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Research on the possibility of using thermography for the determination of insect activity in wood

Bilgin İçel[1,*], Mustafa Avcı[1], Yasemin Şimşek[1], Şükran Oğuzoğlu[1]

[1] Suleyman Demirel University, Faculty of Forestry, 32260 Isparta, Turkiye
[*] Corresponding author: bilginicel@sdu.edu.tr

Abstract: Wood, as a sustainable and renewable natural resource, has been used for packaging material for years. As a biological material, although wood has many advantages, it has also some disadvantages. Biodegradability is the major disadvantage of the material in use. Although the role and importance of international trade on the development of countries is well known, there is a general argument on their negative environmental effects. There has been increasing concern about spread of harmful organisms (fungus, insects etc.), from one country to another one via international trade of wooden materials. In order to protect their forests, a number of countries and trading blocs have taken regulatory action against to harmful organisms' movements. To take precautions some international phytosanitary standards (ie: ISPM 15) have been accepted and implemented in many countries including Turkey. Wood packaging material must be heated in accordance with a specific time–temperature schedule that achieves a minimum temperature of 56 °C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core). Theoretically, materials and products which treated and stamped in these contexts (ie: heat treated wood packages) are thought to be safe. But, in practice exporters have been faced many problems mainly because of unsuitable treatments, illegally stamped materials without any treatment etc. The common control mechanism of these materials is the evaluation of visual signs (or evidence) of infestation. Since tunneling and development of the larvae takes place entirely below the wood surface, the only signs of infestation are the emergence holes made by the adults and the powder-like frass sifting from the holes. It is quite difficult to distinguish insect activity in wood with naked eye or normal imaging techniques, especially at the early stage of insect growing. Actually there is no quick and practical way for inspectors to determine biological activities in wood at field. The main purpose of this work was to find a quick and practical way to separate infected wood materials even at early development phase of insects. As it well known, insects are cold-blooded organism. From this point of view, different (lower) temperature zone would occur on wood surface parallel to organism presence. Although insect activity in wood is not visible at early stage of the activity, it may be possible to determine the infected area using a thermographic technique. For laboratory experiments pine (*Pinus brutia*) wood which was commonly preferred for wooden package material production in Turkey and insect species which are belong to Buprestidae, Curculionidae and Cerambycidae families were used as experimental materials. Experiments applied at laboratory temperature but, because of the fact that insects are cold-blooded organisms, thermal images obtained also at 0 ^{0}C which is the lower than minimum temperature of important Turkish customs. Presence of species in different growth period was monitored using FLIR I7 thermal camera. IRimages were evaluated via FLIR QuickReport software and Süleyman Demirel University Forestry Faculty image analysis system. Although positive results achieved with this preliminary laboratory work, further research including outdoor experiments should be considered.
Keywords: NDE, Thermography, Wood, Quarantine, Harmful organism