NOTAS CIENTÍFICAS

Factors affecting attack rate of whitefly on the eggplant[1]

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Abstract – The objective of this study was to determine the effects of weather, predators and parasitoids, canopy height and plant age, leaf chemical composition, levels of leaf N and K and leaf trichomes on the intensity of *Bemisia tabaci* attack on *Solanum melongena*. A higher density of nymph and whitefly adults was recorded at the base and medium of the plant compared to the apex. A higher number of eggs was observed on the medium part than on the apical and base part of the plants dossel. An increase in the density of whitefly is associated with an increase in temperature.

Index terms: *Bemisia tabaci*, *Solanum melongena*, allelochemicals, parasitoids, air temperature.

Fatores que influenciam a taxa de ataque de mosca-branca em berinjela

Resumo – O objetivo deste estudo foi determinar os efeitos de clima, predadores e parasitóides, altura de dossel e idade de plantas, composição química foliar, níveis foliares de N e de K e tricomas foliares na intensidade de ataque de *Bemisia tabaci* em *Solanum melongena*. A maior densidade de ninfas e de adultos de mosca-branca foi observada nos terços basal e mediano, comparada ao ápice da planta. O maior número de ovos foi observado no terço mediano comparado aos terços apical e basal do dossel das plantas. Um aumento na densidade de mosca-branca está associado com um aumento na temperatura.

Termos para indexação: *Bemisia tabaci*, *Solanum melongena*, aleloquímico, parasitóide, temperatura do ar.

Among the pests that attack eggplants (*Solanum melongena*) is the whitefly *Bemisia tabaci* (Genn.) (Homoptera: Aleyrodidae) (Seal, 1993). It causes severe damage to plants by feeding on sap, by secreting honeydew where black sooty mold grows, and by transmitting viral diseases (Hirano et al., 1993, 1995).

The control of this insect consists primarily of the widespread use of insecticides (Seal, 1993). Extensive use of insecticides can cause negative impacts on the human population and the ecosystem, reduce the number and

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density of natural enemies, cause development of resistance to insecticide and increase production costs (Dent, 1995). One of the main reasons for this extensive application is the lack of information on the factors which control insect population. Such information could help the prediction of the attack by insects which in turn could reduce economic losses (Dent, 1995). Many factors can influence population density of whitefly in host plants such as weather, levels of N and K, age and vigor of plants, type and density of trichomes, allelochemicals and natural enemies (Horowitz et al., 1984; Horowitz, 1986; Hirano et al., 1993, 1995; Dent, 1995; Leite, 2000).

The objective of this study was to determine the effects of weather, predators and parasitoids, canopy height and plant age, leaf chemical composition, levels of N and K and leaf trichomes on the intensity of *Bemisia tabaci* attack in *Solanum melongena*.

This experiment was carried out using five plantations of *Solanum melongena*, var. Natu Nobilis from October, 1998 to December, 1999 in Guidoval County, State of Minas Gerais, Brazil. The experimental design was entirely casualized with five replicates (each of the five plantations). The eggplant plantations had 1,000 plants spaced 1.0 m apart within rows and 1.5 m between rows. The four peripheral rows and the first ten plants on each side of the row formed the outer border while the remaining plantation was considered to be the useful area.

Trichome density was evaluated in one leaf, collected monthly, from the apical part of the canopy of 10 plants/plantation. The preparation of slides and counting of trichomes were made by Leite (2000). Level of N and K in leaves of the eggplant was determined monthly in laboratory in one expanded leaf from the upper part of each of 10 plants/replication. These leaves were dried and ground, then K was determined with flame photometer and N was analyzed by the Nessler method. The gas chromatography/mass spectrometry (GC/MS) analysis was made monthly in fully expanded leaves from the upper part of 10 plants/plantation. Fresh leaves (10 g) were cut with scissors and immersed in a 100 mL hexane for 24 hours. The hexane extract was evaporated to dryness at 30°C in a rotatory evaporator, sealed in nitrogen and stored in a freezer until analysis. The hexane extract was analyzed with GC/MS and only compounds with a similarity index higher than 83% were considered. The morphological, nutritional and chemical analysis were made with three evaluations monthly for each of the five plantations.

Direct counting was used to estimate monthly the number of whitefly (Horowitz, 1993) adults and nymphs (determined as 4th instar by visual inspector) and predators in the bottom, middle and apical parts of 30 plants/plantation (one leaf/part of plant). The beating tray method (Miranda et al., 1998) was used monthly to estimate the number of adult of *Encarsia* sp. (Hymenoptera: Aphelinidae) present in one leaf from each part of the canopy of 30 plants/plantation. Nymphal parasitism index, number of whitefly eggs and spatial distribution of the eggs in the eggplants were evaluated with 40x magnifying lens monthly. One leaf from each part of the canopy of 30 plants/plantation was collected. For each sample, six fields in the median part (field equidistant between the median vein and the margin) were analyzed.

Climatic data of Guidoval (total rainfall and temperature) were obtained by pluviometer and thermometer (minimum and maximum) installed in the field during the experimental period. Density of whitefly, natural enemies and trichomes were submitted to analysis of variance and the means were compared by the Tukey test at 5% probability level. Regression analysis ($P<0.05$) were also carried out.

The negative correlation between nymphs and adults of whitefly densities and eggplant production observed in this study ($y = 4.27 – 0.02x$, $R^2 = 0.93$* and $y = 4.33 – 0.06x$, $R^2 = 0.89$*, respectively) is in agreement with other literature report for tomato (Schuster et al., 1995; Leite, 2000). A higher nymph and whitefly/leaf adults density was recorded at the base (104.68 and 33.56, respectively) and medium (87.56 and 21.62, respectively) and were statistically different as compared to the apex of the plant (4.74 and 3.12, respectively). However, the higher number of eggs/cm^2 of whitefly observed was statistically different on the medium part (2.75) compared to the apical (0.89) and the base (0.38) part of plants dossel. *Bemisia tabaci* lays its eggs on the younger leaves, which are often found at the apical part of the plants (Liu & Stansly, 1995). The second instar nymphs apparently do not move much and since the plant continues to grow, the adults emerge on the inferior third of the tomato plant (Liu & Stansly, 1995; Leite, 2000).

A plausible explanation of the non-occurrence of oviposition preferentially on the apical leaves (5.57) may be due to the fact that these leaves have abundant trichomes/mm^2 that were statistically different compared to the medium (3.64) and the base part (3.32) of plants dossel. This fact can make locomotion, feeding and oviposition of insects difficult (Norris & Kogan, 1980). However, no effect of them was detected on whitefly on the eggplants which could be explained by the fact that they are of non-glandular types (100%). Higher density of star trichomes/mm^2 with one vertical and four to five horizontal arms was observed in the abaxial (5.92±0.27) than in the abaxial face (2.04±0.34) of eggplant leaves. No differences between faces of leaves were found for the density of long simple and non-ramified trichomes (0.25±0.06). This last type of trichome represented about 11% of the total number of them. Increasing levels of K caused a reduction in trichome density ($y = 9.06 – 1.12x$, $R^2 = 0.32$*).

Positive effect of temperature on the nymphs and adults of whiteflies was observed in this work: $y = -296.32 + 13.99x$, $R^2 = 0.41$* and $y = -81.09 + 4.07x$, $R^2 = 0.17$*, respectively. Horowitz et al. (1984) concluded that the temperature and the relative humidity were the most important factors for producing population changes of whitefly in the cotton fields in Israel. Horowitz (1986) has reported that in Sudan, after heavy rainfall, generally a sharp fall occurs in the population of *B. tabaci* in the cotton fields compared to when there is no rain. However, Hirano et al. (1993, 1995), studying dynamic population of *B. tabaci* in soybean and mung beans in Java and Indonesia, respectively, reported that the weather was not among the principal factors to regulate the populations of this insect.

Effect of natural enemies did not affect ($P>0.05$) populations of whitefly on eggplants, probably due to the low number of natural enemies in the region studied. The number of *Encarsia* sp. was 0.01±0.01/leaf and no parasite-infected whitefly nymphs were detected. Predators observed included spiders [*Architis* (Pisauridae), *Cheiracanthium inclusum* (Hentz) (Miturgidae), *Oxyopes* spp. (Oxyopidae), *Misumenops* spp. (Thomisidae) and Anyphaenidae] (0.10±0.02/leaf) and *Cycloneda sanguinea* L. and *Exochomus bimaculosus* Mulsant (Coleoptera: Coccinellidae) (0.13±0.051/leaf).

Three peaks with retention time of 25.503, 28.292 and 48.362 min were recorded for total ion current with hexane extract of *S. melongena* leaves on GC/MS analysis (Figure 1). The peak at 25.503 min (8.89±1.41x10^6 ions/sec) was identified as palmitic/hexadecanoic acid with a similarity index (SI) of 87%. The peak at 28.292 min (46.51±6.77x10^6 ions/sec) was identified as 11,14,17 eicosatrienoic methyl ester acid/myrcenol/1-tetradecen-3-yne with a SI of 83%, while the peak at 48.362 min (6.23±0.45x10^6 ions/seg) was identified as octacosane/pentacosane/nonacosane with a SI index of 93%. Higher total ion current of the peak 25.503 was observed with the increase on level of foliar N ($y = -19.26 + 6.55x$, $R^2 = 0.26^*$). However, chemical composition, N (4.32±0.12/% on dry matter) and K (4.04±0.19/% on dry matter) foliar did not affect ($P>0.05$) whitefly population.

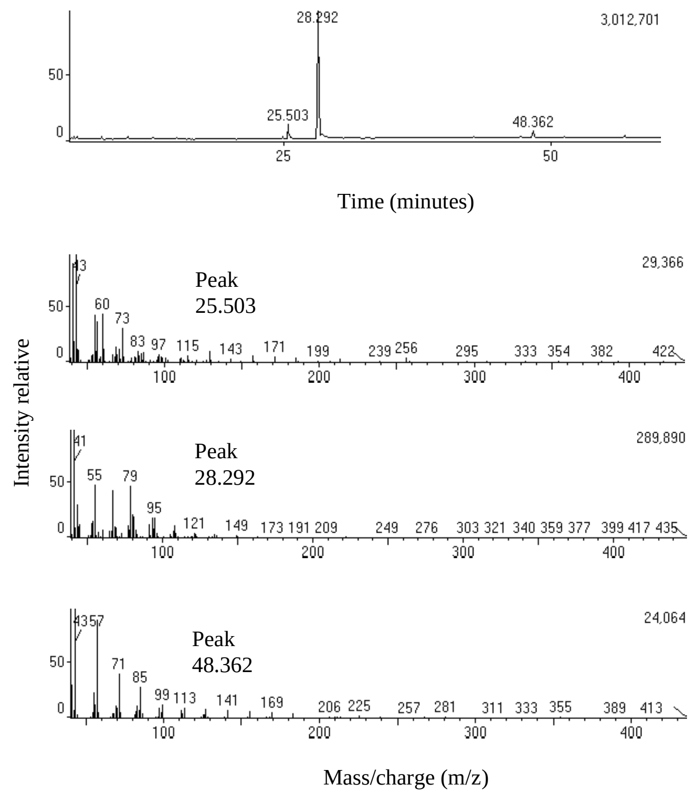

Figure 1. Total ion current of the hexane extract of *Solanum melongena* and mass spectra of peaks elating at 25.503, 28.292 and 48.362 min.The number in the upper right side of each figure was the number of ions.

The results indicate that whitefly can present high populations in eggplant plantations in regions with high temperatures. Only when whitefly reached nominal thresholds, pulverization with selective insecticides should be directed towards the leaves in the median parts of the plants and the base, since these are the regions where the whitefly attack occurs.

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