Evaluating Diatomaceous Earth Application Under Economic and Environmental Dimensions - Abstract

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Summary

The continuous growth of the human population has intensified the necessity to secure essential food to prevent a potential food crisis. On a global scale, approximately 14% of the world's food, worth $400 billion, is lost between harvest and retail. The literature reports that 30-40% of food losses, especially grains, are caused by insect infestations during the storage stage.

In order to maintain these amounts of food in the storage stage, while at the same time promoting the European Union's goals for products that are friendlier to the environment and the final consumer, there is a constant search for alternatives that satisfy the above conditions. It should be stated that apart from the environmental damage, conventional use of insecticides for stored products disinfestation has an increased potential for the development of resistant insect populations, reducing the number and effectiveness of the active substances contained in the insecticides.

Based on the above, there is the possibility of using an innovative product called diatomaceous earth (DE) that covers both the part of effective disinfestation and the part of the environmental dimension. However, the lack of the necessary knowledge about the existence of the specific product combined with the absence of the know-how to use it, makes its extensive use very difficult. For this reason, the contribution of DiatomiteTHEM project focuses on the DE promotion by assessing its economic and environmental efficiency compared to existing disinfestation methods.

Data Envelopment Analysis (DEA) was implemented through the use of deaR library of R studio to acquire the optimum solution based on the following variables. During the DiatomiteTHEM project, insect populations were collected from the THESgi facilities, and their mortality was checked after the use of various disinfestation methods. Using this data in combination with the economic data of disinfestations, the first model was constructed which examines disinfestation costs per ton of product and effectiveness in mortality for the 3 main insect species (*Rhyzopertha dominica, Sitophilus zeamais, Cryptolestes ferrugineus*). The model was named EconDEA and examines the use of 2 phosphine formulations, commercial insecticides, contact insecticide (with pyrimphos-methyl active) and DE. The second model uses the original EconDEA model as its base and introduces two additional variables. The first one is the duration of the disinfestation, and the second one is about the environmental aspect where values were collected from products manuals – in other words, an ordinal scale based on the negative impacts of each product was created.

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Results show that contact insecticides are the best solution when considering only the economic dimension of the benchmarking process, but DE is better when the environmental dimension is embodied in the DEA model. For this reason, THESgi should carefully design its strategy for the upcoming years clarifying the final use of its products, demanding from the market a premium price for products produced and stored with environmentally friendly practices. The use of DE grains is a modern solution, which presents a higher cost than its alternatives, nevertheless, the quality of the final product will define the positive effects of its use on the whole supply chain.

Keywords
DEA, diatomaceous earth, stored products, economy, environment, agriculture

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