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RESEARCH

HOSTING CAPACITY OF HORTICULTURAL PLANTS FOR INSECT PESTS IN BRAZIL

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Factors such as fertilization, allelochemicals, trichomes, weather, and natural enemies can influence pest populations. Thus, it is necessary to understand the factors that predispose vegetable species to pests and the role of polyculture, crop rotation, and neighboring plants. The objective of this research was to study the hosting capacity for pests of *Abelmoschus esculentus* (L.), *Brassica oleracea* L. vars. *acephala* and *capitata*, *Capsicum annuum* L., *Cucurbita moschata* (Duchesne), *Cucurbita maxima* Duchesne and *Cucumis sativus* L., *Lycopersicon esculentum* Mill., *Solanum gilo* Raddi and *Solanum melongena* L., and *Phaseolus vulgaris* L. The higher density of *Bemisia tabaci* (Genn.) adults on *C. sativus* can be due to the higher amount of pentacosane and octacosane in this plant. The occurrence of *Brevicoryne brassicae* (L.) only in *Brassica* spp. can be accounted for by the nonacosane of these plants. The low trichome density and greater palmitic acid level can explain the greatest damage by *Aphis gossypii* Glover in *A. esculentum*. *Empoasca* sp. was more frequent in *P. vulgaris* followed by *A. esculentum*, which are plants with lower K content. *Solanum melongena* was attacked more by *Hydrangea similis* (Walker) and *Epitrix* sp. perhaps because of higher palmitic acid and 11,14,17-eicosatrienoic methyl ester concentrations in their leaves. *Frankliniella* sp. exhibited more damage in *C. sativus* probably owing to higher pentacosane and octacosane in its leaves. *Sistena* sp. was more frequent in *C. maxima* and had higher octadecane levels and trichome density. The presence of ∞-humulene and hexacosane can explain the damage by *Tuta absoluta* (Meyrick) on *L. esculentum*.

Key words: Trichomes, allelochemicals, nitrogen, potassium, insects.

Cultivated plants are attacked by insect pests in the absence of culture rotation with non-host plants, use of insecticides, and chemical fertilizers especially in monocultures. This facilitates the attack of insect pests and reduces natural biological control to make larger amounts of nutrients available for these plants (Gallo *et al*., 2002; Altieri *et al*., 2003).

Factors such as fertilization (Slosser *et al*., 2004; Chau *et al*., 2005), allelochemicals, trichomes, weather, and natural enemies can influence pest populations (Sechser *et al*., 2002; Men *et al*., 2004; Rhainds and Messing, 2005; Satar *et al*., 2005). An N excess or K deficiency can lead to higher accumulations of amino acids which in turn can cause higher attack rates by sucking insects (Jansson and Ekbom, 2002). The high nonacosane level can regulate aphid populations on kale given its high level in this vegetable. The general hypothesis is that wax rarely detains herbivore attack and commonly stimulates it (Woodhead and Chapman, 1986; Leite *et al*., 2005c). Trichomes can affect insect locomotion, feeding, and reproduction both positively and negatively, depending on the type of trichome, plant, and insect involved (Gallo *et al*., 2002). High rainfall is an important mortality factor for some insects in the field (Rhainds and Messing, 2005), as well as natural enemies such as parasitoids of the Braconidae family (Rhainds and Messing, 2005), spiders, ladybird beetles (Men *et al*., 2004), and aphid Syrphidae larva (Sechser *et al*., 2002).

It is therefore necessary to understand the factors that predispose horticultural species to pests and the role of polyculture, crop rotation, and neighboring plants (Brunner *et al*., 2004).

Leaf N and K levels, allelochemicals, trichomes (type and density), natural enemy and pest populations, and weather effect on the main vegetables cultivated in Brazil, such as *Abelmoschus esculentus* (L.) Moench (Malvaceae), *Brassica oleracea* L. vars. *acephala* and *capitata* (Brassicaceae), *Capsicum annuum* L. (Solanaceae), *Cucurbita moschata* (Duchesne), *C. maxima* Duchesne and *Cucumis sativus* L. (Cucurbitaceae), *Lycopersicon esculentum* Mill., *Solanum gilo* Raddi and *S. melongena* L. (Solanaceae), and *Phaseolus vulgaris* L. (Fabaceae), have been studied (Leite *et al*., 2001a; 2001b; 2002a; 2002b; 2002c; 2003; 2005a; 2005b; 2005c; 2006a; 2011) with the objective of comparing host capacity of those plants for insect pests, the relationships of these pests with their morphologic, nutritional, and chemical features,

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their natural enemies, and weather conditions in order to propose crop rotation and management procedures of neighboring plants to reduce insect damage.

MATERIALS AND METHODS

Four okra crops (*A. esculentus* (L.) var. Santa Cruz), kale (*B. oleracea* (L.) var. *acephala* genotype Talo roxo), cabbage (*B. oleracea* (L.) var. *capitata* var. Saturno), sweet pepper (*C. annuum* L. var. Myr-10), pumpkin (*C. moschata* (Duchesne) var. Menina brasileira), winter squash (*C. maxima* Duchesne var. IAC-100), cucumber (*C. sativus* L. var. Joia Agroceres), tomato (*L. esculentum* Mill. var. Santa Clara), gilo (*S. gilo* Raddi var. Gigante português), eggplant (*S. melongena* L. var. Natu Nobilis), and common bean (*P. vulgaris* L. var. Nekito) were studied in the municipalities of Viçosa (20°44'38.7" S, 42°49'18.7" W, 649 m a.s.l.) (two crops) and Guidoval (21°08'36" S, 42°47'54" W, 239 m a.s.l.) (two crops), Minas Gerais, Brazil from October 1998 to December 1999.

The design was completely randomized with four replicates (crops). The four outermost rows in every plot and the first 15 plants on each side of the rows formed the surrounding border, and data were collected on plants in the center of each plot. Fertilization, agronomic practices, spacing between plants and rows have been described for these plants (Filgueira, 2000); moreover, no insecticides were sprayed.

Pests and predators were counted monthly in the municipality of Guidoval and weekly in the municipality of Viçosa. Insects were counted visually on one expanded leaf from each of three canopy strata, i.e., bottom, medium, and apical (0 to 33, 33 to 66, and 66 to 100% of total plant height, respectively) of 10 plants per crop (three leaves per plant) (Horowitz, 1993). The number of adult parasitoids was estimated with the beating tray method on one leaf from each of 10 plants per plantation (Miranda *et al*., 1998) on a monthly basis in Guidoval and weekly in Viçosa. This method consisted of beating and counting the insects in the first fully expanded leaf in a 34 × 26 × 5 cm white tray. The insects dislodged onto the tray were collected with an aspirator or tweezers and individualized in 8 × 2 cm vials with 70% ethanol.

Trichome density was determined on one expanded leaf from the apical, medium, and bottom canopy strata of 10 plants per crop (three leaves per plant), which were collected monthly in Guidoval and Viçosa, prepared on slides, and the trichome assessed (Leite *et al*., 2001a; 2001b; 2002a; 2002b; 2002c; 2003; 2005a; 2005b; 2005c; 2006a; 2011). Leaf N and K levels were determined monthly in the laboratory from one expanded leaf of the upper parts of 10 plants per crop in both municipalities. These leaves were dried and ground, K was determined with a flame photometer, and N analyzed by the Nessler method. Fully expanded apical leaves of 10 plants per crop were sampled monthly in both municipalities by gas chromatography/mass spectrometry (GC/MS) and hexane analyses were performed as in Leite *et al*. (2001a; 2001b; 2002a; 2002b; 2002c; 2003; 2005a; 2005b; 2005c; 2006a, 2011). Morphological, nutritional, and chemical analyses were made with three independent monthly evaluations for each plantation.

Guidoval weather data (rainfall and temperature) were obtained daily, and Viçosa data came from the "Estação Climatológica Principal" of the Federal University of Viçosa (UFV) (INMET/5^{0}DISME/UFV). Weather data were not normally distributed. Density of pests, natural enemies, trichomes, leaf N and K, as well as organic compound levels were subjected to ANOVA, the Scott-Knott test employing transformed data ($\sqrt{x} + 0.5$), and Spearman's correlation. The significance level was 5% in all the tests.

RESULTS

The number of *Bemisia tabaci* (Genn.) (Aleyrodidae) adults were higher in cucumber and eggplant. *Brevicoryne brassicae* (L.), found only in kale and cabbage, had larger populations on the former, whereas *Myzus persicae* (Sulzer) had a higher number of individuals on tomato, and was also found on *Solanum gilo* and sweet pepper. *Aphis gossypii* Glover was found on okra, pumpkin, winter squash, eggplant, and cucumber with higher numbers on the first plant. *Aphis crassivora* Koch (Aphididae) was found only on common bean and *Empoasca* spp. had higher populations in this crop, although it was collected on most vegetable species, except kale and winter squash. *Hydrangea similis* (Walker) (Cicadellidae) was found on eggplant, and also in lower numbers on kale, cabbage, sweet pepper, common bean, gilo, tomato, and okra (Table 1).

Four thrips species (Thysanoptera: Thripidae) were found. *Thrips palmi* Karny was found on eggplant; *Thrips tabaci* Lind. on *Brassica* spp. and with higher numbers in kale; *Caliothrips brasiliense* (Morgan), only on common bean; and *Frankliniella* sp. on cucumber, gilo, pumpkin, winter squash, sweet pepper, okra, and tomato (Table 1).

The main defoliator beetles (Coleoptera: Chrysomelidae) were *Epitrix* sp. on eggplant, pumpkin, common bean, gilo, sweet pepper, tomato, and okra; *Sistena* sp. on winter squash, and in small numbers on pumpkin, kale, cabbage, tomato, gilo, sweet pepper, and common bean (Table 1). Other Chrysomelidae included *Diabrotica speciosa* (Germ.) on pumpkin, eggplant, common bean, gilo, sweet pepper, okra, and tomato; *Colaspis* sp. on pumpkin, eggplant, common bean, gilo, cucumber, sweet pepper, and okra; *Acalina* sp. on pumpkin; *Cerotoma* sp. on eggplant, common bean, gilo, and sweet pepper; and *Epicauta* sp. (Meloidae) on eggplant and sweet pepper (Table 1).

Tuta absoluta (Meyrick) (Lepidoptera: Gelechiidae) was found on tomato and *Liryomiza* sp. (Diptera:

Table 1. Density of herbivorous insects/leaf in some crops. Municipalities of Guidoval and Viçosa, Minas Gerais, Brazil.

Insects	Pumpkin	Eggplant	Kale	Bean	Gilo	Winter squash	Cucumber	Sweet pepper	Okra	Cabbage	Tomato
Bemisia tabaci	0.42B	12.82A	0.19B	0.82B	1.91B	0.38B	19.31A	0.16B	2.23B	0.17B	8.13B
Brevicoryne brassicae	0.00B	0.00B	0.92A	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.51A	0.00B
Myzus persicae	0.00B	0.00B	0.00B	0.00B	0.29B	0.00B	0.00B	0.12B	0.00B	0.00B	1.72A
Aphis gossypii	0.06B	0.39B	0.00B	0.00B	0.00B	0.18B	0.06B	0.00B	5.55A	0.00B	0.00B
*Aphis craccivora**	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Empoasca spp.	0.01B	0.03B	0.00B	1.39A	0.04B	0.00B	0.02B	0.05B	0.39B	0.01B	0.0004B
Hortensia similis	0.00B	0.12A	0.003B	0.01B	0.01B	0.00B	0.00B	0.001B	0.01B	0.002B	0.001B
*Thrips palmi**	0.00	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thrips tabaci	0.00B	0.00B	4.82A	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	3.00A	0.00B
Frankliniella sp.	0.17C	0.001C	0.00C	0.00C	1.98B	0.46C	5.58A	0.19C	0.73C	0.00C	0.20C
Caliothrips brasiliense	0.00B	0.00B	0.00B	9.12A	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B
Epitrix sp.	0.01B	0.78A	0.00B	0.01B	0.02B	0.00B	0.00B	0.06B	0.01B	0.00B	0.0007B
Sistena sp.	0.01B	0.00B	0.002B	0.01B	0.002B	0.15A	0.00B	0.003B	0.00B	0.002B	0.0004B
*Diabrotica speciosa**	0.0042	0.0029	0.0000	0.0164	0.0075	0.0000	0.0000	0.0105	0.0088	0.0000	0.0029
Colaspis sp.*	0.0417	0.0606	0.0000	0.0143	0.0015	0.0000	0.0042	0.0024	0.0471	0.0000	0.0000
Acalina sp.*	0.0333	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cerotoma sp.*	0.0000	0.0029	0.0000	0.0071	0.0050	0.0000	0.0000	0.0048	0.0000	0.0000	0.0000
Epicauta sp.*	0.0000	0.0600	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0000	0.0000	0.0000
Liryomiza sp.*	0.0033	0.0018	0.0027	0.0020	0.0045	0.0001	0.0167	0.0000	0.0118	0.0077	0.0025
*Tuta absoluta**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41

Means in a row with the same upper case letter do not differ according to Scott-Knott test ($P < 0.05$). *Not different by ANOVA.

Agromyzidae) on most plants, except winter squash and sweet pepper (Table 1).

The most frequent parasitoids were *Adialytus* sp. (Hymenoptera: Braconidae) (aphid parasitoid) and *Encarsia* sp. (whitefly parasitoid) (Hymenoptera: Aphelinidae), found mainly on okra (Table 2). The most common predators were *Syrphus* sp. (Diptera: Syrphidae) and the *Cycloneda sanguine* (L.), *Eriops connexa* Germar, *Scymnus* sp. and *Exochomus bimaculosus* Mulsant (Coleoptera: Coccinellidae) ladybugs, found mainly on okra (Table 2). Other predators were spiders [*Architis* sp. (Pisauridae), *Cheiracanthium inclusum* (Hentz) (Miturgidae), *Dictyna* sp. (Dictynidae), *Eustala* sp. (Araneidae), *Latrodectus geometricus* (Koch) (Theridiidae), *Lyssomanes* sp. (Salticidae), *Oxyopes* sp. (Oxyopidae), *Misumenops* spp. (Thomisidae) and Anyphaenidae (Table 2)].

Trichomes of the crop plants were mostly non-glandular, except common bean (68% non-glandular) with higher densities on tomato followed by winter squash, pumpkin, common bean, gilo, eggplant, and cucumber (Table 3). The highest N levels were found in the leaves of pumpkin, gilo, and winter squash, as well as K on sweet pepper (Table 3).

Table 2 . Density of natural enemies and associated ants/leaf in some plant crops. Municipalities of Guidoval and Viçosa, Minas Gerais, Brazil.

Insects	Pumpkin	Eggplant	Kale	Bean	Gilo	Winter squash	Cucumber	Sweet pepper	Okra	Cabbage	Tomato
Adialytus sp.	0.01B	0.10B	0.13B	0.06B	0.05B	0.00B	0.03B	0.05B	0.45A	0.07B	0.01B
Encarsia sp.	0.02B	0.01B	0.00B	0.03B	0.01B	0.08B	0.08B	0.00B	0.26A	0.01B	0.01B
Trichogramma sp.*	0.0167	0.0000	0.0100	0.0057	0.0120	0.0750	0.0291	0.0229	0.0077	0.0039	0.0414
Scelionidae*	0.0040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0167	0.0033	0.0036	0.0000	0.0000
Eulophidae*	0.0040	0.0600	0.0000	0.0300	0.0000	0.0130	0.0142	0.0000	0.0082	0.0300	0.0300
Pteromalidae*	0.0180	0.0194	0.0000	0.0000	0.0220	0.0250	0.0000	0.0467	0.0000	0.0000	0.0039
Encyrtidae*	0.0000	0.0000	0.0082	0.0200	0.0000	0.0000	0.0000	0.0048	0.0000	0.0000	0.0093
Eucoilidae*	0.0140	0.0000	0.0036	0.0500	0.0000	0.0750	0.0125	0.0476	0.0000	0.0000	0.0043
Mymaridae*	0.0000	0.0000	0.0000	0.0000	0.0480	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Platygastridae*	0.0210	0.0000	0.0000	0.0000	0.0020	0.0000	0.0000	0.0033	0.0000	0.0308	0.0000
Torymidae*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0033	0.0000	0.0000	0.0000
Charipidae*	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0115	0.0000
Syrphus sp.	0.00B	0.00B	0.003B	0.002B	0.001B	0.00B	0.00B	0.00B	0.24A	0.01B	0.003B
Coccinellidae	0.03B	0.13B	0.00B	0.02B	0.02B	0.01B	0.07B	0.03B	0.35A	0.00B	0.001B
Carabidae*	0.0058	0.0217	0.0000	0.0807	0.0225	0.0000	0.0058	0.0276	0.2441	0.0039	0.0407
Aelothripidae*	0.0000	0.0059	0.0082	0.0236	0.0145	0.0000	0.0042	0.0257	0.0077	0.0085	0.0189
Orius sp.*	0.0167	0.0106	0.0018	0.0321	0.0040	0.0000	0.0117	0.0071	0.0118	0.0000	0.0014
Chrysoperla sp.*	0.0000	0.0000	0.0000	0.0000	0.0015	0.0000	0.0042	0.0048	0.0177	0.0000	0.0050
Podisus sp.*	0.0000	0.0000	0.0000	0.0000	0.0035	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Lebia sp.*	0.0042	0.0000	0.0000	0.0071	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Geocoris sp.*	0.0000	0.0118	0.0000	0.0021	0.0000	0.0000	0.0000	0.0143	0.0018	0.0000	0.0000
Spiders*	0.0725	0.1729	0.0918	0.2414	0.0700	0.1500	0.0875	0.1919	0.1765	0.0869	0.1271
Crematogaster sp.	0.28A	0.02B	0.01B	0.22A	0.03B	0.29A	0.04B	0.01B	0.20A	0.02B	0.001B

Means in a row with the same upper case letter do not differ according to Scott-Knott test ($P < 0.05$). *Not different by ANOVA.

Table 3 . Trichome density per leaf (mm^2), levels of inorganic (%) and organic (10^6 * ion * s) compounds in some crops. Guidoval and Viçosa, Minas Gerais, Brazil.

Plant characteristics	Pumpkin	Eggplant	Kale	Bean	Gilo	Winter squash	Cucumber	Sweet pepper	Okra	Cabbage	Tomato
Trichomes	8.77C	5.04D	0.00E	9.38C	7.13C	14.52B	3.05D	0.00E	0.30E	0.00E	19.08A
Nitrogen	5.14A	4.32B	4.26B	4.00B	4.74A	4.95A	4.48B	4.53B	4.49B	4.18B	4.28B
Potassium	3.62B	4.04B	4.56B	3.62B	4.05B	3.83B	3.16B	7.09A	2.58B	4.97B	4.64B
Octadecane	0.00C	0.00C	0.00C	0.00C	0.00C	0.27A	0.00C	0.10B	0.00C	0.00C	0.00C
∞-Humulene	1.08B	0.00C	0.00C	0.00C	0.00C	0.39C	0.91B	0.00C	0.00C	0.00C	1.80A
Pentacosane	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.61A	0.00B	0.00B	0.00B	0.00B
Octacosane	0.00D	0.00D	0.00D	0.00D	0.03D	0.17C	0.59A	0.31B	0.00D	0.00D	0.00D
Nonacosane	0.00C	0.38C	13.85A	0.12C	0.00C	0.09C	0.41C	0.27C	0.00C	7.57B	0.00C
Palmitic acid	0.00B	0.82A	0.00B	0.00B	0.54A	0.00B	0.00B	0.16B	0.46A	0.00B	0.81A
11,14,17- Eicosatrienoic methyl ester acid	2.84B	4.46A	0.00C	2.25B	2.99B	0.00C	0.00C	0.92C	2.98B	0.00C	0.00C
Hexacosane	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.00B	0.78A
Triacontane*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16

Means followed by the same upper case letter in the row do not differ according to Scott-Knott test (P < 0.05). *Not different by ANOVA.

Organic compounds with higher levels were ∞-humulene in tomato leaves followed by cucumber, pumpkin, and winter squash (Table 3) mainly in high rainfall periods (r = 0.19, P = 0.0240). The 11,14,17-eicosatrienoic methyl ester acid was more frequent in eggplant than in pumpkin followed by common bean, gilo, okra, and sweet pepper (Table 3), which responded positively for N levels (r = 0.16, P = 0.0467) and negatively for K levels (r = -0.21, P = 0.0155). Palmitic acid was found in eggplant, gilo, tomato, okra, and sweet pepper (Table 3) with a trend to higher levels with increases in N (r = 0.14, P = 0.0781) and K (r = 0.15, P = 0.0672). Octadecane was higher in winter squash than in sweet pepper and responded positively to N level (r = 0.21, P = 0.0157). Pentacosane was only detected in cucumber and decreased with K (r = -0.17, P = 0.0382). Hexacosane and triacontane were detected in tomato in the warmer months of the year (r = 0.19, P = 0.0327). Octacosane was found in higher amounts in cucumber followed by sweet pepper, winter squash, and gilo (Table 3), exhibited a positive correlation with N levels (r = 0.21, P = 0.0117) and a negative correlation with rainfall (r = -0.21, P = 0.0151). A large amount of nonacosane was found in kale followed by cabbage, eggplant, common bean, winter squash, cucumber, and sweet pepper (Table 3) with a trend to higher levels when K increases (r = 0.15, P = 0.0592) and temperature decreases (r = -0.19, P = 0.0286).

DISCUSSION

The highest density of *B. tabaci* on cucumber can be due to the higher pentacosane and octacosane levels that had positive correlations with this insect (r = 0.29, P = 0.0013 and r = 0.22, P = 0.0117, respectively) and were found to be among the factors that regulated *B. tabaci* density in these plants (Leite *et al*., 2006b). This suggests that these organic compounds affect *B. tabaci* density and can explain the highest host capacity of cucumber for this insect. Nutritional and morphological features, organic compound levels, and natural enemies do not explain the highest density of *B. tabaci* on eggplant because none of these characteristics are unique for these plants. The highest occurrence of *B. tabaci* in eggplant can be due to planting time because the warmer periods of the year were positively correlated with this pest in most crops (r = 0.49, P = 0.0000) as found by Leite *et al*. (2003). This agrees with the survival rate of 88.7, 60.2, 67.5, 46.4, and 45.8% of *B. argentifolii* juveniles on *S. melongena*, *L. esculentum*, *Ipomoea batatus* (L.), *C. sativus*, and *P. vulgaris*, respectively (Tsai and Wang, 1996). These authors stated that eggplant was the most adequate host for this whitefly. The lowest density of *B. tabaci* on sweet pepper can be on account of higher K levels (r = -0.26, P = 0.0033) and the absence of trichomes (r = 0.25, P = 0.0026). Trichomes could hinder *B. tabaci* location, parasitism, and predation as shown by the positive correlations between *Encarsia* sp. adults (r = 0.20; P = 0.0058) and ladybugs (r = 0.18; P = 0.0094) with this pest as reported by Simmons *et al*. (2002) and Leite *et al*. (2005a), respectively. Furthermore, the high K level can reduce the amount of accumulated amino acids, which in turn can reduce the density of sucking insects (Jansson and Ekbom, 2002).

The higher number of individuals of the *Brassica* spp. specific pest, *B. brassicae*, on kale than on cabbage can be explained by higher nonacosane levels (r = 0.62, P = 0.0000), as well as lower K levels (r = -0.25, P = 0.0045) in kale. Potassium is included in the synthesis of RNA polymerase and reduces free amino acid levels in the sap of the plant with populations of *B. brassicae* (Marschner, 1995). This agrees with the high number of *B. brassicae* on kale with a greater nonacosane level (Leite *et al*., 2005c), but not in cabbage (Leite *et al*., 2006a). The fact that the high nonacosane level can regulate the *B. brassicae* population on kale can be due to its high level in this plant. The general hypothesis is that wax rarely detains herbivore attack and commonly stimulates it (Woodhead and Chapman, 1986; Leite *et al*., 2005c). Nonacosane, the main wax component in Brassicaceae (Eigenbrode and Pillai, 1998; Leite *et al*., 2005c; 2006a) has been associated with plant resistance to water stress (Hull *et al*., 1975; Leite *et al*., 2005c), such as the negative correlation observed between nonacosane and temperature.

High *M. persicae* occurrence on tomato cannot be explained by the parameters evaluated for this plant, but it can be due to a low density of natural enemies because *Syrphus* sp. (r = 0.39, P = 0.0000) and ladybugs (r = 0.25, P = 0.0006) were positively correlated with aphids on the other crops. This agrees with low parasitism on *B. tabaci* by *Encarsia pergandiella* Howard on tomato and cucumber (Simmons *et al*., 2002). Higher tomato trichome density can hinder this plant's colonization by natural enemies, which agrees with the population increase of *M. persicae* the increase of non-glandular trichomes in *S. gilo* described by Leite *et al*. (2001a). Interaction among several species of insect pests was not observed, but there are reports of competition between *M. persicae* and *A. gossypii* with a predominance of the latter (Vehrs *et al*., 1992).

The greatest *A. gossypii* density on okra can be due to the lower trichome density of this plant (r = -0.14, P = 0.0548) that could facilitate colonization of this pest and increase the number of natural enemies. In spite of the fact that okra had the largest amount of palmitic acid, it was not correlated with *A. gossypii*. However, this acid was found in okra seed oil (28%) (Camciuc *et al*., 1998) as the major triacylglyceride fatty acid in winged forms of *Aphis fabae* Scopoli (Hemiptera: Aphididae) and was associated with flight energy requirements (Itoyama *et al*., 2000).

The presence of *A. crassivora*, a specific legume pest (Gallo *et al*., 2002), cannot be explained by any of the studied variables. However, the largest populations of this aphid can be related to lower temperatures (r = -0.34, P = 0.0000) as reported for aphid species in other plants (Walker *et al*., 1984; Nakata, 1995; Picanço *et al*., 1997; Leite *et al*., 2001b; 2002c; 2005c).

The occurrence of *Empoasca* sp. on common bean, an important pest in this crop (Gallo *et al*., 2002), and on okra, can be due to the 11,14,17-eicosatrienoic methyl ester acid in these plants (r = 0.34, P = 0.0003). Another possible explanation for the density of this pest on these two plants can be their low K levels, which had a negative correlation with *Empoasca* sp. (r = -0.25, P = 0.0051) associated with high densities of the *Crematogaster* sp. ant, which in turn had a positive correlation with *Empoasca* sp. (r = 0.25, P = 0.0003). The K level of negatively affected *Empoasca* sp., another sap-sucking pest, possibly for the same reasons discussed for the other two pests. The association between ants and sap-sucking insects is important because it acts negatively on aphid predators and parasitoids (Picanço *et al*., 1997; Delabie, 2001). This can be one of the factors that explains the low density of natural enemies that had positive correlations with *Empoasca* sp., Aelothripidae (r = 0.27, P = 0.0003), *Orius* sp. (r = 0.33, P = 0.0001), *Lebia* sp. (r = 0.15, P = 0.0218), Encyrtidae and Eulophidae (r = 0.23, P = 0.0011) on common bean and okra. The highest presence of *Empoasca* sp. during medium temperatures (r = -0.18, P = 0.0130) and lower rainfall (r = -0.19, P = 0.0115), mainly on okra, agrees with findings by Leite *et al*. (2002d) for that insect in eggplant.

The high density of *H. similis* and *Epitrix* sp. in eggplant can be due to high palmitic acid levels (r = 0.16, P = 0.0457 and r = 0.30, P = 0.0011, respectively), 11,14,17-eicosatrienoic methyl ester acid (r = 0.33, P = 0.0002 and r = 0.32, P = 0.0005, respectively), and to the low N level in the leaves (r = -0.24, P = 0.0061) of this plant. On the other hand, the great attack of *Colaspis* sp. on eggplant can be due to its high 11,14,17-eicosatrienoic methyl ester acid level (r = 0.24, P = 0.0078). *H. similis* and *Epitrix* sp. were more frequent, mainly on eggplant, during medium (r = -0.32, P = 0.0000) and hotter (r = 0.14, P = 0.0418) temperature periods, respectively (Leite *et al*., 2002d).

The presence of *T. palmi*, only on eggplant, can be due to the fact that this plant has one of the lowest K levels and trichome density that negatively affected this pest (r = -0.26, P = 0.0035 and r = -0.12, P = 0.0975, respectively).

The fact that *T. tabaci* only attacked kale, cabbage, and common bean cannot be explained by any of the studied variables. *Frankliniella* spp. is the most common thrips species in Brazil and its high occurrence in cucumber can be on account of high pentacosane (r = 0.48, P = 0.0001) and octacosane (r = 0.18, P = 0.0338) levels in its leaves and where individuals of this pest were found during periods of higher temperature (r = 0.20, P = 0.0062). A temperature decrease during the development period of thrips can increase its population (Gonçalves, 1997; Leite *et al*., 2002a; 2006a). Pentacosane and *Frankliniella schulzei* (Trybon) (Thysanoptera: Thripidae) were positively correlated in cucumber (Leite *et al*., 2005b). The Scelionidae (r = 0.30, P = 0.0001) and Eulophidae (r = 0.14, P = 0.0367) species, which are considered the most important natural enemies of thrips (Venzon *et al*., 1999; Funderburk *et al*., 2000; Tagashira and Hirose, 2001), exhibited a positive correlation with *Frankliniella* sp.

Sistena sp. was more frequent in winter squash, probably because of its high octadecane level (r = 0.64, P = 0.0001), trichome density (r = 0.18, P = 0.0223), and the presence of the *Crematogaster* sp. ant (r = 0.20, P = 0.0044) on the leaves. None of the studied variables explain *D. speciosa* damage on the plants probably because this pest is polyphagous (Gallo *et al*., 2002) adapted to diverse hosts; *D. speciosa* was detected more in periods of medium temperatures (r = -0.17, P = 0.0151). The monophagy of *T. absoluta* on tomato (Gallo *et al*., 2002) can be explained by the presence of ∞-humulene (r = 0.42, P = 0.0000) and hexacosane (r = 0.58, P = 0.0000) in this plant, which were positively correlated with this moth.

CONCLUSIONS

Some compounds seem to be important for plant selection by pests, such as pentacosane and octacosane for *B. tabaci* and *Frankliniella* sp.; nonacosane for *B. brassicae*;

octadecane for *Sistena* sp.; palmitic acid for *A. gossypii*, *H. similis,* and *Epitrix* sp.; 11,14,17 eicosatrienoic methyl ester acid for *H. similis* and *Epitrix* sp.; ∞-humulene and hexacosane for *T. absoluta*. Furthermore, the increase of plant K levels negatively affects sap-sucking pests and explains the preference for certain host plants. Trichomes are not important for the preference of host plants, but they can negatively affect natural enemies and result in a pest population increase. However, it should be emphasized that these trichomes were non-glandular.

All of the studied plants are hosts for *B. tabaci*, so they should be avoided. However, kale or cabbage can be used because *B. tabaci* had a low density on *Brassica* spp. Furthermore, the use of kale or cabbage is important because *B. brassicae* and *T. tabaci* do not attack other plants and *Brassica* spp. had low densities of these insects. Cultivating plants of different families, one Brassicae (kale or cabbage) and another in the crop rotation can reduce insect pest populations in the field.

Capacidad de alojamiento de plantas hortícolas para plagas de insectos en Brasil. Factores tales como la fertilización, aleloquímicos, tricomas, el clima y los enemigos naturales pueden influir en las poblaciones de plagas. Por lo tanto, es necesario comprender los factores que predisponen a las especies vegetales a las plagas y el papel de policultivos, rotación de cultivos y las plantas vecinas. El objetivo de este trabajo fue estudiar la capacidad hospedera de *Abelmoschus esculentus* (L.), *Brassica oleracea* L. vars. *acephala* and *capitata*, *Capsicum annuum* L., *Cucurbita moschata* (Duchesne), *Cucurbita maxima* Duchesne, *Cucumis sativus* L., *Lycopersicon esculentum* Mill., *Solanum gilo* Raddi, *Solanum melongena* L. y *Phaseolus vulgaris* L. a insectos plaga. La mayor densidad de adultos de *Bemisia tabaci* (Genn.) en *C. sativus* puede deberse al mayor contenido de pentacosano y octacosano en estas plantas. La aparición de *Brevicoryne brassicae* (L.) sólo en *Brassica* spp. puede ser debida a la nonacosano de estas plantas. La baja densidad de tricomas y mayor cantidad de ácido palmítico puede explicar el mayor daño por *Aphis gossypii* Glover en *A. esculentum*. *Empoasca* sp. fue más frecuente en *P. vulgaris*, seguido por *A. esculentum*, las plantas con menor contenido de K. *Solanum melongena* fue más atacada por *Hortensia similis* (Walter) y *Epitrix* sp., tal vez debido al aumento de las concentraciones de ácido palmítico y el éster metílico 11,14,17-eicosatrienoico en sus hojas. *Frankliniella* sp. presentan mayor daño en *C. sativus*, probablemente por el mayor contenido de pentacosano y octacosane en sus hojas. *Sistena* sp. fue más frecuente en *C. maxima* que tenían los mayores niveles de octadecano y densidad de tricomas. La presencia de ∞-humuleno y hexacosane podría explicar el daño por *Tuta absoluta* (Meyrick) en *L. esculentum*.

Palabras clave: tricomas, aleloquímicos, nitrógeno, potasio, insectos.

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