# Performance of an acoustic analysis system for the detection, species identification and estimation of population density of adult beetles in stored wheat: potentialities and limitations

Eliopoulos, P.A.*#[1], Potamitis, E.[2], Givropoulou, E.G.[1], Kontodimas, D.C.[3]

[1]Technological Educational Institute of Thessaly, Department of Agricultural Technologists, 41110 Larissa, Greece
[2]Technological Educational Institute of Crete, Department of Music Technology and Acoustics, 74100 Rethymno, Greece
[3]Benaki Phytopathological Institute, Department of Entomology & Agr.Zoology, 14561 Athens, Greece

*Corresponding author, Email: eliopoulos@teilar.gr
#Presenting author, Email: eliopoulos@teilar.gr

## Abstract

Acoustic emissions of stored grain insects, produced by moving, feeding, ovipositing etc. can be used not only for detection purposes but also for species identification and population density estimation. Bioacoustics of stored grain insects have been studied in the lab during a 3-year research project. Specifically, acoustic emissions of adults of the most important stored grain beetles were recorded infesting wheat, in varying population densities from 0.1 to 10 adults/ kg wheat. The acoustic analysis system is being described. The system was 100% precise in negative predictions (predicting the absence of a pest when none is present) and considerably successful in positive predictions (predicting the presence of the pest when at least one individual is present in the grain mass). The system was very accurate (80-100%) in detecting an insect in one kg of wheat grain which is the most common threshold for classifying a grain mass as "infested" or "not infested". The most impressing feature of our system is the very low detection threshold given that insect individuals were detected even in very low densities (0.1-0.5 insects/ kg grain). Potential and limitations of the method in pest species identification and population density estimation are also being presented. Our results are discussed on the basis of enhancing the use of acoustic devices as detection tools in storage facilities. The present study is a part of the research project "Development of modern and novel methods of Integrated Pest Management against stored products pests" and has been co-financed by the European Union (European Social Fund - ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) - Research Funding Program: ARCHIMEDES III. Investing in knowledge society through the European Social Fund.

Keywords: stored grain, bioacoustic, detection, species identification, density estimation