Monitoring the distribution of stored product insects - and zer0 pesticide control by hermetic storage

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What are stored products?

Plant products:
„products in the unprocessed state or having undergone only simple preparation such as [milling,] drying or pressing…"

(Source: 91/414 EEC, 1991)

But SP pests also attack food, e.g. granola, chocolates, pasta, bread

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Stored product pests

Insects

beetles

moths

dustlice

Capability of stored product insects:

- Survival and reproduction without additional water source
- Orientation towards volatiles from stored goods

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Global warming, climate change

- More weather extremes, reduced harvest
- Faster development, more insects
- More stored product pests in the field, more tropical species move up north
- Increased infestation pressure at harvest and in leaky storages
- New storage method should prevent insect survival

Foto: BayWa 2018

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Project: Preventing pests in Germany

(Abwehr von Vorratsschädlingen in Deutschland) (AVoiD)

Challenge: Global warming increasing infestation pressure in field and storage

Tasks:

a) Hermetic storage to suppress pest attack and residual infestation from field

b) Detection: Trap catches of stored product insects in the field & in storage structures

Partners:

- JKI-ÖPV: efficacy of hermetic structures, methods to deplete oxygen
- JKI-SF: economical effects
- MRI: grain quality before and after storage
- TI: sustainability and workers safety

Supported by climate protection fund (KSP) of the German government

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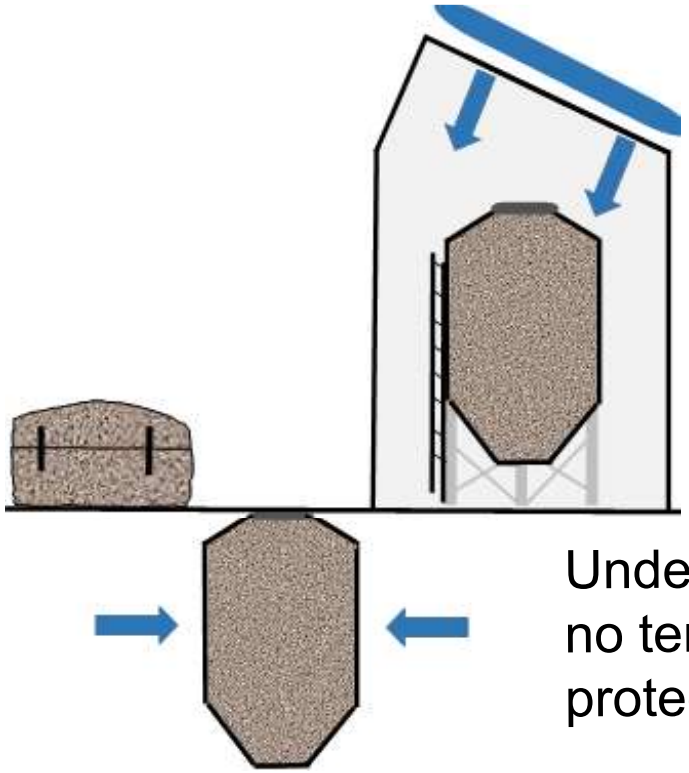
Hermetic storage

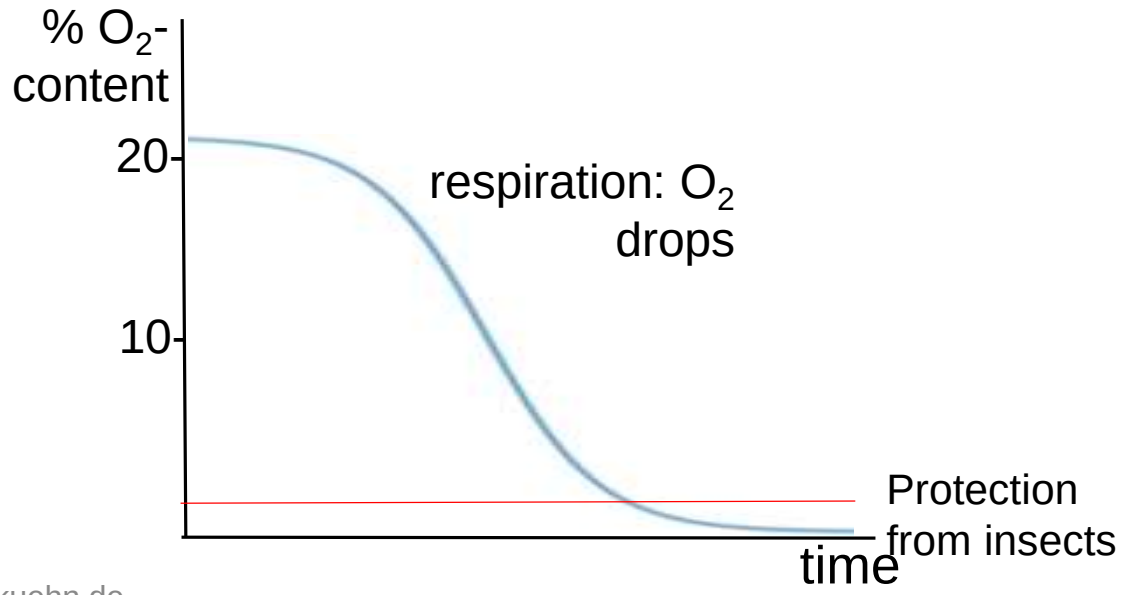
History: Underground storage known since iron ages (700 BC): Africa, Europe, Asia



Underground cooling,
no temperature changes,
protected from pests

Photo: Ismail Sen, Turkey

Photo: kids.kiddle.co



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Hermetic storage – rigid structures

Rigid structures: above-ground glass fiber silo, underground stainless steel silo bin, built in 2023

Aims

- Comparing hermetic above- and underground storages
- Efficacy against SP insects (JKI-ÖPV), Grain quality (MRI), sustainability, workers safety (TI), economical aspects (JKI-SF)

Methods

- Practical & comparative testing various structures
- Start 2024: O_2, CO_2, temperature, r.h., acoustics

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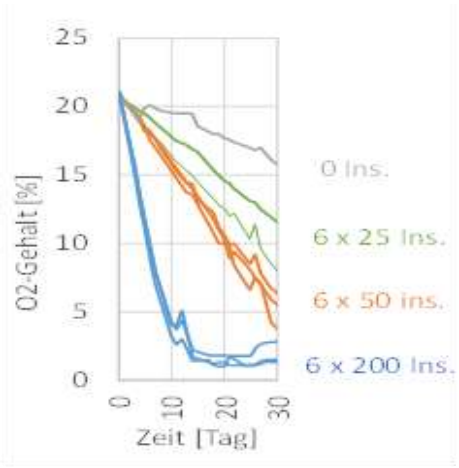
Testing oxygen consumption in gas-tight plastic drums

Volume 33 L, filled with 22 kg of wheat (14.5 % mc)

Addition of six caged weekly stages of *S. granarius* for improved oxygen consumtion

Gas samples taken with syringe, determined with a Toray Oxygen Analyzer



Adding insects in all stages markedly increases oxygen consumption

Which species gives the highest consumption?

Better use insects in different substrate?

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Hermetic storage – flexible structures

Silobags

Monitor practical silobag storage in Germany

Observation: Silobags often not checked for hermeticity (improperly sealed or damaged)

Grainbags & bigbags

Oxygen consumption tested

Hypoxia was achieved in preliminary tests with old grain: mainly microbial respiration

Cocoons

For bag stack storage, with zipper, will be tested in 2024

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Testing gas-tight plastic liners against insect penetration

Candidates for testing:
P. interpunctella larvae prior to pupation,
hatching adults of
R. dominica and
S. paniceum

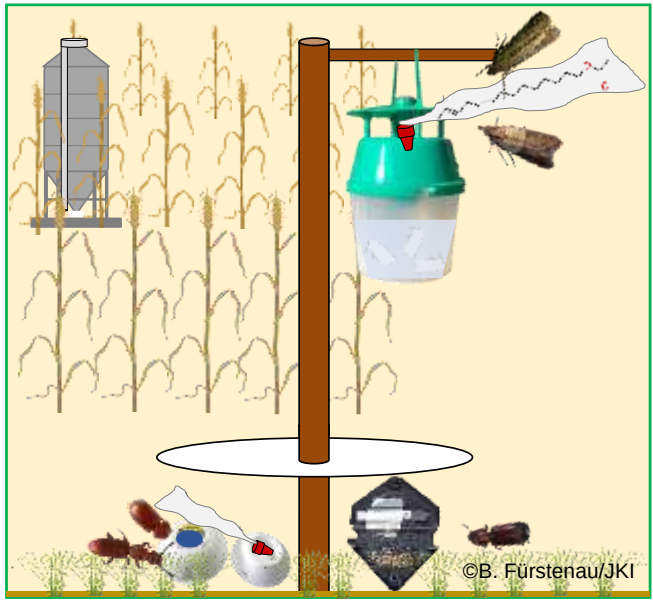
Detection of SP insects

Aims

- Recording occurrance & distribution of SP insects in storages and in the field
- Monitoring of established and possibly new invading SP pest species

Methods

- Trapping for insects on-farm in various regions of Germany
- Evaluating monitoring systems (lures and traps) and pest occurance



Funnel trap for flying insects,
dome trap with pheromone lures,
bait bag trap with food lures

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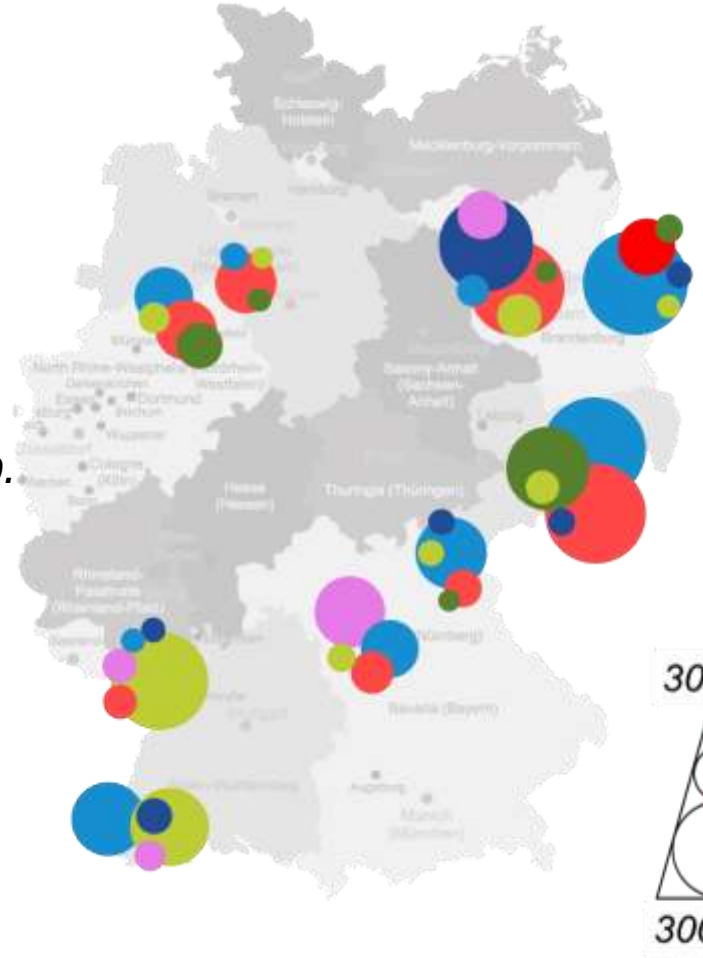
Detection inside and outside storages in 2023

Traps and lures changed monthly (April-Nov. 23)

Substantial numbers of *Rhyzopertha dominica* & *Oryzaephilus surinamensis* found in the field.
Other beetle species occasionally.

In addition *Plodia, Ephestia* and *Nemapogon spp.*



Lesser grain borer (*Rhyzopertha dominica*

Sawtoothed grain beetle (*Oryzaephilus surinamensis*)

Flour-/ warehouse moth (*Ephestia spp.*)

Indianmeal moth (*Plodia interpunctella*)

European grain moth (*Nemapogon granella*)

Dust lices (*Psocoptera*)

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Conclusions

Hermetic grain storage has not been done in Germany, recently .

Hypoxia may give protection against grain damage in infested grains after harvest.

Head space and total available oxygen should be kept at minimum.

Stored product, temperature, r.h., no. & type of pests determine oxygen consumption.

Better use warm and infested grain directly after harvest or assist oxygen consumption.

Certain stored product insects can be found by trapping in agricultural fields.

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AVoiD-Team

(10/2022 – 11/2025)

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