

## NOTAS CIENTÍFICAS

### Effects of leaf compounds, climate and natural enemies on the incidence of thrips in cassava<sup>(1)</sup>

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Abstract – The objective of this study was to determine the effects of rainfall, temperature, sunlight and relative humidity, as well as predators and parasitoids, leaf chemical composition and levels of leaf nitrogen and potassium on the intensity of *Scirtothrips manihoti* (Thysanoptera: Thripidae) attack on cassava *Manihot esculenta* Crantz var. Cacau. The leaf compounds (*E*)-farnesene/trans-farnesol and D-friedoolean-14-en-3-one correlated significantly with the population of *S. manihoti*. Insect population decreased in the dry and cold season probably due to leaf senescence. Significant correlation was observed between Syrphidae with *S. manihoti* populations.

Index terms: *Manihot esculenta*, *Scirtothrips manihoti*, environmental factors, population dynamic, pest control.

#### Efeito de compostos foliares, clima e inimigos naturais na incidência de tripses em mandioca

Resumo – O objetivo deste estudo foi determinar os efeitos de pluviosidade, temperatura, insolação, umidade relativa, predadores, parasitóides, compostos químicos foliares e níveis de nitrogênio e de potássio foliares na intensidade de ataque de *Scirtothrips manihoti* (Thysanoptera: Thripidae) em mandioca *Manihot esculenta* Crantz var. Cacau. Os compostos foliares (*E*)-farneseno/trans-farnesol e D-friedoolean-14-en-3-ona correlacionaram significativamente com a população de *S. manihoti*. A população de insetos decresceu na estação seca e fria provavelmente em decorrência da senescência das folhas. Foi observada correlação significativa entre a população de Syrphidae e de *S. manihoti*.

Termos para indexação: *Manihot esculenta*, *Scirtothrips manihoti*, fatores ambientais, dinâmica de população, controle de pragas.

Cassava (*Manihot esculenta* Crantz) (Euphorbiaceae) is the world's fourth consumed food as a carbohydrate source (Bellotti et al., 1999).

In Brazil, the region which most produces cassava is the Northeast, with an average yield of about 10 ton/ha (50% of the national production) (Bellotti et al., 1999). Cassava is generally produced by small farmers in semi-arid

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regions which have poor distribution of rain and poor soils. Those adverse conditions along with high pest and disease incidence reduce its production potential, 21.3 ton/ha according to Bellotti et al. (1999).

The thrips *Scirtothrips manihoti* (Bondar) (Thysanoptera: Thripidae) is one of the cassava pests in Brazil (Conceição, 1986; Gallo et al., 1988) and causes small chlorosis spots along the leaves. It also attacks seedlings, deforming leaves and can cause death and plant dwarfing (Gallo et al., 1988).

Many factors can influence thrips attack on cassava. Low losses due to insect attack have been reported in regions with high pluviometric rate (Montagnini & Jordan, 1983). Nutritional imbalance can affect the degree of insect attack; excess of N and K deficiency can lead to higher accumulation of amino acids, which in turn can cause higher attack by sucking insects (Marschner, 1995). Compounds present in cassava, such as hydrogen cyanide (HCN) and laticifers, work as chemical barriers to arthropods that have not coevolved with host (Bellotti et al., 1999). Natural enemies play also an important role in pest control (Dent, 1995).

The objective of this study was to evaluate the effects of predators and parasitoids, rainfall, temperature, relative humidity and sunlight, leaf chemical composition and levels of N and K on the intensity of thrips attack on cassava.

The experiment was conducted in a commercial plantation of cassava *Manihoti esculenta* var. Cacao (variety without trichomes), from February to December 1999, in Viçosa, Minas Gerais State, Brazil. Plants were not sprayed with pesticides. The space between plants was 1.00x0.60 m, and the total cultivated area was 5,000 m<sup>2</sup>. The first eight peripheral rows and the 15 plants on each side of the row formed the outer border, while the remaining plantation was considered to be the useful area. Chemical and entomological evaluations were conducted six months after sowing no evaluations were made in September, since there were no leaves on the plants, probably due to the dry season.

The beating tray method (Stansly, 1995) was used weekly to estimate the number of thrips, predators and parasitoids present in the first fully expanded leaf from the apex of each ten plants. This method works by beating the first expanded leaf in a 34x26x5 cm white tray and counting the insects fallen in it. Insects lodged into the tray were removed using an aspirator or tweezers and were held individually in 8x2 cm glass flasks, containing 70% ethanol for late identification.

First fully expanded leaf from the apex of 20 cassava plants were used for hexane extract. Leaves were collected monthly, placed into plastic bags, sealed and transported to the laboratory. Fresh leaves (10 g) were cut with scissors and immersed in 100 mL of bidistilled hexane for 24 hours. The hexane extract was then dehydrated with anhydrous Na<sub>2</sub>SO<sub>4</sub>, evaporated to dryness at 30°C in a rotatory evaporator, sealed in nitrogen and stored in a freezer (-15°C) until analysis. Separated evaluation was made for each monthly blended sample.

The hexane extracts were analyzed in a gas chromatography/mass spectrometry (GC/MS) (Shimadzu, Model QP 5000) with an auto sampler and

a computer-based system to accumulate data, and a mass spectra database (John Wiley) with 160,000 compounds. Gas chromatograph were runned with initial temperature at 33°C, running up to 80°C at a 20°C/minute heating rate and finally to 250°C at 5°C/minute. The injector and transfer line temperatures were 180 and 250°C, respectively. The split ratio was five with Helium as the carrier gas. All analyses were carried out in a DB 1 fused capillary column (J & W Scientific, USA, 30x0.25 mm and film thickness of 0.25 µm). The mass spectrometer was scanned between 40 and 550 atomic mass unit (amu) and the minimum area utilized for peak integration was 390,000 ions/second. The retention times (rt) for the peaks with total ion current (TIC) higher than  $3.9 \times 10^5$  ions/second were recorded and the compounds identified, using the mass spectral database. Only compounds with a similarity index greater than 71% were considered.

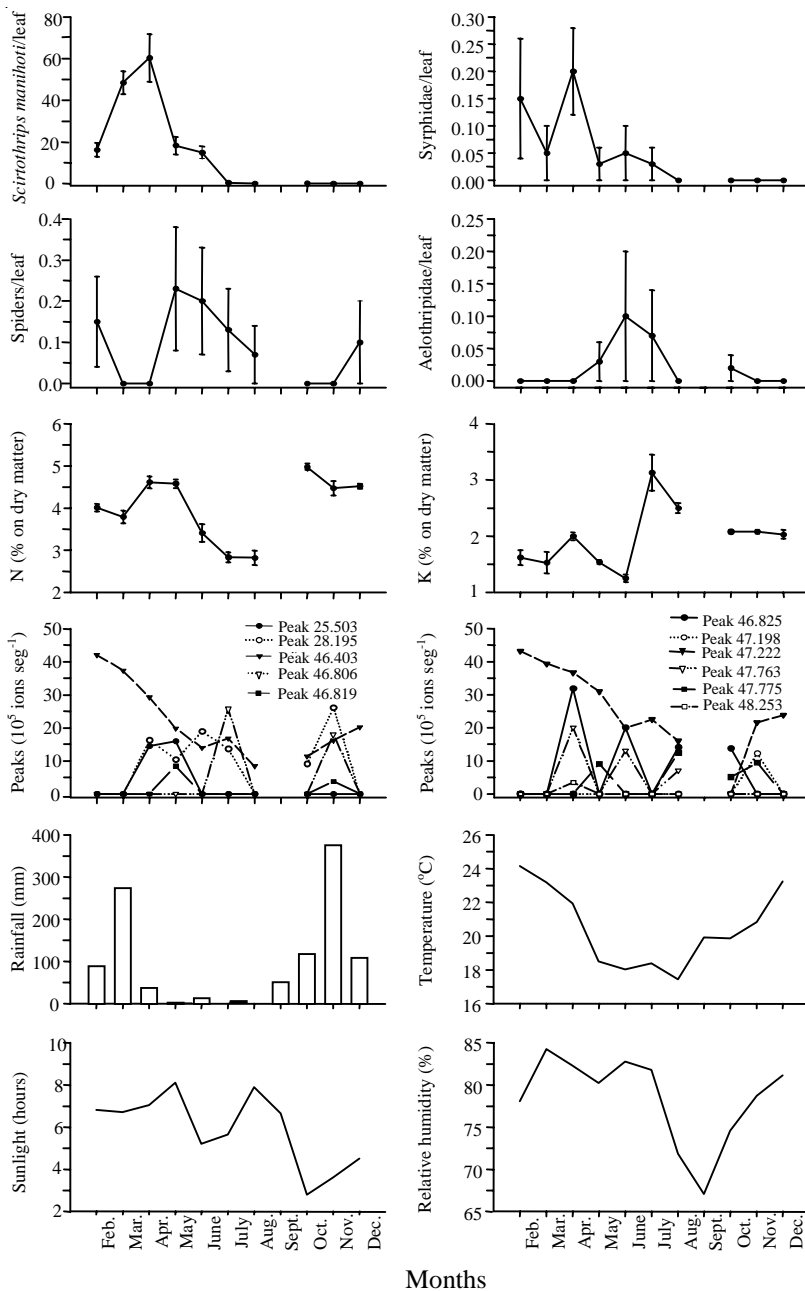
To determine the levels of N and K on leaves, the first fully expanded leaf from the apex of each 20 plants were collected monthly and taken to the laboratory. The leaves were placed in Kraft paper bags, dried in a forced air circulation oven at 67°C for three days and then ground in a Willey mill (20 mesh). The K content was determined with Flame Photometer (Coleman, Model 22) while the N content was analyzed by the Nessler method. Three evaluations were made for each monthly blended sample.

The climatic data (median temperature, sunlight, total rainfall and relative humidity) were collected daily during the experimental period at the “Estação Meteorológica Principal” (INMET/5°DISME/UFV). All data were submitted to regression analysis ( $P < 0.05$ ).

The population of *S. manihoti* peaked in April, decreasing until August, and a small population of this insect was observed on the leaves from October to December (Figure 1). No significant effects ( $P > 0.05$ ) of leaf N and K, rainfall, sunlight, air temperatures and relative humidity were observed on the *S. manihoti* population. Out of the eleven organic compounds detected on GC/MS analysis of leaf hexane (Table 1), only the (*E*)-farnesene/trans-farnesol ( $y = -3.25 - 0.07x + 0.03x^2$ ;  $R^2 = 0.49$ ) and D-friedoolean-14-en-3-one ( $y = -11.31 + 1.27x$ ;  $R^2 = 0.42$ ) affected *S. manihoti* population, with the temperature influencing the D-friedoolean-14-en-3-one ( $y = -54.49 + 3.70x$ ;  $R^2 = 0.67$ ). Burden & Norris (1994), studying the effect of climatic variation on the biosynthesis of allelochemicals, concluded that such variations resulted in the synthesis of iodoacetic acid which influenced the host capacity of plants towards insects.

A decrease in thrips population was most likely due to leaf senescence associated with dry season and cold and/or attack of this insect, which in turn was associated with the compounds (*E*)-farnesene/trans-farnesol and D-friedoolean-14-en-3-one. Thus, apparently, the availability of adequate feed was the most important factor to regulate thrips population. No direct effects of climatic factors were observed on *S. manihoti* population. According to Montagnini & Jordan (1983), regions with high pluviometric rates did not present major problems with insects attack. On the other hand, Embrater (1982) has reported high cassava insect population during the rainy period when plants are more vigorous.

The parasitoids observed were *Encarsia* sp. (Hymenoptera: Aphelinidae)



**Figure 1.** Fluctuations of *Scirtothrips manihoti*, Syrphidae, spiders and Aelothripidae populations per leaf, leaf N and K levels (% on dry matter), intensities of eleven peaks obtained on gas chromatography/mass spectrometry analysis of hexane extract of cassava leaves, and distribution of rainfall (mm), temperature ( $^{\circ}C$ ), sunlight (hours) and relative humidity (%) during the experimental period. The symbols represent the average of 40 leaves for arthropods, three for N and K, and one evaluation for the peaks, and the vertical bars indicate mean standard errors.

**Table 1.** Identification of the leaf compounds in the hexane extract of cassava based on the mass spectral database.

Retention time (minutes)	Compound identified by the mass spectral database	Similarity index (SI)
25.503	Hexadecanoic acid or palmitic acid	86
28.195	11,14,17 eicosatrienoic acid methyl ester	82
46.403	D-friedoolean-14-en-3-one	83
46.806	<sup>(1)</sup>	-
46.819	(+)-aromadendrene	79
46.825	Globulol, veridiflorol or viridiflorol	79
47.198	<sup>(1)</sup>	-
47.222	(E)-farnesene, trans-farnesol	78
47.763	Olean-12-ene	71
47.775	Vellerdiol	75
48.253	Trans-caryophyllene	78

<sup>(1)</sup>Peaks were identified although similarity indices were very low.

(0.02/leaf), Mymaridae (Hymenoptera) (0.01/leaf) and Pteromalidae (Hymenoptera) (0.03/leaf), although they are not thrips parasites. Predators observed included Aelothripidae (Thysanoptera) (0.02/leaf), Araneidae (0.07/leaf) and Syrphidae (Diptera) (0.04/leaf). A reduction in the populations of Syrphidae and spiders was observed from April to August and from May to August, respectively, and their presence was again observed in October (Figure 1). Aelothripidae population peaked in June and in October (Figure 1). Significant correlation was observed between Syrphidae and *S. manihoti* populations ( $y = 0.01 + 0.002x$ ;  $R^2 = 0.57$ ). The spiders, were similarly associated to Syrphidae and Aelothripidae, and to *S. manihoti* population, indicating a populational dependence on their catches. However, their densities were low and did not affect *S. manihoti* population. Yee et al. (2001) observed that phytoseiid mites and spiders were the most abundant predators of *Scirtothrips perseae* Nakahara in avocado orchards in Southern California, USA.

Parasitoids of the family Eulophidae (Hymenoptera) and predators of the family Anthocoridae (Heteroptera) have been considered the most important natural enemies of thrips (Venzon et al., 1999; Funderburk et al., 2000; Tagashira & Hirose, 2001), however, these insects were not observed in this work.

## References

- BELLOTTI, A. C.; SMITH, L.; LAPOINTE, S. L. Recent advances in cassava pest management. **Annual Review of Entomology**, Palo Alto, v. 44, p. 371-396, 1999.
- BURDEN, B. J.; NORRIS, D. M. *Glycine max* signaling of environmental stress: dynamics of inducible aromatic allelochemistry. **Journal of Chemical Ecology**, New York, v. 20, n. 11, p. 2943-2951, 1994.
- CONCEIÇÃO, A. J. **A mandioca**. São Paulo: Nobel, 1986. 382 p.
- DENT, D. R. **Integrated pest management**. London: Chapman and Hall, 1995. 356 p.
- EMBRATER (Brasília, DF). **Descrição das pragas que atacam a mandioca (*Manihot esculenta* Crantz) e características de seus prejuízos**. Brasília, 1982. 47 p.

FUNDERBURK, J.; STAVISKY, J.; OLSON, S. Predation of *Frankliniella occidentalis* (Thysanoptera: Thripidae) in field peppers by *Orius insidiosus* (Hemiptera: Anthocoridae). **Environmental Entomology**, Hyattsville, v. 29, n. 2, p. 376-382, 2000.

GALLO, D.; NAKANO, O.; SILVEIRA NETO, S.; CARVALHO, R. P. L.; BATISTA, G. C.; BERTI FILHO, E.; PARRA, J. R. P.; ZUCCHI, R. A.; ALVES, S. B.; VENDRAMIM, J. D. **Manual de entomologia agrícola**. São Paulo: Agronômica Ceres, 1988. 649 p.

MARSCHNER, H. **Mineral nutrition of higher plants**. London: Academic, 1995. 889 p.

MONTAGNINI, F.; JORDAN, C. F. The role of insects in the productivity decline of cassava (*Manihot esculenta* Crantz) on a slash and burn site in the Amazon territory of Venezuela. **Agriculture, Ecosystems and Environment**, College Park, v. 9, n. 3, p. 293-301, 1983.

STANSLEY, P. A. Seasonal abundance of silverleaf whitefly in Southwest Florida vegetable fields. **Proceedings of the Florida State Horticultural Society**, Deland, v. 108, p. 234-242, 1995.

TAGASHIRA, E.; HIROSE, Y. Development and reproduction of *Ceranisus menes* (Hymenoptera: Eulophidae), a larval parasitoid of thrips: effects of two host species, *Frankliniella intonsa* and *Thrips palmi* (Thysanoptera: Thripidae). **Applied Entomology and Zoology**, Tokyo, v. 36, n. 2, p. 237-241, 2001.

VENZON, M.; JANSSEN, A.; SABELIS, M. W. Attraction of a generalist predator towards herbivore-infested plants. **Entomologia Experimentalis et Applicata**, Dordrecht, v. 93, n. 3, p. 305-314, 1999.

YEE, W. L.; PHILLIPS, P. A.; RODGERS, J. L.; FABER, B. A. Phenology of arthropod pests and associated natural predators on avocado leaves, fruit, and in leaf litter in Southern California. **Environmental Entomology**, Lanham, v. 30, n. 5, p. 892-898, 2001.