Grain irradiation and insect pests

Which insects?

A booklet from the Queensland Department of Primary Industries spells them out for Queensland:

Common name	Scientific name
Rice weevil	Sitophilus oryzae
Lesser garin borer	Rhyzoperta dominica
Rust-red flour beetle	Trilobium castaneum
Dried fruit beetle	Carpophilus dimidiatus
Cadelle	Tenebroides mauritanicus
Bean weevil	Acanthoscellides obtectus
Saw-toothed grain beetle	Oryzaephilus surinamensis
Flat grain beetle	Cryptolestes pulillus
Tobacco beetle	Lasioderma serricorne
Tropical warehouse moth	Ephestia cautella
Indian meal moth	Plodia interpunctella
Angoumois grain moth	Sitotroga cerealella

Radiation sensitivity

The problem with insects is that you are dealing with more than one individual per insect. You have eggs, larvae, pupae and adults. In general the adults are the most radiation resistant.

It turns out that Sitophilus oryzae would need a dose of 20 krad (0.20 kGy) to kill about 99.9% of adults within 21 days. For Oryzaephilus surinamensis the same dose resulted in complete mortality of adults within 15 days (1). The same dose gave 'very high mortality' of adults from Rhyzoperta dominica (2).

Tribolium castaneum was toucher: adults died in 16 days after 50 krad (0.50 kGy) or in 12 days after 100 krad (1 kGy) (3)

Lasioderma serricorne needed 2500 Gy (2.5kGy) for 100% mortality of adults and 750 Gy or 0.75 kGy for 100% mortality of all immature stages (4).
Plodia interpunctella and Sitotroga cerealella are the hardest nuts to crack. All stages of these insects were given doses of about 13, 17, 25, 45 and 100 krad (0.13, 0.17, 0.25, 0.45 and 1 kGy). It turned out that 'the life of insects treated as adults or pupae was not greatly shortened by any of the treatments.'(5).

These are only a number of the in Queensland listed insects as major storage pests. The required dose to kill adults within 1 month varies in the mentioned insects from a low 0.20 kGy to a comparatively high 2.5 kGy.

Critical points in dose range

There are two critical points in this dose range. The most obvious one is that you are not supposed to kill the grain and this can happen from 1 kGy onwards (6, 7). Nobody is interested in silos with dead, stinking grain. And the second critical point is from about 0.50 kGy onwards. Between 0.50 and 1 kGy it has been found that irradiated moulds producing aflatoxins are stimulated in producing more toxin when they get a chance to grow.

Insects love irradiated grains

It is an illusion to think that once grain has been

disinfested it will stay this way. When the little critters get a chance you have them back. Well, how do they thrive on irradiated grain? It turns out they love it. So, think twice before you start irradiating.

Rhyzoperta dominica was reared on irradiated rice with doses varying from 20 to 5000 krad (0.20 to 50 kGy). This resulted in an increase in adult life-span and fecundity of the next generation (8).

Tribolium castaneum had similar preferences. Reared on irradiated diets the numbers in offspring of the second, third and fourth generation were significantly higher than the offspring on unirradiated diet (9).

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