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QUARANTINE TREATMENT FOR *Sitophilus zeamais* (COLEOPTERA: CURCULIONIDAE) THROUGH GAMMA RADIATION FROM COBALT-60

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ABSTRACT

Pests like beetles, moths, fungus and mites normally attack stored products such as grains, spices, flours, brans and tobacco in bale. Among these pests the *Sitophilus zeamais* is one of the most important pests due its elevated potential of reproduction, infesting a great number of products, inducing great damages. This work had as objective to determine the efficacy of gamma radiation from Cobalt-60 as quarantine treatment for *S. zeamais*. The insects used in this experiment were reared in maize grains, at the Laboratório de Artrópodes of the Instituto Biológico/SP, on climatic room with 27 ± 2ºC of temperature and relative humidity of 70 ± 5%. Samples containing 25 adult insects were put in acrylic recipients measuring 2.8cm x 2.8cm. Each treatment had four repetitions, in a total of 100 insects for treatment. They were irradiated with growing doses of gamma radiation: 0 (control); 0,25; 0,5; 0,75; 1,0; 1,25; 1,5; 1,75; 2,0; 2,25 2,5; 2,75; 3,0; 3,5 e 4,0 kGy, in a experimental irradiator of Cobalt-60, model Gammacell-220, located at the Centro de Tecnologia da Radiações - CTR of the Instituto de Pesquisas Energéticas e Nucleares - IPEN/CNEN/SP. After irradiation, the samples were transferred to plastic recipients measuring 3,5cm x 10cm, with perforated lids (to allow gaseous exchanges). After the irradiation the samples were kept in climatic room (27 ± 2ºC and 70 ± 5%). The mortality of insects was evaluated 1 hour after the irradiation and also on the next 7 days. By the results obtained we can conclude that was the dose of 2.75 kGy that induced the immediate mortality for adult insects of the specie *S. zeamais*.

1. INTRODUCTION

The insect *Sitophilus zeamais* is popularly known as maize weevil, considered a major pest of stored grains, attacking a variety of products stored such as: wheat, maize, barley, oats, rye, macaroni, biscuits, sorghum, rice, causing huge losses annually.

The presence of *S. zeamais* causes damage and weight loss, decreases the commercial value of the product and reduces its nutritional value. As attributes, the *S. zeamais* has an elevated potential for reproduction, it's a cosmopolitan, polyphagous primary pest in which both the larva and the adult insect attack whole grains, infesting both the fields and silos in warehouse, especially under the Brazilian climatic conditions [2].

In Brazil, 20% of the annual production of grain, that is around 120 million tonnes, is lost between harvest and storage, and 10% of these losses is due to attack of pests during storage, proving the importance of controlling these pests[1]. The use of insecticides is still the main method utilized in stored products. However, resistance to insecticides has increased considerably in the world and it's currently one of the biggest problems in pest control [5] and [4].

Usually chemical treatments are used in the protection of stored grains such as insecticides like pyrethroids, organophosphates and fumigants, all high-hazard. However, some alternative methods show efficiency in controlling pests such as ionizing radiation [6].

Due the need for better conservation and control of insects with modern technology, advanced high-efficiency, low cost and absence of side effects, the gamma radiation has become the most viable solution. This process consists in disinfecting the grains with a determined dose of radiation, inhibiting reproduction, or even causing the death of the infesting insects.

This work had as objective to determine the efficacy of gamma radiation from Cobalt-60 as quarantine treatment for *S. zeamais.*

2. MATERIALS AND METHODS

The insects of the species *Sitophilus zeamais* were used in the experiment and they came from the Laboratório de Artrópodes of the Instituto Biológico/SP, in São Paulo, where they had been reared in maize grains.

The insects were maintained in climatic room with 27 ± 2ºC of temperature and relative humidity of 70 ± 5%.

2.1. Biossay

At biossay with *S. zeamais,*, there were samples containing 25 adult insects in acrylic recipients measuring 2.8cm x 2.8cm. Each treatment had four repetitions, in a total of 100 insects for each treatment.

After irradiation, the samples were transferred to plastic recipients measuring 3,5cm x 10cm, with perforated lids to allow gaseous exchanges. After the irradiation the samples were kept in climatic room 27 ± 2ºC and 70 ± 5%. The insects were maintained under theses conditions during the experiment, at the Laboratório de Artrópodes of the Instituto Biológico/SP, in São Paulo city.

The mortality of insects was evaluated 1 hour after of the irradiation and on the next following 7 days.

2.2. Gamma Irradiation

The radiation source used in the experiment were the experimental irradiator of Cobalt – 60, model Gammacell-220, located at the Centro de Tecnologia da Radiações - CTR of the Instituto de Pesquisas Energéticas e Nucleares-IPEN/CNEN/SP, in São Paulo city.

The samples were submitted to growing doses of gamma radiation: 0 (control); 0,25; 0,5; 0,75; 1,0; 1,25; 1,5; 1,75; 2,0; 2,25; 2,5; 2,75; 3,0; 3,5 e 4,0 kGy,. These results were submitted to analysis.

3. RESULTS AND DISCUSSION

The experiments conducted by Mitsui in 1970 about the effect of gamma radiation on *Sitophilus zeamais* and *Sitophilus oryzae*, with doses of 0,02, 0,04, 0,06 e 0,08 kGy, with observation of the experiment 3 weeks after irradiation. Those results reported that the disinfestation dose given by DL_{99} for *Sitophilus zeamais* and *Sitophilus oryzae* were 0.075 and 0.08kGy, respectively [3].

The dosage of gamma radiation with immediate efficacy was 2,75kGy (Table 1).

The necessary dose for control is much less than the 5 kGy, which is commercially used in food. This dosage is more than sufficient to control infestations.

Thus the results confirm that gamma radiation from cobalt 60 is an efficient alternative in controlling *Sitophilus zeamais*. Besides its efficiency, it does not represent risk of contamination for living beings and for the environment.

The criteria chosen uses the minimum dose needed in process of disinfection, regardless the material.

Table 1. Evaluation of the effectiveness of the gamma radiation in the quarantine treatment for *Sitophilus zeamais* (Coleóptera: Curculionidae).

Dose (kGy)	Mean*
4,0	25,00a
3,5	25,00a
3,0	25,00a
2,75	25,00a
2,5	14,25 b
2,25	11,00 bc
2,0	5,5 cd
1,75	1,25 d
1,5	0 d
1,25	0 d
1,0	0 d
0,75	0 d
0,5	0 d
0,25	0 d
Controle	0 d
C. V. (%)***	24.26

* * Mean following of same letter indicate there isn't significative difference to level of 5% of probability at Tukey (P≤ 0.05).

4. CONCLUSIONS

According to the results obtained, it was found that gamma radiation promotes 100% control of *S. zeamais* after exposure, being efficient in controlling *Sitophilus zeamais* and as a quarantine treatment. However, some care must be taken during storage in order to avoid reinfestation, since the gamma radiation does not leave waste.

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REFERENCES

1. Campos, T. B., "Pragas dos Grãos Armazenados", *XII Reunião itinerante de fitossanidade do Instituto Biológico – Pragas Agroindustriais*, Ribeirão Preto, Brasil, 20-21 de set. 2005, pp. 5-12 (2005).

2. Campos, T. B. and Zorzenon, F. J., "Pragas dos Grãos Armazenados e Produtos Armazenados". *Boletim Técnico do Instituto Biológico*, São Paulo, Brasil, **Vol. 17**, pp.1-19 (2006).

3. Danno A. "Study of Radiation Disinfestation of food and agricultural products in Japan", *Radiat. Phys. Chem.* **Vol. 29**, n° 5, pp. 381-385 (1987).

4. Guedes, R. N. C., Ribeiro, B. M. Limitações de métodos de controle para o manejo de pragas. In: Zambolim, L. (Ed.). *Manejo integrado: doenças, pragas e plantas daninhas,* UFV, Viçosa, Brasil (2000).

5. Lorini, I Controle integrado de pragas de grãos armazenados, EMPRAPA – CNPT, Passo Fundo, pp.52 (EMBRAPA-CNPT. Documentos, 48) (1998).

6. Lorini, I.; Beckel, H. S. Mecanismos de resistência das pragas de grãos armazenados. In: Lorini, I.; Miike, L. H.; Vildes, M. S. (Eds.). *Armazenagem de grãos,* IBG, Campinas, Brasil (2002).