MEGALUROTHRIPS DISTALIS (THYSANOPTERA: THRIPIDAE) BREEDING IN THE FLOWERS OF KUDZU IN FLORIDA

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Two Oriental species of Thripidae are reported here from Florida breeding on the widespread cover-crop, kudzu, *Pueraria lobata* (Fabaceae), turned highly invasive. *Salpingothrips aimotofus* Kudo was described originally from Japan on *Pueraria*, but is reported more recently from Georgia (Braman et al. 1993). In contrast, *Megalurothrips distalis* (Karny), a species widespread in eastern Asia, is here identified from North America for the first time. *Megalurothrips* is an Old World genus associated with the flowers of Fabaceae, with one species from Africa and 12 from Southeast Asia. The African species, *M. sjostedti* (Trybom) and two of the Asian species, *M. usitatus* (Bagnall) and *M. distalis*, are known as pests of legume crops that sometimes require insecticidal control (Kooner et al. 2007). The identification here of *M. distalis* from Florida therefore has significance for crop production in this country.

The only previous record of *Megalurothrips* in USA was based solely on females, collected in Alabama, Florida, Georgia, South Carolina, and Tennessee (Diffie et al. 2008). These females were provisionally identified as *M. mucunae* Priesner, based on females in museum collections in Washington and Canberra. However, most species in this genus can be distinguished satisfactorily only in the male sex, because females all look very similar to each other (Palmer 1987). The males of two species, including *M. distalis*, are easily recognized by an array of short, spear-shaped setae ventrally on the abdomen (Fig. 1). A further problem is recognition of the plant species on which these thrips can maintain a population. These thrips are highly vagile, and the females that predominate in all populations land on many plants on which they cannot breed (Mound 2013).

Thrips were sampled during Jun, Jul, and Aug 2012 by beating kudzu plants over a plate at locations in Gadsden and Leon counties (N 30° 32' 52" W -84° 35' 36" and N 30° 28' 37" W -84° 21' 30", respectively). Thrips were transferred to 2-mL containers containing 70% ethyl alcohol using a small paint brush before being placed onto microscope slides for identification. The adult thrips were identified to species by the keys contained in Mound & Marullo (1996) and Palmer (1987). Other species of thrips were *Thrips hawaiiensis* (Morgan), *Frankliniella tritici* (Fitch), *F. bispinosa* (Morgan), *Haplothrips gowdeyi* Franklin, and *Leptothrips mali* (Fitch). Voucher specimens were deposited in the Florida State Collection of Arthropods, Florida Department of Agriculture and Consumer Services, Gainesville; in the Australian National Insect Collection, CSIRO, Canberra; and at the North Florida Research and Education Center, Quincy.

Six samples of 10 mature and 10 young leaves, 10 shoots, and 3 inflorescences (when available) were randomly collected on 11 dates in 2013 from the previous Gadsden County location. Samples were placed in 100-mL vials containing 70% ethyl alcohol. The numbers of adult and larval thrips of each species and the numbers of adult and nymphal *Orius insidiosus* (Say) (Hemiptera: Anthocoridae) were determined under a stereomicroscope at 17 to 230X magnification. Mean numbers on each plant part were compared using analysis of variance for a completely randomized design and the least significant difference at $P = 0.05$ using un-transformed data (PROC ANOVA, SAS Institute 2008). Because reliable morphological keys were not available to identify the thrips larvae, additional samples were taken to verify the species of larvae by rearing them to adulthood. Randomly selected flowers and shoots were clipped from the kudzu on 26 Aug and 7 Sep 2013, and the extracted larvae were placed individually in 30-mL plastic cups each containing a 2-cm section of green bean pod, *Phaseolus vulgaris* L. (Fabaceae). Male and female adults of *M. distalis* and *S. aimotofus* developed from the collected larvae. The morphology of first and second instars of *M. distalis* and *S. aimotofus* was distinctive from each other and from the larvae of the other species. Ratios of lar-

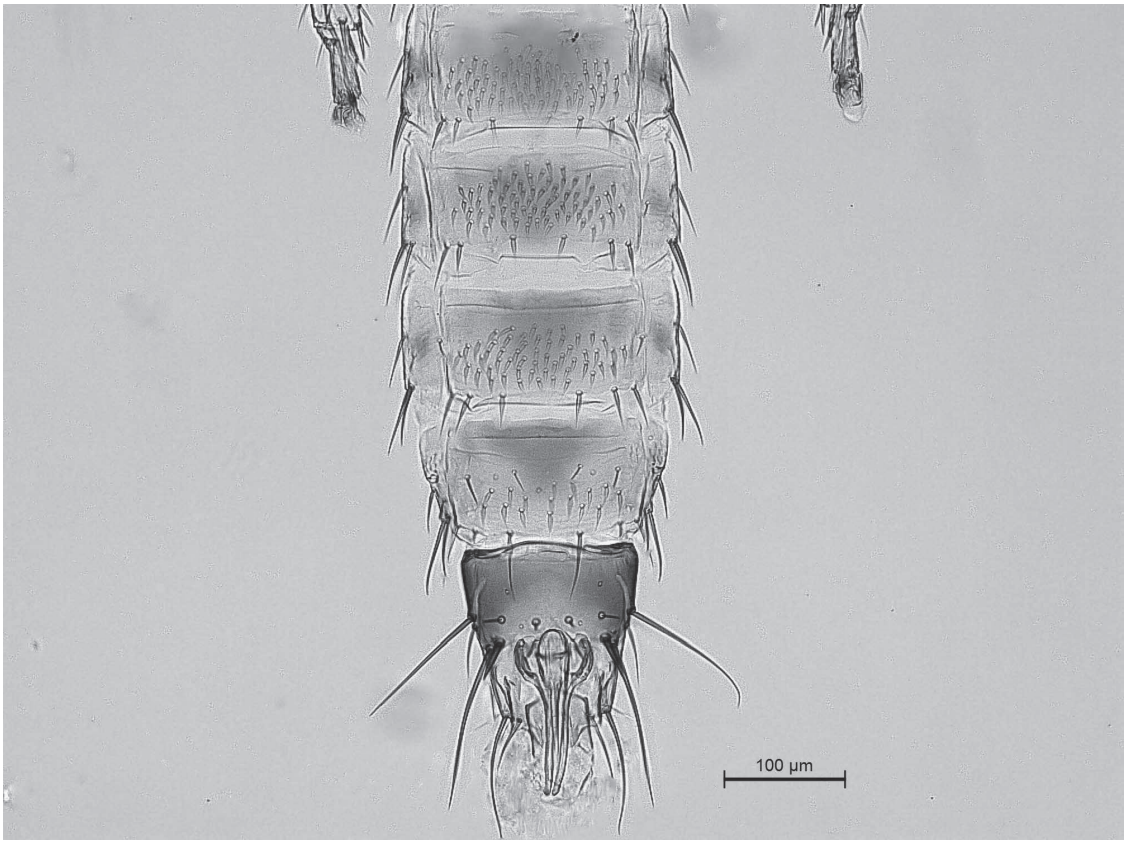

Fig. 1. The unique spear-shaped sternal discal setae of adult male *Megalurothrips distalis* that were collected from *Pueraria lobata* in northern Florida in 2012 and 2013.

vae per adult female of each thrips species of less than and greater than one were considered indicative of declining and increasing populations, respectively (Northfield et al. 2008).

The adults and larvae of *S. aimotofus* were highly aggregated in the kudzu shoots with a ratio of larvae to adult females of 2.6 (Table 1). In contrast, the adults and larvae of *M. distalis* were found only in the inflorescences. The mean number of adult and larval *M. distalis* and *S. aimotofus* per leaf, shoot, and inflorescence on sample dates during the flowering period are shown in Table 1. The ratio of larvae to adult females over all sample dates was 1.5, indicating an increasing population of *M. distalis* on kudzu. The total number of nymphs and adult *O. insidiosus* over all dates and plant parts was 15 and 22, respectively. This predator is capable of suppressing natural populations of *Franklinielle* species in Florida (Funderburk et al. 2000). Moreover, Viswanathan and Ananthakrishnan (1974) reported that the Asian anthocorid *O. minutus* L. is an effective predator of *M. distalis* and that predation is density-dependent.

The identity of the females of *Megalurothrips* reported by Diffie et al. (2008) remains in doubt due to the problems in identifying females in this genus. However, these females cannot be distinguished from those here identified as *M. distalis* through the presence of males, and it seems likely that this species is widely established across the southeastern USA.

Summary

Two Asian species of Thripidae are reported breeding in northern Florida on kudzu (*Pueraria lobata*), *Salpingothrips aimotofus* Kudo in the shoots, and *Megalurothrips distalis* Karny in the flowers, the latter being a new record for North America.

Key Words: aggregated distributed, host-plant dependencies, *Pueraria lobata*, larvae to adult ratio

Table 1. The mean number (SEM) on eleven 2013 sample dates of adult female, adult male, and larval *Megalurothrips distalis* and *Salpingothrips aimotofus* per *Pueraria lobata* plant part in Gadsden County, Florida (n for shoots, mature leaves, and young leaves = 6 samples of 10 plant parts and n for inflorescences = 6 samples of 3 inflorescences, when available). *F*- and *P*-values are from analyses of variance to compare mean numbers on different plant parts

	Mean Number of Thrips per Plant Part (SEM)					
	Megalurothrips distalis			*Salpingothrips aimotofus*		
Plant Structure	Females	Males	Larvae	Females	Males	Larvae
			3 Jun			
Shoot	0	0	0	4.1 a(1.6)	0.1(0.1)	6.6 a(2.4)
Mature Leaf	0	0	0	0 b	0	0 b
Young Leaf	0	0	0	0 b	0	0 b
Flower	—	—	—	—	—	—
$F_{2, 15}$	0	0	0	6.1	1.0	7.4
P	0.99	0.99	0.99	0.01	0.39	0.0006
			10 Jun			
Shoot	0	0	0	6.7 a(2.2)	0.2 a(0.1)	22.0 a(8.3)
Mature Leaf	0	0	0	0 b	0 b	0 b
Young Leaf	0	0	0	0 b	0 b	0 b
Flower	—	—	—	—	—	—
$F_{2, 15}$	0	0	0	9.3	8.9	7.0
P	0.99	0.99	0.99	0.002	0.003	0.007
			17 Jun			
Shoot	0	0	0	11.2 a(4.9)	0.3 a(0.1)	25.2 a(8.0)
Mature Leaf	0	0	0	0 b	0 b	0 b
Young Leaf	0	0	0	0 b	0 b	0.1 b(0.1)
Flower	—	—	—	—	—	—
$F_{2, 15}$	0	0	0	5.2	4.4	9.9
P	0.99	0.99	0.99	0.02	0.03	0.002
			24 Jun			
Shoot	0	0	0	9.9 a(2.8)	0.1 a(0.1)	30.0 a(7.2)
Mature Leaf	0	0	0	0 b	0 b	0 b
Young Leaf	0	0	0	0 b	0 b	0 b
Flower	—	—	—	—	—	—
$F_{2, 15}$	0	0	0	13.0	3.8	17.2
P	0.99	0.99	0.99	0.0005	0.05	0.0001

Mean numbers in each column of the same sample date are not significantly different at $P = 0.05$ according to the least significant difference.

TABLE 1. (CONTINUED) THE MEAN NUMBER (SEM) ON ELEVEN 2013 SAMPLE DATES OF ADULT FEMALE, ADULT MALE, AND LARVAL *MEGALUROTHRIPS DISTALIS* AND *SALPINGOTHRIPS AIMOTOFUS* PER *PUERARIA LOBATA* PLANT PART IN GADSDEN COUNTY, FLORIDA (N FOR SHOOTS, MATURE LEAVES, AND YOUNG LEAVES = 6 SAMPLES OF 10 PLANT PARTS AND N FOR INFLORESCENCES = 6 SAMPLES OF 3 INFLORESCENCES, WHEN AVAILABLE). *F*- AND *P*-VALUES ARE FROM ANALYSES OF VARIANCE TO COMPARE MEAN NUMBERS ON DIFFERENT PLANT PARTS

	Mean Number of Thrips per Plant Part (SEM)					
	Megalurothrips distalis			*Salpingothrips aimotofus*		
Plant Structure	Females	Males	Larvae	Females	Males	Larvae
			1 Jul			
Shoot	0	0	0	15.3 a(5.0)	0.2 a(0.1)	37.4 a(13.5)
Mature Leaf	0	0	0	0 b	0 b	0.1 b(0.1)
Young Leaf	0	0	0	0 b	0 b	0.2 b(0.1)
Flower	0.3(0.3)	0	0	0 b	0 b	0 b
$F_{3, 15}$	0.1	0	0	6.5	6.5	5.2
P	0.99	0.99	0.99	0.005	0.005	0.01
			8 Jul			
Shoot	0	0	0	13.8 a(2.6)	0.2 a(0.1)	37.6 a(8.0)
Mature Leaf	0	0	0	0 b	0 b	0.1 b(0.1)
Young Leaf	0	0	0	0 b	0 b	0.6 b(0.2)
Flower	0	0	0	0 b	0 b	0.1 b(0.1)
$F_{3, 15}$	0	0	0	19.5	10.3	14.7
P	0.99	0.99	0.99	0.0001	0.0006	0.0001
			15 Jul			
Shoot	0	0	0	10.8 a(4.7)	0.1 a(0.0)	37.2 a(4.7)
Mature Leaf	0	0	0	0 b	0 b	0 b
Young Leaf	0	0	0	0 b	0 b	0.5 b(0.2)
Flower	0	0	0.1(0.1)	0 b	0 b	0 b
$F_{3, 17}$	0	0	2.4	35.2	13.0	50.1
P	0.99	0.99	0.10	0.0001	0.0001	0.0001
			23 Jul			
Shoot	0	0	0	4.3 a(1.6)	0	12.2 a(6.0)
Mature Leaf	0	0	0	0 b	0	0 b
Young Leaf	0	0	0	0 b	0.2(0.2)	0.2 b(0.2)
Flower	0	0	0.3(0.3)	0 b	0	0 b
$F_{3, 18}$	0	0	0.9	6.6	2.2	3.5
P	0.99	0.99	0.5	0.003	0.13	0.04

Mean numbers in each column of the same sample date are not significantly different at $P = 0.05$ according to the least significant difference.

Table 1. (Continued) The mean number (SEM) on eleven 2013 sample dates of adult female, adult male, and larval *Megalurothrips distalis* and *Salpingothrips aimotofus* per *Pueraria lobata* plant part in Gadsden County, Florida (n for shoots, mature leaves, and young leaves = 6 samples of 10 plant parts and n for inflorescences = 6 samples of 3 inflorescences, when available). *F*- and *P*-values are from analyses of variance to compare mean numbers on different plant parts

	Mean Number of Thrips per Plant Part (SEM)					
	Megalurothrips distalis			*Salpingothrips aimotofus*		
Plant Structure	Females	Males	Larvae	Females	Males	Larvae
			29 Jul			
Shoot	0	0	0	2.4 a(1.1)	3.5 a(2.2)	3.2 a(1.9)
Mature Leaf	0	0	0	0 b	0 b	0 b
Young Leaf	0	0	0	0 b	0 b	0.1 b(0.1)
Flower	0.2(0.2)	0	0.5(0.4)	0 b	0 b	0 b
$F_{2, 14}$	1.6	0	2.6	3.8	2.1	2.3
P	0.23	0.99	0.11	0.05	0.17	0.14
			5 Aug			
Shoot	0	0	0 b	2.9 a(0.9)	0	0.8 a(0.2)
Mature Leaf	0	0	0 b	0 b	0	0b
Young Leaf	0	0	0 b	0 b	0	1.3 a(0.5)
Flower	0.4(0.4)	0.1(0.1)	1.0 a(0.7)	0 b	0	0 b
$F_{3, 17}$	2.4	2.4	5.1	9.1	0	4.6
P	0.10	0.10	0.01	0.0008	0.99	0.02
			29 Aug			
Shoot	—	—	—	—	—	—
Mature Leaf	0 b	0 b	0 b	0	0	0.1(0.1)
Young Leaf	—	—	—	—	—	—
Flower	1.7 a(0.2)	0.7 a(0.1)	2.5 a(0.7)	0	0	0
$F_{1, 8}$	106.7	37.5	19.2	0	0	0.6
P	0.0001	0.0003	0.002	0.99	0.99	0.44

Mean numbers in each column of the same sample date are not significantly different at $P = 0.05$ according to the least significant difference.

RESUMEN

Adultos y larvas de *Megalurothrips distalis* Karny fueron encontrados agregados en flores de *Pueraria lobata* (Wildenow) Ohwi en el norte de la Florida. Este es un nuevo registro para América del Norte.

Palabras Clave: agregados distribuidos, dependencia de la planta hospedera, *Pueraria lobata*, proporción de larvas y adultos

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