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Predicting oxygen depletion during grain storage using hermetic bag technology

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ABSTRACT

The agriculture sector in low-income countries faces a significant challenge in solving problems with postharvest losses. Postharvest handling operations, including storage, plays a vital role in keeping the commodity safe from deterioration. One of the growing alternative innovative storage technologies that aim to improve smallholder farmers' food safety and security is the hermetic storage. Hermetic storage can effectively control insect activity in stored grain and thus preserve grain quality. Grain moisture content stabilizes while oxygen (O_2) level reduces, and carbon dioxide (CO_2) increases through respiration of the commodity, insects, and fungi. One kind of hermetic storage technology uses gas impermeable film as a liner inside a woven polypropylene (PP) or jute sack. Despite the increasing adoption of hermetic storage bag technology in Sub-Saharan Africa and Asia, there are still gaps needed to understand the factors that influence these hermetic liners' effectiveness. One of which is how these bags achieve and maintain a low-oxygen concentration and effectively preserve stored grains.

In this study, a spreadsheet was developed to calculate the predicted oxygen depletion in hermetic storage bags as a function of insect and grain respiration at different moisture contents and temperatures and the oxygen transmission rate. Results confirmed that insect respiration dominated oxygen depletion in maize stored at safe storage moisture contents of 12-14% while grain respiration was negligible. Results provided a basis for a better understanding of the hermetic storage technology. This will also assure the continued successful adoption of this critically important storage technology among smallholder farmers to control biological activity in stored grains.

Keywords: Grain respiration, Hermetic storage bag, Insects, Oxygen depletion, Oxygen transmission rate