their growth stages, primarily due to small animals referred to as pests, which interfere with plant growth by feeding on them. Common pests affecting maize farming include stem borers, leafhoppers, cob borers, and thrips [8]. Pests are known to attack plants throughout both vegetative and generative growth phases [9]. The incidence and diversity of pest attacks are influenced by the age of the maize. Pest attack intensity during vegetative and generative phases varies significantly and continues to evolve up to 60 days after planting (DAP). Initial observations at 12 DAP indicated a pest attack intensity of 0.22%. By 33 DAP, it increased to 0.36%, reaching 0.51% at 54 DAP. However, no further pest attacks were recorded at 61 DAP and 75 DAP (local report).

Recognizing information about pest insects proves crucial in corn cultivation [10]. In North Sumatra, particularly in Deli Serdang Regency, maize production on a national scale is significant, with a harvested area of 20.23 hectares yielding 101.93 tons, averaging 50.16 kg/ha . The Technical Implementation Unit or Unit Pelaksana Teknis (UPT) for Food Crops (Palawija) and Horticulture Seed Parents, situated at Tanjung Selamat Village, Sunggal Subdistrict, Deli Serdang Regency, North Sumatra, operates as a research institute dedicated to the study, development, and utilization of palawija and horticulture crops, prominently featuring corn cultivation. Understanding the species of pest insects at various vegetative and generative growth stages is pivotal for effective and efficient pest management, with the ultimate goal of controlling pests adequately and enhancing corn production yields. This study aims to assess species composition at different DAP of maize and highlight the importance of biodiversity based on ecological parameters at UPT Tanjung Selamat.

2. Method

This study was conducted from October 2022 until completion, situated in a corn farming field at 25 DAP (Days After Planting) and 60 DAP in the Technical Implementation Unit or Unit Pelaksana Teknis (UPT) Tanjung Selamat, North Sumatra, Indonesia. The selection of sampling plot locations was determined using the Purposive Sampling method. Plots were determined in maize fields at sites deemed representative of pest insect presence. Sampling in the study utilized the Yellow Sticky Trap (YST) method, a trapping technique for collecting pest insects. At each research point/plot, four wooden poles measuring 210 cm in height, spaced 25.4 cm apart, and 20.3 cm in width (forming a square), were installed for Yellow Sticky Trap placement. The traps were stapled onto the wooden poles according to the age and height of the corn plants, facing the cardinal directions (East-West and South-North), with four traps in total (Figure 1). The installation took place at 4 PM in the late afternoon, and retrieval occurred at the same hour the following day, encompassing a 24-hour period. Insects obtained from the traps were morphologically identified using available insect identification books and online tools. Evaluated ecological parameters included Density (ind/m²), Shannon's diversity index (H'), Pielou's evenness index (J), and Sorensen's Coefficient Similarity index (SCSI). These parameters were crucial in assessing the ecological dynamics of pest insects in the corn cultivation area.

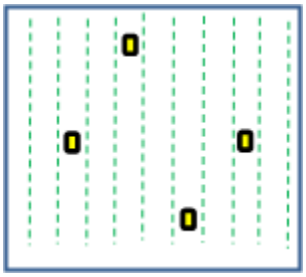

Figure 1. Schematic layout of plots installed with yellow sticky trap in a maize field

3. Results and Discussion

3.1 Insect Pest Species Composition in Maize Fields

Our study identified a total of 7 insect pest species, classified into 1 class, 3 orders, 6 families, and 87 genera (Table 1). Notably, at the 60 DAP stage, the maize crops exhibited a higher diversity with 7 pest species belonging to 1 class, 3 orders, 6 families, and 7 genera. In contrast, at the 25 DAP stage, only 3 pest species were identified, falling into 1 class, 1 order, 3 families, and 3 genera. The greater diversity of insect pest species observed in the 60 DAP maize crops compared to the 25 DAP crops is attributed to the advanced growth stage of the former. At 60 DAP, the maize plants had entered the production phase, reaching a height of >160 cm, displaying flowers and cobs, and forming stem organs and true leaves. This advanced stage led to a more varied presence of insect pests, affecting leaves, stems, young cobs, and maize kernels. In contrast, the 25 DAP maize plants, being shorter and featuring only a few emerging leaves, experienced a more limited range of insect pests, primarily affecting young leaves and stems.

Table 1 Taxonomy and insect pest in maize fields with different growth stages

Order	Family	Species	Local Name	Ecological Description	Maize (+ = Present, – = Absent)	
					25 DAP	60 DAP
Hemiptera	Alydidae	*Leptocorisa oratorius*	*Walang sangit*	Insect pests, in their adult stage, feed by sucking fluids from various parts of the maize	-	+
	Aphididae	*Rhopalosiphum maidis*	*Kutu daun*	Insect pests, in their adult stage, attack the leaves of maize by sucking leaf fluids	+	+
	Cicadellidae	*Cicadulina bipunctata*	*Wereng jagung oranye*	Insect pests, in their adult stage, induce gall formation by attacking the leaves of maize	+	+
		Recilia dorsalis	*Wereng loreng*	Insect pests attack both rice and maize	-	+
	Derbidae	*Proutista moesta*	*Wereng batang*	Insect pests, in their adult stage, attack the ventral side of maize leaves by sucking leaf fluids	+	+
Diptera	Muscidae	*Atherigona soccata*	*Lalat bibit*	Insect pests, in their larval stage, infest the stems of maize by tunneling inside (stem borers)	-	+
Lepidoptera	Noctuidae	*Helicoverpa armigera*	*Ngengat*	Insect pests, in their larval stage, infest the cobs, shoots, and tassels of maize by tunneling inside (cob borers)	-	+
				Total	**3**	**7**

The insect pests predominantly attacking young corn plants, specifically those aged < 35 days, primarily belong to the larval group that feeds on leaves and young stems. Only a few insect pest species in their adult stage target both leaves and stems. However, during the reproductive phase of corn plants, numerous insect

pests, both in larval and adult forms, are commonly encountered [11]. The variation in insect pest species attacking corn plants is evident based on the plant's age. During the vegetative phase (0-14 DAP), pests such as seed flies (Atherigona sp), cutworms (Agrotis ipsilon), and May beetles (Phyllophaga hellen) are prevalent. In the vegetative phase (15-42 DAP), stem borers (Ostrinia furnacalis), armyworms (Spodoptera litura), and corn leaf aphids (Peregrinus maidis) are commonly found. During the pollination and fertilization phase (43-70 DAP), corn earworms (Helicoverpa armigera) are observed [12]. Losses of up to 80% in yield due to insect pest infestations can significantly impact regional and national food security. The high incidence of insect pests attacking corn plants results in decreased corn production [13].

3.2 Density of Insect Pest Community in Maize Fields

The insect pest with the highest population density at both growth stages of maize is Cicadulina bipunctata, with 48.12 ind/m² at 60 DAP and 36.67 ind/m² at 25 DAP (Table 2). The abundance of C. bipunctata during the dry season sampling is likely attributed to environmental conditions highly conducive to its survival, such as elevated air temperatures. The development period of eggs and nymphs of C. bipunctata occurred rapidly during the summer when the air temperature ranges from 31.4 to 34.0°C, leading to an increase in population density [14]. Moreover, the YST method proves significantly more effective in trapping C. bipunctata in maize compared to other methods such as light trap and suction trap. The yellow color also demonstrates higher efficacy as a trap for C. bipunctata compared to other colors like blue [15]. The factors supportive to the life history of insect pests are influenced by both internal and external elements. Internally, factors such as a robust reproductive capacity, swift life cycle, and the developmental stages of the insects play crucial roles. Externally, these conditions are shaped by environmental factors encompassing physical-chemical and biological aspects, including air temperature, humidity, rainfall patterns, the presence of plentiful and sustain food sources, as well as the existence of predatory organisms [16].

Table 2. Density of insect pest populations in maize fields with different growth stages

No.	Species	Density (ind/m^2)	
		25 DAP	60 DAP
1.	*Leptocorisa oratorius*	-	1.25
2.	*Rhopalosiphum maidis*	11.46	4.37
3.	*Cicadulina bipunctata*	36.67	48.12
4.	*Recilia dorsalis*	-	1.04
5.	*Proutista moesta*	1.25	1.04
6.	*Atherigona soccata*	-	4.37
7.	*Helicoverpa armigera*	-	1.25
	Total	49.38	61.44

3.3 Ecological Index of Insect Pest Community in Maize Fields

The highest diversity index value was recorded at 60 DAP, with a value of 1.283, while the lowest value was obtained at 25 DAP, with a score of 0.652 (Figure 2). Meanwhile, evenness index values tended to be similar between the two maize ages. This indicates that insect pests on maize at 25 DAP exhibit low diversity, low individual species abundance, low community stability, moderate evenness, and a labile community. In contrast, maize at 60 DAP showed moderate diversity, moderate individual species abundance, moderate community stability, moderate evenness, and a labile community for insect pest life.

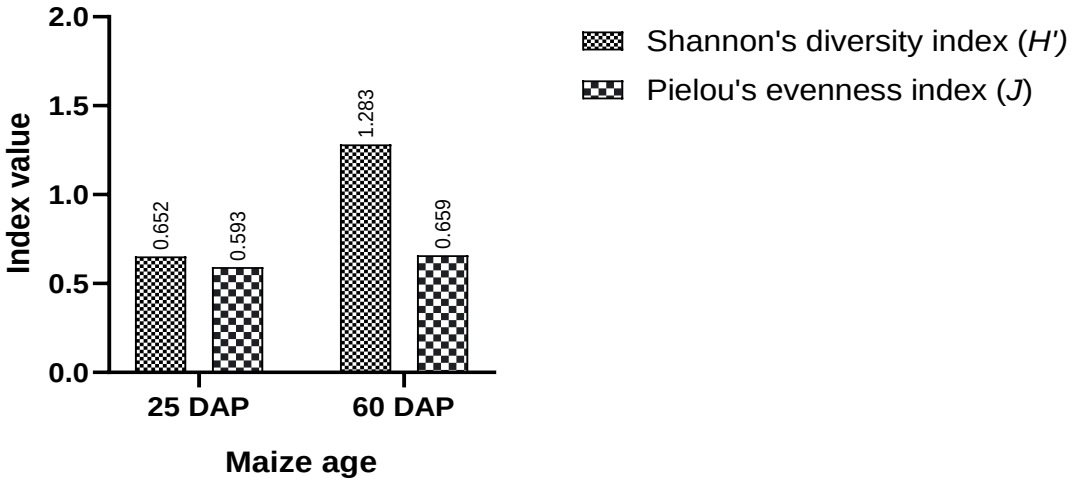

Figure 2. Bar graphs illustrating the Shannon's diversity and Pielou's evenness indices of insect pest community in maize fields with different growth stages

Population density, diversity, and evenness of fauna in an area are strongly influenced by land management practices and its use in agricultural activities, as observed in this case study for food or secondary crops (palawija) during the dry season [17]. The Sorensen Similarity Index (SCSI) value for insect pests at the two research times is 60%. According to the Sorensen similarity index criteria, this indicates that the two different ages of corn plants have a relatively similar level of similarity. This is due to the study being conducted in the same area but at different times. The high level of similarity is closely related to the availability of food sources from corn plants, plant age, and climate. A similarity level above 50% for herbivorous insects is considered high. This suggests that the insect pest communities at the two different ages of corn plants in the same area are almost identical and have a sufficiently supportive environment [18].

4. Conclusion

In conclusion, the study on insect pest diversity in maize fields at 25 and 60 DAP in the UPT Tanjung Selamat area of Deli Serdang Regency yielded several key findings. Firstly, three pest species were identified at 25 DAP, belonging to 1 class, 1 order, 3 families, and 3 genera, while at 60 DAP, seven pest species were recorded, falling into 1 class, 3 orders, and 7 families. Secondly, the highest total insect pest density was observed at 60 DAP, reaching 61.44 individuals/m², whereas the lowest density was recorded at 30 DAP, totaling 49.38 individuals/m². Thirdly, the diversity index peaked at 60 DAP (1.283), contrasting with the lowest value at 25 DAP (0.652). Similarly, the evenness index was highest at 60 DAP (0.659) and lowest at 25 DAP (0.593). Lastly, the Sorensen similarity index indicated a 60% similarity between the two research periods, categorizing the insect pest compositions as relatively similar. These findings provide valuable insights into the dynamics of insect pest populations in maize fields at different growth stages, emphasizing the importance of age-specific management strategies.

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