AGRICULTURAL ENTOMOLOGY / SCIENTIFIC COMMUNICATION

DOI: 10.1590/1808-1657000242017

Weeds associated with cotton crop and hosting whitefly

Plantas daninhas associadas à cultura do algodoeiro e hospedeiras de mosca-branca

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ABSTRACT: The whitefly can be hosted by weeds and cause damage to cotton crops. The objective of this work was to identify which species of weeds among the floristic compositions occurring in the cotton crop are hosts of whiteflies (*Bemisia tabaci* biotype B). Bi-weekly evaluations were performed in a cotton area (FM 975 WS) in Sinop, Mato Grosso, Brazil, during the reproductive phase of the crop. An inventory square (0.25 m side) was randomly cast 15 times between the cotton rows. The weeds were cut close to the ground, conditioned and taken to the laboratory to identify the family and species, and to quantify the eggs and nymphs of whiteflies. Eleven families were detected, with the most frequent being Amaranthaceae (16.67%), Convolvulaceae (12.5%), Rubiaceae (12.5%) and Poaceae (12.5%). The most frequent species were *Amaranthus* spp. (13.79%) and *Alternanthera tenella*, *Ipomea* spp., *Richardia brasiliensis* and *Eleusine indica*, with 10.34% each. From the 15 collected species, the presence of whitefly eggs or nymphs was only not observed in *Portulaca oleracea* and *E. indica*. The highest incidence of *B. tabaci* occurred in *Euphorbia heterophylla*. The occurrence of these species should be monitored, so that the whitefly population does not interfere in the cotton fiber quality.

KEYWORDS: infestation; crop management; Bemisia tabaci; host plants.

RESUMO: A mosca-branca pode hospedar-se em plantas daninhas e causar prejuízos ao algodoeiro. O objetivo deste trabalho foi identificar, entre a composição florística de plantas daninhas que ocorrem na cultura do algodoeiro, quais são hospedeiras da mosca-branca (*Bemisia tabaci* biótipo B). Em uma área de algodoeiro (FM 975 WS) em Sinop, Mato Grosso, Brasil, foram feitas avaliações quinzenais na fase reprodutiva da cultura. Um quadrado inventário (0,25 m de lado) foi lançado aleatoriamente 15 vezes nas entrelinhas do algodoeiro. As plantas daninhas foram cortadas rente ao solo, acondicionadas e levadas para o laboratório para identificação da família e da espécie, quantificação dos ovos e ninfas de mosca-branca. Foram detectadas 11 famílias, sendo as mais frequentes Amaranthaceae (16,67%), Convolvulaceae (12,5%), Rubiaceae (12,5%) e Poaceae (12,5%). As espécies mais frequentes foram *Amaranthus* spp. (13,79%) e *Alternanthera tenella*, *Ipomea* spp., *Richardia brasiliensis* e *Eleusine indica*, com 10,34% cada uma. Das 15 espécies coletadas, apenas em *Portulaca oleracea* e *E. indica* não foi constatada a presença de ovos ou ninfas de mosca-branca. A maior incidência de *B. tabaci* ocorreu em *Euphorbia heterophylla*. A ocorrência dessas espécies deve ser monitorada para que a população de mosca-branca não interfira na qualidade da fibra do algodoeiro.

PALAVRAS-CHAVE: infestação; manejo; *Bemisia tabaci*; plantas hospedeiras.

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Received on: 03/20/2017. Accepted on: 09/10/2018

Weeds are among the biotic factors that affect agricultural systems, affecting their productivity by reducing yield and product quality. Among the weeds that compete with the cotton plant, there are *Amaranthus* spp., *Alternanthera tenella*, *Bidens* spp., *Commelina benghalensis*, *Digitaria insularis*, *Eleusine indica*, *Ipomoea* spp., *Portulaca oleracea*, *Richardia brasiliensis*, and *Sida* spp. (CHRISTOFFOLETI et al., 2011).

According to YAMASHITA et al. (2008), controlling limiting factors such as weeds is fundamental, so that the crop can express its full productive potential. Since weeds compete for water, light and nutrients, the cotton must remain free of these plants for a good part of its cycle in order to avoid weed competition, the proliferation of pests and diseases and to guarantee the quality of the plume produced (CHRISTOFFOLETI et al., 2011). Inadequate weed management can lead to losses in income greater than 90% (RAIMONDI et al., 2014). During the cotton cycle, weeds not only compete for environmental resources (water, light and nutrients), but also alternative hosts for viruses and various pest arthropods capable of attacking this crop. *Sida rhombifolia* (arrowleaf sida) and *Scaphyglottis micrantha* (orchid) species host the virus that causes the common mosaic virus (*Abutilon* mosaic virus) transmitted by the *Bemisia tabaci* biotype B whitefly (SUASSUNA; COUTINHO, 2015).

Whitefly adults and nymphs settle on the underside of the cotton leaves to feed themselves. The insects suck large volumes of phloem sap, rich in sucrose, but they have low concentrations of essential amino acids (TERRA; FERREIRA, 2009). Amino acids are important for performing the insect's physiological processes and need to be concentrated. For this, excess water is withdrawn by the filter chamber present in its digestive system and excreted along with sugars in the form of mela, which is deposited on the cotton leaves or plume. This substance is used as a substrate for growing saprophytic fungi such as *Capnodium*, followed by the fumagine that reduces the photosynthetic area of the leaves. Both honeydew and sooty mold contaminate the fiber and reduce its quality, rendering it unsuitable for the textile industry. ARAÚJO; BLEICHER (2004) report that the crop's critical period to attack from whiteflies is starting from the emergence of the plants until the appearance of the first buds.

When thinking about structuring a whitefly management plan, it is important to know its interaction with the alternative hosts in the field. Thus, the objective of this work was to identify which species of weeds among the floristic compositions occurring in the cotton crop are host of whitefly (*B. tabaci* biotype B).

The experiment was carried out in a commercial area of three hectares planted with FM 975 WS cotton cultivar on September 1st, 2015, in the municipality of Sinop, Mato Grosso, Brazil (latitude 11º5'39"S, longitude 55º36'04" W), with the altitude of 335 m. The soil of the experimental area was classified as dystrophic red-yellow latosol (SANTOS et al., 2006). The evaluations of whitefly presence in the weeds were done biweekly in the period from April to June, which corresponds to the reproductive crop phase.

A square of 0.25 m per side was used to inventory the plants and released 15 times between the cotton rows. The weeds were cut close to the ground, placed in sacks of craft paper, which were then packed in a styrofoam box and taken to the cold chamber of the Brazilian Agricultural Research Corporation (Embrapa) Agrosilvipastoral entomology laboratory.

The plants were identified by comparing the botanical characteristics of each specimen with those described in the literature by MOREIRA; BRAGANÇA (2010) and LORENZI (2014). For each family and species present, we calculated the frequency and relative frequency of the weed community according to MUELLER-DOMBOIS; ELLEMBERG (1974). After identification, the whitefly eggs and nymphs present in the weeds were quantified. All leaves were observed by means of an optical microscope with a magnification of 20 times. The total values of eggs and nymphs were used to construct the whitefly fluctuation in the different weed species during the sampling months.

The weed infestation community collected in the cotton crop was composed of 11 families, with 81.8 and 18.2% belonging to the *Magnoliopsida* and *Liliopsida* classes, respectively. There were the following families from the *Magnoliopsida* class: *Amaranthaceae, Asteraceae, Convolvulaceae, Euphorbiaceae*, *Fabaceae*, *Portulacaceae*, *Rubiaceae, Scrophulariaceae and Solanaceae*; and in the *Liliopsida* class, we found the *Commelinaceae* and *Poaceae* families. The families that presented the highest relative frequencies were *Amaranthaceae* (16.67%), *Convolvulaceae* (12.5%), *Rubiaceae* (12.5%) and *Poaceae* (12.5%) (Table 1). CARDOSO et al. (2010) and RAIMONDI et al. (2014) reported the occurrence of these families infesting naturally colored fiber cotton (BRS Safira) in Missão Velha (CE, Brazil) and white fiber cotton in Chapadão do Sul (MS, Brazil), respectively.

The most frequent weed species were *Amaranthus* spp., with 13.79%, and *A. tenella*, *Ipomea* spp., *R. brasiliensis* and *E. indica*, with 10.34% each (Table 1). CORREA; SHARMA (2004), FREITAS et al. (2006) and CHRISTOFFOLETI et al. (2011) also reported these species as competing with cotton.

During the collection period (Fig. 1), two species were collected four times (*Amaranthus* spp. and *R. brasiliensis*), four species were collected three times (*A. tenella*, *E. indica*, *Ipomoea* spp. and *S. latifolia*), two species were present in two sampling (*N. physaloides* and *S. obtusifolia*), and seven species were collected only once (*C. hirta*, *C. benghalensis*, *Conyza* spp., *E. heterophylla*, *P. oleracea*, *S. dulcis* and *S. oleraceus*). In April, the species with the highest whitefly incidence were *E. heterophylla* (154) and *N. physaloides* (149); in May, *S. latifolia* (47); and in June, *C. hirta* (117) (Fig. 1). May was the month in which fewer species were collected (seven); this may have been influenced by the crop management practices executed in the area, such as weeding. The frequency variability of the collected species made it impossible to perform a statistical analysis capable of determining which were the preferred species of oviposition for the whitefly.

The plants were collected after the weed-competition period, which starts 15 days after plant emergence (DAE) and closes at 70 DAE (CHRISTOFFOLETI et al., 2011). However, in May and June the cotton was in the phase of its fruit branches filling out and bolls opening, meaning the crop

Table 1. Weed community in the FM 975 WS cultivar cotton crop from April to June 2015, Sinop, Mato Grosso, Brazil.

Family	Relative frequency (%)	Species	Relative frequency (%)
Amaranthaceae	16.67	*Alternanthera tenella*	10.34
		Amaranthus spp.	13.79
Asteraceae	8.33	*Conyza* spp.	3.45
		Sonchus oleraceus	3.45
Convolvulaceae	12.50	*Ipomea* spp.	10.34
Euphorbiaceae	8.33	*Chamaesyce hirta*	3.45
		Euphorbia heterophylla	3.45
Fabaceae	8.33	*Senna obtusifolia*	6.90
Portulacaceae	4.17	*Portulaca oleracea*	3.45
Rubiaceae	12.50	*Richardia brasiliensis*	10.34
		Spermacoce latifolia	6.90
Scrophulariaceae	4.17	*Scoparia dulcis*	3.45
Solanaceae	8.33	*Nicandra physaloides*	6.90
Commelinaceae	4.17	*Commelina benghalensis*	3.45
Poaceae	12.50	*Eleusine indica*	10.34

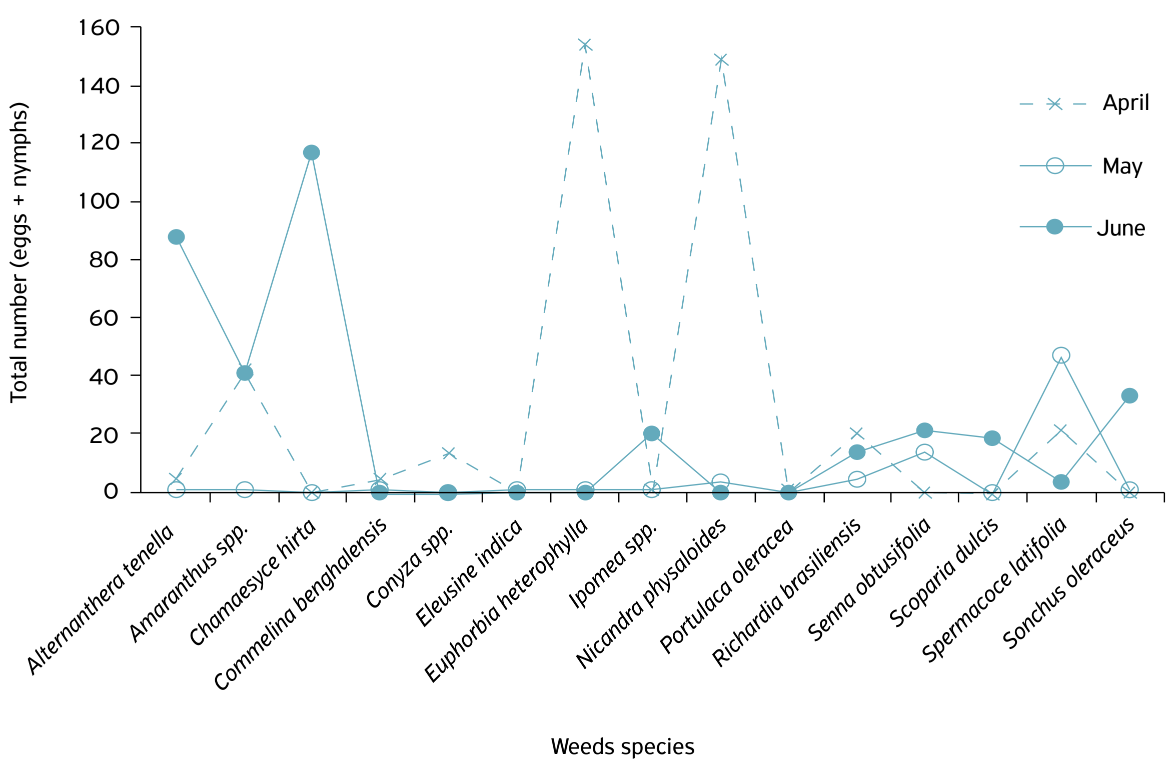

Figure 1. *Bemisia tabaci* biotype B fluctuation in the weeds present in the FM 975 WS cultivar cotton crop from April to June 2015, Sinop, Mato Grosso, Brazil.

was still susceptible to the pest and requiring a lot of attention. So, the whiteflies did not leave the weeds and infest the crop, increasing its population to the point of interfering in the plume quality due to honey dew deposition.

The presence of whitefly eggs or nymphs was only not observed in *P. oleracea* and *E. indica* among the 15 species present in the area. Corroborating the results presented in this study, VILLAS BOAS et al. (2003), SIMMONS et al. (2008), ABD-RABOUD; SIMMONS (2010) and SOTTORIVA et al. (2014) also reported the plants *E. heterophylla*, *S. obtusifolia*, *S. oleraceus*, *C. hirta*, *C. benghalensis*, and *Ipomoea* spp. as whitefly hosts.

The highest *B. tabaci* incidence occurred in the glabra *E. heterophylla* plant (154) (Fig. 1); the same fact was verified by GACHOKA et al. (2005) and SOTTORIVA et al. (2014). In some studies, it is reported that the whitefly prefers ovipositing in pubescent plants (CHU et al., 2001, CETINTAS; MCAUSLANE, 2009). In other studies, it was not possible to establish a positive correlation between trichome density and number of whitefly eggs (BOIÇA JÚNIOR et al., 2007, JINDAL; DHALIWAL, 2011). According to PROCÓPIO et al. (2004), the *E. heterophylla* plant is characterized for being more efficient in using nitrogen (N) absorbed in the soil than soybean and bean plants. It is probably this plant's intrinsic capacity makes it so attractive to the whitefly, since nitrogen is one of the constituent elements of the essential amino acids present in the phloem sap, which are vital for the insect's life cycle. The direct relationship between nitrogen applied to the soil and the population increase of sucking insects such as whiteflies is a fact, but it is not yet clear how this fertilization influences population growth (BI et al., 2005; IDRISS et al., 2015).

If on the one hand weeds can be used as food sources and shelter for the whitefly turning into a pest outbreak within the crop, on the other hand they act as reservoirs of biological control agents (predators, parasitoids and entomopathogens). In this study, we found nymphs in the fourth instar parasitized by an *Aphelinidae* parasitoid in the species *Amaranthus* spp., *R. brasiliensis* and *A. tenella*. NAVEED et al. (2007) consider that conserving these natural enemies around the crop can help reduce the whitefly population.

Thirteen weed species, namely *Amaranthus* spp., *A. tenella*, *C. benghalensis*, *C. hirta*, *Conyza* spp., *E. heterophylla*, *Ipomea* spp., *N. physaloides*, *R. brasiliensis*, *S. dulcis*, *S. obtusifolia*, *S. oleraceus* and *S. latifolia*, which were growing within the cotton crop, are alternative whitefly (*B. tabaci* biotype B) hosts in the municipality of Sinop. Based on the information obtained in this work, farmers can structure a management plan aiming to reduce the incidence of host weeds either in the harvest or in the off season, monitoring them and eliminating them if necessary.

ACKNOWLEDGMENTS

The authors thank André Filipiaki for the support in installing and executing the experiment, and EMBRAPA for funding the project SEG EMBRAPA (PA no. 02.11.07.005.00.04).

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