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Determining sound signature of major insect pests in stored rice using inexpensive acoustic system

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Abstract

Insect pests in stored grains can cause a maximum of 10 % losses, but the use of early detection device such as acoustic sensor can prevent subsequent damage in storage. Acoustic detection can directly identify the cause of damage in stored grains (i.e., insects) rather than the effect (e.g., humidity, temperature) as it happens with other sensors, and it is capable of handling high information density due to the broad frequency band and the different sound signature and levels. This research adapted and investigated the applicability of the acoustic sensor from the smart apiculture management system (SAMS) project of Uni Kassel for use in detecting insect pests in stored rice products.

The Adafruit SPH0645, an inexpensive MEMS (micro-electromechanical systems) microphone currently available in the market is an important component of the acoustic detection system that is adapted in this study to detect insect pests in stored rice grains through their sound signature. Three major insect pests that commonly feeds on paddy and milled rice products, namely, lesser grain borer (*Rhyzopertha dominica*), rice weevil (*Sitophilus oryzae*), and red flour beetle (*Tribolium castaneum*) were collected in rice mills and grain storage warehouses in Laguna, Philippines and reared at postharvest laboratory, IRRI, Philippines. Baseline sound recordings for each of the insect were replicated over time for at least 3 days in acoustic shielding chamber. The recorded sounds of the insects in wav file were analysed using R and Audacity softwares to establish specific sound signature of each insects. Insect sounds of major pests in one-ton storage were detected at 0.62 % for *R. dominica*, 0.22 % for *T. castaneum* and 0.58 % for *S. oryzae*, which represents the percentages of lured insects by the attractants used (e.g., red LED and air blower) against the total density of insects in the storage.

The application of machine learning technique will be employed for easy identification of these insects when the acoustic device is deployed in actual storage conditions.

Keywords: Acoustic system, insect pests in rice storage, machine learning, MEMS microphone, sound signature

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