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Seasonal abundance of Thysanoptera species in *Tillandsia usneoides* (Poales: Bromeliaceae)

Ozan Demirozer¹, Kara Tyler-Julian², and Joe Funderburk^{2,*}

Abstract

Spanish moss, *Tillandsia usneoides* (L.) (Poales: Bromeliaceae), is widely distributed in the southeastern United States. A diversity of arthropod species from numerous taxa are known to inhabit this common epiphytic plant. Thysanoptera species inhabiting Spanish moss were sampled monthly over the course of a year from trees in 4 different genera and included 10 species of thrips from 8 genera and 3 families represented. Breeding populations of predatory *Karnyothrips* (Phlaeothripidae) were common in Spanish moss during all months of the year. The adults of 2 phytophagous species of *Frankliniella* (Thripidae) were common in the spring months, but only a few larvae were collected over the course of the year. The adults of other species collected were: *Heterothrips quercicola* J. C. Crawford (Heterothripidae); *Chilothrips pini* Hood, *Neohydatothrips variabilis* (Beach), and *Selenothrips rubrocinctus* (Giard) (Thripidae); and *Hoplandrothrips pergandei* Hinds and *Liothrips ocellatus* Hood (Phlaeothripidae). Although a diverse group of phytophagous thrips species inhabited Spanish moss, there was little evidence that it was a host. It may simply have been a temporary shelter with no other biological significance. The predatory thrips were abundant probably feeding on the diverse group of small arthropods that inhabit Spanish moss.

Key Words: thrips; *Frankliniella bispinosa*; *Karnyothrips melaleucus*; epiphytic plant

Resumen

El musgo español (o barba de viejo), *Tillandsia usneoides* (L.) (Poales: Bromeliaceae), está ampliamente distribuido en el sureste de Estados Unidos. Se sabe que hay una diversidad de especies de artrópodos de numerosos taxones que habitan esta planta epífita común. Se muestrearon mensualmente las especies de Thysanoptera que habitan el musgo español en el transcurso de un año a partir de 4 géneros diferentes de árboles y se incluyen 10 especies de 8 géneros y 3 familias de trips representadas. Las poblaciones reproductivas de depredadores *Karnyothrips* (Phlaeothripidae) fueron comunes en el musgo español durante todos los meses del año. Los adultos de 2 especies fitófagas de *Frankliniella* (Thripidae) fueron comunes en los meses de primavera, pero sólo unas pocas larvas fueron recolectadas en el transcurso del año. Los adultos de otras especies recolectadas fueron: *Heterothrips quercicola* J.C. Crawford (Heterothripidae); *Chilothrips pini* Hood, *Neohydatothrips variabilis* (Beach) y *Selenothrips rubrocinctus* (Giard) (Thripidae); y *Hoplandrothrips pergandei* Hinds y *Liothrips ocellatus* Hood (Phlaeothripidae). Aunque un grupo diverso de especies de trips fitófagos habitan el musgo español, hubo poca evidencia de que se trataba de ser un hospedero. Podría simplemente haber sido un refugio temporal con ningún otro significado biológico. Los trips depredadores fueron abundantes probablemente alimentándose sobre un grupo diverso de pequeños artrópodos que habitan en el musgo español.

Palabras Clave: trips; *Frankliniella bispinosa*; *Melaleucus*; *Karnyothrips*; planta epífita

Spanish moss, *Tillandsia usneoides* (L.) (Poales: Bromeliaceae), is an epiphytic plant that ranges from the coastal plain of the southeastern USA extending through Central America south to Argentina and Chile (Garth 1964). Spanish moss obtains its minerals and moisture from atmospheric conditions as it has no absorbing root system but instead possesses absorbing scales over the entire plant. It is best adapted to well-lighted, moist habitats and requires high relative humidity and regular rains in order to sustain optimal growth. It has a scorpioid dichotomous growth pattern. Growth of the plant is proportional to visible solar radiation, and more plants will be found on the most exposed areas of the tree (Garth 1964). Spanish moss flowers between mid-Apr and early Jun in Georgia, USA, but every plant does not flower every year.

Young & Lockley (1989) studied the diversity and seasonal abundance of species of arthropods inhabiting Spanish moss. No thrips were reported from the 2,600 arthropods collected. Whitaker & Ruckdeschel (2010) were interested primarily in the seasonal abundance of mites in Spanish moss, although the total number of thrips of all species was reported. Thrips were most abundant in the spring. More thrips were found in the Spanish moss that had fallen to the ground than that remaining on the trees.

Funderburk et al. (2015) reported the population dynamics of *Frankliniella bispinosa* (Morgan) (Thysanoptera: Thripidae) on crepe myrtle, *Lagerstroemia indica* L. × *fauriei* Koehne (Myrtales: Lythraceae). Populations were almost completely aggregated in the flowers over the leaves. The adults and very rarely the larvae were found on the Spanish moss epiphytic on the trees. Two species of *Karnyothrips* (Thysanoptera: Phlaeothripidae), predators of small insects, were common in the Spanish moss, and other thrips species were collected. The purpose of this study was to determine the diversity and seasonal abundance of thrips inhabiting Spanish moss in North Florida, USA.

Materials and Methods

EXPERIMENTAL LOCATIONS

Spanish moss was collected monthly between Dec 2011 and Nov 2012 from oak (*Quercus* sp.) (Fagales: Fagaceae), pecan (*Carya illinoensis* [Wangenheim] K. Koch; Fagales: Juglandaceae), and sweet gum

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(*Liquidambar styraciflua* L.; Saxifragales: Altingiaceae) in Gadsden County, Florida, USA (30°32'52"N, 84°35'36"W); and oak and dogwood (*Cornus florida* L.; Caryophyllales: Cornaceae) in Leon County, Florida, USA (30°28'37"N, 84°21'30"W).

SAMPLING SPANISH MOSS FOR THRIPS

Sampling procedures were modified from Funderburk et al. (2015). Five samples of 3.8 L bags of moss were collected from each tree species monthly. Samples were collected between 2:00 and 4:00 p.m. Eastern Standard Time or Eastern Daylight Time. Samples were carried immediately to the laboratory and placed in a freezer for at least 24 h, after which time the samples were removed from the freezer and allowed to come to room temperature. Rinsing methods were derived from those used by Frank et al. (2004) on bromeliads and modified by Funderburk et al. (2015) for Spanish moss. Each bag was filled with water, the Spanish moss was agitated in the water, and the water was drained through a sieve to catch the thrips. This was repeated 4 more times. The contents were placed into 70% ethyl alcohol, and the thrips were separated from other materials under a microscope with 40× magnification. Thrips were mounted on slides for identification.

VOUCHERS

Keys used in identification included Mound & Marullo (1996) and Vierbergen et al. (2010). Comparisons were made with the Thysanoptera collections at the Natural History Museum, London, United Kingdom, and at the Systematic Entomology Laboratory, Beltsville, Maryland, USA. Voucher specimens are located at the collection at the North Florida Research and Education Center, University of Florida, in Quincy, Florida, USA.

Results

Ten thrips species belonging to 8 genera and 3 families were found in the Spanish moss samples (Table 1). The species were *Heterothrips quercicola* J. C. Crawford (Heterothripidae); *Chilothrips pini* Hood, *F. bispinosa*, *Frankliniella tritici* (Fitch), *Neohydatothrips variabilis* (Beach), *Selenothrips rubrocinctus* (Giard) (Thripidae); and *Hoplandrothrips pergandei* Hinds, *Liothrips ocellatus* Hood, *Karnyothrips harti* (Hood), and *Karnyothrips melaleucus* (Bagnall) (Phlaeothripidae).

In total, 651 adult thrips were collected. Species of *Frankliniella* and *Karnyothrips* were 83 and 16%, respectively, of the total adult thrips collected. The adults of *F. bispinosa*, *F. tritici*, *K. harti*, and *K. melaleucus* were common species in the moss collected from all trees.

The total number of *Frankliniella* species larvae collected was less than 1% of the total number of *Frankliniella* adults collected (Table 2); therefore, the Spanish moss was not a host plant species used for breeding. The total number of *Karnyothrips* species larvae collected was about 55% of the total number of *Karnyothrips* adults collected (Table 2); therefore, the Spanish moss was utilized as habitat for breeding. The larvae of *S. rubrocinctus* were collected from Spanish moss on sweet gum during Nov, Jan, and Feb (Table 2).

Discussion

The same *Frankliniella* and *Karnyothrips* species commonly were collected from Spanish moss epiphytic on *L. indica* × *fauriei* in Leon County, Florida (Funderburk et al. 2015). The phytophagous *F. bispinosa* and *F. tritici* are the most common species of thrips in flowers in northern Florida (Paini et al. 2007). All *Karnyothrips* are predatory on small arthropods (Mound 2005).

The adults of *F. bispinosa* and *F. tritici* are highly dispersive in their behavior (Ramachandran et al. 2001) and, as a result, land on a wide range of substrates including plants that are not hosts. *Frankliniella* adults were collected in this study mostly during Apr and May, which coincides with the traditional period of greatest population abundance and movement on crop (Ramachandran et al. 2001) and uncultivated hosts (Paini et al. 2007). The adults may simply have used the Spanish moss as a landing place, or the Spanish moss may have served as an important feeding or behavioral resource.

Funderburk et al. (2015) previously reported that Spanish moss was habitat for reproduction of *Karnyothrips*. Small arthropods including Acari, Psocoptera, Collembolla, and Coccidae are common inhabitants of Spanish moss (Whitaker & Ruckdeschel 2010). This suggests an abundance of suitable prey for both adult and larval *Karnyothrips*. Insects in the order Thysanoptera are mainly phytophagous or mycophagous, and obligate predation is limited to only several lineages (Mound 2005).

Selenothrips rubrocinctus is common throughout the Neotropics feeding on the leaves and fruits of cacao, *Theobroma cacao* L. (Malvales: Malvaceae) (Fennah 1965). The species is collected rarely in northern Florida, although dense populations were recorded recently in Leon

Table 1. The number of male and female adults of each thrips species collected from five 3.8 L samples of *Tillandsia usneoides* epiphytic on trees of different species in Leon and Gadsden Counties, Florida.

Thrips family & species	<i>Quercus</i> species	<i>Liquidambar styraciflua</i>	<i>Cornus florida</i>	<i>Carya illinoensis</i>
Heterothripidae				
<i>Heterothrips quercicola</i>	1 ♀	1 ♀	0	0
Thripidae				
<i>Chilothrips pini</i>	0	1 ♀	0	0
<i>Frankliniella bispinosa</i>	129 ♀, 1 ♂	88 ♀	103 ♀, 3 ♂	139 ♀
<i>Frankliniella tritici</i>	36 ♀, 1 ♂	8 ♀	13 ♀, 1 ♂	10 ♀
<i>Neohydatothrips variabilis</i>	2 ♀	0	0	0
<i>Selenothrips rubrocinctus</i>	0	1 ♀	0	0
Phlaeothripidae				
<i>Hoplandrothrips pergandei</i>	1 ♀	0	0	0
<i>Liothrips occellatus</i>	3 ♀	0	0	0
<i>Karnyothrips harti</i>	24 ♀	5 ♀	31 ♀	1 ♀
<i>Karnyothrips melaleucus</i>	17 ♀	8 ♀	4 ♀	4 ♀, 1 ♂
Total	215	113	155	166

Table 2. The number of adult and larval thrips of each species collected monthly between Dec 2011 and Nov 2012 from five 3.8 L samples *Tillandsia usneoides* in Leon and Gadsden Counties, Florida.

Species	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
<i>Heterothrips quercicola</i>	0	0	2	0	0	0	0	0	0	0	0	0
<i>Chlothrips pini</i>	0	0	1	0	0	0	0	0	0	0	0	0
<i>Frankliniella bispinosa</i>	1	0	0	0	211	234	12	5	0	0	0	0
<i>Frankliniella tritici</i>	20	11	1	0	13	16	4	0	0	0	0	8
<i>Frankliniella</i> species larvae	0	0	0	0	0	3	0	0	0	0	0	0
<i>Neohydatothrips variabilis</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Selenothrips rubrocinctus</i>	0	0	0	0	0	0	0	0	0	0	0	1
<i>Selenothrips</i> larvae	0	6	2	0	0	0	0	0	0	0	2	30
<i>Hoplandrothrips pergandei</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Liothrips occellatus</i>	3	0	0	0	0	0	0	0	0	0	0	0
<i>Karnyothrips harti</i>	0	0	0	4	1	24	11	7	13	4	7	5
<i>Karnyothrips melaleucus</i>	4	1	1	0	0	4	4	2	3	4	2	9
<i>Karnyothrips</i> larvae	9	3	1	1	5	1	22	2	4	2	6	6

County in Florida from *Rosa* species (Rosales: Rosaceae) in Feb 2013 (J. F., unpublished). The restless behavior of thrips can obscure biological significance. Many host-plant records represent nothing more than thrips finding places with no other biological significance (Mound 2013). There was no indication that Spanish moss was a host or even an important shelter for *L. occellatus*, *H. pergandei*, *N. variabilis*, *C. pini*, and *H. quercicola*. At most, a few adults of each of these species were collected over the course of the study, and no larvae of these species were collected.

In this study, the thrips fauna of Spanish moss epiphytic on *Quercus* species, *C. illinoensis*, *L. styraciflua*, and *C. florida* were very similar to the results of the thrips fauna of Spanish moss epiphytic on *L. indica* L. \times *fauriei* reported by Funderburk et al. (2015). Two species of *Karnyothrips* were common reproducing year-round. The adults of *Frankliniella* were common during the spring.

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