

(RESEARCH ARTICLE)



Temporal variation in aphid abundance throughout cucumber plant growth stages

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Abstract

This study aims to analyze the abundance of aphids (*Aphis gossypii*) on cucumber plants (*Cucumis sativus* L.) during both the vegetative and generative growth phases in the agricultural land of the Jambi farming community. The research employs a descriptive exploratory approach. Data were collected using a total sampling technique, involving the counting of all aphids found on sampled cucumber plants. Measurements of air humidity, temperature, and light intensity were conducted during the observation period. The results revealed that during the vegetative phase, the highest abundance of aphids occurred in the third week after planting (696 individuals), with an average abundance of 174. Conversely, the lowest abundance was observed in the first week after planting (42 individuals), averaging 10.5. In the generative phase, the highest abundance of aphids was recorded in the fifth week after planting (798 individuals), with an average abundance of 133; whereas the lowest abundance was noted in the tenth week after planting (36 individuals), averaging 6.

Keywords: Abundance; Aphids (*Aphis gossypii* Glover); Cucumber (*Cucumis sativus* L.); Vegetative growth; Generative growth

1. Introduction

Aphids, as one of the most harmful polyphagous pests, are primarily known to infest cucumber plants (Cucurbitaceae), while they may act as minor pests on other plants like onions, okra, tobacco, and cocoa [1]. Their infestation results in symptoms such as wrinkled, curly, and rolled leaves, with aphids also serving as vectors for viruses [2] [3], leading to decreased cucumber production and crop failure

Currently, farmers manage aphid infestations in the field by regularly spraying synthetic insecticides on a weekly basis. However, this control method has adverse effects on the environment, including resistance development, resurgence of aphid populations, and the depletion of natural enemies [4] [5]. Consequently, studying aphid presence in the field becomes imperative. Such research not only provides valuable insights for controlling aphids through chemical and biological means but also serves as a foundation for the development of insect ecophysiology.

2. Materials and methods

The study was conducted in the agricultural area of the Jambi farming community. This research employed a descriptive exploratory approach utilizing a total sampling technique. A total of 50 cucumber plants were planted with a spacing of 40 cm x 60 cm. Observations commenced when the cucumber plants were one week old after planting, continuing from the vegetative growth phase to the generative phase. Data were collected by systematically counting all aphids present on the cucumber plants, including those located at the top, middle, and bottom. Concurrently, environmental parameters such as temperature, humidity, and light intensity were measured during observations. The analysis of aphid abundance was performed by tallying the number of aphids found on each part of the cucumber plant.

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3. Results and discussion

The results of observing and counting aphids for ten weeks in the field are presented. The number and average abundance obtained each week during both the vegetative and generative phases of cucumber plants are summarized in Table 1.

Table 1 Aphid abundance on cucumber plants

Growth phase	Week of observation	Total amount	Average abundance
Vegetative	1	42	10,5
	2	153	38,25
	3	696	174
	4	169	42,25
	Amount	1.060	265
Generative	5	798	133
	6	66	11
	7	341	56,83
	8	130	21,67
	9	72	12
	10	36	6
	Amount	1.443	240,5
	Total Amount	2.503	505,5

Table 1 illustrates that the highest number of aphids, totaling 798 individuals, was observed five weeks after planting, whereas the lowest number, comprising 36 individuals, was recorded ten weeks after planting. Additionally, it is noteworthy that the total number of aphids found during the vegetative growth phase was lower (1060 individuals) compared to the generative growth phase (1443 individuals), as depicted in Figure 1.

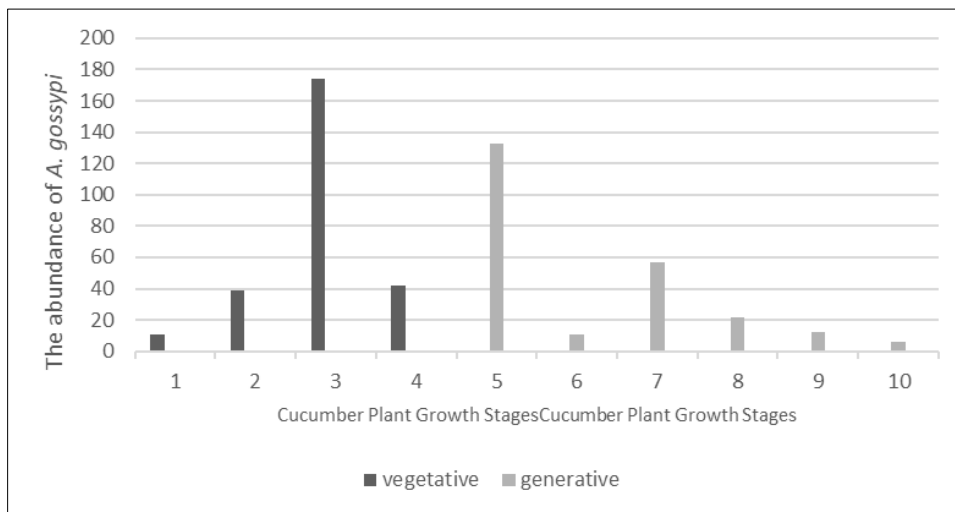


Figure 1 The abundance of *Aphis gossypii* for each week of observation

Figure 1 illustrates that during the observation period spanning both the vegetative and generative growth phases, a total of 2,503 aphids were recorded. In the vegetative phase, the highest number of aphids was observed three weeks after planting, totaling 696 individuals, with an average abundance of 174 individuals. Conversely, the lowest

abundance was noted one week after planting, with 42 individuals recorded, averaging 10.5 individuals. Figure 1 also indicates a decline in the average abundance of aphids in the vegetative growth phase around four weeks after planting, attributed to rainy weather conditions prevailing before and during the observation period

During the generative phase, the highest abundance of aphids occurred five weeks after planting, totaling 798 individuals, with an average abundance of 133 individuals. Conversely, the lowest abundance was observed ten weeks after planting, with only 36 individuals recorded, averaging six individuals. It is plausible that the abundance peak observed at five weeks after planting coincides with the period of abundant young shoots and leaves, providing ample food supply for aphids. However, as the plants age during the generative growth phase, the availability of suitable food sources for aphids decreases, leading to a decline in their average abundance. Furthermore, a significant decrease in aphid abundance was observed six weeks after planting, attributed to heavy rainfall rendering the environment unsuitable for aphid survival. Numerous factors influence insect abundance, including nutrient availability, tissue hardness, and environmental conditions [6] [7] [8].

The first part of the plant attacked by aphids is the shoots and young leaves, where they insert their stylet and suck the host plant's nutrients [9]. Aphids exhibit selectivity in their choice of food, settling in specific parts of the plant and causing distinct damage. They often congregate in groups, primarily at the tips of plant stems and on young leaves. Aphids feed by extracting plant fluids, showing a preference for tender plants or young leaves [10] [11]. The population growth of aphids typically mirrors the growth and development of the host plants, with the age of the plant influencing aphid development [12] [13].

The lowest average abundance of aphids was recorded ten weeks after planting. This could be attributed to the aging of cucumber plants, resulting in reduced food availability for aphids and subsequently decreasing aphid abundance. Additionally, environmental factors also play a role in influencing aphid abundance.

Based on the number of individual aphids found on cucumber plants, the highest numbers were observed on the upper parts of the plants or on the plant shoots (Table 2)

Table 2 Abundance of aphids on different parts of cucumber plants

SR. No	Growth phase	Plant parts		
		Top	Middle	Bottom
1	Vegetative	600	184	276
2	Generative	892	351	200
Total amount		1492	535	476

Figure 2 illustrates that during the vegetative growth phase, the highest number of aphids was observed on the upper leaves (600 individuals), whereas the lowest number was recorded on the middle leaves (184 individuals). Similarly, during the generative phase, the highest abundance of aphids was found on the upper leaves (892 individuals), while the lowest abundance was observed on the lower leaves (476 individuals) (Figure 2).

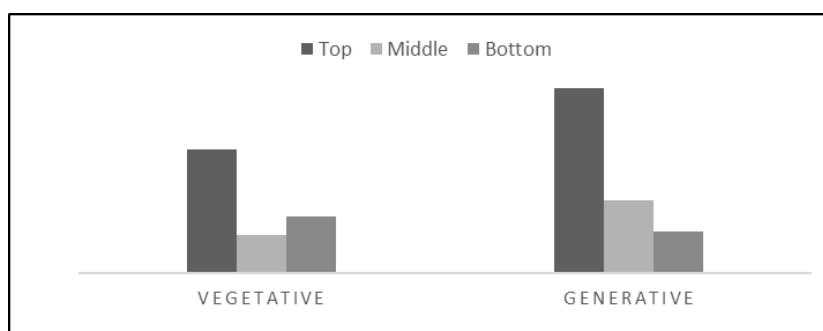


Figure 2 The number of aphids on different plant parts

In Figure 2, it is evident that aphids are more commonly found on the upper part of the plant. This occurrence can be attributed to the fact that the leaves at the top (shoots) typically have better nutrition and softer tissues. Aphids tend to favor young leaves and shoots of plants, as these parts offer optimal nutrition. Conversely, as plants age, the quality of their nutritional content decreases due to physiological changes [14] [12] [15] [16]. Additionally, older cucumber plants produce secondary metabolites [17].

The results of environmental factor measurements, including temperature, air humidity, and light intensity, conducted during observations, are presented in Figure 3.

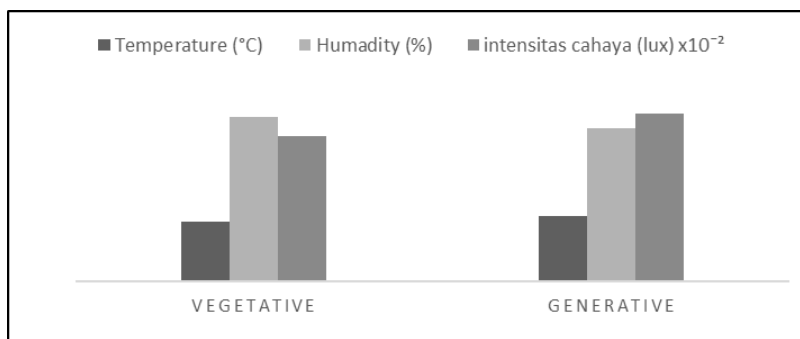


Figure 3 Graph depicting environmental parameters during the vegetative and generative phases of cucumber plants

Measurements of environmental factors during the vegetative growth phase yielded an average temperature of 27.55°C, whereas during the generative growth phase, the average temperature was 30.18°C. The optimal temperature range for aphid survival and reproduction is 21-27°C. Insects exhibit specific temperature preferences, with higher temperatures leading to increased insect mortality rates [18] [19].

The average humidity during the vegetative phase was 76%, compared to 71% during the generative phase. The ideal humidity range for aphid development is 73-100%. Optimal humidity levels promote aphid population growth, with insect survival rates typically peaking at humidity levels within the range of 73-100% [20] [21]. Adequate water availability enhances insect survival, although excessive or insufficient water can adversely affect pest populations [22] [23].

Light intensity also influences aphid abundance. The average light intensity measured during the vegetative phase was 67.32 (x) lux, while during the generative phase, it was 77.67 (x) lux. Light intensity significantly impacts insect activity, with an optimal light intensity range being neither too high nor too low for insects [24] [13] [25].

4. Conclusion

Based on the results of the research conducted, the following conclusions can be drawn:

- The highest abundance of aphids during the vegetative growth phase of cucumber occurred three weeks after planting (696 individuals), with the lowest abundance observed one week after planting (42 individuals).
- The highest abundance of aphids during the generative growth phase occurred five weeks after planting (798 individuals), while the lowest abundance was recorded ten weeks after planting (36 individuals).

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Author's contributions

The research involved preparation, implementation, data collection, analysis, paper editing (AJ), field research execution and data collection (PT), paper editing (M), and paper editing (UY) and (MN).

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