Title Microwave treatment of flowing grain for disinfestation of stored product insects.

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Abstract

The research reported here used a microwave unit with a 28 GHz, 200 kW gyrotron to (1) conduct dose-response studies with flowing grain containing different insect species and life stages, to determine those most tolerant to microwaves, and (2) conduct validation studies with a near-commercial-scale applicator using power sufficient to kill 99% of tolerant insects in flowing grain. Dose-response studies used 170-g samples of wheat that each contained about 200 individuals of either eggs, young larvae, or pupae of one of the following pest species: lesser grain borer (*Rhyzopertha dominica*), rice weevil (*Sitophilus oryzae*) or red flour beetle (*Tribolium castaneum*). Samples were poured through the test applicator and exposed to powers of 28 GHz microwaves that ranged from 1.8 to 15 kW. The most susceptible insects were the pupae of the rice weevil, and the most tolerant were larvae of the red flour beetle and eggs of the lesser grain borer. A test of exposure time limits showed that the energy needed for effective treatment could be delivered to flowing grain either as high-energy short bursts or lower-energy pulses in longer bursts equal to the grain residence time in the applicator. Validation studies utilized 15 kg lots of hard red winter wheat artificially infested with 150 larvae of the red flour beetle and passed through a larger applicator at near-commercial rates. No insects survived treatment, and grain showed no market quality loss as determined in milling and baking studies. Ancillary studies using 2.45 GHz applied to 15 kg of infested static wheat gave total kill of test insects, and suggested that this commonly used frequency could be applied to disinfesting stored grain.