



The Effect of Mistletoe on the Growth of Scots Pine

Murat Han Ertuğrul

¹Gümüşhane Üniversitesi, Fen Bilimleri
Enstitüsü, Ormancılık ve Çevre Bilimleri
Anabilim Dalı, 29000, Gümüşhane,
TÜRKİYE

Osman Komut

Gümüşhane Üniversitesi, Gümüşhane
Meslek Yüksekokulu, Ormancılık
Bölümü, 29000, Gümüşhane, TÜRKİYE
osmankomut@gumushane.edu.tr

Abstract-Scots pine (*Pinus sylvestris*) is the third most common pine found within the pine forests of Turkey. Because of their status, the biotic and abiotic factors that have a negative impact on this species are significant. Mistletoe (order: Santalales) is a semi-parasite plant that affects the growth and increment of Scots pine, fir (*Abies*), and all deciduous tree species under many conditions.

Our study was conducted in the natural regeneration and afforestation area of the Gümüşhane region, Turkey. While selecting the areas to study, our priority was that there would be no significant differences in growth conditions for Scots pine. From each area, two healthy and two mistletoe-infected; eight young Scots pine were selected for study. The trunk of the trees was analyzed and the vertical growth rates were investigated. In addition, whether there was any correlation between the Erinc index and vertical growth rate was determined.

At the end of the study, we determined that the regional climate has a more negative impact on young Scots pine growth than mistletoe.

Keywords-Mistletoe, tree trunk analysis, regeneration

I. INTRODUCTION

The total acreage in Turkey comprises 28.6% forest. These forests are composed of 33% deciduous trees, 48% coniferous trees, and a 19% mix of both types. [1]. There are many abiotic and biotic factors that affect Turkey's forest trees, and semiparasites are one of the most significant of these factors.

Mistletoe is an evergreen semi-parasitic plant that grows on the trunk and branches of trees and contains chlorophyll for photosynthesis [2]. The plant creates dryness within the host, making it more vulnerable to insects, fungi, and similar secondary pests and causing the host to lose its vital biological functions. [3] Although mistletoe is considered to be a pest in Scots pine stands, it has important medicinal properties, which is why the fight to eradicate this plant is an unclear phenomenon in forestry management [4].

The aim of this study was to uncover whether mistletoe impacts the vertical growth rate of Scots pine trees in natural regeneration and afforestation areas by analyzing the characteristics of tree trunks.

II. METHODS

Studies were conducted within the borders of the Gümüşhane Forest Directorate natural regeneration and afforestation regions in Turkey. The area lies between 40°32' and 40°14' north latitudes and 39°56' and 40°20' east longitudes in Gümüşhane Province. To amplify the

differences in natural regeneration and afforestation, the selected areas were under the same growth conditions for Scots pine.

The Erinc index was used to determine the climatic properties of the study area. The index depends on the ratio between annual precipitation and annual average maximum temperature within a region (1). For calculating the Erinc index, the precipitation values within the study area over the last 20 years was obtained from the Turkish State Meteorological Service.

$$I_m = \frac{P}{T_{om}} \quad (1)$$

where I_m is the precipitation index, P is the annual precipitation (mm), and T_{om} is the annual average maximum temperature (°C). After calculating the precipitation index, the following table based on the Erinc index was used to determine the types of climate within the study area (Table 1).

Table 1. Types of the climates according to the Erinc index*.

Climate Class	Precipitation Index	Vegetation
Completely Dry	$I_m < 8$	Desert
Dry	$8 < I_m$	Desert-Steppe
Semi-Dry	$15 < I_m < 23$	Steppe
Semi-Wet	$23 < I_m < 40$	Park-Like Forest
Wet	$40 < I_m < 55$	Wet Forest
Extremely Wet	$55 < I_m$	Very Wet Forest

*[5]

From the study areas, trunk analyses were conducted on two healthy and two mistletoe-infected trees from each region, for a total of eight trees, to determine the differences in growth and increment (per-year growth at a specified age). The distribution of the trees for trunk analyses is provided in Table 2.

Table 2. Distribution of the analyzed trees (D stands for "doğal" means natural in Turkish, and A "ağaçlandırma" means afforestation in Turkish).

Regeneration Type	Mistletoe Infection	
	Present	Absent
Natural	D1, D2	D3, D4
Afforestation	A1, A2	A3, A4



The sample trees were cut down in the field and separated into different sections. Cross sections were taken from lowermost 0.30 m high sections. For each tree, the number of rings on the 0.30-m-high cross sections were counted, and the age of a corresponding tree at a height of 0.30 m was added to calculate its age. Using MS Excel, the height–age curve for each tree was created. Using this curve, the height a tree reaches in 5-year-intervals was calculated, and using these values, the average increment for each tree was determined.

III. RESULTS AND DISCUSSION

The determined average increment rates for Scots pine individuals from the tree trunk analyses are provided in Fig. 1 for the afforestation area and in Fig. 2 for the natural regeneration area.

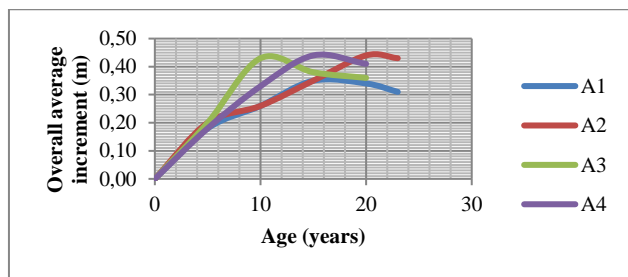


Figure 1. General average increment values for trees in the afforestation area calculated by tree trunk analyses.

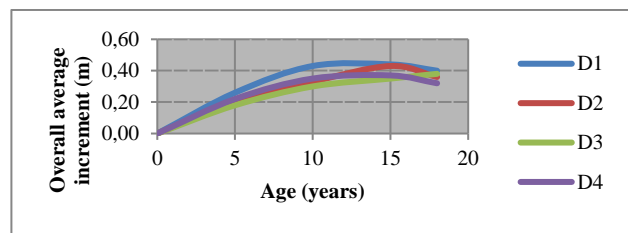


Figure 2. General average increment values for trees in the natural regeneration area calculated by tree trunk analyses.

From the graphs, it is apparent that vertical growth rate decreases in both healthy and mistletoe-infected trees, and that mistletoe has no significant effect on this rate. In addition, according to the Erinç index, the climate type within the region is semiarid. According to the literature, the vertical growth rate decreases from dry to wet regions and, when field stress is considered, the growth rate in trees facing north is lower than in those facing south [6]; however, even in south-facing stands, if the climate is not humid enough, growth rates decrease. The fact that these

areas are not humid enough and the fields faced south explains why the growth rate was decreasing.

IV. CONCLUSIONS AND FUTURE SUGGESTIONS

The effects of mistletoe, the growth conditions in the region, and the regional climate on the development of the Scots pine stand were examined using an analysis of tree trunk characteristics. The mistletoe had no negative effect on the trees, based on the data obtained from healthy and infected individuals; however, but both the regional climate and growth conditions are factors that affect growth rate. Although the mistletoe had no negative effect on growth rate, the plant is still considered to be semiparasitic because it degrades the trunk quality of individual trees. In addition, because mistletoe is important in medicine and is a significant forage for livestock, it can be classified under nonwood forest products; therefore, not only can the villagers in the area find employment opportunities in the industry, but also the positive results can enhance the management of mistletoe stress on trees

V. ACKNOWLEDGEMENTS

This study is a part of a master thesis entitled “The Increment-Growth Relationships and Economic Conditions of Scots Pine Natural Regeneration and Afforestation Areas: Gümüşhane Case” prepared by Murat Han ERTUĞRUL under the supervision of Assistant Professor Osman Komut in Gümüşhane University.

REFERENCES

- [1] OGM, 2015. Türkiye Orman Varlığı, Orman İdaresi ve Planlama Dairesi Bşk., s.26
- [2] Yüksel, B., Akbulut, S. ve Keten, A., 2005. Çam Ökseotu (*Viscum Album ssp. Austriacum* (Wiesb.) Vollman)’nun Zararı, Biyolojisi ve Mücadelesi, Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi, Sayfa: 111-124
- [3] Dobbartin, M. ve Rigling, A., 2006. Pine Mistletoe (*Viscum Album ssp. Austriacum*) Contributes to Scots Pine (*Pinus sylvestris*) Mortality in the Rhone Valley of Switzerland, *Forest Pathol.*, 36, 349-322.
- [4] Bilgili, E., 2014. Ökseotu (*Viscum album L.*)’nun Doğu Karadeniz Bölgesi Sarıçam (*PinusSylvestris L.*) Meşcerelerinde Yayılışının Belirlenmesi ve Çap Artımı Üzerine Olan Etkisinin Modellenmesi, TÜBİTAK Projesi, Proje No: 112O258.
- [5] Erinç, S., 1965. Yağış Müessiriyeti Üzerine Bir Deneme ve Yeni Bir İndis, İ.Ü.Coğrafya Enstitüsü Yayın No:41, İstanbul, 1965.
- [6] OGM, 2015. Sündiken Dağlarında (Eskişehir) Sarıçam (*Pinus sylvestris L.*) Ağaçlarının Yetiştirme Ortamı Özelliklerine Göre Beslenme ve Büyüme İlişkilerinin Belirlenmesi, *Ormanlık Araştırma Bülteni*, Sayı:2, s.4.