Presentation to the Tanzanian Pesticide Approval and Registration Technical Subcommittee (PARTS) on diatomaceous earths October 2002.

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Diatomaceous earths

using the past

to protect the future

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Inert dusts - History

- Birds and mammals take "dust baths" to free themselves of mites and other parasites
- The Chinese used DE for pest control 4000 years ago
- The Aztecs of ancient Mexico are said to have mixed maize with lime to preserve their grain

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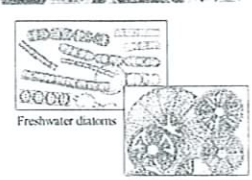
Diatomaceous earths (DE)

- are obtained from the fossils of phytoplanktons (diatoms)
- are composed mainly of amorphous hydrated silicates
- when diatoms settle to the bottoms of lakes and seas, diatomaceous earth deposits are formed



Freshwater diatoms

Marine diatoms

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DE - mode of action

Exert their effects on insects through physical means

- Act as dessicating agents - DEs adsorb wax from the cuticle leading to water loss and dehydration of insects, DE's may also abrade the cuticle.
- Repellent - dusts in general are repellent to insects

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Which insects are most susceptible to DE's?

- Insects with a large surface area to volume ratios (often smaller insects)
- Insects with body hair e.g. *Oryzaephilus mercator*
- Insects with a thin cuticle
- Insects protected by a low-melting grease e.g. cockroaches, rather than those with a hardened waxy cuticle
- Those that feed on dry grain as opposed to those that constantly obtain water by sucking on vegetation

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Use of DEs in other aspects of pest management

- DE can be used to treat cracks and wall crevices to repel insects

- DE's are also used against some field pests

- Cattle, poultry and dog owners add 1-2% DE to animal feed

DE is used in many commercial products including:

- food additives
- baby powders

- oil removers from concrete floors
- deodorizing compounds
- swimming pool filter systems

- filters in the brewery industry
- detergents

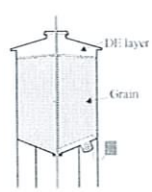
Current DE grain protectant uses

DE products are registered for use as grain protectants in Australia, Brazil, Canada, Croatia, China, Germany, Indonesia, Japan, Philippines, Saudi Arabia, United Arab Emirates and USA

Uses:

Grain treatment using a dust applicator

Structural treatment of grain silos with DE slurry spray application



Top dressing with DE layer combined with fumigation or aeration

Safety and diatomaceous earths

Toxicity - very low mammalian toxicity.

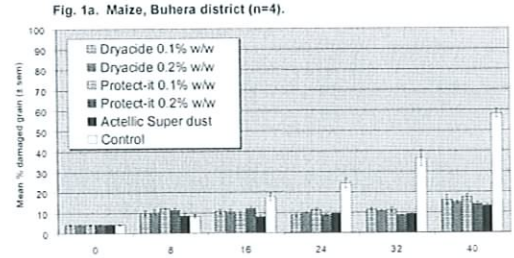
Inhalation can cause respiratory problems, hazard level is affected by:

- Amount of dust
- Particle size
- Crystalline silica contamination

Inert dusts, particularly diatomaceous earths, offer safer alternatives to synthetic chemicals, but information on their efficacy under tropical small-scale farming conditions is limited.

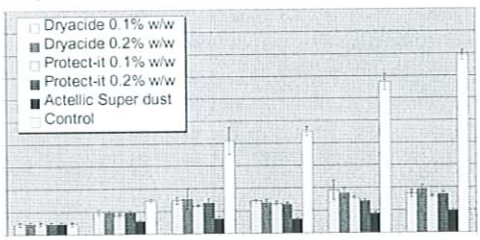
Traditional storage structures in Binga and Buhera districts, Zimbabwe

Insect damage to commodities treated with diatomaceous earth or chemical protectants during the 1998/99 storage season in Zimbabwe.



Insect damage to commodities treated with diatomaceous earth or chemical protectants during the 1998/99 storage season in Zimbabwe.

Fig 1b. Maize, IAE, Harare (n=4)



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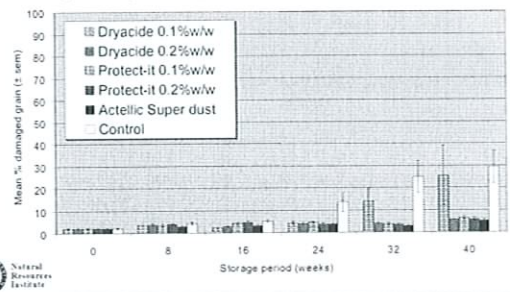
Insect damage to commodities treated with diatomaceous earth or chemical protectants during the 1998/99 storage season in Zimbabwe.

Fig. 1c. Sorghum, Binga district (n=4).



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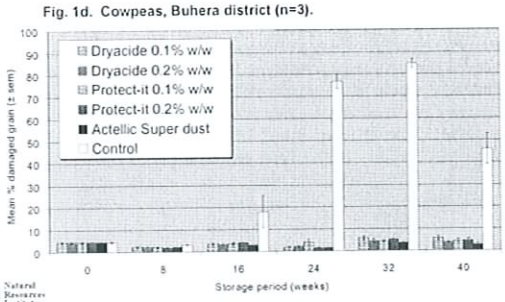
Insect damage to commodities treated with diatomaceous earth or chemical protectants during the 1998/99 storage season in Zimbabwe.

Fig. 1d. Cowpeas, Buhera district (n=3).



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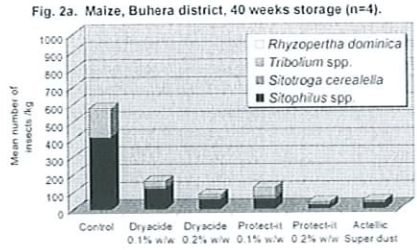
Mean total number of adult insects found in samples of treated and untreated grain after 40 weeks storage (1998/99)

Fig. 2a. Maize, Buhera district, 40 weeks storage (n=4).



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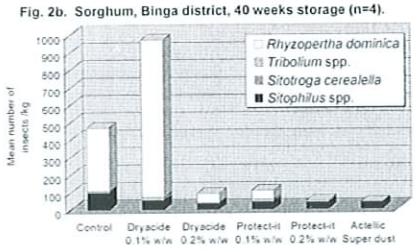
Mean total number of adult insects found in samples of treated and untreated grain after 40 weeks storage (1998/99)

Fig. 2b. Sorghum, Binga district, 40 weeks storage (n=4).



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Insect damage to commodities treated with diatomaceous earth or chemical protectants during the 1999/00 storage season in Zimbabwe.

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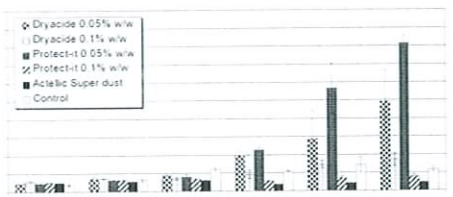
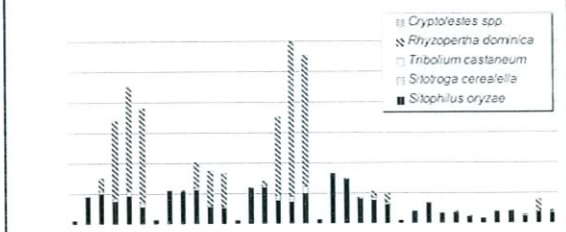
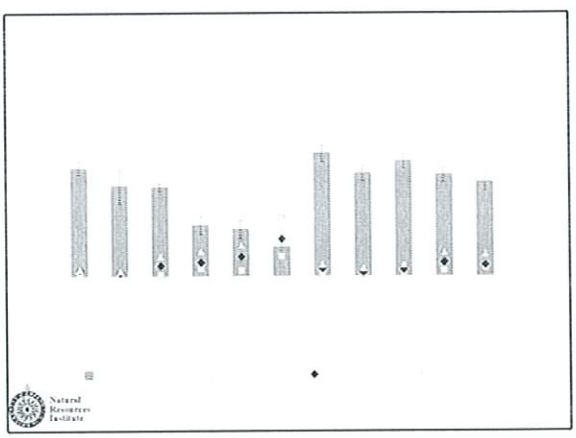


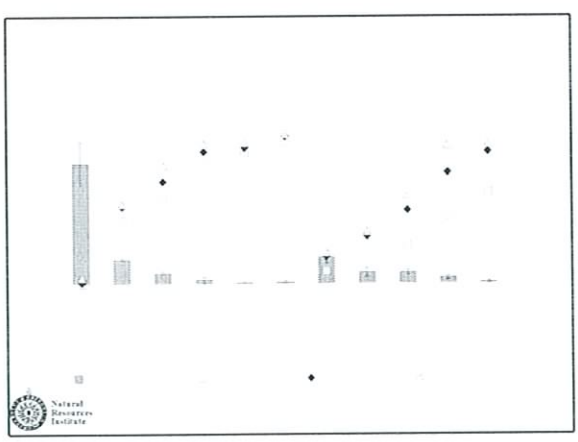


Inert dusts as admixes

Summary

- Protect-it and Dryacide are effective and persistent against the major insect storage pests attacking sorghum, maize and cowpeas in Zimbabwe, for storage period of 40 weeks. However efficacy is dosage linked and differs between commodities.
- Low damage in all samples during first 16 weeks, suggests it is not worth treating grain which will be consumed within 4 months.
- It is concerning that 0.05%w/w Dryacide and Protect-it and 0.1% Dryacide admixed with sorghum resulted in higher damage levels than the untreated control.





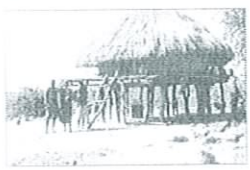
What about farmers perceptions of the inert dusts as grain protectants?

- Farmers were involved in the evaluation of these treatments after 40 weeks storage.

- Important parameters included presence of adult insects, larvae, trash, poor taste, smell, damage, weight of grain.

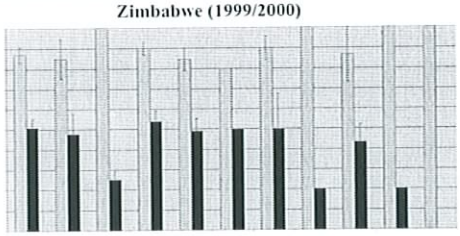
Farmer Managed Inert Dust Trials

- Simultaneous trials were set up which farmers managed themselves.
- Evaluation were made by farmers and researchers at the start of the trial and after 5 and 7 months storage.

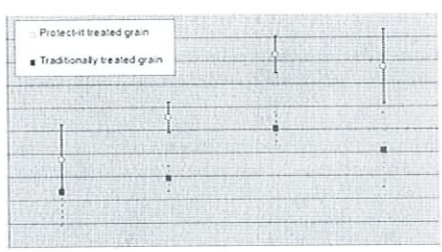


Farmers used their own parameters to compare the Protect-it treated sample with the traditionally treated sample.

Farmers comparison of their Protect-it treated and traditionally treated shelled maize after 7 months storage in Buhera district, Zimbabwe (1999/2000)



Comparison of farmer perceived price of their Protect-it treated and traditionally treated grain in Buhera and Binga districts, Zimbabwe (1999/2000).



Note: ZS60 = £1 during the trial period

Advantages

- Non-toxic
- Easy to separate from grain by washing or milling
- Small amounts of commodity can be protected
- Does not affect plumpness, moisture content of grain, or baking characteristics of flour (La Hue, 1967a)
- Act also as a repellent, therefore less Darwinian selective pressure, and thus less chance of resistance occurring
- May be possible to recycle

Disadvantages

- Decreases bulk density of grain, as dust adhering to the kernels affects the nestling and settling qualities of the grain, and it does not pack as tightly. This can affect the grading standard
- Respiratory hazards

The work on diatomaceous earths in Zimbabwe has now been published in the Crop Protection journal

STATHERS, T., MVUMI, B. and GOLOB, P. (2002). Field assessment of the efficacy and persistence of diatomaceous earths in protecting stored grain on small-scale farms in Zimbabwe. *Crop Protection*, 21(10): 1033-1048

STATHERS, T.E., CHIGARIRO, J., MUDIWA, M., MVUMI, B.M. and GOLOB, P. (2002). Small-scale farmer perceptions of diatomaceous earth products as potential stored grain protectants in Zimbabwe. *Crop Protection*, 21(10): 1049-1060

Protect-It is currently in the process of being registered for use as a grain protectant in Zimbabwe by EcoMark Ltd.

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Use of diatomaceous earths in Tanzania

Further work to evaluate whether diatomaceous earths and other treatments are safe, effective and affordable treatments for rural householders was initiated by the Plant Health Services Division of the Tanzanian Ministry of Agriculture and Food Security in July 2002

"Small-scale farmer utilisation of diatomaceous earths during storage"

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As the larger grain borer (*P. truncatus*) is already widespread these studies hope to test different concentrations and combinations of DEs to identify alternative options to the currently available (and often adulterated) organophosphate based pesticides for Tanzania farmers

The project will also investigate local deposits of diatomaceous earths to see whether any of them have potential as grain protectants. Deposits are known to exist in Dodoma, Kagera and Bukoba in Tanzania and in Kenya, Zimbabwe and South Africa

The project will also study the flow of post-harvest information among different stakeholders to help identify effective pathways for the promotion of post-harvest management information

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Trials have been set up in:

Mlali village, Kongwa district, Dodoma Region
Mwama karanga village, W. Shinyanga district, Shinyanga Region
Kishapu village, E. Shinyanga district, Shinyanga Region
Arri village, Babati district, Arusha Region
Singe village, Babati district, Arusha region

The commodities being studied are: maize, sorghum and beans

The grain protectants being tested include:

- traditional protectants (ash, plant materials)
- Actellic Super dust
- Protect-It and Dryacide (two diatomaceous earths)
- combinations of diatomaceous earths & synthetic chemical pesticides

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R8179. Crop Post Harvest Programme

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