Determination of Age of Mistletoe (*Viscum album* ssp. *austriacum* (Wiesb.) Vollman) on Scots Pine (*Pinus sylvestris* L.)

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Abstract:

Mistletoe (*Viscum album* L.) is a small semi-parasitic evergreen shrub growing on many plants. Mistletoe grows on the trunk or branches of a tree and obtains water and mineral nutrients from host trees through root like structures called haustoria that penetrate into the wood, and produces its own food by photosynthesis. Mistletoe results in deterioration of tree crown structure, a decrease in height and diameter growth and a reduction in length and number of needles. Mistletoe infected trees may become sufficiently stressed as to attract bark beetles or other secondary pests. Death of the host tree occurs slowly in most cases depending on the severity of infection. Determination of age in organisms is essential for investigating species biology and its management. Because age is an important biological variable that forms the basis for calculations of growth, mortality and reproduction. Nevertheless, except in trees, determination of age for long lived plants such as mistletoe can be generally problematic. Little information exist on the determination of age in pine mistletoe. The objective of this study is to determine the age of mistletoe both morphologically and anatomically. The study was carried out in mistletoe infected pure Scots pine stands within the boundaries of Şiran and Kelkit State Forest Enterprises in Gümüşhane province. To determine the age of mistletoe, mistletoe infected branches were cut from the trees and taken to the laboratory. In morphological method, the longest stem of mistletoe was taken and the total number of nodes were counted. To determine the age of mistletoe anatomically, the haustoria of mistletoe which are longitudinally oriented in the host branches were evaluated under laboratory conditions. The results of the two methods were analyzed. The results of this study can be invaluable in determining the effect of mistletoe on diameter and height growth of infected trees, modelling efforts and in controlling mistletoe damage.

Key Words: Mistletoe (*Viscum album* L.), Scots Pine (*Pinus sylvestris* L.), Age Structure

Introduction:

Mistletoe (*Viscum album* L.) is an evergreen semi-parasitic shrub growing on many plants (Preston 1977, Norton et al. 2002, Mathiasen et al. 2008, Dobbertin and Rigling 2006, Rigling et al. 2010, Galiano et al. 2011, Zweifel et al. 2012, Sanguesa-Barreda et al. 2013). Instead of producing roots in the ground, mistletoe sends out root-like structures into host tree branches and trunk called haustorium (Mathiasen et al. 2008), through which it acquires water and mineral nutrients used for its own photosynthesis. However it does not provide the host tree with the photosynthesize produced, resulting in the deterioration of crown and leaf structure (Hosseini et al. 2007), a decrease in height and diameter growth (Kanat et al. 2010, Catal and Carus 2011) and a reduction in needle length and number. Infected trees may become so weakened as to attract bark beetles or other secondary pests (Tsopelas et al. 2004, Kenaley et al. 2006, Kenaley et al. 2008). Death of the host tree occurs slowly in most cases depending on the drought season, severity of infection and on the vigor and size of the tree (Kenaley et al. 2008, Sanguesa-Barreda et al. 2013).

Age determination in organisms is important for determining species biology. A thorough understanding of pests’ biology is of crucial importance in controlling the damage incurred by the pest. However, except in conifers, determination of age for long lived plants can be generally problematic. Little information exist on the determination of age in pine mistletoe (Srivasta.L and Esau 1961, Scharpf and Parmeter 1966, Calvin 1967, Dawson et al. 1990, Tercero-Bucardo and Kitzberger 2004).

The objective of this study is to determine the age of mistletoe both morphologically and anatomically. The results of two methods were analyzed and the regression model was produced.
Material and Methods:

In this study, the age of mistletoe was determined both morphologically and anatomically. The study area was selected in mistletoe (Viscum album ssp. austriacum (Wiesb.) Vollman) infected Scots pine (Pinus sylvestris L.) forests within the boundaries of Şiran and Kelkit State Forest Enterprises in Gümüşhane province. The sampling was carried out in June. To show variation of age differences, branches infected by mistletoes at different infection levels and sizes were cut from different parts of the trees and taken to the laboratory (Figure 2). The first technique used to determine the age of mistletoe is morphological method (Dawson et al. 1990). In this method, total number of nodes on the longest stem of mistletoe is counted to determine the age (Figure 1).

![Fig.1](image1.png)

Fig.1. Mistletoe branch structure in Viscum album ssp. austriacum. The numbers at each branch node indicate different age. The illustrated mistletoe is 3 years old.

![Fig.2](image2.png)

Fig.2. A 2-year-old (a), a 7-year-old (b) and a 13-year-old (c) mistletoe.

In anatomic method, the haustoria (sinkers) of mistletoe which are longitudinally oriented in the host branches or trunk (Figure 4), is evaluated in the laboratory. Transverse sections are obtained at the junction between the branch and mistletoe stem from the mistletoe samples in laboratory using Richter sliding microtome (Figure 3a) at 15-20 µm intervals to determine the age of Viscum album and of infected branch. These transverse sections were treated with sodium hypochlorite until they got transparent in about 15-20 minutes and then washed with distilled water. The sections were neutralized with acetic acid for a period of 1-2 minutes, then washed with distilled water and stained with safranine (Figure 3b). After staining, transverse sections were washed thoroughly with distilled water and respectively passed through 50%, 75%, and 95% alcohol series. Then, permanent preparations of the samples were made using “basic fuchsin glycerin-gelatin”.

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Results and Discussions:

Anatomical method gives more reliable and accurate results compared to morphological method (Srivasta and Esau 1961, Calvin 1967, Dawson et al. 1990). However this method is destructive, time consuming, and labour intense. The use of this method may not be so
practical under field conditions (Dawson et al. 1990). The results of the study indicated that there were up to 3 years of age difference between the two methods. Correlation and regression analyses were conducted to examine the relationship between morphological age and anatomical age results. There was a high correlation between the results of the two methods ($r=84.3\%$; $p<0.01$).

There exists a positive relationship between morphological age and anatomical age. The linear regression analysis yielded the following equation (Figure 5):

$$\text{Anatomical Age} = 0.038 + 0.838 \times \text{Morphological Age} \quad (r^2=0.71)$$

![Fig 5. Relationship between morphological and anatomical age of mistletoe on Scots pine.](image)

Conclusions:

Mistletoe ($Viscum album L.$) absorbs water and mineral nutrients from its host, Scots pine trees. Healthy Scots pine trees can tolerate few mistletoe branch infections but heavily infested trees may experience a reduction in vigor, be stunted or even killed, especially if they are stressed by other problems such as drought or disease. The amount of mistletoe on a host tree is proportional to the age of the pest. Thus it is important to determine the age of the pest to determine the damage level. Both methods provide invaluable results. The morphological method based on branch structure of mistletoe presented here provides a formal, easily used and non-destructive way of determining the age of individual mistletoe ($Viscum album L.$) plants. The results show that the difference between two methods is not significant. Morphological method may be advised for practical purposes.

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References


