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Host Specificity of American Mistletoe (*Phoradendron leucarpum*, Viscaceae) in Garrard County, Kentucky

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ABSTRACT

American mistletoe (*Phoradendron leucarpum*) was observed on 1740 host trees from 12 species in 8 families in Garrard County, Kentucky. *Juglans nigra* was the predominant host tree; *Prunus serotina, Ulmus americana,* and *Robinia pseudoacacia* followed. These four host species accounted for 1560 (89.7%) of the total infested trees. American mistletoe exhibits an aggregated or clumped spatial distribution pattern among host trees, which is characteristic of its life history and avian method of dispersal. In density, the occurrence value was 3.33 infested trees per kilometer traveled.

INTRODUCTION

American mistletoe (*Phoradendron leucarpum,* Viscaceae) is an evergreen hemiparasitic shrub of several deciduous host-tree species in the eastern United States. It has long been considered an obligate hemiparasite because it obtains water and inorganic minerals from a woody host while possessing chlorophylls *a* and *b* to manufacture its own carbohydrates (Hull and Leonard 1964a, 1964b). American mistletoe (hereafter, mistletoe) ranges from eastern Texas, eastward through the Gulf States, northward from Florida to southern New Jersey, southeastern Pennyslvania, and West Virginia, westward to southern Ohio, Indiana, Illinois, and Missouri, thence to eastern Oklahoma (Kuijt 2003; Scharpf and Hawksworth 1974).

Until 1989, American mistletoe had been referred to as *Phoradendron serotinum* (Raf.) M. C. Johnston in most manuals and floras of the eastern United States. Reveal and Johnston (1989) gave the correct nomenclature as *Phoradendron leucarpum* (Raf.) Reveal & M. C. Johnst. Kuijt (2003) recognized American mistletoe as *Phoradendron serotinum* (Raf.) M. C. Johnst. var. *serotinum.*

To date, three mistletoe studies have been published in Kentucky (Reed and Reed 1951; Thompson 1992; Thompson and Noe 2003). As part of this ongoing research, we conducted a survey of host trees infested with *Phoradendron leucarpum* in Garrard County, Kentucky. The first report for mistletoe in Garrard County was a sight record by Braun (1943). Mistletoe had been observed in Garrard County on *Juglans nigra, Prunus serotina,* and *Ulmus americana* by Reed and Reed (1951).

THE STUDY AREA

Garrard County is located in central Kentucky and comprises 606 km^2, of which 599 km^2 is land and 7 km^2 is water. Lancaster, the county seat, is located at latitude 37°37′07″N and longitude 84°34′46″W. In the 2000 census, the population of Garrard County was 14,492 people, with 3734 people in Lancaster (Wikipedia 2005).

Woods et al. (2002) divided Garrard County into four ecoregions within the Interior Plateau Region based on geology, soils, and vegetation: Inner Bluegrass, Hills of the Bluegrass, Outer Bluegrass, and Knobs-Norman Uplands (Figure 1). The Inner Bluegrass is underlain by Middle Ordovician limestone of the Lexington Formation. The Hills of the

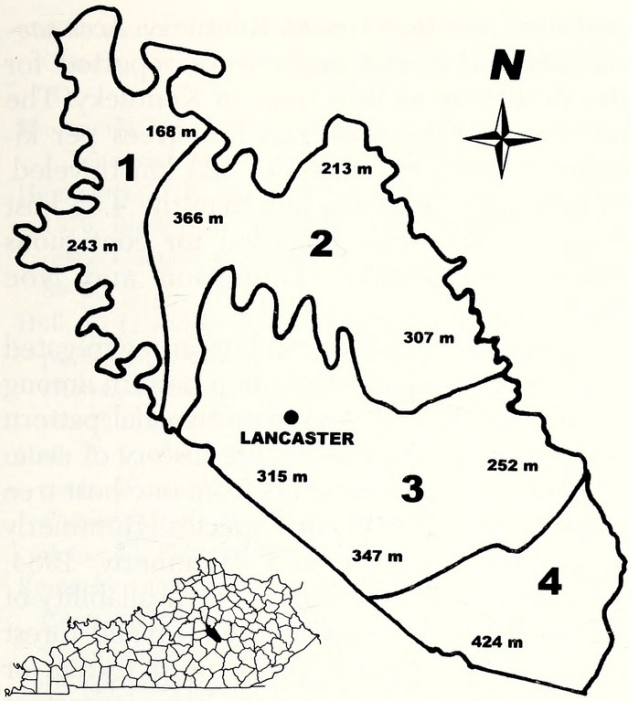

Figure 1. Garrard County, Kentucky, Ecoregions: (1) Inner Bluegrass, (2) Hills of the Bluegrass, (3) Outer Bluegrass, (4) Knobs-Norman Uplands (Woods et al. 2002).

Bluegrass are composed of Upper Ordovician calcareous siltstone and shale of the Garrard and Clays Ferry Formations. The Outer Bluegrass is underlain by Upper Ordovician limestone and dolomite of the Ashlock and Drakes Formations. The Knobs-Norman Uplands are comprised of Middle Silurian Crab Orchard shale and Brassfield dolomite, Middle Devonian New Albany shale and Boyle dolomite, and Lower Mississippian siltstone of the Wildie, Nada, Halls Gap, Cowbell, and Nancy Members and New Province shale Member of the Borden Formation (McDowell et al. 1981). Elevation ranges from 157 m in the northern part near the Kentucky River across from Jessamine County to 424 m in the southern part adjacent to Rockcastle County (Figure 1).

Major soil associations in the Inner Bluegrass are Maury-Hampshire-Loradale soil series, Hills of the Bluegrass belong to the Eden-Nicholson-Lowell soil series, Outer Bluegrass is Lowell-Shelbyville-Fairmont soil series, and the Knobs-Norman Uplands belong to the Colyer-Rockcastle-Otway soil series (Bailey and Winsor 1964). These soils are derived from the lithological parent materials within each ecoregion.

Braun (1950) classified the vegetation of the Kentucky Interior Plateau as belonging to the Western Mesophytic Forest Region, a mosaic of mixed *Quercus-Carya* and mixed mesophytic forests. Küchler (1964) classified the potential natural vegetation of this eastern deciduous region as *Quercus-Carya* forest. Natural upland communities are represented in the four ecoregions of Garrard County by a scattered mosaic of woodlands and forests. Much of the county is agricultural cropland and pastureland with *Festuca arundinacea* prevalent. The Inner Bluegrass is mainly *Quercus-Carya* on drier sites with *Quercus-Acer* on moister sites. The Hills of the Bluegrass are dominated by *Quercus-Carya* on drier sites and *Quercus-Fraxinus* on moister sites. The Outer Bluegrass includes *Juniperus-Robinia* and *Quercus-Carya* on drier sites, and mixed hardwoods on moister sites. The Knobs-Norman Uplands have *Quercus-Carya* on drier sites, *Quercus-Pinus* on drier sites, and mixed hardwoods on moister sites (Woods et al. 2002).

In central Kentucky, the climate is continental humid temperate, consisting of cool winters and warm summers, with precipitation spread throughout the year (Trewartha and Horn 1980). Climatological data, 1977–2000, are derived from Danville, Boyle County, ca. 16.0 km west of Lancaster (Kentucky Climate Center 2001). Mean annual temperature is 12.8°C, with the mean lowest temperature, −0.5°C, in January, and the mean highest temperature, 24.4°C, in July. The mean annual precipitation is 124.1 cm, with the lowest precipitation, 8.0 cm, in October and the highest precipitation, 12.6 cm, in March and May. At 0°C, the mean growing season is 200 days, with the median first fall occurrence of frost on 28 October and the last spring occurrence on 10 April (Kentucky Climate Center 2001).

METHODS AND MATERIALS

We conducted a survey of mistletoe host trees within Garrard County, Kentucky, from 3 Jan until 23 Jan 2004. We used a vehicle, binoculars, and a 1997 Garrard County highway map for reference and traveled all the paved and passable gravel roads within the county. Road mileage was recorded by odometer, and host trees were identified and tallied by species. All trees counted had visible signs of

Table 1. Host specificity of *Phoradendron leucarpum* in Garrard County, Kentucky.

Tree species	Total	Percentage
Juglans nigra L.	856	49.20
Prunus serotina Ehrh.	335	19.25
Ulmus americana L.	209	12.01
Robinia pseudoacacia L.	160	9.20
Fraxinus americana L.	83	4.77
Celtis occidentalis L.	37	2.13
Maclura pomifera (Raf.) Schneid.	18	1.03
Acer saccharinum L.	16	0.92
Gleditsia triacanthos L.	15	0.86
Acer saccharum Marsh.	6	0.34
Carya ovata (Mill.) K. Koch	4	0.23
Quercus muhlenbergii Engelm.	1	0.06
Total: 12	1740	100.00

mistletoe infestation, i.e., branch or trunk clumps, cankers, clusters, limb die-back, and swellings. Hemmerly (1989) was followed to derive a mistletoe occurrence factor value. This density factor is a reflection of the total number of infested trees per kilometer, and it represents both spatial distribution and relative abundance of host trees. Our mistletoe occurrence factor was determined for Garrard County by dividing the total number of infested trees by the total kilometers of roads traveled. We collected certain representative mistletoe specimens and their host tree winter twigs for vouchers of each tree species. Specimens were obtained by using a 12-m fiberglass extendable linesman pole with an attached hook. Mistletoe and twig specimens were mounted and deposited in the Berea College Herbarium (BEREA). Nomenclature for all tree species is from Gleason and Cronquist (1991).

RESULTS AND DISCUSSION

Phoradendron leucarpum was observed on 1740 trees from 12 host tree species in 8 families within Garrard County (Table 1). The predominant host tree species was *Juglans nigra* with 856 trees (49.20%), followed by *Prunus serotina* with 335 trees (19.25%), *Ulmus americana* with 209 trees (12.01%), and *Robinia pseudoacacia* with 160 trees (9.20%) (Table 1). *Juglans nigra* and *Prunus serotina* were the two most important host trees in two other surveys in central Kentucky (Thompson 1992; Thompson and Noe 2003). *Quercus muhlenbergii* was recorded for only the second time as a host tree in Kentucky. *Acer saccharum* and *Carya ovata* were reported for the third time as host trees in Kentucky. The occurrence value was 3.33 host trees per kilometer based on a total of 523 km traveled. This density value was less than the 4.35 host trees per kilometer recorded for contiguous Rockcastle County (Thompson and Noe 2003).

American mistletoe exhibits an aggregated or clumped spatial distribution pattern among its host trees. This aggregated spatial pattern is highly influenced by its life history of avian dispersal of mistletoe fruits from one host tree to other trees of the same species (Hemmerly et al. 1979; Sadler and Hemmerly 1984; Thompson and Noe 2003). The availability of tall, mature host trees in open, upland forest terrain, rather than lowland forest terrain or closed, upland forest terrain, is an important factor in mistletoe distribution and infestation (Thompson and Noe 2003). Small towns in Garrard County, i.e., Bryantville, Davistown, Lancaster, and Paint Lick, had a greater infestation of mistletoe than other upland terrain as a general rule, which is likely a consequence of urban allurement of avian vectors.

Mistletoe has a considerable host tree specificity in certain regions over others, which is related to physiography, geological substrates, soils, and existing vegetation (Panvini 1991; Reed and Reed 1951; Thompson and Noe 2003). The limestone Inner Bluegrass and Outer Bluegrass ecoregions accounted for a majority of the host trees. The Knobs-Norman Uplands were next in number of host trees, and the Hills of the Bluegrass had the least number. The unique host specificity of this hemiparasite probably includes several other factors, e.g., the genetic variation of American mistletoe (leading to ecotypes or genetic race distinctions) and the subsequent genetic diversity of host trees (Panvini 1991; Thompson and Noe 2003).

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