

Great Lakes Basswood Decline Evaluation

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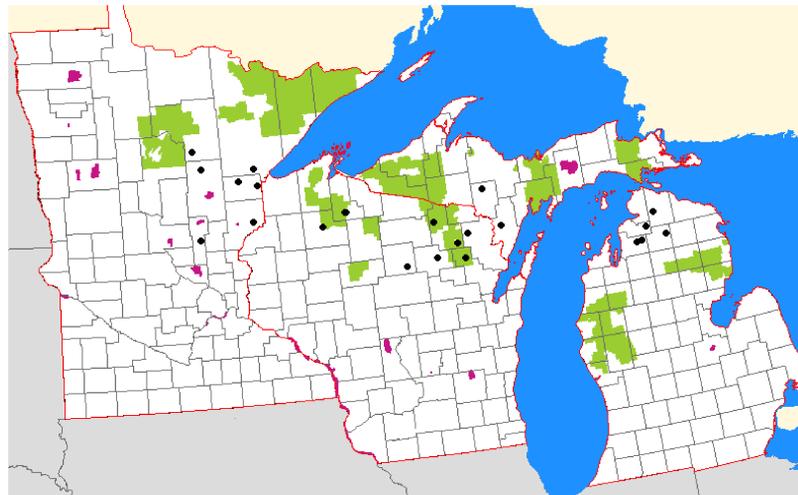
Introduction

Forest Health Monitoring in the Great Lakes Region has recorded increases in crown dieback, foliage transparency and mortality of American Basswood, *Tilia americana* L. (Figure 1). This project was initiated in 1998 to determine causal agents related to this problem.

Objectives

- Assess annual basswood crown condition
- Determine insect species composition and abundance among *Tilia americana* sites in the Great Lakes region
- Estimate reasons for decline in basswood condition site factors
- Determine factors associated with basswood health

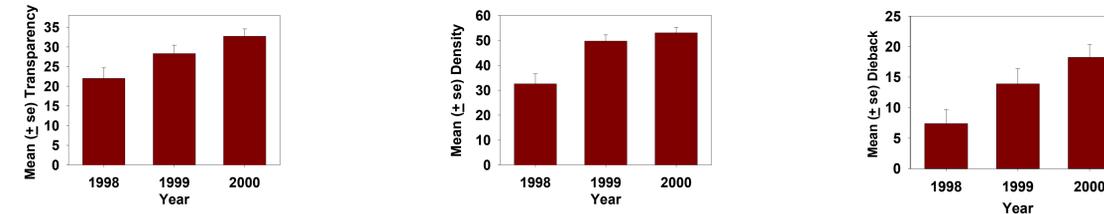
Figure 2: Map of Intensive Study Sites



Methods

- 22 sites established in 1998 to monitor basswood condition (FHM data), insects, soil, and other site factors (Figure 2), in collaboration with J. Witter (University of MI) who is monitoring basswood at 78 additional sites in the Great Lakes region
- Two 15 x 30 plots per site
- Sites/plots chosen to maximize overlap with previous monitoring networks (MIMS, FHM, NAMP)
- Basswood condition monitored using FHM protocol to measure branch dieback, foliage transparency, crown density in June and August from 1998-2000
- Insects sampled from foliage of ten basswood trees per site using shotgun, pole pruner, or tree climber twice in 1998 (May, June) and three times in 1999 and 2000 (May, June, August)
- Lepidoptera sampled from bole using burlap bands applied to ten trees per site from May to June from 1998-2000.
- Soil cores from 5 random points per site in 1999. Samples analyzed for relative site pH, organic matter, P, K, Ca, Mg, nitrate and ammonium.
- Increment cores from 5 basswood trees per site in 2000

Figure 3: Mean annual condition of basswood in Great Lakes region



Results

Mean transparency increased from 22 to 33% among the study sites from 1998-2000. Mean dieback increased from 7 to 17% from 1998-2000. Surprisingly, average crown density also increased from 1998-1999, possibly due to the necessity of elimination of trees which died as the study progressed. High variability in transparency, density, dieback, and soil type was observed among sites (Figure 2). Disease was rarely observed. Site conditions, including temperature, precipitation, and site history will be correlated with basswood condition to evaluate factors related to basswood health.

Nine species of Thysanoptera, representing over 82,000 individuals, were collected from foliage samples from 1998-1999 (Figure 5). The introduced basswood thrips (*Thrips calcaratus*) dominated insect abundance, accounting for over 99% of total Thysanoptera (Figure 6a). Other herbivorous Thysanoptera obtained include the pear thrips, *Taeniothrips inconsequens* (Figure 6b), and the native basswood thrips, *Neohydatothrips tiliae*. The pear thrips is only known to damage sugar maple and the native basswood thrips is not known to damage basswood. *Leptothrips mali*, the Black Hunter thrips, a predaceous species, was also caught in low abundance. Introduced species far outnumbered native thrips species, comprising at least 95% of the total insect abundance obtained from foliage samples in 1998 and 1999 (Figure 7).

Very few lepidopteran larva were obtained from burlap bands and basswood foliage. Among the samples, basswood leafroller, linden looper, gypsy moth, and forest tent caterpillar were the predominant species.

Figure 4: Mean 2000 basswood condition among study sites in Great Lakes Region

Site	Transparency	Density	Dieback
Antrim 105	31.25 (1.92)	52.75 (2.04)	10.25 (1.12)
Antrim 106	29.75 (2.28)	50.00 (3.66)	15.00 (2.69)
Charlevoix 242	32.04 (2.52)	47.05 (3.96)	15.23 (2.07)
Cheboygan 101	29.50 (1.62)	52.75 (2.10)	13.75 (1.35)
Otsego 244	32.00 (1.56)	53.75 (2.02)	15.75 (1.22)
Dickinson	30.75 (2.79)	55.75 (2.65)	16.25 (3.48)
Menominee 16	28.50 (1.50)	58.00 (1.05)	12.75 (1.79)
NAMP 3	37.25 (1.90)	50.25 (1.94)	21.25 (2.17)
NAMP 4	28.00 (1.47)	59.00 (1.80)	18.00 (2.16)
NAMP 5	32.00 (1.33)	58.00 (1.38)	16.00 (1.65)
NAMP 6	30.00 (0.96)	53.50 (1.96)	10.75 (1.04)
FHM 44	34.00 (1.72)	54.25 (1.51)	14.25 (1.51)
FHM 68	26.82 (1.34)	57.95 (1.38)	18.86 (1.74)
NAMP 16	33.75 (2.08)	47.50 (2.89)	30.50 (2.51)
NAMP 14	39.75 (2.45)	42.50 (3.02)	31.75 (3.27)
Cloquet B	36.25 (2.02)	45.25 (3.02)	21.50 (3.08)
Cloquet C	37.00 (2.00)	48.50 (2.52)	29.00 (2.61)
Cloquet A	38.25 (2.60)	51.75 (2.38)	18.00 (2.06)
Grand Rapids D	35.75 (1.79)	52.50 (1.97)	27.00 (3.35)
Hill City F	32.75 (2.36)	57.75 (2.34)	18.50 (2.50)
Duxbury G	32.75 (1.56)	58.75 (1.73)	14.00 (1.34)
Onamia H	32.00 (1.56)	59.50 (1.85)	13.50 (1.36)
F (p > F)	3.23 (0.001)	4.23 (0.0001)	7.76 (0.0001)

Figure 1: a) Thin basswood crown and mortality in Great Lakes region, b) Basswood bud, damaged by *Thrips calcaratus* feeding and c) Undamaged basswood bud

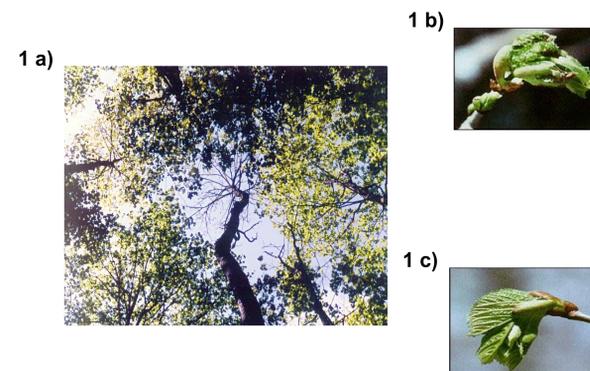


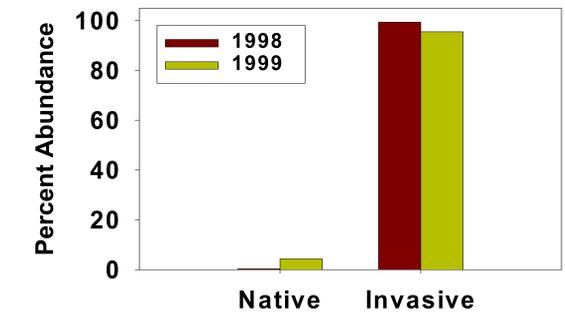
Figure 5: Relative Abundance of Thysanoptera species obtained from

Species	basswood	Larvae	Adults	Total
Introduced basswood thrips, <i>Thrips calcaratus</i> Uzel		61761	17363	79124
Pear thrips, <i>Taeniothrips inconsequens</i> (Uzel)		247	3	250
Native basswood thrips, <i>Neohydatothrips tiliae</i> (Hood)		2745	214	2959
Black hunter thrips, <i>Leptothrips mali</i> (Fitch)		38	75	113
<i>Aeolothrips melaleucus</i> Halliday		1	1	2
<i>Haplothrips kurdjumovi</i> Karny		0	9	9
<i>Aeolothrips</i> sp.		2	1	3
<i>Frankliniella</i> sp.		2	1	3
<i>Leptothrips</i> sp.		1	0	1
Total 1998/99 Thysanopteran Abundance				82464

Figure 6: a) Introduced basswood thrips, *Thrips calcaratus*; adult feeds on basswood buds in early spring in Great Lakes region b) SEM photo of larva of pear thrips, *Taeniothrips inconsequens*, a species that is more strongly associated with sugar maple than basswood



Figure 7: Mean abundance of native and introduced Thysanoptera in basswood



Conclusions

- Crown dieback and foliage transparency increased from 1998-2000.
- High variability in transparency, density, dieback, and soil type was observed among sites
- *Thrips calcaratus* appears to be primary agent of basswood decline, while lepidopteran herbivores and disease appear to be a minor contributors
- Thysanoptera species composition shows temporal and spatial variation among collections, states, sites and trees
- Introduced Thysanoptera (especially *T. calcaratus*) dominate insect abundance in *Tilia* sites of the Great Lakes region
- Introduced species of Thysanoptera are associated with *Tilia* buds and young leaves, while native species are associated with mature leaves