

Beetle Sound Tube – early acoustic detection of grain storage insect pests

Grain pest protection was improved by an innovative early detection system in silos, flat stores and other containers.

EAFRD-funded projects

Location: Brandenburg, Germany

Programming period: 2014-2020

Priority: P1 - Knowledge transfer and innovation

Focus Area: Innovation and cooperation

Measures: M16 - Cooperation

Funding:

Total budget	1 449 268 (EUR)
EAFRD	948 612 (EUR)
National/Regional	237 153 (EUR)
Private	263 503 (EUR)

Timeframe: 11/2017 - 11/2022

Project promoter: agrathaer GmbH*

*The project promoter/beneficiary is an [EIP Operational Group](#)

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Summary

Protecting stored grain is an important part of food security. An EIP Operational Group used CAP funds to develop the Beetle Sound Tube system. It is a permanently installed, early-detection acoustic system for grain pests in silos, flat stores and big bags. It consists of a tube that is inserted into the grain with a tube holder, an acoustic trap, a computer unit and software that detects the infestation. The system evaluates the collected data and communicates it to the storekeeper by e-mail. Early recognition of insect infection in stored grain gives farmers better options for action, including avoiding the unnecessary use of insecticides, which is particularly useful for organic farming.

Project results

- The Beetle Sound Tube system enables the early detection of pests so the infestation processes of stored grain can be stopped, which can prevent it from being sold as animal feed at a lower price.
- Thanks to the system, there is no need for preventative weekly pest inspections, which require the regular intervention of personnel. Instead, inspections only need to be initiated in response to a system message.
- The stationary prototype costs around EUR 6 600, while the mobile version costs EUR 1 400 per tube, in addition to minor maintenance and operating costs. A market-ready system could be significantly less expensive.





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Key lessons and recommendations

- The importance of protecting storage facilities for food supply chains can often be underestimated by companies and policymakers.
- When developing an innovation process, it is important to follow an iterative project design so that adjustments can be made in light of new information.
- To ensure effective cooperation within an EIP Operational Group, scientists and agricultural practitioners need to work together as equals and form relationships based on trust.

Context

Protecting stored grain is an important part of food security. Grain is stored fresh after the harvest until it is ready for use for human consumption, livestock feed or seed. During this time, it may be infested and damaged by insects. Damage caused by feeding pests can cause the moisture level in the grain to increase, resulting in mold development and the growth of toxic substances. Such issues will make the grain unusable, resulting in major damage for farmers and storekeepers.

The initial idea behind the project was preventative monitoring for grain, to prevent damage and protect natural resources. Avoiding and detecting pests is an important part of this vision. Early detection of infestations allows for the use of alternatives to traditional chemical treatments with hydrogen phosphide, such as cooling, cleaning or using beneficial insects.

The grain supply is also threatened by climate change. Firstly, moist warm summers foster insect infestations. Secondly, droughts and storms result in poorer grain harvests which need to be protected with even more urgency. Maintaining grain stores and reducing loss means less CO₂ is emitted through the production of new grain. In this way, protecting grain is also part of protecting the climate.

Objectives

The main aims of this project were to:

- Develop an innovative system for the early detection of grain storage pests with time-saving technology.
- Raise awareness among farmers about the topic of grain protection, provide training on the steps needed to maintain a clean, pest-free grain store, and discuss how to respond to infestations.
- Address the natural and environmental conservation issues by identifying alternatives to chemical methods of fighting grain pests, even in conventional farms.
- Create new job positions by providing services for the system: maintenance, installation, production of beneficial insects, advising on grain protection.

Activities

The Beetle Sound Tube system facilitates early detection of grain storage pests with time-saving technology. To do so, the approach makes use of the fact that insects generate noise in the grain, namely by crawling and eating. The system utilises modern digital technology. This involves tubes equipped with microphones and trap holders, which are placed inside the stored grain. They transmit recorded sounds to the WI-FI-enabled system that warns the operations manager via email once noises exceed a set threshold and intervention is required. The steps implemented to develop this system were:

- Developing and installing an on-farm prototype.
- Developing the system further (2019). This focused on the mobile system for grain bags and flat stores, in addition to the permanently installed system for silos.



- Completing tests on running systems (2018-2022), including the collection and evaluation of important monitoring data for basic research and storage protection.
- Revising the prototype (2022).
- Carrying out public relations work such as workshops at a world-leading trade fair for ecological consumer goods, the Biofach Nuremberg (2018), and presentation at Germany's largest agricultural start-up exhibition, innovate! in Osnabrück (2019), website maintenance, various publications and presentations, and a project wrap-up event (2022).
- Informing professional audiences, for instance, by giving a presentation at the EIP-AGRI network 'Farm data for better farm performance', at the conference of the IOBC-WPRS Working Group on the Integrated Protection of Stored Products, to a delegation of 18 international agricultural attachés and two representatives of the German Federal Ministry of Food and Agriculture.
- Advising farms on dealing with infestations, individual operational consulting and deployment of beneficial insects.
- Developing a strategy to transition the prototype to market by an external third party.

The EIP project partners were scientists, farmers/storage keepers, regional and local construction firms, farmers associations, NGOs, advisory and innovation support service providers.

Main results

- If pests are detected early by using the Beetle Sound Tube system, then infestation processes can be stopped, which can prevent the grain from being sold as animal feed at a lower price.
- There is no need for preventative weekly pest inspections. Instead, inspections only need to be initiated in response to a system message.
- The stationary prototype costs around EUR 6 600, while the mobile version costs EUR 1 400 per tube, in addition to minor maintenance and operating costs. A market-ready system could be significantly less expensive.
- Since the storage types are universal and as detection is not species-specific, the use of the Beetle Sound Tube system is not restricted by region, language, species range, or climate, but rather by storage type. It can be used in grain bags, flat stores and silos with a volume of up to 80 tonnes.
- The advantages of the system compared to commonly used early detection measures are earlier and allow for more effective detection of an infestation and lower staffing expenses since weekly checks become obsolete.
- The early detection of infestations allows for the use of more environmentally friendly and economic control measures.
- Continuous monitoring also ensures that an infestation is caught earlier, since stores are checked regardless of any activity pattern.

Key lessons and recommendations

- The relevance of storage protection in food supply chains can often be underestimated by companies, as well as by policy-makers. Compared to plant protection in the field, there is no structured advisory provision for storage protection available within Germany, except from the Julius Kühn-Institut.
- A large number of insects appeared in the grain early on that could not have been detected without using the Beetle Sound Tube system. In addition, the pest species found were different from those expected.
- This testing had to be abandoned for 300 tonne silos because the structural requirements and forces acting on the system exceeded estimates and required more accurate forecasting.
- Planning while simultaneously implementing the system was a challenge. Advanced planning would be useful in this case.
- The innovation process was designed to be an iterative process so that adjustments could be made in light of new information.
- The goal was for scientists and agricultural practitioners to work together as equals and form relationships based on trust.



“The biggest advantage is that we detected problems a full six weeks earlier, that’s huge!”

Roland Wolters, Gut Schmerwitz

“Unlike larger pests, smaller ones cannot be heard directly when they dig through the grain, but you hear the sound when they fall into the acoustic trap.”

Isabell Szallies, agrathaer

Additional information:

<https://agrathaer.de/de/projekt/beetle-sound-tube-eip-projekt>

<https://thefurrow.co.uk/beetle-sound-tube/>

