Factors affecting colonization and abundance of *Aphis gossypii* GLOVER (Hemiptera: Aphididae) on okra plantations

Germano Leão Demolin Leite¹; Marcelo Picanço²; Vinicius Matheus Cerqueira¹; Leandro Bacci²; Marcelo Fialho de Moura²; Cândido Alves da Costa¹

¹NCA/UFMG; Montes Claros, MG, 39404-006, CP: 135; E-mail: gldleite@ufmg.br. Corresponding author; ²Universidade Federal de Viçosa (UFV); Viçosa, MG, 36571-000; E-mail: picanco@mail.ufv.br.

**ABSTRACT**

The objective of this study was to determine the effects of predators and parasitoids, height of canopy, plant age, leaf areas, organic compounds leaves, levels of leaf nitrogen and potassium, density of leaf trichomes, total rainfall and median temperature on attack intensity of *A. gossypii* on two successive *A. esculentus* var. Santa Cruz plantations. Monthly number estimates of *A. gossypii* and natural enemies occurred on bottom, middle and apical parts of 30 plants/plantation (one leaf/plant). Plants senescence, leaf areas and natural enemies, mainly *Adialytus* spp., spiders and Coccinellidae, were some of the factors that most contributed to aphid reduction.

**Keywords:** *Abelmoschus esculentus*, aphid, natural enemies, leaf area, nitrogen.

**INTRODUCTION**

The aphid *A. gossypii* Glover has been controlled primarily with insecticides mainly due to a lack of knowledge on factors affecting its population growth. Such information could be used in predicting attack of this pest which in turn could reduce economic losses to okra plants (DENT, 1995).
Several factors can influence the occurrence of aphid populations and the fertilization is the most important one. The aim of the present investigation was to evaluate the effects of predators, parasitoids, leaf organic compounds, levels of N and K, leaf trichome density, canopy height, plant age, leaf areas, rainfall and temperature on attack intensity of *A. gossypii* on successive okra plantations under field conditions.

**MATERIAL AND METHODS**

This experiment was carried out in two okra plantations of *A. esculentus* var. Santa Cruz from Guidoval, Minas Gerais, Brazil the plants were not sprayed with insecticides. The two okra plantations were 50 m apart, each plantation comprised 3.6 ha with 10,000 plants 0.30 m apart on the row, 1.2 m between rows. The 10 peripheral rows and 40 plants on each end of the row were not considered, leaving a useful area of 2.7 ha, i.e. 30 rows, 176 m long. The first, the 16-day-old plantation, was evaluated from March 1st to June 30th 1999 and the second, the 50-day-old plantation, was evaluated from July 1st to November 30th 1999. After the final evaluation, the first plantation was eliminated. These plantations were far from other vegetable crops, at least 1.000 m.

Monthly number estimates of *A. gossypii* (adults + nymphs), predators (adults + larvae) and parasitoids (adults), both leaf surfaces (adaxial and abaxial), were obtained by visual inspections on the bottom, middle and apical parts of 30 plants/plantation (one leaf/plant part). The first expanded leaf/apex of the plant they are collected the arthropods and placed individually in glass flasks, containing 70% ethanol for identification.

One apical leaflet from each part of the canopy of nine plants/plantation was collected, monthly. The number of adaxial and abaxial trichome was counted under a light microscope on the apical leaflet's median part. The trichomes were classified as glandular or non-glandular. Leaf areas were determined on the bottom, middle and apical parts of 45 plants (one leaf/plant) using a leaf area meter LI-COR model LI-3000 (Lincoln, Nebraska, USA).

One expanded leaf from the apex of 15 plants/plantation was monthly collected and taken to the laboratory for N and K determination. Potassium was determined with a Flame Photometer (Coleman, Model 22) and nitrogen analyzed by Nessler method (JACKSON, 1958). Three replications, consisting of five leaves in each evaluation, were made for each collection of two plantations.

For gas chromatography/mass spectrometry (GC/MS) analysis, fully expanded apical leaves of 15 plants/plantation were sampled monthly, placed in plastic bags, sealed, and transported to the laboratory. One evaluation was made for each collection of two
plantations. The hexane extracts were analyzed by an autosampler Shimadzu, Model QP 5000. The split ratio was five, with He as the carrier gas. All analyses were carried out on a fused capillary column of 30 m/0.25 mm and film thickness of 0.25 µm. The ionization voltage was 70 eV and the mass spectrometer scanned between 40 – 550 amu. The compounds were identified using the mass spectral database and only compounds with a similarity index greater than 83% were considered as positive identifications.

Guidoval’s climatic data, total rainfall and median temperature, were read daily from a pluviometer and thermometer, installed in the field. Canopy height effects on predators, parasitoids, trichome densities, leaf areas, and A. gossypii were verified by variance analyses and the Tukey’s multiple range test (P ≤ 0.05). Regression analyses (P ≤ 0.05) were used to evaluate the relationships of predators, parasitoids, organic compounds in the leaves, leaf N and K levels, leaf trichome density, plant age, rainfall and temperature with the A. gossypii number on okra plants.

RESULTS AND DISCUSSION

The aphid A. gossypii presented higher number of apterous and winged individuals during the months of May (first plantation) and September (second plantation) on okra plants. A lower aphid attack was observed in the second (35.0/leaf) okra plantation, planted 50 m apart from the first (485.0/leaf). Population increase of apterous aphids caused the appearance of winged individuals of this species for dispersal. Higher number of apterous forms of this insect was observed on leaves with larger areas, which were located in medium (462.96 ± 173.32 AB), bottom (577.52 ± 149.98 A) and apical (68.48 ± 19.27 B) parts of the plant canopy. Lower populations were recorded after leaves were colonized and winged forms of this insect for dispersal were observed.

Adialytus spp. which are aphid parasitoids, presented population peaks in June and October whereas the ladybird beetles and Scymnus sp. had higher populations in April and October and the spiders Cheiracanthium inclusum, Dictyna sp., Eustala sp., Lyssomanes sp., Misumenops spp. and Theridiidae in June and October. At the beginning of the first and second plantations, number of natural enemies (initial colonization phase) was reduced. Adialytus spp. attacked more than 55% of A. gossypii in the last plantation. Significant relationships (P < 0.05) with densities of Adialytus spp. (y = 0.22 + 0.004x; R² = 0.83), spiders (y = 0.02 + 0.001x - 6.35*10⁻⁷x²; R² = 0.67) and ladybird beetles (y = 0.11 + 0.01x; R² = 0.51) were registered for aphids. No correlation (P > 0.05) was found between
Syrphus sp. (0.01 ± 0.01/leaf) and Chrysoperla sp. (0.15 ± 0.13/leaf) and aphid populations.

A higher number of apterous/leaf and mummified aphids and percentage) were recorded on the bottom part (163.60 ± 68.23 A/leaf and 27.41 ± 4.26 A%) of the plant canopy, compared to the medium (103.64 ± 41.84 AB/leaf and 22.05 ± 3.68 AB%) and apical (10.22 ± 3.57 B/leaf and 13.47 ± 3.11 B%) parts. Higher leaf areas were observed in the medium part (300.89 ± 26.32 A) than in the bottom (226.69 ± 14.53 B) and apical (140.39 ± 9.99 C) parts of Abelmoschus esculentus. Higher density of non-glandular trichomes/mm² (100% of trichomes) was observed in the apical part (0.21 ± 0.06 A) than in the medium (0.09 ± 0.02 B) and bottom parts (0.10 ± 0.05 B) of Abelmoschus esculentus, and in the Abaxial (0.30 ± 0.04 A) than in the Adaxial (0.08 ± 0.01 B) leaf surface.

No significant effects (P > 0.05) of plant age, trichome density, leaf organic compounds, leaf N and K levels, total rainfall and median temperature on aphid population were observed. A significant correlation (P < 0.05) between trichome density (y = 0.35 - 0.002x; \(R^2 = 0.87\)) and leaf K levels (y = 4.07 - 0.02x; \(R^2 = 0.53\)) was observed as plant age increased. The lower aphid attack was observed in the second okra plantation, planted 50 m apart from the first, probably due to the fact that part of the Adialytus spp. (20.8 and 11.9 percentage of aphids mummies/leaf, respectively) population migrated from the first plantation, as well as other natural enemies, increasing proportion natural enemies/aphids in the second okra plantation. Another possibility is that the plants were older (50 days old) and, thus less suitable for this aphids. At the beginning of the first and second plantations, number of natural enemies (initial colonization phase) was reduced, indicating that these arthropods were latent in nearby areas until okra plants infested with aphids appeared. The effects of leaf N and K levels in okra an aphid population were not detected due to the small variation of these nutrients in the leaves during the experimental period.

Aphid population in okra is affected by crop senescence, plant canopy, leaf areas and natural enemies. Aphis gossypii can be a harmful pest in okra producing regions of lower total rainfall. Apparently, non-glandular trichomes or their low density, organic compounds in the leaves and levels of N and K are not correlated with aphid population.

REFERENCES

DENT, D. R. Integrated pest management. London: Chapman and Hall. 1995. 356p.

JACKSON, M.L. Soil chemical analysis. Prentice Hall, New Jersey, 498p. 1958.