Tropentag, October 11-13, 2006, Bonn

"Prosperity and Poverty in a Globalised World—
Challenges for Agricultural Research"

Thermal Disinfestation of Stored Grain Using Solar Energy

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Abstract

Food grains are a major dietary source for humans. During storage, grains are seriously affected by many factors, which cause deterioration and losses. Most losses result from infestation by biological agents, mainly insects, which are more active under tropical conditions. Losses as high as 50 % have been reported in many tropical countries. The most common control method is chemical insecticides, but serious problem have been identified their future. High temperature treatment is one of the promising alternatives. It is safe, effective and highly accepted in the market, but it has been seriously constrained by its high-energy requirement. Solar energy has the potential as alternative source of energy because it is free, abundant, and environmental friendly. This study aimed to reduce using non-sustainable energies and eliminate insecticides using, therefore, protecting environment and preserving grains in a good condition for prolonged time.

Experiment was carried out at the Department of Crop Science, Agricultural Engineering Goettingen University, Germany. Thermal disinfestation apparatus was designed to heat grain a continuous-flow system. A solar collector, (3×0.25 m), was constructed from black-painted stainless steel as absorbing material, glass cover, polystyrene for bottom insulation and wood as side insulation and frame. Grain wheat, 10 % moisture content was used in the experiment. System was running under direct solar radiation. Grain, collector and ambient temperatures and solar radiation were recorded. Possibility of obtaining insect lethal temperature 60°C, using different grain flow-rates, was examined.

Results explained that, using solar energy, lethal temperature for all stored-grain insects, could be obtained using different grain flow-rates. Grain flow-rate was found to be in the range of 13.33–30.67 $^{kg}/_{h}.m^2$ of absorber surface area, according to solar radiation quantity. Maximum solar radiation recorded was 850 $^{W}/_{m^2}$. The system can work for 5 $^{h}/_{day}$ under German weather conditions.

With these results it is possible to construct solar driven thermal disinfestation apparatus for grain flow in a continuous-flow system. Results seem to be promising in tropics and subtropics where much solar radiation is available.

Keywords: Solar energy, stored grain, thermal disinfestation

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