



# Evaluation of Yellow-poplar Decline in Indiana

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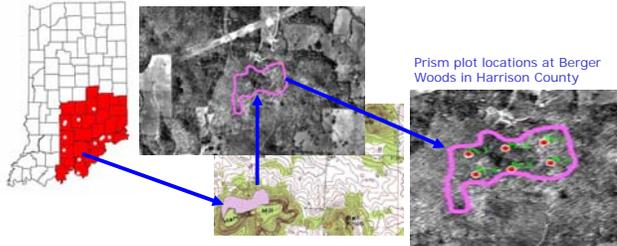
## Introduction

Yellow-poplar (*Liriodendron tulipifera*) is an important component of Indiana's hardwood forests. The species comprises nearly 13% of state sawtimber volume, and the stand is valued at well over \$800 million using current stumpage prices. Yellow-poplar grows best on rich, mesic sites and has been long regarded a drought-sensitive forest species.

Indiana foresters have reported pockets of declining yellow-poplar in southeastern parts of the state, following substantial, prolonged droughts in 1999 and 2002. Decline symptoms include chlorosis of leaves, sparse crown, dieback, trunk and branch cankers, and root sprouts.

In this study, observations were conducted on 223 yellow-poplar trees in 62 prism plots at 12 locations. The purpose of this study was to identify factors associated with yellow-poplar decline in southeastern Indiana and evaluate the effectiveness of FHM/FIA data and methods in detecting yellow-poplar decline.

Southeastern Indiana showing yellow-poplar decline study locations



## Methods

Foresters working in southeast Indiana were surveyed during spring 2004, to locate tracts of declining yellow-poplar. A reconnaissance survey was conducted in each tract

Tracts with sufficiently extensive areas and numbers of decline-symptom trees were surveyed using 10 basal area factor prism plots. Parameters measured in each plot include:

### 1. Plot Data (62 plots):

- slope;
- aspect;
- topographical position;
- GPS coordinates.

### 2. Tree data (223 yellow-poplar trees / 485 total trees):

- species;
- diameter (DBH);
- number of 12' log lengths exceeding FAS/1F grade;
- FHM crown conditions and damages.
- Increment cores (150 trees)

### 3. Ordinal Tree Condition Data

Yellow-poplar trees were rated (good, fair, or poor condition), based on the severity observed in several decline symptoms. This multi-factor approach is similar to one developed by the authors when studying ash decline, and overcomes limitations of using single FHM parameters for describing yellow-poplar decline.

## Results

**Extent of Decline:** Approximately 10% of yellow-poplar trees encountered were in poor condition, 58% in fair condition, and 32% in good condition.

**Yellow-poplar decline associated with site parameters:** Decline symptoms were significantly correlated with aspect, diameter, crown position, crown light, and crown density (Fig. 1-5). Mortality (measured by standing snags) accounted for a 5.2% loss of yellow-poplar trees, and was significantly correlated with smaller diameter classes (results not pictured).



Figure 1: Relationship of Aspect and Tree Condition  
Chi-Square = 24.11051, df = 4, p = .0001

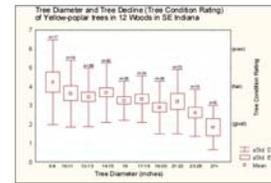


Figure 2: Relationship of Tree Diameter and Tree Condition  
Chi-Square = 17.16663, df = 9, p = .0462

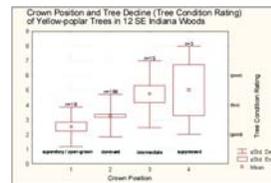


Figure 3: Relationship of Crown Position and Tree Condition  
Chi-Square = 8.099007, df = 3, p = .0440

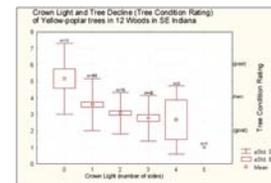


Figure 4: Relationship of Crown Light and Tree Condition  
Chi-Square = 15.64156, df = 5, p = .0080

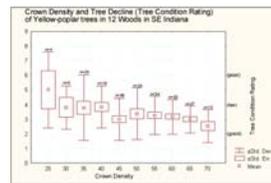


Figure 5: Relationship of Crown Density and Tree Condition  
Chi-Square = 16.41699, df = 9, p = .0587

**Note on Tree Condition Rating:** Trees rated on decline symptoms (see box at left) as either:  
Good: 1-2 (vigorous, little or no observable decline);  
Fair: 3-5 (moderate decline symptoms); and  
Poor: 6-8 (heavy decline symptoms and poor vigor).

**Yellow-poplar decline and incremental growth:** Yellow-poplar averaged 3.5 mm of incremental (radial) growth per year (1995-2004).

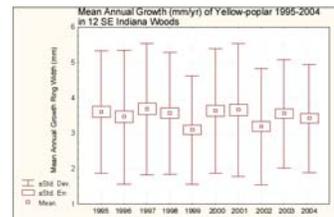


Figure 6: Radial Growth in Yellow-poplar in 12 SE Indiana Woods with Yellow-poplar Decline

### Drought affected radial growth:

Reflecting drought-sensitivity, yellow-poplar trees reduced incremental growth during the drought years 1999 and 2002 (Fig. 6). Oak species (not pictured), in contrast, did not significantly vary in incremental growth.

**Significant relationships:** Variations in crown light, crown position, and crown density were significantly associated with changes in incremental growth.

**No correlations:** Incremental growth changes were not significantly correlated with decline, live crown ratio, DBH, foliage transparency or dieback.

## Yellow-poplar Decline Symptoms

1. Bark splits.
2. Trunk and branch cankers.
3. Leaf chlorosis.
4. Branch dieback.
5. Witches' brooms.
6. Root collar and epicormic sprouts.
7. Shortened internodes on lateral branches.
8. Tree mortality.



Deliquescent branching, showing loss of apical dominance on slow-growing lateral branches.



Fusarium solani cankers on yellow-poplar.



Root collar sprouts.



## Discussion

**Drought:** Yellow-poplar decline is strongly associated with prolonged drought events. Decline symptoms were most pronounced on exposed slopes, and first appeared after the 1999 and 2002 drought.

**Suppressed trees:** Decline symptoms and mortality were most pronounced on smaller-diameter trees with suppressed crowns. Commercial thinning / salvage operations do not appear warranted or feasible when single-year drought events occur, because trees most affected are of low economic value.

**Use of FHM/FIA dataset:** Several FHM crown condition parameters were strongly correlated with yellow-poplar decline. Insufficient Indiana P3 crown condition data, however, restricts use of the current on-plot data set to extrapolate the extent of yellow-poplar decline statewide.

**Mortality:** Plotting of FIA mortality data (1985-2005) closely follows both the distribution of drought-vulnerable soils and areas of the state with reported decline, further indicating yellow-poplar decline to be drought-associated.

