Solar Heaters For Improved Cowpea Storage

CRSP 

Technical Bulletin 2

Agronomic Research Institute of Cameroon (IRA)
Maroua Research Center
CRSP Cowpea Storage Project

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INTRODUCTION

Callosobruchus maculatus, the cowpea weevil or cowpea bruchid, is the principal storage pest of cowpeas in northern Cameroon. Infestations start in the field on pods but population growth accelerates following threshing, when eggs can be laid directly on the seeds.

The adults live 5 - 10 days. Each female lays 40 - 60 eggs which she glues to the cowpea seeds. Bruchid larvae feed and develop inside the seeds and emerge as adults after about 3 - 4 weeks. The adults mate and give rise to another generation in the store. The cycle is repeated again and again.

Since each female lays so many eggs and there are multiple generations, even minor infestations at harvest can lead to almost total loss of the cowpea store after only a few months of storage.

Life Cycle of the Cowpea Bruchid

Callosobruchus maculatus

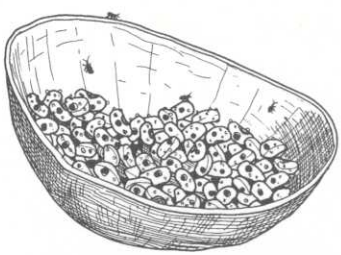
The life cycle of the bruchid is composed of four stages: egg, larva, pupa, and adult. The complete life cycle takes about 5 weeks.

Egg (duration: 7 days)
40 to 60 eggs which hatch in about 7 days are laid on pods or directly on the seeds.

Larva (duration: 14 days)
Larvae feed and develop inside the seeds.

Pupa (duration: 7 days)

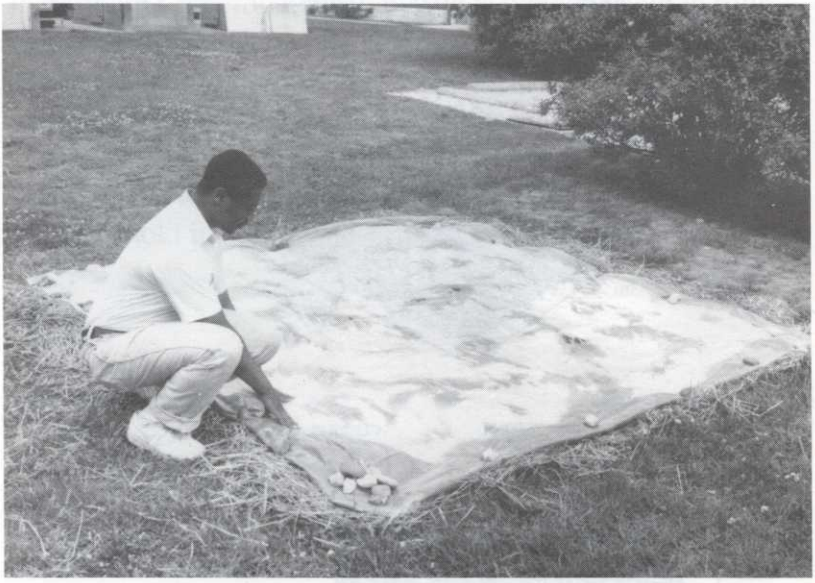
Adult (duration: 7 days)
Adults emerge from the seeds.



High Temperatures Kill Bruchids

IRA/CRSP researchers have shown that high temperatures (57°C for 1 hour), will kill bruchid eggs, larvae, pupae, and adults.

Using this finding, IRA/CRSP scientists have designed a low-cost solar heater that can eliminate bruchid infestations.

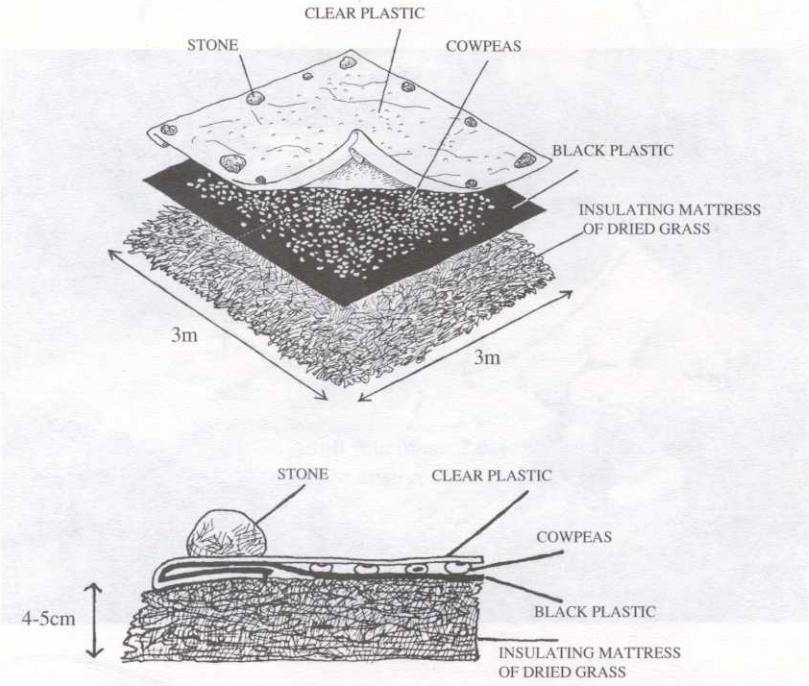


The following pages describe how to construct and use this simple solar heater.

Solar Heater Design

Solar heaters are constructed using a bottom layer of black plastic to absorb solar radiation (heat) and a covering of clear plastic to trap this heat.

Cowpea seeds are placed on the black plastic and covered with the clear plastic. The heater is placed on an insulating mattress of dried grass or threshed cowpea pods to prevent heat loss to the ground.



These heaters can attain temperatures of 65°C and higher even during the coolest months of the year.

Materials Needed

Materials needed to construct a solar heater include:

1) 3m x 3m sheet of black polyethylene plastic

2) 3m x 3m of clear plastic

3) 2-3 sackfuls of dried grass or threshed cowpea pods

In northern Cameroon, black plastic is typically sold in rolls which are 1.5 meters wide. Six meters should be purchased and cut in half to produce two 3m x 1.5m pieces. These can be sewn together to provide a black surface area 3m x 3m.

Only 3m of clear plastic need be purchased since this plastic is typically sold in 3.6m wide strips.

Construction

To assemble the heater:

1) **Lay** an insulating mattress of dried weeds or grass (3m x 3m area and 4-5cm thick) on the soil surface.

2) **Place** the 3m x 3m sheet of black plastic (two 3m x 1.5m sheets sewn together) directly on the insulating mattress.

3) **Spread** out 50 kgs of cowpea seeds evenly on the 3m x 3m black plastic surface.

4) **Cover** the cowpea seeds with a 3m x 3m sheet of clear plastic.

5) **Fold** the edges of the black plastic and the clear plastic covering together to prevent air circulation around the seeds.

6) **Place** small stones on the folded edges to seal the seeds into what is now a plastic envelope with the clear side facing the sun.

Construction: Illustrated

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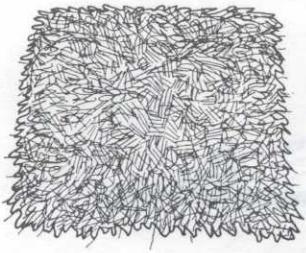

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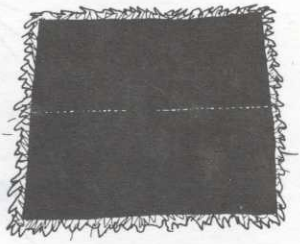

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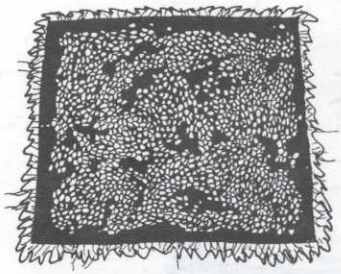

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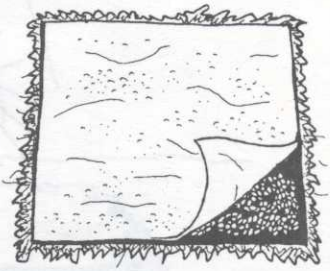

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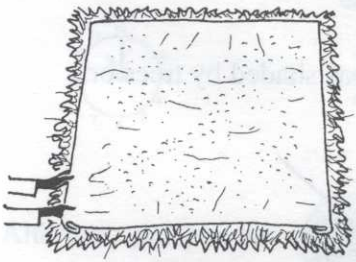

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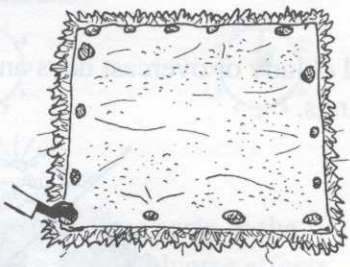
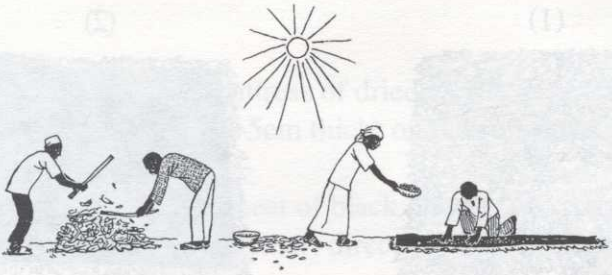
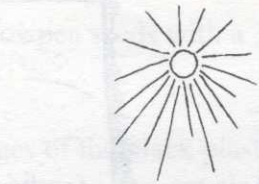


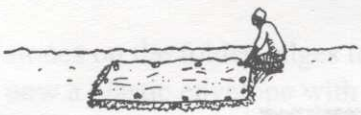
Use of the Heater

Treat the cowpeas as soon as possible after threshing.

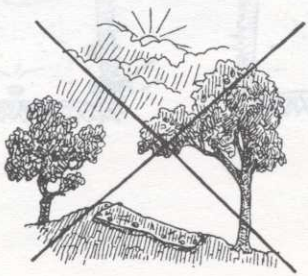


Use the heater when the weather is clear and sunny.
Place the heater in a sunny, level location.

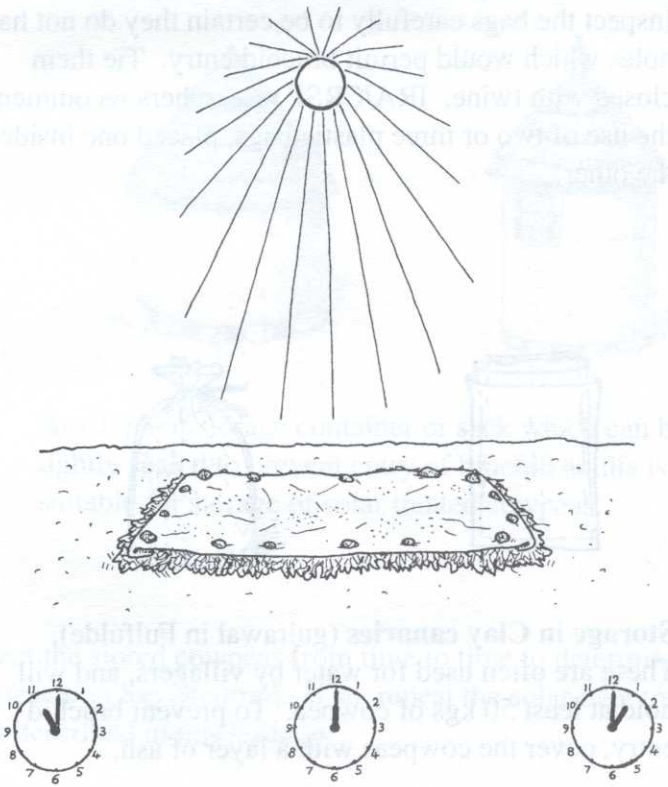




Avoid cloudy or overcast days and areas shaded by trees or buildings.



Treat the seeds for at least 2 hours around midday, preferably between 1100 and 1300 hours.

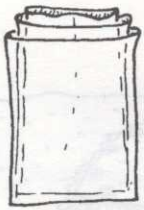


Alternatively, you can set the heater in place early in the morning and leave it until evening, without adverse effects.

Post Solar Heater Storage

After disinfesting cowpeas using the solar heater, it is important to prevent re-infestation. There are several options:

Storage in tightly sealed clear plastic bags. Clear plastic bags are available in northern Cameroon for 150 CFA. They will hold 50 kgs of cowpea seed. Inspect the bags carefully to be certain they do not have holes which would permit bruchid entry. Tie them closed with twine. IRA/CRSP researchers recommend the use of two or three plastic bags, placed one inside the other.



Storage in Clay canaries (guirawal in Fulfulde). These are often used for water by villagers, and will hold at least 50 kgs of cowpea. To prevent bruchid entry, cover the cowpeas with a layer of ash.

Storage in traditional granaries can be used to preserve solar-treated cowpeas. However, the granary must be well sealed and carefully cleaned before use and the cowpeas should be covered with a layer of ash 2-3cm thick to prevent bruchid entry and oviposition.

Any type of storage container or sack which can be tightly sealed to prevent entry of bruchid adults is suitable for storage of solar treated cowpeas.

Inspect the stored cowpeas from time to time to determine if re-infestation has occurred. If so, repeat the solar-heat treatment described in this bulletin.

If cowpeas are solar-treated following the procedures described in this bulletin, there should be no adverse effects on germination of the seeds or on cooking time.

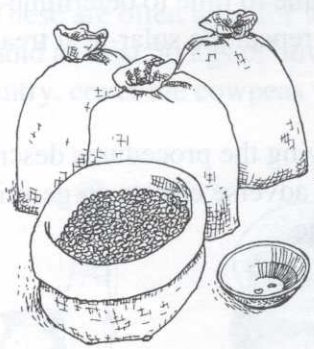
Cost / Benefits

Costs for constructing a solar heater, based on 1990 prices in the Maroua central market are as follows:

Black plastic	= 6m x 800 CFA	=	4.800 CFA
Clear plastic	= 3m x 700 CFA	=	2.100 CFA
Sewing charges		=	500 CFA
	Total cost	=	7.400 CFA

Since cowpeas will normally sell for at least 200 CFA per kg, a typical low-resource farmer with an average total grain yield of 200 kgs could expect a gross profit of 32,600 CFA, assuming that the entire crop is sold.

200 kgs cowpea x 200 CFA/kg	=	40.000 CFA
Solar heater cost	= (-)	7.400 CFA
Gross Profit	=	32.600 CFA



200 kgs x 200 CFA/kg = 40.000 CFA

Experience suggests that a solar heater constructed with the plastic available in the Maroua market should be useable for two or more years if treated carefully.

During demonstration-tests with local farmers it was suggested that the solar heater materials could be purchased and used communally by three to five farmers, making the use of solar heaters even more economical.

Acknowledgements:

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