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## Thermal disinfestation of stored grains by solar energy

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### Abstract

Chemical control especially fumigants is the most commonly used method to control stored-grain pests. A safer alternative for disinfestation is by heating up grains to a temperature of 50-60 °C. However, this alternative consumes high thermal energy due to the relatively high temperature required to achieve the required goal. Using solar energy as heat source for low temperature applications has become a viable mean for heating applications. Heating of grains using solar energy requires special design of grain storage system as well as development of efficient heat transfer mechanism to increase grain temperature over a limited period of time. The main objective of the current study is to use thermal disinfestation as a non-chemical, safe control method for grain management. A heating system based on solar energy has been developed as heat generator to control stored-grain insects. The target temperature range is 50-60 °C, which is enough to kill most of stored-grain insects. The grain hopper heating system relies on hot water supplied from a solar collector. The temperature of grains can be controlled based on the amount of grains contained in the hopper and the amount of energy transmitted to grains inside the hopper. The effectiveness of the system will be measured by reaching the best temperature and time combination for each insect species without affecting the seeds quality. The best temperature and time combination for cowpea beetles will be discussed in more details.

## Retrospect, insights and foresights:

### Biological control of *Anobium punctatum* with *Spathius exarator*

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### Abstract

Biological control using beneficial organisms is getting more and more important in Integrated Pest Management. An effective strategy in the fight against the most common timber pest species, the furniture beetle *Anobium punctatum*, is based on the parasitoid wasp species *Spathius exarator*. This braconid wasp parasitizes its host species by piercing its ovipositor directly through the wood surface followed by oviposition onto the beetle larva. After feeding on the larva and pupation, the adult wasp emerges through a tiny 0.5 mm wide wood hole, which can be clearly distinguished from the 2 mm wide hole of *A. punctatum*. This enables us to observe easily the treatment success as each new *S. exarator* exit hole is equivalent to one killed beetle larva.

Between 2012 and 2017, the braconid wasps were introduced into about 80 *A. punctatum* infested buildings. At least twelve treatments over a period of up to three years were performed. On exactly defined areas, the newly emerged exit holes of *A. punctatum* and *S. exarator* were counted and the parasitisation rate was calculated. Here we present pooled data of 29 *A. punctatum* infested churches, successfully treated and monitored over a period of one to five years. Furthermore, as a representative sample, we show the results of one church over a period of six years.

We demonstrate the biological control of the common furniture beetle with this braconid wasp as an efficient, sustainable alternative to conventional residual methods. However, after a period of up to three years intensive treatment, a continuous monitoring-program with necessary additional single treatments should follow.

**Key words:** biological control, wood pest, cultural heritage, common furniture beetle, parasitic wasps