

Impact of Introduced Basswood Thrips on Forest Health in the Great Lakes Region: Relationship with Predators and Host Plants

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INTRODUCTION

The introduced basswood thrips, *Thrips calcaratus* Uzel, has been associated with decreased crown condition of American basswood, (*Tilia americana* L.) in the Great Lakes region (Fig. 1). Adults (Fig. 2) emerge from the soil in spring and feed on developing buds and young foliage. Females reproduce asexually and oviposit into leaf midveins. Larvae feed on foliage for two weeks before dropping to the soil, where they overwinter in a "pupa like" stage. *T. calcaratus* is not a pest within its native European range, but has the potential to become damaging in its introduced range due to a lack of natural enemies or coevolution with host plant defenses.

Figure 1: a) Thin basswood crown b) Bud damaged by *T. calcaratus* c) Undamaged bud



Figure 2: *T. calcaratus* adult



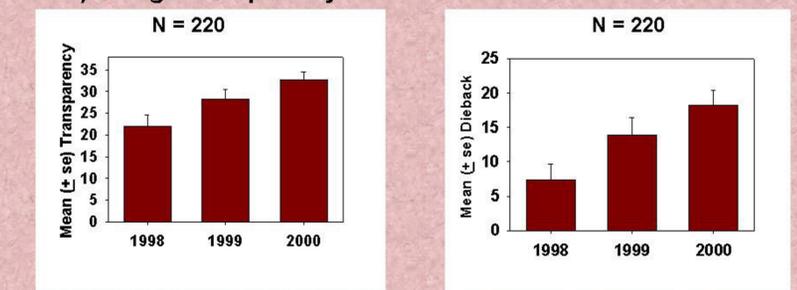
Table 1: Relative Abundance of predominant Thysanoptera obtained from *T. americana* foliage samples, 1998-2000

Species	Introduced or Native	Herbivore or Predator	Total # Adults	Total # Larvae
<i>Thrips calcaratus</i>	I	H	24,945	106,681
<i>Taeniothrips inconsequens</i>	I	H	9	335
<i>Neohydatothrips tiliae</i>	N	H	399	3,372
<i>Leptothrips mali</i>	N	P	100	39
<i>Aeolothrips melaleucus</i>	I	P	12	0

Thysanoptera obtained from the paired seedling planting were distributed evenly between *T. americana* and *T. cordata*. The laboratory bioassay yielded similar results, with equal numbers of *T. calcaratus* obtained on both species. During each 12 h. observation period, 35%-46% of thrips switched tree species.

T. americana crown condition decreased in the Great Lakes region from 1998-2000 (Fig. 4). Mean transparency increased from 22 to 33% among the study sites from 1998-2000. Mean dieback increased from 7 to 17% from 1998-2000.

Figure 4: Mean annual condition of basswood in Great Lakes region
4 a) Foliage Transparency
4 b) Branch Dieback



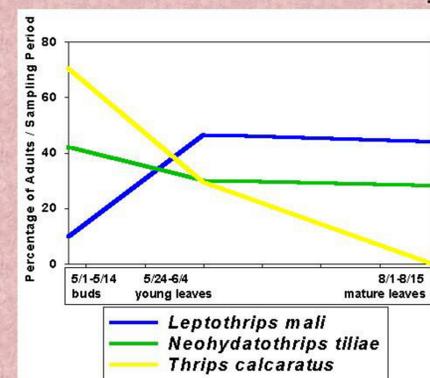
RESULTS

Five species of Thysanoptera representing over 135,000 individuals were collected from foliage samples from 1998-2000 (Table 1). *Thrips calcaratus* comprised over 99% of total abundance. Other herbivorous Thysanoptera obtained include the pear thrips, *Taeniothrips inconsequens* and the native basswood thrips, *Neohydatothrips tiliae*. The predaceous *Leptothrips mali* and *Aeolothrips melaleucus* were also obtained. Introduced species far outnumbered natives, and herbivores far outnumbered predators (Table 1). Relatively few lepidopteran larvae (about 1,100) were obtained.

Adults of the introduced herbivore, *T. calcaratus*, emerge early in the season when buds, which are most sensitive to feeding, are present (Fig. 3). Abundance of this species decreases sharply by August. In contrast, most native basswood thrips, *N. tiliae*, emerge later in the season when mature foliage is present (Fig. 3). Temporal synchrony with the native predator, *L. mali*, is high for the native herbivore, but low for the introduced species (Fig. 3). The introduced predator, *Aeolothrips mali* showed high temporal synchrony with introduced herbivores, but was rarely obtained (Table 1). The ratio of herbivores to predators was 871 for the introduced basswood thrips and 25 for the native basswood thrips.

120 Thysanoptera were obtained from the adult emergence - host synchrony experiment. 79 were from 6 sites in the Great Lakes region; 41 were obtained in Croatia, Finland, Hungary, Norway and Sweden. *T. calcaratus* dominated trap catch in both regions. Abundance of *T. calcaratus* peaked in both regions just before budbreak.

Figure 3: Seasonal Abundance of Adult Thysanoptera



OBJECTIVES

Compare relative abundance and phenology of native and introduced insect herbivores and predators associated with *T. americana*

Evaluate reasons for differential damage of *T. calcaratus* in its native and introduced range: examine relationships with host and predators

Assess basswood crown condition

METHODS

Established 22 sites in northern hardwood forests in MN, WI, and MI in 1998 to monitor insects and basswood condition: foliage transparency and branch dieback

Sampled foliage of 10 trees / site using shotgun, pole-pruner, or tree climber twice in 1998 (May, June) and 3 times in 1999 and 2000 (May, June, August). Lepidoptera larvae sampled using burlap from May - June, 1998 - 2000

Evaluated synchrony of adult *T. calcaratus* emerging from soil in spring with budbreak of primary hosts in introduced and native ranges, *T. americana* in North America vs. *T. cordata* in Europe, from April - June 2001

Planted 100 *T. americana* and *T. cordata* seedlings in a paired design in a Wisconsin site with high thrips populations; sampled foliage 3 times in 2001

Performed laboratory preference bioassays with field collected thrips and foliage of *T. americana* and *T. cordata* in April 2001

CONCLUSIONS

Introduced herbivorous Thysanoptera, especially *T. calcaratus*, dominate insect abundance on *Tilia* in the Great Lakes region. This was associated with increased crown dieback and foliage transparency.

Introduced species of Thysanoptera are associated with *Tilia* buds and young leaves, while native species are associated with mature leaves. Results of the emergence synchrony experiment, seedling planting, and *Tilia* bioassay indicate similar relationships between *T. calcaratus* and its host plant in its native European and introduced North American ranges. Impacts of *T. calcaratus* on forest health appear to arise largely from escape from predators in its introduced range.

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