HERMETIC MAIZE STORAGE SYSTEMS FOR SUBSISTENCE FARMERS

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Maize Production Practices

- Harvest maize on the ear at 18 to 25% moisture
- Remove husk
- Dry ears in sun until below 14% moisture
- Shell kernels from cob by hand

or

- Shell kernels from cob by hand
- Dry kernels in sun until below 14 % moisture

- Store maize up to a year for use or sale or seed

Drying maize in Tanzania

Maize storage in bags in Tanzania

Selling maize in Tanzania market

Postharvest maize losses

- Without proper management: 100% loss
- 22% loss Southern and Eastern Africa 2008 (PHL)
- Sub-Saharan Africa:

  Annual postharvest loss is $US 4Billion out of $US 27 Billion worth of grains produced. (FAO)
- PHL reduction costs less than increased production

Postharvest maize losses

- Rodents
- Birds
- Fungi
- Insects

Prevention of postharvest maize losses

- Rodents----------robust container
- Birds
- Fungi
- Insects

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Prevention of postharvest maize losses

- Rodents----------robust container
- Birds----------robust container
- Fungi----------dry to under 14 % moisture
- Insects----------?????

Principal insect pest of stored maize

Maize weevil (*Sitofilus zeamais)*

Maize kernels damaged by maize weevils

Destroyed maize kernels

Control of maize weevil

- Traditional procedures (ashes, garlic, neem oil, screening)
- Insecticide (phosphine, actellic, fenitrothion, malthion)
- Hermetic storage

Selling maize in Tanzania market

Control of maize weevil

- Traditional procedures (ashes, garlic, neem oil, screening)
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- Hermetic storage

Hermetic storage

- Principle:

  Place maize in airtight container, allow weevils to use up oxygen. Weevils die of lack of oxygen.

- Advantages:

❑ Effective

❑ Simple

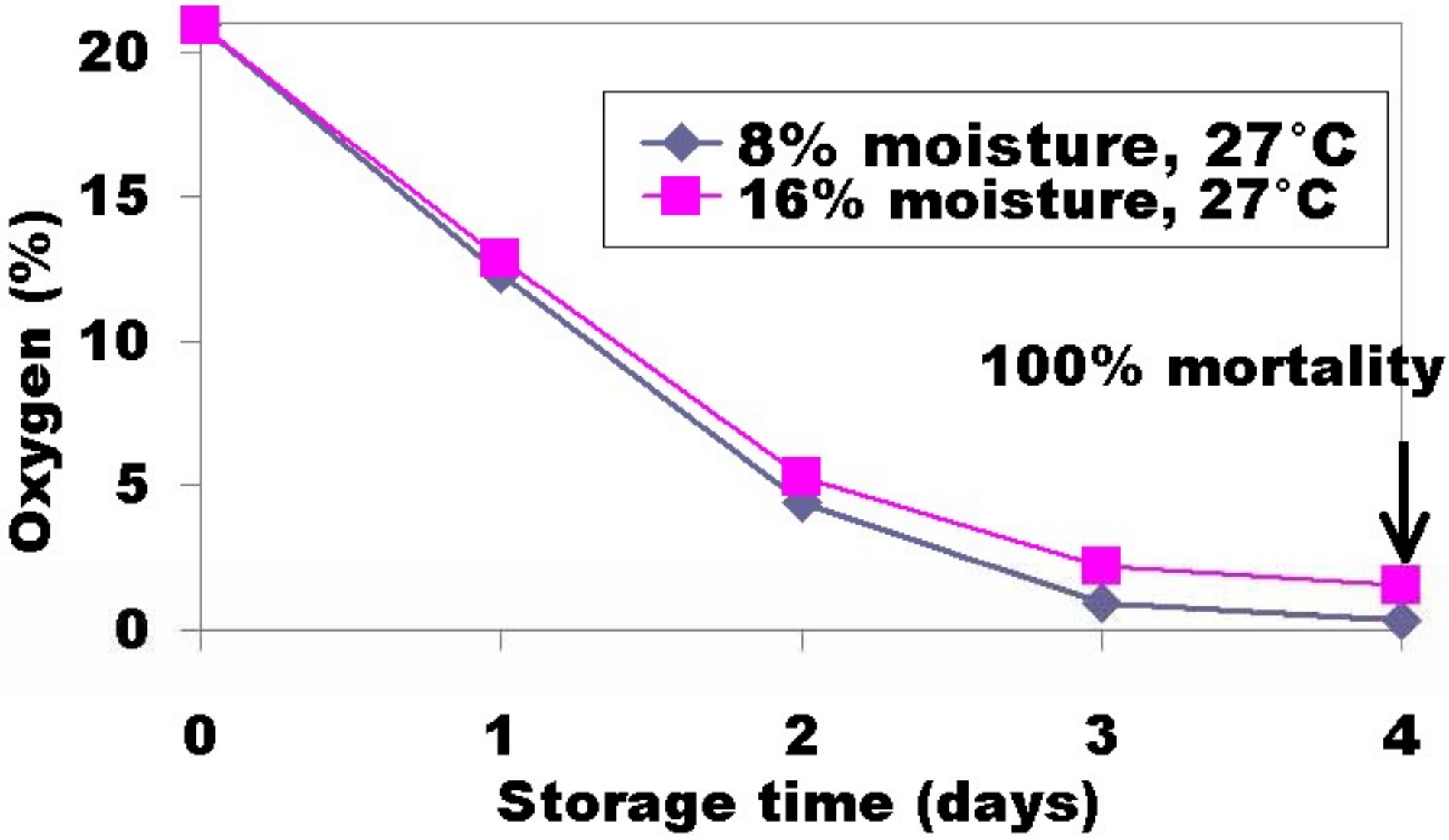
❑ No chemicals

- Disadvantages:

❑ Requires sealable container

❑ Requires careful management to maintain seal

Oxygen level in maize with weevils



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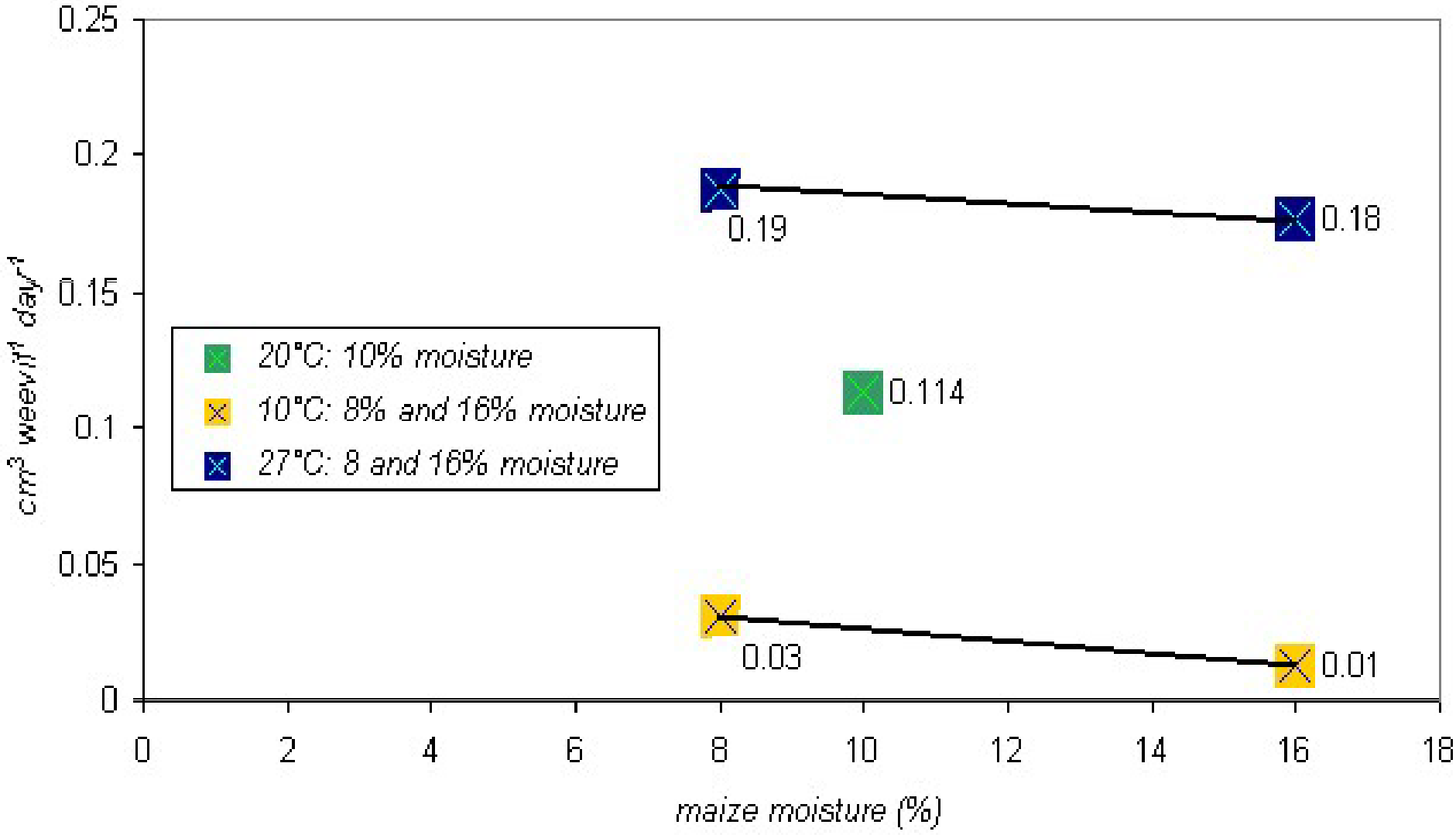
Oxygen consumption of maize weevils



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Oxygen consumption of maize weevils

Example:

- 225-L (55-gal) barrel contains 162 kg maize at 10% moisture, stored hermetically at 20C
- From graph: oxygen consumption = 0.114 $cm^3 weevil^{-1} day^{-1}$
- Weevils die when O_2 reaches 4 %
- Kernel density = 1.24 g cm^{-3}
- Maize volume = 131 L Air volume = 94 L
- Time to 100 % mortality of adult weevils = 9 days

Hermetic storage systems

- **Postcosecha galvanized steel silo**

Postcosecha steel silos

Galvanized steel silo

Postcosecha steel silos

Postcosecha bin construction

Hermetic storage systems

- Postcosecha galvanized steel silo
- **Purdue improved cowpea storage system**

PICS 80µm inner bag

PICS woven outer bag

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Maize storage containers

Purdue triple bag system

Hermetic storage systems

- Postcosecha galvanized steel silo
- Purdue improved cowpea storage system
- **GrainPro membrane bags**

GrainPro SuperGrainbag Ziplock

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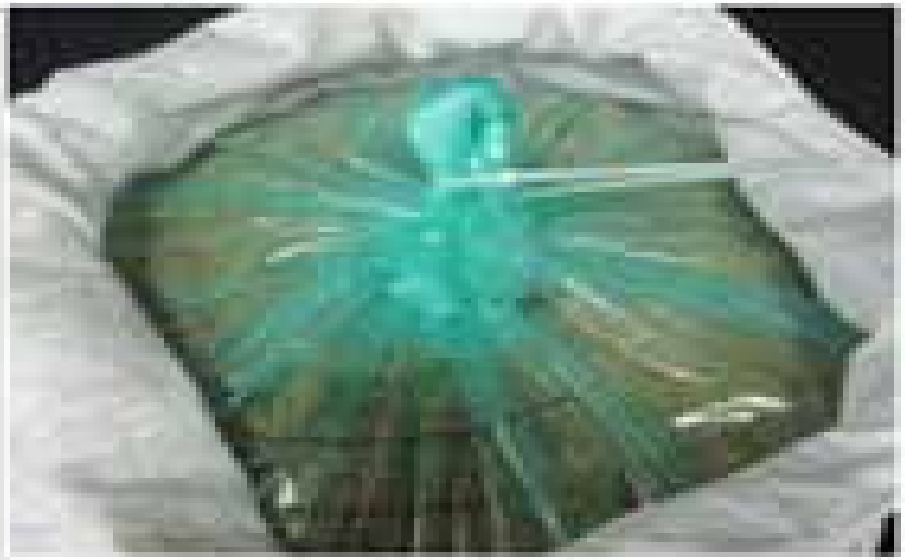
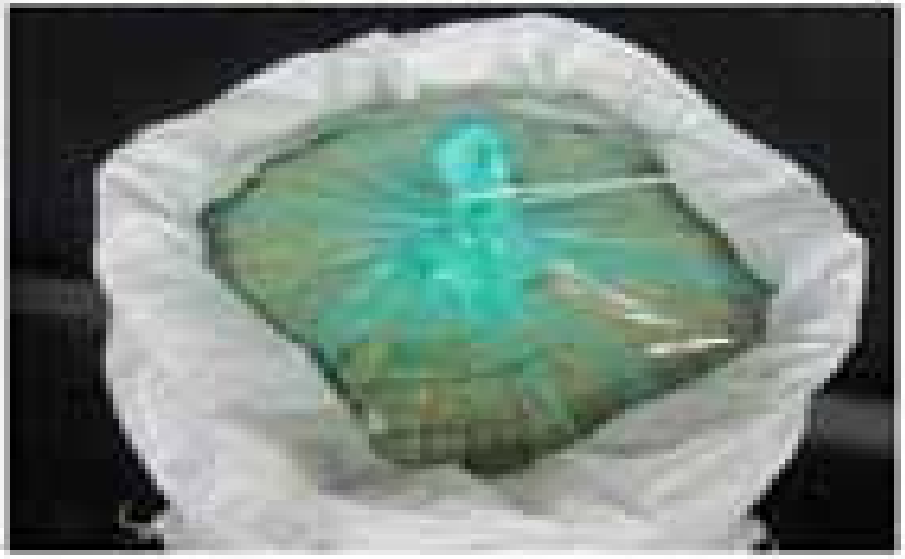
GrainPro SuperGrainbag, plastic tie seal





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Rat damage to plastic bag

Maize storage containers

- Galvanized steel silo
- Grain-Pro plastic bag system
- Purdue triple bag system
- **Recycled food container**

Maize storage containers

Recycled food container

- 10-L edible oil container
- Cost: 2000 UGsh ($1US) Kamali, Uganda
- Cost: 2300 TZS ($1.62US) Same, Tanzania

Used containers in Same, TZ market

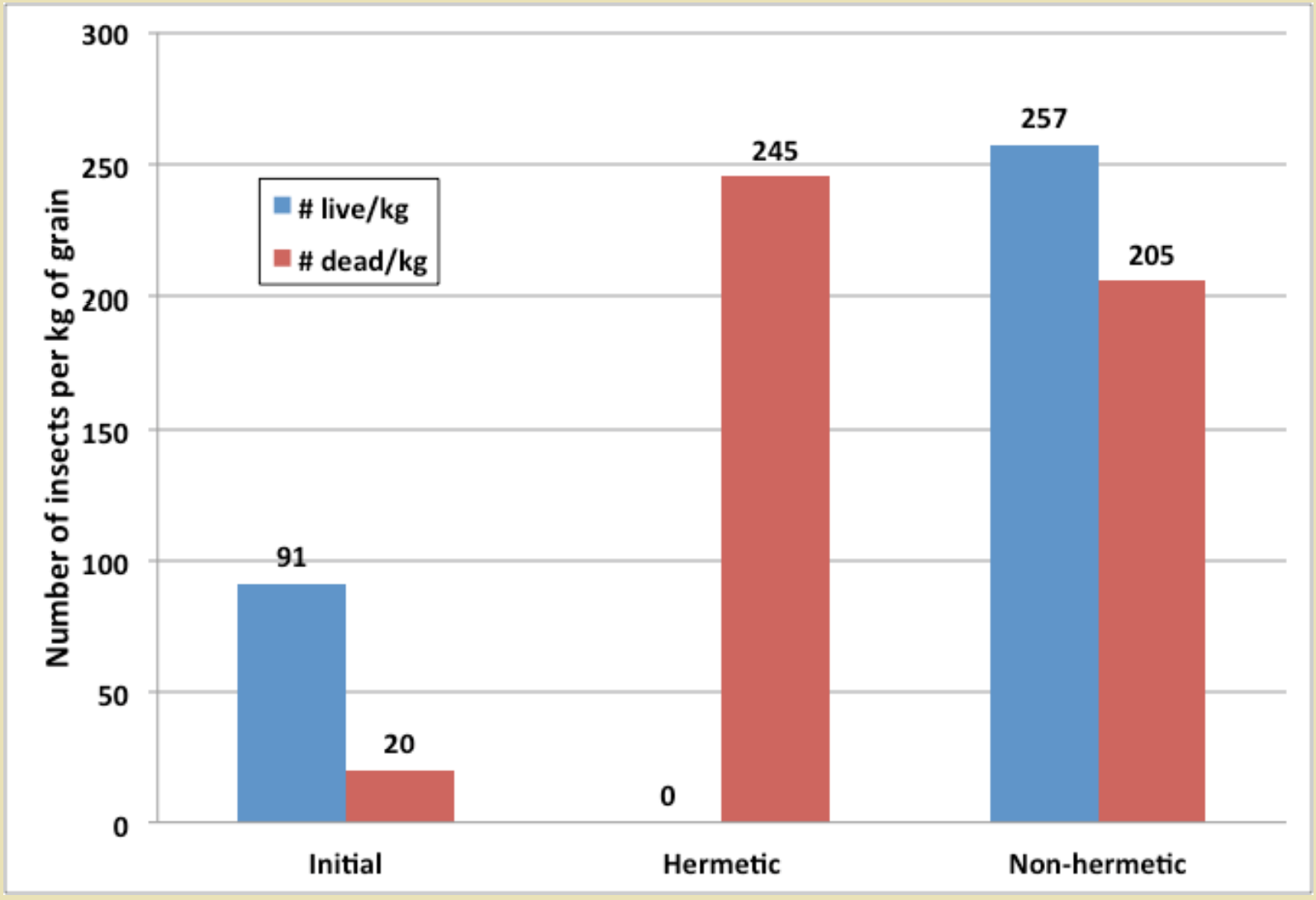
Storage experiment, Tom Brumm, Uganda

- 12 10-L used edible oil containers purchased at the local market
  - Cleaned with soap and water
  - Half of them modified to allow air infiltration.

Uganda edible oil container experiment

- Maize equally divided to fill 3 containers each:
  - Hermetically sealed.
  - Open to air infiltration.
- Initial and final analyses of grain quality characteristics
- Stored for 4 weeks at ambient conditions

Recycled oil container experiment results



Container cost comparison

Maize storage container costs

Container type	Maize capacity, kg	Cost, US$	Useful life, Years	Storage cost, US$/Mg/year
Postcosecha steel silo	1360	145	25 to 40	4.26 to 2.67
Purdue triple bagging	100	3	2	15.00
GrainPro Membrane	60	3.50	5	11.67
Recycled edible oil container	7.74	1	3	43.06

Conclusions

- **Four hermetic maize storage systems are in use on subsistence farms**
- **Each system can be effective in preventing storage losses to maize**
- **Availability and local conditions determine which system is the best choice**