

NEW COLLECTION RECORDS AND HOST RANGE OF THE COTTONWOOD LEAFCURL MITE, *TETRA LOBULIFERA* (KEIFER) (ACARI: ERIOPHYIDAE), IN THE USA*

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ABSTRACT - The cottonwood leafcurl mite, *Aculops lobuliferus* Keifer, 1961, is renamed as *Tetra lobulifera* (Keifer). This eriophyid mite is capable of inflicting substantial damage on plantation- and native-grown cottonwoods (*Populus* spp.). We report new State and County collection records from the eastern and northwestern U.S.A. as well as new host records, including *Populus grandidentata* Michx. (big-tooth aspen), for this pest. This updates the established geographic range of *T. lobulifera*, and demonstrates its ability to utilize other host plants in the genus *Populus* for development.

Key words - Acari, Eriophyidae, cottonwood leafcurl mite, distribution, *Populus*, *Tetra lobulifera*, USA.

INTRODUCTION

Tetra lobulifera (Keifer, 1961) (Keifer, 1961, 1966) is one of several North American eriophyid mites that feed on trees in the genus *Populus* (Salicales: Salicaceae) (Wilson and Oldfield, 1966). *Tetra lobulifera* actively feeds on both surfaces of young foliage of *Populus deltoides* Bartr. ex Marsh, and then migrates to hibernates in bark crevices or at the base of the tree trunk (Morris *et al.*, 1975). All *T. lobulifera* life stages can be found together on young leaf tissues (Morris *et al.*, 1975). Populations increase in dry conditions (Morris *et al.*, 1975). As of this date, deutogynes have not been found for this mite.

The damage first appears as leaf curling and discoloration, leading to premature leaf abscission and, in some cases, terminal mortality (Coyle, 2002). *Tetra lobulifera* can be a severe pest in nurseries (Keifer, 1961; Morris *et al.*, 1975) as well as established plantations (Coyle, 2002). Foliar damage can be exacerbated, in part, by certain cultural treatments such as fertilization (Coyle, 2002) which is often employed in commercial plantings

(Stanton *et al.*, 2002). Currently, the only effective means of control is chemical (Newsome and Solomon, 1980; Coyle, 2002).

Morris *et al.* (1975) stated that *T. lobulifera* occurred throughout most of the commercial range of *Populus*, yet few confirmed collections exist. Until recently, *T. lobulifera* had been confirmed in only four states: West Virginia, South Dakota, Mississippi, and Ohio (Baker *et al.*, 1996). Coyle (2002) documented *T. lobulifera* in South Carolina on *P. deltoides*. This is the only host plant reported for *T. lobulifera* (Keifer, 1961; Wilson and Oldfield, 1966; Briones and McDaniel, 1976; Davis *et al.*, 1982; Amrine and Stasny, 1994; Baker *et al.*, 1996). Here we present several new State and County collection records for *T. lobulifera*, as well as information regarding previously undocumented host plants.

MATERIALS AND METHODS

Mites were collected from leaves of cottonwood and big-tooth aspen and processed according to the methods

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Table 1. *Tetra lobulifera* collection and host records as of summer 2003.

State	County	<i>Populus</i> host	Reference
Georgia	Richmond	<i>P. deltoides</i> Bartr. ex Marsh.	New record
Indiana	Jefferson	<i>P. deltoides</i> Bartr. ex Marsh.	New record
Mississippi	Washington	<i>P. deltoides</i> Bartr. ex Marsh.	Keifer, 1961
North Carolina	Robeson	<i>P. deltoides</i> Bartr. ex Marsh.	New record
		<i>P. trichocarpa</i> × <i>P. deltoides</i>	New record
Ohio	Franklin	<i>P. deltoides</i> Bartr. ex Marsh.	Baker <i>et al.</i> , 1996
Oregon	Morrow	<i>P. deltoides</i> Bartr. ex Marsh.	New record
Oregon	Morrow	<i>P. trichocarpa</i> × <i>P. deltoides</i>	New record
		<i>P. trichocarpa</i> × <i>P. nigra</i>	New record
		<i>P. deltoides</i> × <i>P. trichocarpa</i>	New record
		<i>P. deltoides</i> × <i>P. nigra</i>	New record
South Carolina	Aiken	<i>P. deltoides</i> Bartr. ex Marsh.	Coyle, 2002
		<i>P. trichocarpa</i> × <i>P. deltoides</i>	New record
		<i>P. deltoides</i> × <i>P. maximowiczii</i>	New record
		<i>P. deltoides</i> × <i>P. nigra</i>	New record
		<i>P. nigra</i> × <i>P. maximowiczii</i>	New record
		<i>P. trichocarpa</i> × <i>P. nigra</i>	New record
South Carolina	Barnwell	<i>P. deltoides</i> Bartr. ex Marsh.	New record
		<i>P. trichocarpa</i> × <i>P. deltoides</i>	New record
		<i>P. deltoides</i> × <i>P. maximowiczii</i>	New record
		<i>P. deltoides</i> × <i>P. nigra</i>	New record
		<i>P. nigra</i> × <i>P. maximowiczii</i>	New record
South Carolina	Lexington	<i>P. deltoides</i> Bartr. ex Marsh.	New record
South Dakota	Brookings	<i>P. deltoides</i> Bartr. ex Marsh.	Briones and McDaniel, 1976
Washington	Walla Walla	<i>P. deltoides</i> Bartr. ex Marsh.	New record
West Virginia	Monongalia	<i>P. deltoides</i> Bartr. ex Marsh.	Baker <i>et al.</i> , 1996
West Virginia	Monongalia	<i>P. grandidentata</i> Michx.	New record

of Amrine and Manson (1996). As many as 15-20 mites were placed on individual slides. Mites were also retained on dried leaf material in labelled envelopes. Identification was made by the second author using keys of Amrine (1996) and Amrine *et al.* (2003), and by comparison with descriptions and illustrations in Keifer (1961), Jeppson and Keifer (1975) and Baker *et al.* (1996), and to slide material on hand at West Virginia University.

RESULTS

The cottonwood leafcurl mite, formerly known as *Aculops lobuliferus* Keifer, 1961, is renamed *Tetra lobulifera* (Keifer). Preparations of this mite show that in both sexes the opisthosoma has a wide dorsal trough, bordered by marginal ridges (Figs. 1, 2), which are the characters of *Tetra*, and necessitate reassignment of the mite. This character was uniformly present in all preparations and is not an artifact.

Tetra lobulifera was found in many additional locations as follows.

COLLECTIONS

Georgia - *Tetra lobulifera* was collected south of Augusta, Georgia, in Richland County (33.4° N, 82.0°

W). Collections were made on a 1-year-old plantation comprised of several *P. deltoides* selections (Table 1). The 3-acre planting was located on the Savannah River floodplain, and was surrounded by native bottomland hardwoods including sycamore (*Platanus occidentalis*), sweetgum (*Liquidambar styraciflua*) and several oak (*Quercus*) and willow (*Salix*) species. The plantation was fertilized in spring of 2003 and did not receive irrigation.

Indiana - *Tetra lobulifera* was collected in Madison, Jefferson County, Indiana (38.5° N, 85.7° W), at Clifty Falls State Park from naturally occurring *P. deltoides* on 19 May 1988.

North Carolina - *Tetra lobulifera* was collected in Robeson County, North Carolina (34.6° N, 79.0° W). Collections were made on an irrigated and fertilized 1-year-old commercial plantation near Lumberton, NC. The 8-acre plantation contained pure and hybrid *Populus* selections (Table 1), both of which supported *T. lobulifera* populations. The plantation was surrounded by predominantly mixed pine (*Pinus* sp.) forest.

South Carolina - *Tetra lobulifera* was collected in Aiken (33.2° N, 81.4° W), Barnwell (33.1° N, 81.4° W), and Lexington (34.0° N, 81.2° W) Counties in South Carolina. The Aiken and Barnwell Co. collections were made on the Savannah River Site, a National Environmental Research Park, located near Aiken, SC. Mites

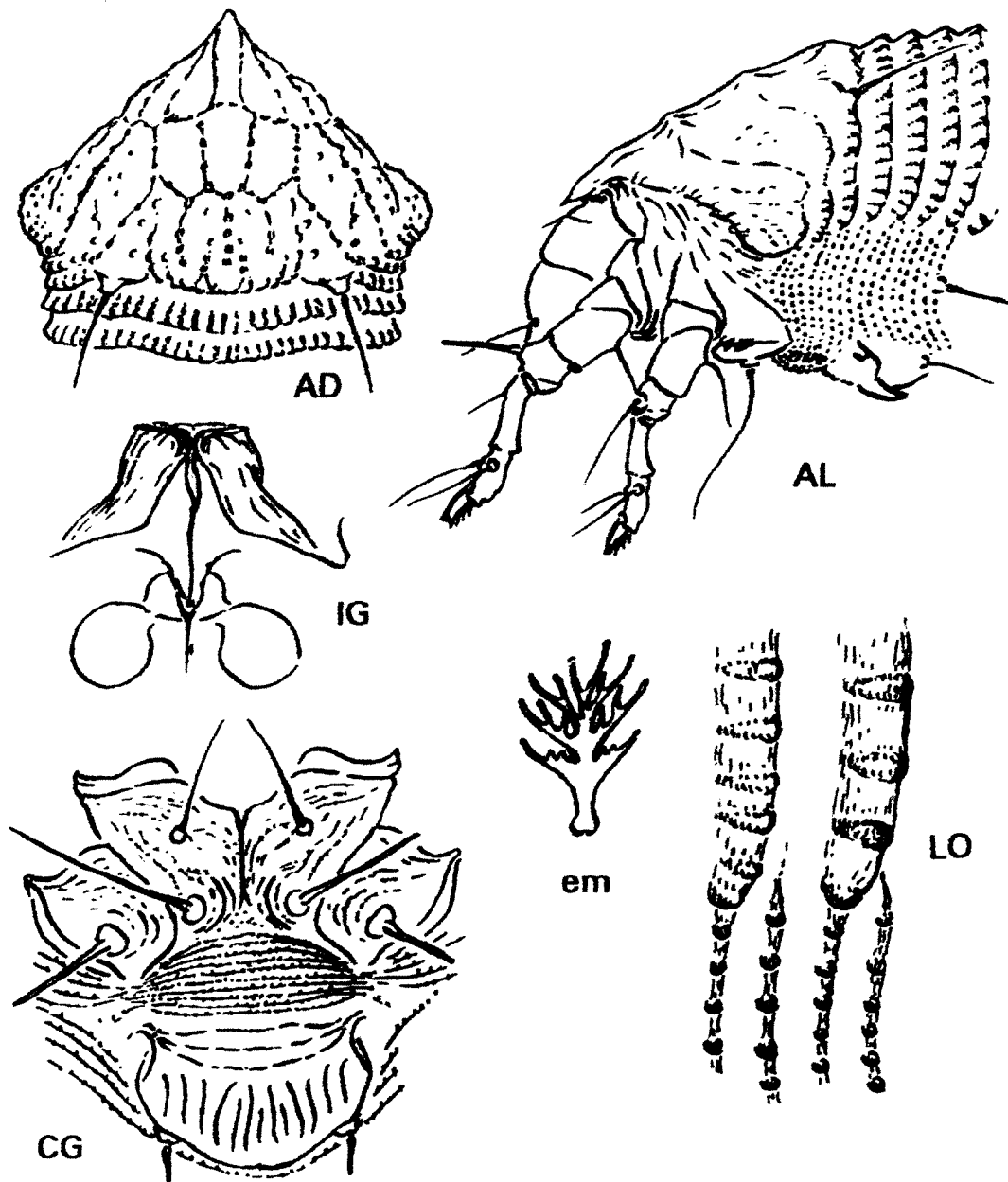


Fig. 1. Keifer's illustration of the cottonwood leaf curl mite, *Tetra lobulifera* (Keifer): AD, anterodorsal mite; AL, anterolateral mite; CG, coxcox-genital region; em, empodium; LO, lateral opisthosoma.

were collected on an irrigated and fertilized *P. deltoides* research plantation (Coyle, 2002). The Barnwell Co. collection, also made on the Savannah River Site, occurred on several *Populus* hybrids (Table 1) in a small study plot near the Savannah River. This plot was in the first year of a larger study (WSRC, 2000) and received drip irrigation containing low levels of trichloroethylene. This study was surrounded by a mixed bottomland hardwood/pine forest, and was adjacent to a coal burning facility. In both Aiken and Barnwell counties, *T. lobulifera* occurred on *P.*

deltoides as well as several hybrids (Table 1). All hybrids are new host records. The Lexington Co. collection was made within the Lexington town limits. This collection was made on wild *P. deltoides* trees growing in the Twelve Mile Creek floodplain just north of an apartment complex. Trees were in their second growing season. Surrounding vegetation included sweetgum (*L. styraciflua*), tulip poplar (*Liriodendron tulipifera*), black willow (*Salix nigra*), cattails (*Typha latifolia*), and several oak (*Quercus*) species.

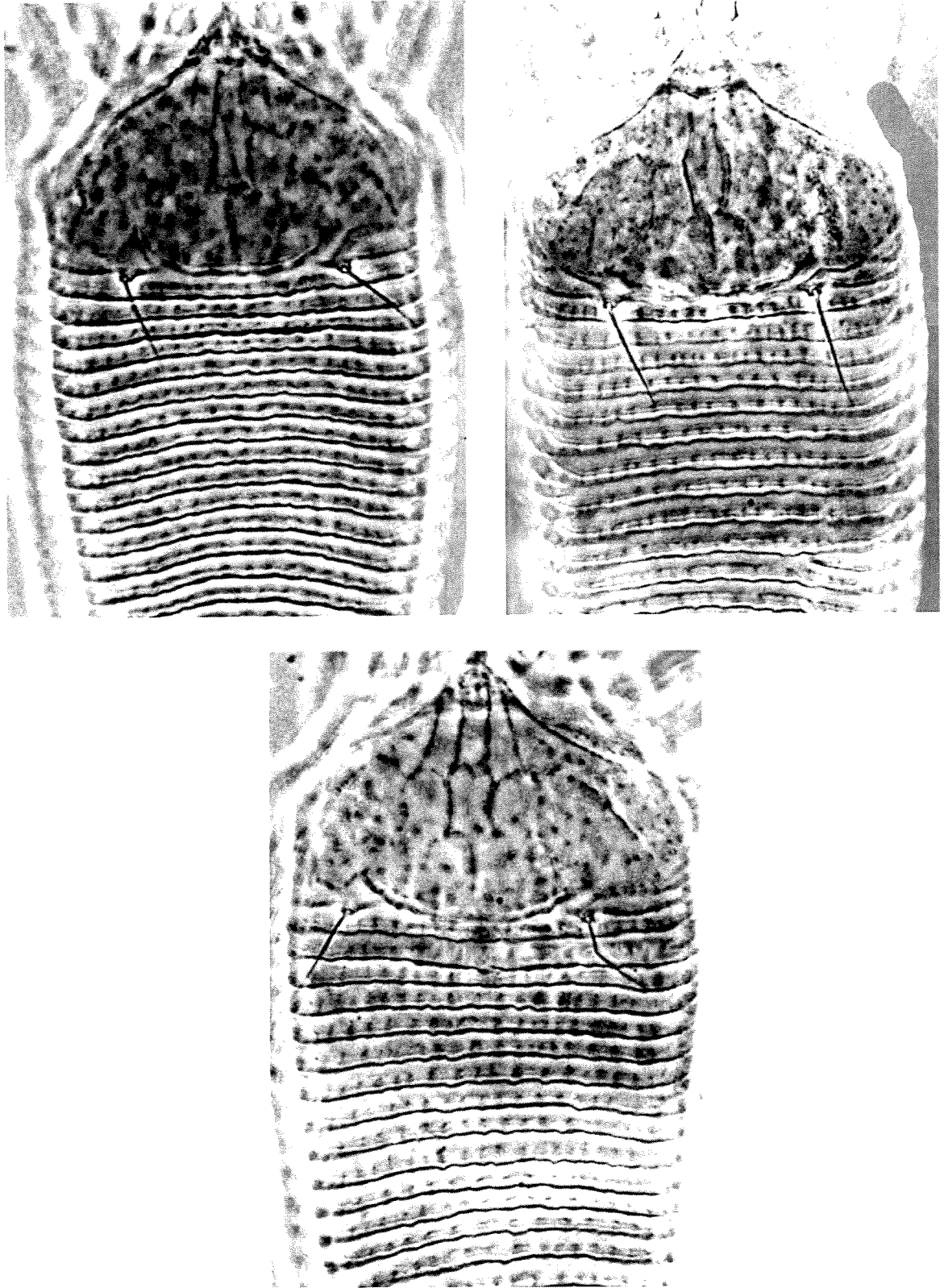


Fig. 2. Photographic montages of three female *Tetra lobulifera* (Keifer) from *P. deltoides* hybrid, Morrow Co., Oregon, August 2003.

Oregon - *Tetra lobulifera* was collected on two commercial plantations in Morrow County, Oregon (45.2° N, 119.3° W) (Table 1). Both collections were from irrigated and fertilized *Populus* plantations. The first collection was on a 6-year-old plantation several thousand acres in size that consisted primarily of *P. deltoides*. The second collection occurred on a 1-year-old clone trial. Several *Populus* hybrids were infested (Table 1). Both plantations were surrounded by agricultural land.

Washington - *Tetra lobulifera* was collected in Walla Walla County, Washington (46.1° N, 118.3° W). This collection occurred on an irrigated and fertilized commercial 6-year-old *P. deltoides* plantation (Table 1). The plantation was several hundred acres in size and surrounded by agricultural land and other *Populus* plantations.

West Virginia - *Tetra lobulifera* was collected in Monongalia County, West Virginia, Camp Mountaineer Boy Scout Camp (39.3° N, 79.9° W) on 7 July 1995 from big tooth aspen, *P. grandidentata* Michx. This is a new alternate host; mites were sparse, but taken in four collections.

DISCUSSION

Several new *T. lobulifera* collections were recorded in the southeastern and northwestern regions of the United States, bringing the number of states with positive *T. lobulifera* identifications to ten (Table 1).

Questions remain regarding the distribution and ecology of *T. lobulifera*. Is *T. lobulifera* being spread, either by human or wind (Zhao and Amrine, 1997), into areas not previously colonized? Dormant cottonwood cuttings are often shipped great distances from supplier to grower, and this could provide a means for *T. lobulifera* introduction into new areas. We investigated this possibility by examining 50 field collected *P. deltoides* hardwood cuttings, similar to those that would be shipped to growers, collected from the Savannah River Site in winter 2002. Cuttings were from trees with known *T. lobulifera* populations the previous summer. Bud scales on 50 cuttings were examined, but no *T. lobulifera* were found. Introductions via bark crevices on larger timber are unlikely, as harvested timber is usually milled locally.

To our knowledge there have been no studies examining the potential or realized host range of *T. lobulifera*. Due to the minute size of most mites, this group of fauna may go unnoticed, particularly if inhabiting tree canopies (Walter and Behan-Pelletier, 1999). Mite species richness has been greatly underestimated, and there is a lack of mite diversity studies compared to other biota (Walter and Behan-Pelletier, 1999). This makes it difficult to determine if *T. lobulifera* is expanding its host and geographic range, or if this pest is cosmopolitan in its distribution across the U.S., with localized populations occur-

ring naturally on native *Populus* stands as in Lexington Co., SC, Monongalia Co., WV, or Jefferson Co., IN. To this point, no alternate hosts had been reported for *T. lobulifera* (Amrine and Stasny, 1994). However, we found *T. lobulifera* on several hybrid *Populus* species and *P. grandidentata* (Table 1), confirming that the host range for *T. lobulifera* is much greater than just *P. deltoides*. Arthropod preference and increased performance has been documented on hybrid plants, particularly with the poplar bud gall mite, *Aceria parapopuli* Keifer (Acari: Eriophyidae) on the cottonwood hybrids *P. fremontii* × *P. angustifolia* (Whitham *et al.*, 1999; McIntyre and Whitham, 2003) and *P. deltoides* × *P. balsamifera* (Kalischuk *et al.*, 1997). In each of these studies, significantly higher numbers of galls occurred on hybrid compared to the pure species parent trees. *Populus* is known to readily hybridize among natural populations (Eckenwalder, 1996), thus creating a large potential host range for *T. lobulifera*. Mite populations may be exacerbated if *T. lobulifera* shows enhanced development on hybrids, as seen with *A. parapopuli*.

This paper provides evidence that *T. lobulifera* has a larger geographic distribution and host range in the U.S. than was previously known. Data are scarce regarding *T. lobulifera* biology, host range and preference, and distribution. Commercial cottonwood plantations frequently receive silvicultural treatments such as irrigation and fertilization (Stanton *et al.*, 2002). Coyle (2002) documented increased foliar injury and terminal mortality from *T. lobulifera* on trees receiving additional silvicultural treatments, and showed the potential economic impact of this species. Additional studies are needed to identify mite biology, modes of dispersal, and true economic impact, particularly in commercial plantings.

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