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EFFECTS OF GAMMA RADIATION ON PUPAE OF ORIENTAL FRUIT MOTH, *Grapholita molesta* (BUSCK)(LEPIDOPTERA: TORTRICIDAE).

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ABSTRACT

As insects increase in radiotolerance as they develop and usually several developmental stages of pest may present in fresh shipped commodity, it is important to know the radiation susceptibility of stages of the target insect before the establishment of ionizing radiation quarantine treatments. This study was performed to determine the radiotolerance of pupae of the oriental fruit moth, *Grapholita molesta* (Busck) (Lepidoptera: Tortricidade), to gamma radiation. This specie is considered as on of the most serious worldwide pests for temperate fruits, especially peaches. Pupae of 3 days old were exposed to 0 (control), 25, 50, 75, 100, 125, 150, 175, 200, 250, 300 and 350 Gy of gamma radiation of source Cobalt-60, type Gammacell-220 at dose rate of 0,508 kGy/hour. Each treatment had 4 repetitions with 10 pupae in the total 40 pupae per treatment. Surviving pupae allowed to feed on an artificial diet. After irradiation the insects were keep in room with climatic conditions of 25±5ºC and 70±5% RH. The results showed that the sterilizing dose to adults was 200Gy and that the dose of 350Gy was not sufficient to kill all pupae of insects.

Key word: Gamma radiation, oriental fruit moth, *Grapholita molesta*, pupae.

1. INTRODUCTION

In international agricultural markets, the use of radiation as a method for the prevention of quarantine insects represents an important alternative post-harvest pest control, reducing the need for chemical fumigants and other similar toxic products. The US Food and Drug Administration (FDA) has approved radiation up to 1 kGy to control insects in foods and to extend the shelf life of fresh fruits and vegetables [1, 2].

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The advantages of radiation include the no resistance development by pest insects, the absence of residual radioactivity and few significant changes in the physicochemical properties or the nutritive value of the treated products [4,5]. A major disadvantage is

that it is the only commercially applied quarantine treatment that does not result in significant acute mortality, stated that the objective of irradiation is not acute mortality but prevention of development or reproduction, as most commodities do not tolerate the usual dose ranges required to reach it, and any quarantine treatment must be virtually 100% effective [6, 7, 11].

As insects increase in radiotolerance as they develop and theoretically many developmental stages of the pests may be present in the shipped commodity, many investigations have been conducted to know the radiations susceptibility of the target insect life stages [9].

The results from radiobiology studies can be useful for example to determine the effective radiation dose against the most tolerant life stage of quarantine pests [8]. As the effects of gamma radiation on the oriental fruit moth, *Grapholita molesta* (Busck) (Lepidoptera:Tortricidae) eggs remain largely un explored, the current study was performed to investigate the response of *G. molesta* eggs to arrange of doses of gamma radiation. The oriental fruit moth is considered to be one of the most important pests of peaches in several growing areas [10, 11, 12]. It is also one of the most serious worldwide pests for temperate fruits like stone fruits (*Prunus* spp.), pomes (*Malus, Pyrus* and *Cydonia*) and some species of Rosaceae [13]. In Brazil, it causes losses to peach growers by three to five percent [14]. Nonetheless, *G. molesta* is a quarantine pest for many export destinations [7].

Previous works have been done only for pupae and adults of the oriental fruit moth [15, 8], [7] irradiated *G. molesta* fifth instars and reported that no fertile adults emerged after a dose of 200 Gy. Besides determining the minimum doses required to prevent *G. molesta* eggs normal development, this study was also designed to assess the effect of gamma radiation on the fertility of surviving insects under a sub dose, since Lepidoptera may suffer great sterility in subsequent generations [16, 9].

This study was performed to determine the radiotolerance of pupae of the oriental fruit moth, *Grapholita molesta* (Busck) (Lepidoptera: Tortricidade), to gamma radiation.

2.MATERIAL AND METHODS

The oriental fruit moths were obtained from a colony established from larvae collected from infested peach fruits (*Prunus persica* L.) in Pelotas, southern Brazil. The larvae were reared on an artificial diet modified. This diet consisted of agar, corn flour, wheat germ, brewer's yeast, ascorbic acid, benzoic acid, formalin and water at a proportion of 4:28:7:7:1:0.1:0.1: 900 mL, respectively.
Pupae of 3 days old were exposed to 0 (control), 25, 50, 75, 100, 125, 150, 175, 200, 250, 300 and 350 Gy of gamma radiation of source Cobalt-60, type Gammacell-220 at dose rate of 0,508 kGy/hour. Each treatment had 4 repetitions with 10 pupae in the total

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40 pupae per treatment. Surviving pupae allowed to feed on an artificial diet. After irradiation the insects were keep in room with climatic conditions of 25±5ºC and 70±5% RH. Were evaluated the emergence of adults and viability of eggs laid by female under of each repetitions in the treatments.

3. RESULTS

Table 1. Number mean of adults emerged, eggs and larvae hatch of the pupae irradiated with doses of gamma radiation of Cobalt-60.

Doses/Gy	Adults/emerged	Number/eggs	Number/larvae
0	9,0a	141a	120a
25	8,2a	135a	113a
50	8,3a	147a	126a
75	8,6a	125ab	111a
100	8,1a	120ab	115a
125	8,0a	113ab	101a
150	7,5ab	84bc	63b
200	5,5b	63c	21c
250	2,7c	11d	0d
300	1,2d	0e	0d
350	0,1e	0e	0d

Original means in this table .Means with in lines followed by the same letter are not significantly different, ANOVA at ($P \leq 0.05$).

The current study explored the effects of exposing *G. molesta* pupae o gamma radiation. Therefore, the evaluation of the acceptability of the radiation doses tested as a quarantine treatment to disinfest peaches or other temperate fruits from *G. molesta* pupae was not the purpose of this study. In Table 1 the results showed that increasing radiation doses caused reduced egg hatch and adults emergence when 3 days old pupae were irradiated. The lethal dose to pupae was larger than 350 Gy and sterilizing dose to adults emerged of pupae irradiated was 250 Gy.

Those results are of agreement with the other works done by the researchers mentioned to proceed. Was reported that 100 Gy was enough to completely prevent adult emergence from irradiated codling moth *Cydia pomonella* L. eggs [17]. Showed that one and two day old *C. pomonella* eggs failed to hatch following an 80 Gy dose [18].

A generic dose of 400Gy was approved as a phytosanitary treatment for all insects other than Lepidoptera for commodities entering the United States [9] and [20] suggested that a generic dose of 600Gy for all insects in ambient atmosphere would be efficacious to attend quarantine purposes. In practice, the goal of an irradiation quarantine treatment can be the induction of mortality of immature stages before the adult or inhibition of reproduction, in order to lower the risk of establishment of invasive pests [21].

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Considering the lack of adult emergence as a criterion for effectiveness, relatively low doses of radiation were effective in inhibiting the normal development of *G. molesta* pupae. Damages to fresh commodities could be significantly reducing data dose range of 100–400 Gy when applied on a commercial scale. However, as the eggs are not the most advanced stage of the insect and there fore, the most radiotolerant, potentially found on peaches and other fruit commodities, doses lower than 200Gy should not been endorsed as a general quarantine treatment against his pest[7].

Further more, the percentage egg hatch may be an in appropriate criterion for quarantine effects when order Lepidoptera eggs are exposed to gamma radiation [22, 24]. The results of this work make part of the basic research in the radiobiology of the oriental fruit moth. At last, the development of any phytosanitary treatment must include a precise description of the response that achieves efficacy, so regulatory agencies [20].

Considering no emergence of adult as a criterion for effectiveness, relatively low doses of radiation were effective inhibiting the normal development of *G. molesta* pupae. Damages to fresh commodities could be significantly reduced data dose range of 100–350Gy when applied on a commercial scale. However, as the pupae are not the most advanced stage of the insect and, therefore, the most radiotolerant, potentially found on peaches and other fruit commodities, doses lower than 400Gy should not be endorsed as a general quarantine treatment against this pest [7]. The percentage of adults emerged of irradiated pupae may be an inappropriate criterion for quarantine effects when older Lepidoptera pupae are exposed to gamma radiation [22, 23]. The results of this work make part of the basic research in the radiobiology of the oriental fruit moth.

4. CONCLUSION

The lethal dose to pupae was larger than 350 Gy and sterilizing dose to adults emerged of pupae irradiated was 250 Gy.

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