



Detecting the impact caused by oak lace bug (*Corythucha arcuata*, Say 1832) in pedunculate oak forests of the Pannonian Plain

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Supported by the rapidly increasing global trade and the climate change, alien and invasive species are appearing at an alarming rate throughout the World, causing unexpected disturbances to the forests, and frequently resulting in significant economic losses. The oak lace bug (*Corythucha arcuata*, Say 1832), native to North America, is a new invasive species in Central Europe, spreading rapidly and causing damage on foliage, primarily of oak trees, potentially jeopardizing the long term health and stability of natural oak forests. Since it was first recorded in Northern Italy in 2000, the spread and the magnitude of the oak lace bug infestation has gained momentum, now noticeably affecting - among many other regions - the valuable pedunculate oak forests of the Pannonian Plain. Damage to the leaves caused by the oak lace bug, as a result of leaf-sucking, affects leaf photosynthesis negatively. Damage (early discoloration) becomes particularly pronounced in the second part of the vegetation season and could be observed and quantified by means of satellite remote sensing, such as using Normalized Difference Vegetation Index (NDVI).

In the present study we used C006 MOD09 and MOD13 NDVI time-series of the MODerate resolution Imaging Spectroradiometer (MODIS) with the finest 250 m spatial resolution to detect, both at temporal and spatial scale, and to quantify the damage caused by the oak lace bugs in larger oak stands in the Pannonian Plain. The results demonstrate, in each year starting from 2016, a remarkable NDVI decline in the oak forests of the Spačva Basin (located in eastern part of Croatia and western part of Serbia), showing a 0.15 negative NDVI anomaly relative to the multiannual mean values for at least 2 months long during the period of August-October. The timing of the significant NDVI decrease seems to be affected by the weather conditions, too. Field observations (tree cores) provided background information on the effects of the high population density of oak lace bugs in the Slavonian forests of the Spačva Basin. Data of the MultiSpectral Instrument (MSI) onboard the recently launched European Sentinel-2A/2B satellites was also investigated for the applicability of detecting the damage caused by the oak lace bugs, however due to their recent launch time, their measurements still do not provide a long enough archive dataset to detect anomalous phenomena. Although Sentinel data has a great potential due to its fine spatial resolution, harmonization with MODIS is needed.

Keywords: oak lace bug, *Corythucha arcuata*; forest, NDVI; MODIS; phenology; disturbances