Preferences of *Scirtothrips dorsalis* Hood 1919 (Thysanoptera: Thripidae) for different structures of cotton (*Gossypium hirsutum* L.) plants in the Magdalena warm valley of Colombia

Preferencias de *Scirtothrips dorsalis* Hood 1919 (Thysanoptera: Thripidae) por diferentes estructuras de la planta del algodón (*Gossypium hirsutum* L.) en el valle cálido del Magdalena

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ABSTRACT

Thrips samples were collected from cotton crops in the Andean region of the Magdalena warm valley, an area represented by the Colombian departments of Tolima, Huila and Cundinamarca. Ten cotton plants were randomly selected per hectare in each plot. Five young leaves, five floral buds, five opened flowers and five bolls or fruits were inspected. Immature stages were separated from the adults and a first classification was made according to the present thrips morphotypes, separating the adults of possible *S. dorsalis* specimens from the others. T-Student and Kruskal-Wallis tests were performed in order to find statistical differences between the different evaluated variables. The selectivity of *S. dorsalis* for each plant structure was determined by Z tests, Spearman correlation analysis and the Bray-Curtis similarity index. *Scirtothrips dorsalis* was found in 77% (n = 46) of the inspected sites. The species exhibited greater affinity to the boll, followed by young leaves and buds. Opened flowers constituted a resource not frequented by the pest with a similarity range of I = 0.8 (<1). It is suggested that cotton plants are hosts to the thrips species; it means that the pest life cycle is highly associated to the cotton production in the Andean region. The importance of the results related to the cotton production and other crops associated to the insect species in the region is discussed.

Key words: thrips, bolls, host, selectivity.

RESUMEN

En la región Andina que comprende el valle cálido del alto Magdalena representado por los departamentos de Tolima, Huila y Cundinamarca en Colombia se recolectaron muestras de trips en cultivos de algodón. En cada predio se seleccionaron diez plantas de algodón al azar por hectárea en las cuales se inspeccionaron cinco hojas jóvenes o terminales foliares, cinco botones florales, cinco flores abiertas y cinco cápsulas o frutos. Los estados inmaduros se separaron de los adultos y se hizo una primera clasificación de acuerdo a los morfotipos de trips presentes, separando los adultos de posibles especímenes de *S. dorsalis* de los demás. Se llevaron a cabo pruebas de T y Krustall-Wallis con el fin de encontrar diferencias estadísticas entre las variables evaluadas. La selectividad de *S. dorsalis* por cada estructura de planta fue determinada por medio de pruebas de Z, análisis de correlación de Spearman y el índice de similitud de Bray-Curtis. Se encontró *Scirtothrips dorsalis* en el 77% (n = 46) de los predios inspeccionados. La especie presentó mayor afinidad por las cápsulas, seguido de las hojas jóvenes y botones florales. Las flores abiertas constituyeron un recurso no frecuentado por la plaga con un rango de similitud de I = 0.8 (<1). Se sugiere que las plantas de algodón constituyen hospedantes para la especie, lo que implica que el ciclo de vida de la plaga está altamente asociado a la producción de algodón en la región andina y se discute la importancia de los resultados en términos de la producción de algodón en esta región y otros cultivos que se han encontrado asociados a la especie de insecto.

Palabras clave: trips, cápsulas, hospedero, selectividad.

Introduction

Cotton (*Gossypium hirsutum* L.) is an important crop highly related to the economic, social and agro-industrial development of many communities. In Colombia there are approximately 10,284 ha planted with cotton, mainly distributed in the Caribbean, Orinoquia and Andean regions. The Andean region represents 7,000 ha in the Magdalena warm valley which corresponds to the departments of Tolima, Huila and Cundinamarca. The national average yield is 1,971 kg of fiber ha^{-1} (Conalgodón, 2018).

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The cotton industry generates 10,945 direct jobs with a production cost of $4.5 million pesos/ha (Conalgodón, 2018). As a strategy for pest management, the Instituto Colombiano Agropecuario (ICA) implemented the plan for the exclusion, suppression and eradication of cotton pests (ICA, 2000) in all producing regions. In this context, there are two annual planting seasons, the first one in the first half of the year in the Andean region, and the second one at the end of the second semester in the Orinoquia and Caribbean regions (ICA, 2000).

The Thripidae family comprises important pests of cotton because they are associated with direct damages such as leaf distortion, defoliation, bud and boll abortion, premature boll opening, and indirect damage such as viruses transmission that can affect yield and fiber quality (Wilson and Bauer, 1993; Leigh, 1995; Cermeli *et al*., 2009; EFSA, 2014; ThripsWiki, 2017). In the global context of cotton production, the genera *Caliothrips* Daniel, *Retithrips* Marchal, *Sericothrips* Haliday, *Thrips* Linneaeus, *Frankliniella* Karny and *Scirtothrips* Shull have been registered (Wilson and Bauer, 1993; Leigh, 1995; Mailhot *et al*., 2007; Kumar *et al*., 2013).

The insect *S. dorsalis* Hood, 1919 is a polyphagous species of tropical Asian origin (Ananthakrishnan, 1993) that feeds on young leaves of more than 200 species of dicotyledonous plants in about 40 different botanical families (Hoodle and Mound, 2003; Hooddle *et al*., 2008). *S. dorsalis* feeds preferentially from the epidermis and, sometimes, from palisade tissues and tissues of the apex of young fruits, especially when they are still hidden under the calyx. In many hosts, it can feed on the upper surface when infestation levels are high. Larvae and adults are often located in the midrib or near the damaged leaf tissue area. Pupae can be found in leaf litter, leaf axils, and deformed leaves or under the calyx (Kumar *et al*., 2013). The associated damage in plants infested by *S. dorsalis* is characterized by a silvering on the surface of the infested leaf, feeding scars, linear thickening of the leaf blade, and brown spots on leaves and fruits. A concentric ring often appears in healed tissue around the apex. Poor fruit formation and early leaf senescence take place as well (Hodges *et al*., 2005; Kumar *et al*., 2013).

Thrips *S. dorsalis* are small insects (<1 mm in length), with thigmotactic behavior and similar morphology features as other thrips species (Kumar *et al*., 2011). It is a species of great economic importance in the world, which was registered for the first time in Colombia in 2010 (ICA, 2012). Due to this, it is necessary to evaluate the potential and actual phytosanitary impact of the species at regional and national levels. The objective of the present study was to determine the infestation and preferences of *S. dorsalis* for the structures of young leafs, floral buds, flowers and bolls (fruits) in cotton plants from the Magdalena warm valley of Colombia.

Materials and methods

Study area

The geographical context of this study corresponded to the Andean region, the Magdalena warm valley in the departments of Huila, Tolima and Cundinamarca. The research area presents an altitudinal range below 600 m a.s.l., characterized by tropical dry forest vegetation (bs-T) (Holdridge, 1967; IAvH, 2014). Farms were inspected in the municipalities of Villavieja, Campoalegre (Huila); Venadillo, Natagaima, Ambalema, Lerida, Armero, Espinal (Tolima) and Ricaurte (Cundinamarca) (Fig. 1).

Sampling

The sampling included 60 farms with productive cotton crops (60 to 90 d after sowing) with floral buds, opened flowers and bolls (fruits). All cotton crops corresponded to genetically modified or transgenic varieties. Ten cotton plants were randomly selected per hectare in each plot. Five young leaves or leaf terminals, five floral buds, five opened flowers and five bolls or fruits were randomly inspected in the lower, middle or upper strata of each plant. The thrips were collected using brushes previously moistened with ethanol and deposited in 1.5 mL plastic vials with 70% ethanol. The sampling unit was represented by 20 vials per inspected plant. In each plot, a code that represented the geographical location, the number assigned to the plant and the plant structures B (buds), C (boll), F (flower), H (leaf), P (farms) were assigned (Pedigo, 1996). The samples were packed in plastic bags according to the farm and municipality, and were transported to the Laboratories of Entomology of the Nataima research center of the Corporación Colombiana de Investigación Agropecuaria AGROSAVIA (Espinal-Tolima) and BIOQUALITYAGRO in the municipality of Mosquera, Cundinamarca, with the purpose of preparing the specimens and carrying out the taxonomic identification. The geographical coordinates for some localities were obtained and/or corrected using Google Earth (www.googleearth.com) and the map was made in Arcmap (ArcGis) software (Pulido *et al*., 2015).

Sample treatment

Immature stages were separated from the adults and a first classification was made according to the present thrips morphotypes, separating the adults of possible *S. dorsalis* specimens from the others. The number of adults was recorded and the specimens were rinsed using 5-10% KOH.

Then the specimens were washed with distilled water and dehydrated in ethanol for semi-permanent mounting in Hoyer's solution on slides (Mound and Marullo, 1996). The taxonomic identification was made based on the morphological characters and according to the available keys (Hoddle and Mound, 2003; Moritz *et al.*, 2007; Kumar *et al.*, 2013), and with the aid of a Leica® ZOOM 2000 stereoscope (Wetzlar, Germany) and a Nikon® Type-119YS2-T microscope (Tokyo, Japan) and photographic camera Canon® Type SX530-16MP (Tokyo, Japan).

Data analysis

The abundance of *S. dorsalis* adults in each plant structure (young leaf, floral buds, opened flower and boll) per plant, per plot, in each municipality and department evaluated was determined. Considering this information, the percentages of infestation per plot and the preference of *S. dorsalis* for certain plant structures in cotton plants were estimated. T-Student and Kruskal-Wallis tests were performed in order to find statistical differences between the different evaluated variables (Ebratt *et al.*, 2004). The selectivity of *S. dorsalis* for each plant structure was determined by Z tests ($P \leq 0.05$) with paired comparisons per structure, and Spearman correlation analysis between infested plant structures (STATISTICA v10; InfoStat, 2016). Percentage records of the calculations to obtain the Bray-Curtis similarity index* were transformed on a logarithmic scale in base 10, in order to define the preference for the resource as follows: a) positive preference (I>1), b) neutral or accidental preference (I = 1), and c) non-preference (I<1). This is a statistic used to quantify the compositional dissimilarity between two different sites, based on counts at each site:

$$* \ BCij = 1 - \left(\frac{2\,Cij}{Si + Sj}\right)$$

where C_{ij} *Cij* is the sum of the lesser values for only those species in common between both sites, while S_i and S_j *Si* and *Sj* are the total number of specimens counted at both sites (Silveira-Neto *et al.*, 1976; Johnson, 1980; Ramirez, 2006; Zamar, 2011; Yara and Reinoso, 2012).

Results

Presence and distribution

A total of 12,000 plant structure samples were obtained. These samples corresponded to 30 farms in the department of Tolima (10 in the northern zone, 10 in the central zone and 10 in the southern zone), 20 farms in the department of Huila (10 in the northern zone and 10 in the central zone) and 10 farms in the southwestern zone of Cundinamarca.

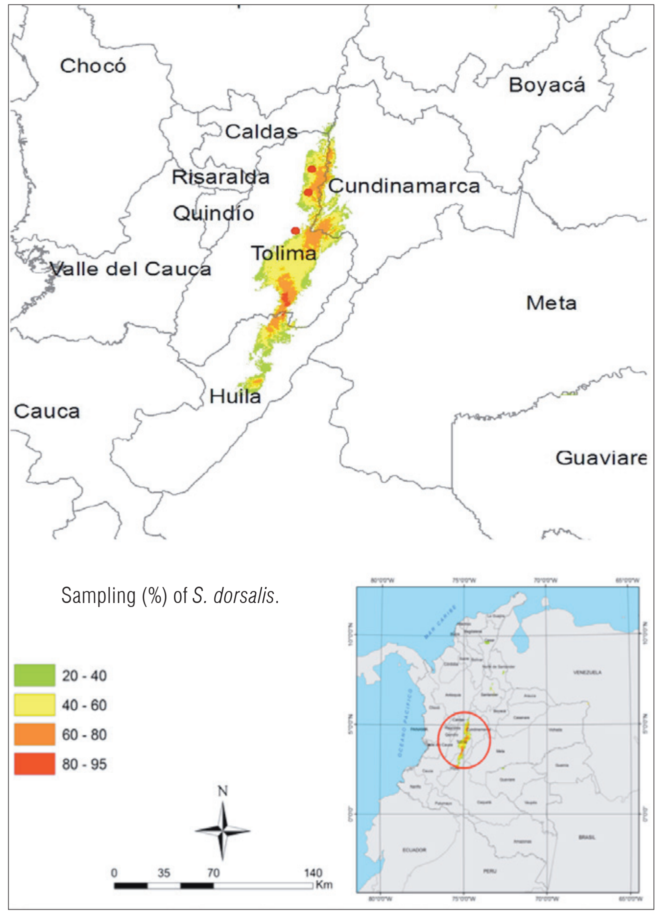

FIGURE 1. Sampling sites of *S. dorsalis* in cotton crops in the Magdalena warm valley.

The thrips *S. dorsalis* was found in 46 farms (77%) with infestation rates between 20 and 100% (Tab. 1). The species was not recorded in 14 farms (23%) located in the municipalities of Armero (5 farms), Ambalema (1 farm), Venadillo (1 farm), El Espinal (5 farms), Natagaima (2 farms), all located in the department of Tolima. The infestation in bolls reached 61.6% (n = 60 ± 6.33), followed by young leaves with 55% (n = 60 ± 6.47), floral buds with 41.66% (n = 60 ± 6.41) and opened flowers with 28.33% (n = 60 ± 5.86). In all cases, *S. dorsalis* was found to be associated with young leaves and bolls (n = 60; $R = 0.4592$; $P<0.001$) whereas flowers and floral buds showed low abundance (C = 0.85; gl = 3; H = 19.65; $P<0.0001$) (Fig. 2). The south of Cundinamarca and south of Tolima presented the highest abundances in young leaves, bolls and floral buds. The same preference was found in the central and northern zones of Huila and in the central area of Tolima, but with significantly low abundances. In the northern region of Tolima, *S. dorsalis* abundances were significantly lower in young leaves, flowers, floral buds and bolls (C = 0.94; gl = 5; H = 19.89; $P<0.0008$) (Fig. 3).

TABLE 1. Sampling and abundance location of *S. dorsalis* Hood (Thysanoptera: Thripidae) in cotton crops from the Magdalena warm valley, Colombia.

Geographic coordinates			Geografic Location				Abundance of *S. dorsalis* in structures			
Number	N	W	Altitude (m a.s.l.)	Departament	Municipality	Life Zone	Leaf	Flower	Floral buds	Boll
1	05° 00' 51,4"	074° 54' 18,4"	312	TOLIMA	Armero	bs-T	0	0	1	4
2	04° 59' 29,1"	074° 54' 19,3"	312			bs-T	0	0	0	0
3	05° 00' 22,9"	074° 54' 21,4"	296			bs-T	0	0	0	0
4	04° 59' 29,1"	074° 54' 19,3"	312			bs-T	0	0	0	0
5	05° 00' 30,1"	074° 54' 22,4"	296			bs-T	0	0	0	0
6	04° 40' 50,2"	074° 54' 31,0"	368	TOLIMA	Ambalema	bs-T	0	0	0	0
7	04° 54' 54,8"	074° 52' 29,6'	275	TOLIMA	Venadillo	bs-T	0	0	0	0
8	04° 40' 40,1"	074° 54' 18,8"	360			bs-T	0	0	0	2
9	05° 06' 24,7"	074° 53' 23,2"	368	TOLIMA	Armero	bs-T	0	1	0	5
10	05° 05' 11,8"	074° 52' 44,8"	324			bs-T	0	0	0	0
11	04° 09' 4,74"	074° 51' 9,6"	318	TOLIMA	El Espinal	bs-T	46	8	10	10
12	04° 09' 7,26"	074° 51' 38,2"	330			bs-T	0	0	0	0
13	04° 09' 58,6"	074° 55' 21,8"	356			bs-T	0	3	0	0
14	04° 11' 38,3"	074° 57' 57.7"	391			bs-T	0	0	0	0
15	04° 08' 13,8"	074° 51' 34,6"	321			bs-T	0	0	0	0
16	04° 07' 38,1"	074° 50' 29,7"	319			bs-T	16	11	0	21
17	04° 09' 24,9"	074° 56' 55.2"	342			bs-T	0	0	2	0
18	04° 09' 24,9"	074° 56' 55,1"	355			bs-T	2	0	0	0
19	04° 07' 37,8"	074° 50' 30,1"	388			bs-T	0	0	0	0
20	04° 11' 21,2"	074° 57' 19,4"	394			bs-T	0	0	0	0
21	03° 29' 30,7"	075° 07' 47,5"	348	TOLIMA	Natagaima	bs-T	9	1	15	8
22	03° 29' 41,9"	075° 07' 52,9"	347			bs-T	15	2	4	1
23	03° 29' 48,8"	075° 07' 40,1"	348			bs-T	11	0	6	0
24	03° 29' 3,9"	075° 07' 53,2"	348			bs-T	0	0	0	0
25	03° 29' 2,6"	075° 07' 48,5"	344			bs-T	5	0	5	0
26	03° 28' 12,4"	075° 07' 43,2"	356			bs-T	0	0	0	0
27	03° 28' 51,1"	075° 07' 32,8"	347			bs-T	5	0	4	0
28	03° 40' 37,9"	075° 06' 9,78"	333			bs-T	4	0	8	6
29	03° 40' 15,7"	075° 05' 50,5"	333			bs-T	27	2	6	19
30	03° 39' 57,3"	075° 05' 40,3"	329			bs-T	5	1	9	2
31	03° 22' 32,8"	075° 09' 45,8"	374	HUILA	Villavieja	bs-T	0	0	0	3
32	03° 22' 29,5"	075° 09' 43,9"	370			bs-T	0	0	0	5
33	03° 21' 54,9"	075° 09' 46,9"	373			bs-T	3	0	2	1
34	03° 11' 46,2"	075° 13' 45,6"	387			bs-T	0	0	0	1
35	03° 12' 32,4"	075° 13' 37,9"	402			bs-T	0	0	2	5
36	03° 12' 35,4"	075° 13' 31,0"	387			bs-T	0	0	0	9
37	03° 12' 40,6"	075° 13' 28,8"	383			bs-T	2	0	3	4
38	03° 12' 29,5"	075° 13' 24,2"	386			bs-T	23	0	0	6
39	03° 20' 46,0"	075° 11' 33,4"	376			bs-T	7	0	3	5
40	03° 20' 48,7"	075° 13' 29,7"	377			bs-T	3	0	1	8
41	02° 41' 34,4"	075° 21' 04,6"	519	HUILA	Campoalegre	bs-T	5	9	5	6
42	02° 41' 35,7"	075° 21' 11,3"	518			bs-T	5	1	1	0

Continue

Geographic coordinates			Geografic Location				Abundance of *S. dorsalis* in structures			
Number	N	W	Altitude (m a.s.l.)	Departament	Municipality	Life Zone	Leaf	Flower	Floral buds	Boll
43	02° 41’ 43,6”	075° 21’ 13,9”	509			bs-T	1	0	0	3
44	02° 42’ 11,1”	075° 21’ 01,9”	498			bs-T	5	0	2	12
45	02° 42’ 23,5”	075° 20’ 54,4”	507			bs-T	0	8	0	10
46	02° 43’ 12,2”	075° 19’ 01”	547	HUILA	Campoalegre	bs-T	5	5	2	5
47	02° 40’ 46,4”	075° 21’ 23,6”	526			bs-T	11	5	6	10
48	02° 40’ 54,7”	075° 21’ 25,9”	527			bs-T	6	6	1	4
49	02° 40’ 55,7”	075° 21’ 21,8”	525			bs-T	2	9	0	4
50	02° 40’ 39.0”	075° 21’ 36,2”	532			bs-T	5	0	2	0
51	04° 17’ 5,8”	074° 44’ 22,0”	302			bs-T	23	0	0	15
52	04° 17’ 03,5”	074° 44’ 19,4”	301			bs-T	18	0	0	23
53	04° 17’ 01,4”	074° 44’ 16,3”	301			bs-T	8	0	0	20
54	04° 17’ 18,9”	074° 44’ 07,4”	305			bs-T	17	0	0	16
55	04° 17’ 19,7”	074° 44’ 01,5”	311	CUNDINAMARCA	Ricaurte	bs-T	10	0	0	6
56	04° 17’ 19,7”	074° 44’ 05,2”	345			bs-T	0	0	0	18
57	04° 17’ 18,3”	074° 44’ 11,0”	283			bs-T	17	3	4	12
58	04° 17’ 52,7”	074° 44’ 31,7”	291			bs-T	37	0	8	3
59	04° 17’ 43,7”	074° 44’ 23,8”	297			bs-T	0	1	0	14
60	04° 16’ 30,6”	074° 44’ 1,9”	290			bs-T	4	0	0	0

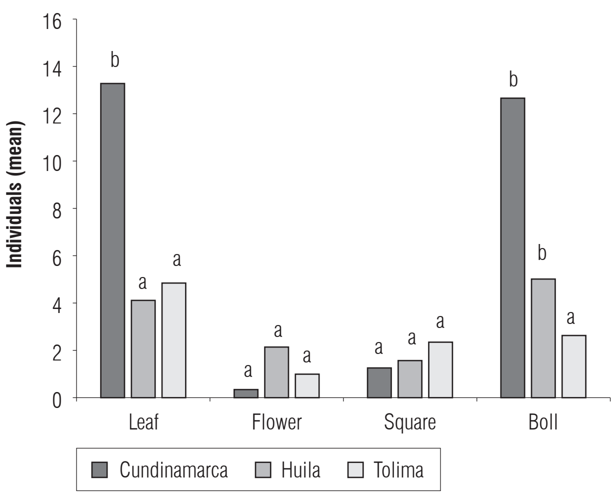

FIGURE 2. Abundance of *S. dorsalis* on plant structures of the cotton crop per department (C = 0.85; gl = 3; H = 19.65; *P*<0.0001).

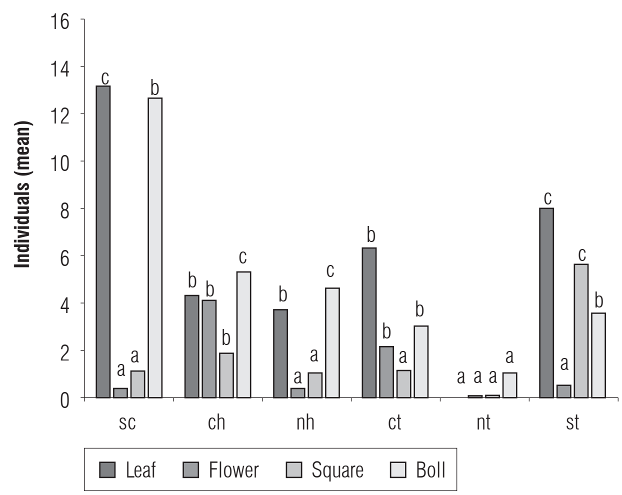

FIGURE 3. Mean abundance of *S. dorsalis* in structures per sampled geographical area (sc. South of Cundinamarca; ch. Central Huila; nh. North of Huila; ct. Central Tolima; nt. North of Tolima; st. South of Tolima; l. Leaf; f. Flower; s. Floral buds; b. Boll) (C = 0.94; gl = 5; H = 19.89; *P*<0.0008).

Preference for structures

According to the similarity indices (Is) applied, significant differences (P<0.05) were found in the abundances of *S. dorsalis* between structures in the cotton plant: leaf-flower (Is = 0.40), leaf-bud (Is = 0.71), leaf-boll (Is = 0.52), flower-bud (Is = 0.24), flower-boll (Is = 0.16) and bud-boll (Is = 0.78). The Bray-Curtis similarity-affinity index showed significant differences between the paired structures flower-boll (Rs = 0.6742; P = 0.01), flower-leaf (Rs = 0.5900; P = 0.006) and boll-leaf (Rs = 0.5277; P = 0.017). However, no significant differences were observed between the paired structures flower-bud (Rs = 0.4244; P = 0.062) and boll-bud (Rs = 0.4037; P = 0.077). The preference analysis based on the abundance of *S. dorsalis* in the evaluated structures revealed that the species had a higher affinity for the bolls (I = 1.7>1), followed by young leaves (I = 1.3>1) and buds (I = 1.2>1). Opened flowers were not a frequented resource for the pest with a similarity range of I = 0.8 (<1) (N = 60;

cophenetic correlation = 0.927; read cases = 60; omitted cases = 0; $P<0.05$). Paired comparisons using the Z test ($P = 0.05$) revealed that there were significant differences between boll-flower and young leaf-flower (Fig. 4).

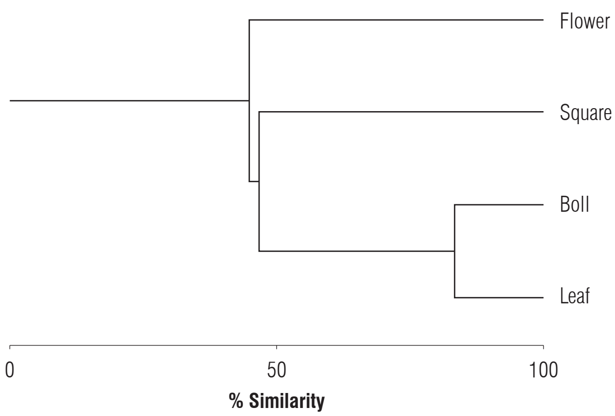

FIGURE 4. Bray-Curtis clustering analysis for *S. dorsalis* in structures of the cotton crop in the Magdalena warm valley in Colombia.

Discussion

This study indicates that *S. dorsalis* was found to be associated with cotton crop plants of the Magdalena warm valley in Colombia, with a preference for young leaves, floral buds and bolls. It is clear that these microhabitats have sufficient food and reproductive resources to complete the life cycle and maintain the populations of the species (Mound and Stiller, 2011), which poses a high risk for crop yield and profitability (Mound and Stiller, 2011; Mannion *et al.*, 2013). It has been reported that leaves and other non-flowering structures may be more stable food sources for the development of immature stages (Funderburk *et al.*, 2002), contrasting the information described to the genus *Frankliniella* Karny, strongly associated with flowers due to the fact that pollen constitutes an essential nutritional contribution to increase egg production. In general, it is understood that young leaves have a higher nutritional content, but also more secondary metabolites, so insect populations must develop efficient strategies to regulate their intake (Schoonhoven *et al.*, 2005), as observed in *S. dorsalis*, which prefers to feed around the main veins of the leaves or in areas bordering damaged zones (EFSA, 2014).

Due to the fact that immature stages of *S. dorsalis* were found during the sampling performed in the present study, it is suggested that cotton plants constitute true hosts where the species can develop and complete its life cycle (Mound and Marullo, 1996; Marullo, 2004; Marullo, 2009; Vierbergen *et al.*, 2010; Alves-Silva *et al.*, 2013). This result is relevant because there is scarce knowledge about host plants and feeding strategies of the genus *Scirtothrips*, which has been a barrier for the definition of surveillance and control strategies (Zwölfer, 1983; Lacasa *et al.*, 1996; Mound and Marullo, 1996; Hall *et al.*, 1997; Pérez, 1999; Hernandez, 2005; Alves-Silva, 2013; Kumar *et al.*, 2013; Burckhardt *et al.*, 2014). The specialization in insects corresponds to the general rule and not to the exception (Pérez, 1999; Schoonhoven *et al.*, 2005), so that the recognition of preferences could offer important ethological elements in the differentiation of the species and could also give clarity on their economic importance (Thorsteinson, 1960; Stern, 1973; Zwölfer, 1983; Bernays and Chapman, 1994; Sha *et al.*, 1998; Zamar and Neder, 2012; Cook *et al.*, 2013). In the present study, symptoms such as leaf distortion (leaf curl), leaf wilting, leaf fall, and discoloration of boll and floral buds (bronzing), were attributed to the insect presence in the cotton plants (Fig. 5).

The insect *S. dorsalis* is an introduced species in Colombia, with a type "r" reproductive strategy and records of polyphagia (Morse and Hoddle, 2006; Rodríguez, 2006; Liebhold and Tobin, 2008). All the above, in conjunction with the distribution recorded in the present study, can generate negative effects on biodiversity, uncultivated native flora and other crops of economic interest such as mango, citrus, avocado, tomato, chili and aromatic herbs, which are also established in the Magdalena warm valley in the Andean region of Colombia (Mound and Palmer, 1981; Hoodle and Mound, 2003; Liebhold and Tobin, 2008; Kumar *et al.*, 2011; Kumar *et al.*, 2013; Wegier and Piñero, 2013). It is clear that the introduction and establishment of non-native species affect trophic networks and can alter processes of population dynamics that allow species regulation (Lewis, 1997; Schoonhoven *et al.*, 2005; Gutiérrez, 2006). This fact must be considered as an important risk if the cultivated area is a cotton monoculture.

Considering the percentages of infestation and insect preferences found for cotton crop in the Andean region of Colombia, it is clear that *S. dorsalis* could become a major phytosanitary problem that should be carefully monitored because: a) it could adversely affect the expected yields and the quality of the fiber, b) it produces direct damages that cause the fall of leaves, floral buds and bolls, c) it favors the distortion in leaf blades in the shape of rosettes, d) it contributes to the foliar malformation, e) it can generate dwarfism and death of the plant (Fig. 6). Several researches have established that *S. dorsalis* causes indirect damage related to the transmission of viral particles such as *Groundnut chlorotic fan-spot virus*, *Groundnut yellow spot virus* and *Tobacco streak virus*, as recorded in cotton crops in Australia and the United States of America with a reduction of 77% in seed production, 25% in yield and 67% in

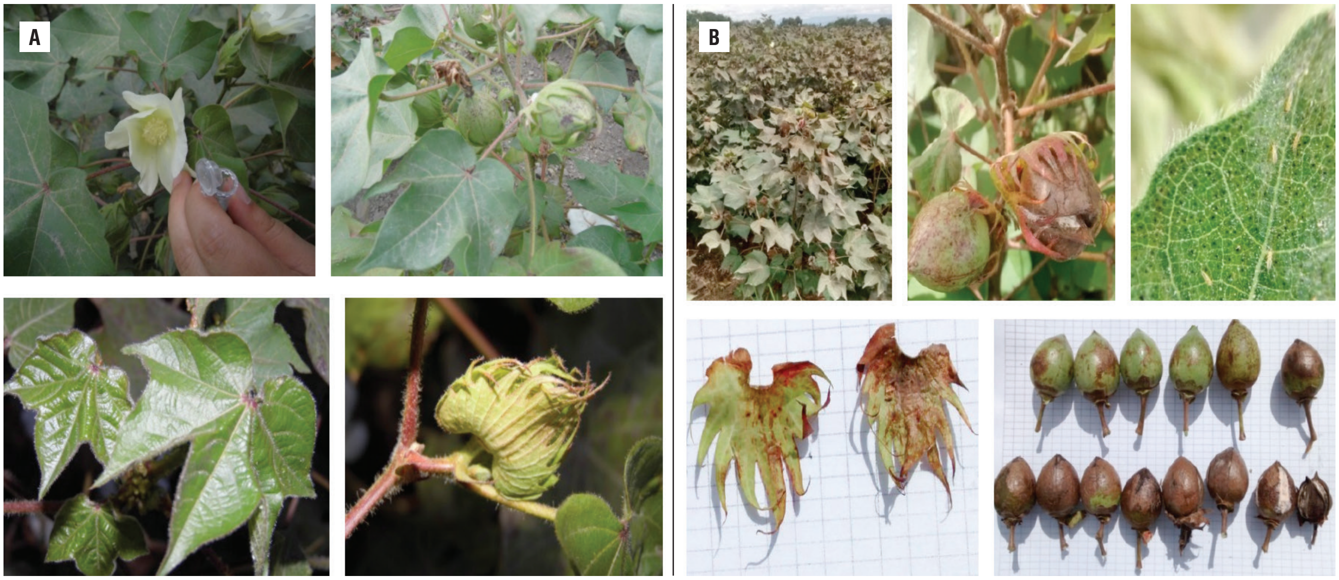

FIGURE 5. Cotton crop. **A.** Structures without damage. **B.** Structures affected by *S. dorsalis*.

fiber quality, (Funderburk, 2002; Jones, 2005; Shukla *et al*., 2005; Riley *et al*., 2011; EFSA, 2014). It has been found that *Frankliniella tritici* may be associated with cotton flowers (10%) causing detriments due to its feeding, but also as a carrier of the fungus *Fusarium verticillioides*, causal agent of the so-called Hard Lock syndrome (Mailhot *et al*., 2007), which coupled with the damage caused by *S. dorsalis* to cotton plants, constitute important risks for the cotton production chain. However, it is interesting that the insect was not present in 14 of the total farms evaluated (23%), which could be explained by agronomic management practices based on the regular use of insecticidal molecules of chemical synthesis, or due to abiotic factors that do not favor the establishment of the species. The entomological surveillance of the species should be continued, not only in cotton crops but in other plants that can serve as hosts, which can be established through models of distribution and ecological niche of the species (Pulido *et al*., 2015).

Conclusions

The importance of the association of *S. dorsalis* in cultivated cotton plants described in the present study leads to opportunities to perform projects oriented towards biology, ethology and the recognition of natural enemies of this pest species. Those projects may allow the definition of strategies of integrated pest management and the evaluation of the impact on the cotton production chain for the country.

The tropical dry forests correspond to a life zone where agriculture has grown with many extensive crops such as chili, mango, rice and cotton, which have been reported as host plants for *S. dorsalis*. This species has been dispersed and established in this region because it is considered as a favorable ecological niche in this area.

The introduction and establishment of species such as *S. dorsalis* could affect the trophic networks present, altering processes of population dynamics that allow the regulation of the species. This, for the present study, would constitute an important risk to the evaluated areas, if these areas have appropriate environmental conditions as ecological niches for the establishment of the invasive species.

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